APPENDIX E

LETTER B25 ATTACHMENTS

Attachment #1

Existing plus Approved Projects (2018) scenarios, the following approved projects were included in the traffic modeling:

- Lessera Development
- Carson Creek – Unit 1 (302 housing units)
- Carson Creek – Unit 2 (634 detached and half-plex senior houses and 305 attached senior houses)
- Ridgeview 9 (44 housing units)
- Sun Stone Business Park
- Hilldale Office Park
- Sparks Property (25 housing units)*
- Lomita Way Rezone from RE 10 to R2A (24 housing units)*
- West Valley Villages 6&7 (111 housing units)
- Promontory Village Center (64 housing units)
- El Dorado Professional Center (19,500 square feet of office)
- Wilson Estates (49 housing units)*
- Saratoga Mixed Use Center (32,900 square foot shopping center)
- Diamante Estates (20 housing units)*
- Parkes Property (47 housing units)*
- Green Valley Center (29,000 square feet of retail and office)
- Chartraw (8 housing units)*
- Ghori Property (Summerbrook, 29 housing units)*
- Silver Springs (244 housing units)*
- Serrano Village K5 (143 housing units)*
- Serrano Village K1/2 PH5 (166 housing units)*
- Serrano Village K1/2 PH4 (47 housing units)*
- Serrano Village M3 (30 housing units)*
- Serrano Village M4 (38 housing units)*
- Serrano Village M2 (73 housing units)*
- Serrano Village M5 (10 housing units)*
- Springs Ranch Equestrian Center*

The traffic model outputs were used to assess the potential cumulative air quality, global climate change, and noise impacts. To assess potential cumulative impacts for the remaining environmental topics, the County of El Dorado was consulted for a list of past, present, and reasonably anticipated projects located within the project vicinity (within 2 miles of the project site). These projects are denoted in the list above with an (*). A discussion of cumulative impacts is included within each environmental section.

Attachment #2

ACKNOWLEDGEMENTS

2010 El Dorado County Bicycle Transportation Plan

Adopted by the Board of Supervisors November 9, 2010

Norma Santiago, Chair, District V
John R. Knight, District I
Ray Nutting, District II
James R. Sweeney, District III
Ron Briggs, District IV

Recommended by the Planning Commission August 12, 2010

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Prepared by

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ACKNOWLEDGEMENTS

El Dorado County Bicycle Advisory Committee, Ratified by EDCTC October 2, 2008

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Lynn Murray, Disabled Community Representative
Carol Patton, City of Placerville Business Representative
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Lacey Symons, Sacramento Area Council of Governments

EXECUTIVE SUMMARY

The El Dorado County Bicycle Transportation Plan provides a blueprint for the development of a bicycle transportation system on the western slope of El Dorado County. The plan updates the currently adopted El Dorado County Bicycle Master Plan, which was adopted in January 2005. The 2010 plan is in compliance with California Streets and Highways Code (sections 890-894.2, *appendix b*), enabling the county to be eligible for State Bicycle Transportation Account funds.

The Bicycle Transportation Plan represents the efforts of the EDCTC staff, the Bicycle Transportation Plan Advisory Committee, El Dorado County, El Dorado Hills Community Services District and numerous dedicated citizens in the area. The plan was developed with the overall goal of *providing a safe, efficient, and convenient network of bicycle facilities that establish alternative transportation as a viable option in El Dorado County and neighboring regions.* The plan addresses the following specific issues pertaining to non-motorized transportation:

1. Bicycle Commuting - Develop a bicycle transportation system that enhances the safety and convenience of bicycling to neighboring jurisdictions, employment centers, residential neighborhoods, campgrounds, parks, education, commercial and other activity centers in El Dorado County.
2. Safety and Education - Maximize bicycle safety.
3. Implementation and Maintenance – Identify detailed and prioritized improvements in the El Dorado County Bicycle Transportation Plan.
4. Land Use Development - Integrate bicycle and pedestrian planning with other regional and community planning, including land use and transportation.
5. Multi-Modal Integration - Maximize multi-modal connections to the bicycle transportation system.
6. Funding - Obtain all possible funding for plan implementation.
7. Connectivity - Develop a well-connected bikeway system.
8. The El Dorado Trail – In usable segments, develop Class I Bike Paths on the El Dorado Trail.

The proposed bikeway system is slightly over 280 miles in length, and includes a strategy for development of Class I Bike Path along the entire Sacramento-Placerville Transportation Corridor, also known as “The El Dorado Trail.” The development of the proposed system will provide better access to the County’s transit network and activity centers as well as encourage increased use of the bicycle as a transportation mode.

An increase in bicycle transportation benefits the entire region in terms of improving air quality, reducing congestion, and improving the health and overall quality of life for the residents of El Dorado County. Improving the bicycle transportation system will also help implement Caltrans’ Deputy Directive DD-64-R1, a policy that recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system. Improvements to the bicycle transportation system will also provide benefits to recreational cyclists and help El Dorado County promote geotourism and agritourism by making areas such as El Dorado’s wineries, Apple Hill, and the

South Fork of the American River in Coloma more accessible to tourists who chose to visit these areas by bicycle.

The following is a list of significant improvements that have been made to the bicycle transportation system since the El Dorado County Bicycle Transportation Plan was adopted in January 2005:

- Class I bike path on Bass Lake Road from Serrano Parkway to Silver Dove Way
- Class I bike path on the El Dorado Trail from Parkway Drive to Los Trampas Drive
- Class I bike path on the El Dorado Trail from Forni Road to Missouri Flat Road
- Class II bike lanes on Green Valley Road from Pleasant Grove Middle School to Cameron Park Drive
- Class II bike lanes on Latrobe Road from Town Center Boulevard to Investment Boulevard
- Class II bike lanes on White Rock Road from Joeger Cut-Off Road to Latrobe Road
- Class II bike lanes on White Rock Road from Latrobe Road to Carson Crossing Road
- Class II bike lanes on Green Valley Road from the County line to 400 feet west of El Dorado Hills Boulevard
- Class II bike lanes on Cameron Park Drive from Winterhaven Drive to Alhambra Drive
- Class II bike lanes on Missouri Flat Road from US 50 to the Southern Pacific Transportation Corridor right of way
- Bicycle and pedestrian facility on the eastbound US 50 Weber Creek Bridge with connecting Class I bike path between Missouri Flat Road and Placerville Drive

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CHAPTER 6: BIKEWAY NETWORK IMPLEMENTATION STRATEGY

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1.1 Purpose and Need

The purpose for revising/ updating the El Dorado County Bicycle Master Plan is twofold. First, it will provide a blueprint for the development of an "ultimate bicycle transportation system." Second, it will bring the plan into compliance with California Streets and Highways Code (sections 890-894.2, *appendix b*), enabling the county to be eligible for State Bicycle Transportation Account (BTA) funds.

The current El Dorado County Bicycle Master Plan was adopted in January 2005. Several updates were written between 1979 and the present, but the 2005 update was the only one formally adopted. In the development of the 2010 Plan the work within the preceding updates was analyzed and applicable components were incorporated.

For the bicycle to become a viable transportation option in El Dorado County, some improvements are necessary both locally and regionally. There is continued development on the western slope of the County, with a majority of the most recent growth concentrated in El Dorado Hills near the Sacramento County line. The residential boom in El Dorado Hills and Cameron Park has increased the demand for transportation options. In more isolated areas, there is demand for the county to provide bicycle facilities within communities so residents can leave their cars at home for short, local trips.

The current El Dorado County Bicycle Master Plan was adopted in January 2005. Several updates were written between 1979 and the present, but the 2005 update was the only one formally adopted.

Improving the bicycle transportation system will help to implement Caltrans' Deputy Directive DD-64-R1, a policy that recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system. Improvements to the bicycle transportation system will also ensure that individuals have transportation choices aside from driving and allow bike commuters to bypass congestion and even arrive at their destinations faster than if they had driven a car. According to the 2010 National Bicycling and Walking Study, in addition to transportation benefits, improvements to the bicycle transportation system can also have the following benefits:

- Health Benefits: Daily bike rides can reduce the risk of coronary heart disease, stroke, and other diseases and result in lower health care costs and improved quality of life;
- Environmental Benefits: Replacing short vehicle trips with bicycling can help reduce energy consumption and decrease carbon dioxide emissions from cold starts caused by short car trips;
- Economic Benefits: The cost of owning and operating a car can account for up to 18 percent of a typical household's income. Bicycling can provide options for those who would like to save money. Communities are using bicycle facilities to revitalize businesses and bring new economic life to downtowns;
- Quality of Life Benefits: More travel options can increase a sense of independence in seniors, young people, and others who cannot or choose not to drive. Increased levels of bicycling can have a great impact on an area's sense of livability by creating safe and friendly places for people to live and work.

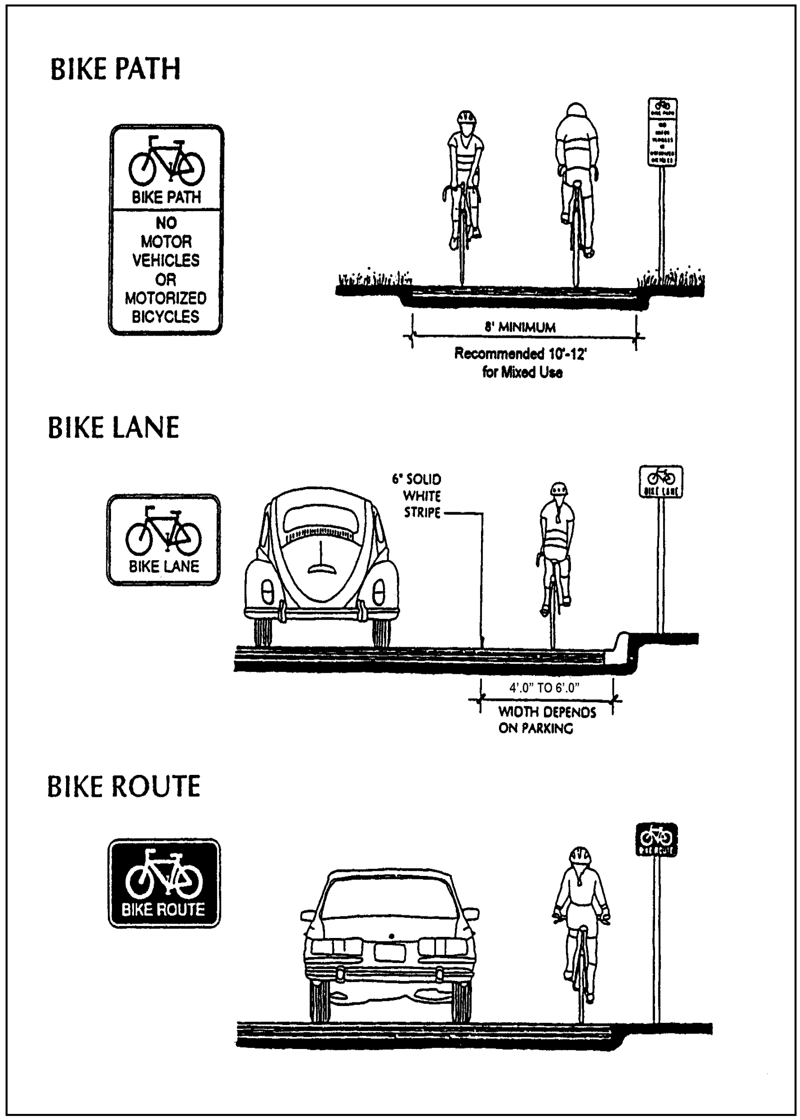
Once completed, the ultimate bikeway system will provide a uniform network of on and off-street bikeways throughout the western slope of El Dorado County, which will support facilities and programs that encourage bicycling.

1.2 Previous Planning Efforts

The first update to the 1979 El Dorado County Bicycle Master Plan occurred in 1995 under the title “Bicycle Transportation Plan.” The Bicycle Transportation Plan existed in various draft forms, and was continually updated from 1995 to 2001, but was never formally adopted by the County Board of Supervisors. Even without a current planning document, the County Department of Transportation (DOT) implemented bicycle projects in various areas throughout the County from 1995 to 2001. The Plan was updated in 2005 and that update was formally adopted in January 2005.

1.3 Definition of Bikeway Facilities

The most commonly used bikeway design standards are contained in the Caltrans Highway Design Manual, Chapter 1000 – Bikeway Planning and Design, dated September 1, 2006. The Caltrans standards are based largely on standards developed by the American Association of State Highway and Transportation Officials (AASHTO). The Manual on Uniform Traffic Control Devices, Federal Highway Administration, 2009, contains standards for bikeway signage and striping. Following are brief descriptions of the three most common bikeway facilities and their typical cross sections. More detailed explanations of bikeway design standards are provided in Chapter 6, Section 6.3.



Class I Bikeway (Bike Path) – Provides a completely separated facility designed for the exclusive use of bicycles and pedestrians with minimal cross flows by motorists. Minimum paved width is eight feet for two-way travel and five feet for one-way travel. Bike Paths closer than five feet (1.5 meters) from the edge of the shoulder shall include a physical barrier to prevent bicyclists from encroaching onto the roadway.

Class II Bikeway (Bike Lane) – Provides a striped lane for one-way bicycle travel on a street or highway. The minimum width for a bike lane is four feet (1.2 meters), but can be wider depending on adjacent parking, curb and gutter configurations.

Class III Bikeway (Bike Route) – Provides for shared use with pedestrian and motor vehicle traffic. Signs or permanent markings designate a bike route, and there is no minimum width since it is a shared use facility.

1.4 Relationship to Other Documents

1.4.1 Sacramento-Placerville Transportation Corridor Master Plan

The Sacramento-Placerville Transportation Corridor (SPTC) Master Plan covers the Southern Pacific railbanked railroad corridor from the western El Dorado County line near Latrobe to the City of Placerville at Ray Lawyer Drive. The preserved corridor is planned for use as an alternative transportation corridor with multiple uses including bicycle, pedestrian and equestrian trails, excursion trains, and utility easements.

The SPTC Plan includes a majority of the "El Dorado Trail," a concept for a trail that spans the entire length of El Dorado County from the western county line to Lake Tahoe. The SPTC Master Plan covers 28 miles of the trail alignment proposed for the El Dorado Trail, and includes an environmental document. The El Dorado County Bicycle Transportation Plan has been coordinated with the SPTC Plan and provides linkages to the SPTC where possible as well as proposed Class I bike paths along segments of the SPTC.

The SPTC Plan does not establish priorities or a specific schedule for project implementation. The discussion on project phasing reads as follows:

"Projects will be developed as usable segments. That is, the result of each project should be usable and independent from the need for future projects. Moreover, projects should be proposed with thought given to connectivity, continuity, and consistency with existing projects."

The El Dorado County Bicycle Transportation Plan establishes phasing and priorities for the development of certain segments of the SPTC Corridor usable for bicycle transportation.

1.4.2 El Dorado County General Plan

The General Plan provides long-range direction and policy for the use of land within El Dorado County. It provides a mechanism through which the County can focus on the issues of greatest local concern as well as a basis for rational decision-making regarding long-term physical development. The circulation element of the General Plan contains objectives and policies pertaining to non-motorized transportation.

1.4.3 City of Placerville Non-Motorized Transportation Plan

The City of Placerville Non-Motorized Transportation Plan (NMTP) provides for a network of bicycle routes throughout the City of Placerville and an inventory of the existing sidewalk conditions (to the extent which they provide a transportation benefit). The City of Placerville NMTP serves as the Non-Motorized Circulation Element of the General Plan. The City of Placerville NMTP was developed in conjunction with the El Dorado County Bicycle Transportation Plan and provides a consistent network of linked bikeways for travel to and through the City.

1.4.4 Cross State Bicycle Route Study

The Cross State Bicycle Route Study – Bay Area to Lake Tahoe concept was developed by Caltrans District 3 as an effort to coordinate local and regional planning efforts. In 2002, Caltrans began collecting all bicycle planning documents within District 3 for the purpose of developing a comprehensive Geographic Information Systems (GIS) database. Through this effort, Caltrans recognized that planning for bicycle facilities is often conducted on a local and regional level, which results in various gaps between and within regions. The Cross State Bicycle Route Study was a timely effort for mapping purposes and an excellent exercise in improving connectivity and regional partnerships.

The actual development and implementation of the Cross State Bicycle Route is the responsibility of individual jurisdictions. The Cross State Bicycle Route Study is intended to provide key information that will assist local jurisdictions in decision-making toward development of the route. Ultimately, the California Cross State Bicycle Route could become the first "Interstate" bike route in California.

1.4.5 El Dorado Hills Community Services District Bikeway Master Plan

In 1995, the El Dorado Hills Community Services District (CSD) developed a Bikeway Master Plan for the El Dorado Hills area. The master plan was developed by a committee specific to the El Dorado Hills area and reflected the bikeway system desired in El Dorado Hills. The plan was submitted to the El Dorado County Transportation Commission as well as the Department of Transportation with the recommendation that it be included as the El Dorado Hills component of the County Bicycle Transportation Plan.

In conjunction with the development of the 2005 El Dorado County Bicycle Transportation Plan, the El Dorado Hills CSD conducted a parallel process with a Bicycle Advisory Committee specifically dedicated to the needs of El Dorado Hills. The 2005 plan took a more local view of El Dorado Hills and provided a more in-depth analysis of the pedestrian and recreation needs specific to El Dorado Hills. Those needs were re-evaluated and analyzed during development of the 2010 plan.

1.4.6 Lake Tahoe Regional Bicycle and Pedestrian Master Plan

The Lake Tahoe Regional Bicycle and Pedestrian Plan provides a blueprint for development of a regional bicycle and pedestrian system that includes both on and off street facilities as well as support facilities and programs throughout the Tahoe Region. The plan includes the eastern portion of El Dorado County near the Lake Tahoe Basin, which is under the authority of the Tahoe Regional Planning Agency/Tahoe Metropolitan Planning Organization (TRPA/TMPO). The TRPA/TMPO programs and allocates funds for transportation and bikeway projects in the Tahoe Basin. The transportation projects in the TRPA jurisdiction and in the City of South Lake Tahoe (El Dorado County) are developed by El Dorado County Department of Transportation, but paid for by TRPA/TMPO. For this reason, the El Dorado County Bicycle Transportation Plan will emphasize projects in the west slope of El Dorado County, and reference the Lake Tahoe Regional Bicycle and Pedestrian Plan for projects within the Tahoe Basin.

The study area of the El Dorado County Bicycle Transportation Plan is that of the Regional Transportation Planning Agency for El Dorado County, the El Dorado County Transportation Commission (EDCTC). EDCTC was designated as the Regional Transportation Planning Agency (RTPA) for El Dorado County on July 23, 1975. This planning and programming authority does not include that portion of the County within the TRPA/TMPO boundaries. TRPA is the RTPA for the Tahoe Basin area. As the RTPA for El Dorado County, EDCTC has prepared the Bicycle Transportation Plan for El Dorado County. The plan will maintain consistency with the TRPA's Lake Tahoe Regional Bicycle and Pedestrian Plan.

1.4.7 Sacramento Area Council of Governments (SACOG) Regional Bicycle, Pedestrian, and Trails Master Plan

The SACOG Regional Bicycle, Pedestrian, and Trails Master Plan is a component of the Metropolitan Transportation Plan for 2035, which established the region's 28-year transportation investment plan. The Regional Plan is intended to guide the long-term decisions for the Bicycle and Pedestrian Funding Program, adopted by the SACOG Board of Directors in March 2008. The projects included in the plan are forward-thinking, regionally significant projects that require at least partial regional funding.

1.4.8 El Dorado County Transit Design Manual

The El Dorado County Transit Design Manual is a handbook that provides EDCTA with transit improvement standards appropriate to the specific conditions of the transit organization and its area. The Design Manual provides specific standards for bus stop improvements and roadways along transit routes. The standards are intended to guide government agencies, commercial and residential developers, employers, and others in their efforts to provide useful, attractive, and safe transit facilities for the region's transit patrons. The Design Manual is not intended to supersede the authority of the local jurisdictions, but rather to offer criteria, complementary to existing standards, for the design of a more pedestrian-oriented, bicycle-oriented, and transit-friendly environment. It is important for individual jurisdictions and business leaders to consider how best to incorporate land uses and road networks that support public transportation, while providing transportation infrastructure that supports overall community goals. The transit improvement standards included in the Design Manual are organized by section for quick reference. Sections of the Design Manual include the following; Vehicle characteristics, Site design and pedestrian access-ways, Bus stop placement, Bus stop spacing, Bus pullouts, Passenger amenities, Park-and-ride/multi-modal facilities, and Vehicle turning radii.

1.5 Community Involvement

The community was involved in the development of the update of the 2010 El Dorado County Bicycle Transportation Plan on many levels. A Bicycle Advisory Committee was assembled and ratified by the EDCTC on October 2, 2008. The Committee met initially for a discussion of the bicycle planning history in El Dorado County then established the scope of the update of the plan.

The Bicycle Advisory Committee (BAC) participated in the existing conditions inventory and the resultant selection of projects for inclusion in the plan. The BAC reviewed the Administrative Draft Plan in June 2010 and their comments were incorporated. During the months of June and July 2010 the Bicycle Transportation Plan was open for public review and comment. The plan was also presented at the following public meetings:

- Bike Plan Workshop, June 30, 2010
- EDCTC Public Meeting, August 5, 2010
- El Dorado County Trails Advisory Committee Meeting, August 9, 2010

- El Dorado County Planning Commission Meeting, August 12, 2010
- El Dorado County Parks and Recreation Commission Meeting, September 16, 2010
- El Dorado County Board of Supervisors Meeting, TBD
- EDCTC Public Meeting, TBD

The comments received, and responses are included in Appendix F of this document.

1.6 Compliance with Bicycle Transportation Account Guidelines

This Plan complies with the California Streets and Highways Code, section 891.2, items A-K as described below:

Caltrans requirement	Section/Description................................Location
A. Estimated number of existing bicycle commuters in the plan area and the estimated increase in the number of bicycle commuters resulting from implementation of the plan	Bicycle Commuter Projections...........................Chapter 2, p. 3-4
B. A map and description of existing and proposed land use and settlement patterns which shall include, but not be limited to, locations of residential neighborhoods, schools, shopping centers, public buildings, and major employment centers	Land Use Discussion...Chapter 2, p. 2-3 Map Set ....Chapter 5, p. 19
C. A map and description of existing and proposed bikeways.	Map Set ....Chapter 5, p. 19 Description (existing) ....Chapter 4, p. 5 Description (proposed) ....Chapter 5, p. 10
D. A map and description of existing and proposed end-of-trip bicycle parking facilities. These shall include, but not be limited to, parking at schools, shopping centers, public buildings, and major employment centers	Map Set ....Chapter 5, p. 19 Description..Chapter 4, p. 2-4
E. A map and description of existing and proposed bicycle transport and parking facilities for connections with and use of other transportation modes. These shall include, but not be limited to, parking facilities at transit stops, rail and transit terminals, ferry docks and landings, park and ride lots, and provisions for transporting bicyclists and bicycles on transit or rail vehicles or ferry vessels.	Multi-Modal Connections ....Chapter 5, p.4 Map Set ....Chapter 5, p. 19
F. A map and description of existing and proposed facilities for changing and storing clothes and equipment. These shall include, but not be limited to, locker restroom, and shower facilities near bicycle parking facilities.	Existing ....Chapter 4, p. 2 Proposed Improvements...........................Chapter 5, p. 4 and 10
G. A description of bicycle safety and education programs conducted in the area included within the plan, efforts by the law enforcement agency having primary traffic law enforcement responsibility in the area to enforce provisions of the Vehicle Code pertaining to bicycle operation, and the resulting effect on accidents involving bicycles.	Bicycle Safety ....Chapter 2 p. 5 Education..Chapter 2 p. 6
H. A description of the extent of citizen and community involvement in the development of the plan, including, but not limited to, letters of support.	Citizen/community involvement ....Chapter 1, p. 5

Caltrans requirement	Section/Description................................Location
I. A description of how the bicycle transportation plan has been coordinated and is consistent with other local or regional transportation, air quality, or energy conservation plans, including but not limited to, programs that provide incentives for bicycle commuting.	Description..Chapter 1, p. 3
J. A description of projects proposed in the plan and a listing of their priorities for implementation	Proposed Improvements.....................................Chapter 5, p. 10 Priority Projects...Chapter 6, p. 1
K. A description of past expenditures for bicycle facilities and future financial needs for projects that improve safety and convenience for bicycle commuters in the plan area.	Past Expenditures...Chapter 4, p. 1 Future Financial Needs...Chapter 6, p. 2

2.1 Study Area

The study area of the El Dorado County Bicycle Transportation Plan is the same as the planning area of the Regional Transportation Planning Agency (RTPA) of El Dorado County Transportation Commission (EDCTC). EDCTC was designated as the RTPA for El Dorado County on July 23, 1975. This planning and programming authority does not include that portion of the County within the Tahoe Regional Planning Agency (TRPA) boundaries. TRPA is the RTPA for the Tahoe Basin area.

As the RTPA for El Dorado County, EDCTC has prepared the Bicycle Transportation Plan for El Dorado County Department of Transportation. The plan will maintain consistency with the TRPA's Lake Tahoe Regional Bicycle and Pedestrian Plan. The TRPA programs and allocates funds for transportation and bikeway projects in the Tahoe Basin. The transportation projects in the TRPA jurisdiction and in the City of South Lake Tahoe (El Dorado County) are developed by El Dorado County Department of Transportation, but paid for by TRPA. For this reason, the El Dorado County Bicycle Transportation Plan will emphasize projects in the West Slope of El Dorado County, and reference the Lake Tahoe Regional Bicycle and Pedestrian Plan for projects within the Tahoe Basin.

2.2 Setting

El Dorado County is located in the foothills and mountains of the Sierra Nevada, extending eastward from the eastern portion of California's Central Valley. The western portion of the county is characterized by rolling foothills, increasing in elevation to the east. The rolling hills provide a bicyclist with beautiful landscapes and challenging terrain. Many of the regional routes have gradual slopes that are navigated with relative ease by an intermediate cyclist. The foothills and mountains of El Dorado County make it a popular destination for recreational cyclists. In total, the county contains 1,805 square miles ranging in elevation from 200 feet above sea level to 10,881 feet above sea level at the highest mountain peak.

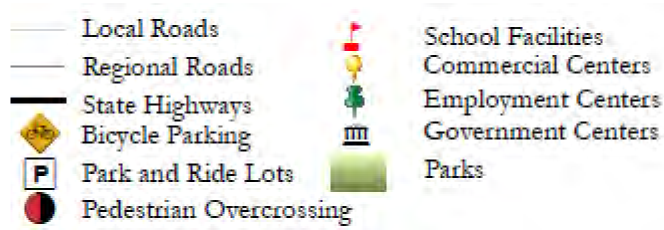
El Dorado County is bordered by Placer County to the north, Amador County to the south, Sacramento County to the west and the State of Nevada to the east. A portion of Lake Tahoe is located in El Dorado County.

The weather in El Dorado County varies greatly depending on the elevation - from warm, dry summers and mild winters in El Dorado Hills and Placerville to cool summers and snowy winters in South Lake Tahoe. Typically, temperatures in the lower elevations are higher in summer and winter, while mountain temperatures are lower. The rainy season occurs between November and April, but excessive rainfall and damaging winter storms are rare.

2.3 Land Use Discussion

The City of Placerville, the county seat, is the only incorporated city in the western slope of El Dorado County. The primary population centers in the western slope are the communities of El Dorado Hills, Cameron Park, and the City of Placerville. Numerous other unincorporated communities are spread out throughout El Dorado County. These include Shingle Springs, El Dorado, Diamond Springs, Latrobe, Fairplay, Somerset, Grizzly Flat, Camino, Pollock Pines, Coloma/Lotus, Cool, Garden Valley, Georgetown, Rescue, Mt. Akum, Pleasant Valley, Kyburz, and Strawberry. Some of the small communities of El Dorado County provide unique opportunities for increased local bicycle commute trips.

As a bicycle transportation plan, this document complies with California Streets and Highways Code, section 891, sections A-K. One of the requirements is to identify land uses on maps in order to demonstrate transportation connections on proposed bike routes. Each map has a set of icons to indicate areas of land use. Land uses indicated on the maps include schools, shopping centers, employment centers, bicycle parking facilities, government centers, park and ride lots and parks as follows:



A review of the population and land use in El Dorado County is a necessary first step in developing accurate bicycle commuter projections. In 2000, El Dorado County's population grew at a rate of 2.6%. By 2008 the rate of annual growth had slowed to .91%. Over the nine years spanning 2000 to 2008, the County population grew at an average annual rate of 1.7% per year. The trend of future growth, changes in demographics, and changes in land use will affect both the bikeway system and the number of potential bicycle commuters. Many new bikeway projects will be constructed as part of new developments and road construction. Construction of new employment centers will reduce travel times and distances to work, making bicycling a more attractive commute mode. It is recognized that El Dorado County has a jobs-housing imbalance, evidenced by the high average travel time to work (28 minutes in 2000).

El Dorado County Population and Travel Time to Work; U.S. Census

	1980	1990	2000	Total Change 20 years	Percent Change 20 years
Population	85,812	125,995	156,299	70,487	82%
Mean travel time to work	21 min	24 min	28 min	7 min	33%

The following features describe the land use in the west slope of El Dorado County:

- Major agricultural regions, including the South County Wine Region and the orchards of the Camino area's "Apple Hill"
- Highway 50 is the major transportation corridor in El Dorado County
- The City of Placerville, with a population of 9,906 in 2009
- Folsom Lake College – El Dorado Center near Placerville
- Residential 'suburbs' of Cameron Park and El Dorado Hills
- The El Dorado Hills Business Park

Areas in the county where the major development will occur include El Dorado Hills, Cameron Park, and Diamond Springs. El Dorado Hills was recently added as part of the Sacramento

Metropolitan Area, and is rapidly conjoining with the City of Folsom. As shown in the table below, El Dorado County is poised for explosive growth in the coming years.

El Dorado County Growth Projections: Developed by SACOG						
	2000	2005	2013	2018	2035	Historical 1990
Total El Dorado County	124,910	154,428	182,087	194,832	225,032	94,674
City of Placerville	9,630	13,646	14,761	15,654	18,179	8,225
Unincorporated El Dorado County	115,280	140,782	167,326	179,178	206,853	86,449

2.4 Bicycle Commuter Projections

A common term used in analyzing choices people make in transportation is “mode split.” Mode split refers to the transportation option a person chooses, be it taking a bus, walking, carpooling, driving, or bicycling. Mode split is often used to evaluate transportation mode choices, and the trend in the Sacramento region today is to create a more evenly distributed mode split. The census data in the table below shows a .3% bicycle mode split for El Dorado County. Bicycle commute habits are difficult to measure accurately without extensive data collection efforts. The Census records only “Means of Transportation to Work” and thus, home-to-school, trips to the store, trips to a friend’s house, or other transportation related trips remain unaccounted for. Additionally the Census asks specifically for the “primary mode” of transportation to work, so those who bicycle less than 50% of the time, or combine the bicycle with other commute modes are likely unaccounted for.

U.S. Census Data: Means of Transportation to Work for Workers age 16 and over; Census 2000 – El Dorado County (includes the Lake Tahoe area)		
Transportation Mode	**Number of Persons**	**Percent of Work Trips or Mode Split**
Drove alone	54,656	76%
Carpooled	9,599	13%
Public Transportation	1,294	1.7%
Motorcycle	123	.2%
Bicycle	244	.3%
Walked	1,570	2.2%
Other means	418	.6%
Worked at home	4,215	6%
TOTAL	**72,119**	**100%**

Many recent studies document the potential of the bicycle as a transportation mode. The 2009 National Household Travel Survey (NHTS) states that bicycling trips have increased from 1.7 billion in 1990 to 4 billion reported trips in 2009. The NHTS also stated that bicycling trips have increased 25% since 2001. A Harris Poll conducted in 1991 found that nearly half (46%) of American adults age 18 or above had bicycled in the past year. Of these:

- 46% stated they would sometimes commute by bicycle if safe bicycle lanes were available
- 53% would if they had safe, separate, designated paths on which to ride
- 45% would if their workplace had showers, lockers, and secure bicycle storage; and
- 47% would if their employer offered financial or other incentives

Source: National Bicycling and Walking Study, U.S. Dept. Of Transportation

Many factors influence the decision to bicycle, and studies show that the primary factor is the availability of safe bicycling facilities. Some retrofitting would be required, but El Dorado County has the unique opportunity to integrate the bicycle as a part of the transportation system today as new development occurs. The 1990 Nationwide Personal Transportation Survey (NPTS) determined that two out of five travel trips are two miles or less, and nearly half are three miles or less. The small communities of El Dorado County provide unique opportunities for increased short, local bicycle transportation trips. With improved bicycle facilities, the county could increase the mode split for bicycles and become a “bicycle friendly community.”
Source: National Bicycling and Walking Study, U.S. Dept. Of Transportation

2.5 Types of Bicyclists

Bicyclists can be divided into three general categories:

EXPERIENCED: These are cyclists who can operate under most traffic conditions. They comprise the majority of the users on collector and arterial streets and usually prefer direct access to destinations. The existing street and highway system provides them the opportunity to operate at maximum speed with minimum delays. Experienced bicyclists negotiate streets in much the same manner as motor vehicles, merging across traffic lanes to make left turns and avoiding bike lanes that contain gravel, glass, and other debris. The experienced bicyclist will benefit from and prefers wide curb lanes, bike lanes, and loop detectors at signals.

CASUAL: These are new adult and teenage riders who are less confident of their ability to operate in traffic without special provisions for bicycles. The casual rider is uneasy about riding in traffic and unsure about lane positioning when making turns. In some cases, casual riders may perceive side streets (or sidewalks) as being safer alternatives than major through routes, when in fact they may be less safe. Casual cyclists ride shorter distances than the experienced rider and are unfamiliar with the rules of the road.

Some casual riders will develop greater skills and progress to the advanced level, but there will always be ‘casual cyclists.’ Casual cyclists prefer: comfortable access to destinations - preferably by a direct route, using either low-speed, low traffic volume streets or designated bike facilities, and well-defined separation of bicycles and motor vehicles on arterial and collector streets (bike lanes or shoulders) or separated paths or trails.

CHILDREN: These are pre-teen riders whose roadway use is initially monitored by parents. Eventually they are accorded independent access to the transportation system. Children and their parents feel most comfortable in a transportation system with the following attributes: access to key destinations surrounding residential areas including schools, recreation facilities, shopping or other recreational areas; residential streets with low traffic volumes and car speeds; well defined separation of bicycles and motor vehicles on arterial and collector streets; or separated bike paths.

2.6 Bicycle Safety and Education Programs

Bicycle safety and education programs are an important component of any bicycle transportation system. For both existing and potential users, perceptions about safety directly affect the numbers of potential bicyclists in the County. Bicycle education programs and accident data were reviewed as a component of this plan.

2.6.1 Accident Data

The California Department of Health Services, EPIC Branch, has compiled data on bicycle injuries and fatalities in El Dorado County for the time period of 1991-2005. The table below displays a summary of the annual totals of non-fatal hospitalized injuries and fatal injuries to bicyclists throughout the time period. The EPIC Branch data includes details on the person's age when the injuries and fatalities occurred. The age ranges of 5-12 years and 21-44 years accounted for 75 and 107 of the 309 total bicycle injuries or 59% of all injuries between 1991 and 2005. In fatal injuries, the age range of 5-12 was highest with 4 of the 8 total fatalities during the time period.

El Dorado County Bicycle Injuries, 1991-2007		
Year	**Non-Fatal Hospitalized Injuries**	**Fatal Injuries**
1991	14	0
1992	21	1
1993	15	1
1994	23	0
1995	19	2
1996	12	0
1997	30	0
1998	22	0
1999	23	0
2000	27	1
2001	19	0
2002	22	1
2003	15	0
2004	25	1
2005	22	1
2006	23	Not Available
2007	Not Available	1
TOTAL	**309**	**8**

The California Highway Patrol maintains Statewide Integrated Traffic Records System (SWITRS) accident data. The data is contained in the "California Report of Fatal and Injury Motor Vehicle Traffic Collisions." The most recent data available is from 2008, and the El Dorado County portion relating to bicycles and pedestrians is listed below.

El Dorado County Collisions - 2008				
Incorporated Cities and Type of Roadway	**Collisions**			
	Pedestrian Involved		**Bicycle Involved**	
	Fatal	**Injury**	**Fatal**	**Injury**
City of Placerville	0	3	0	1
South Lake Tahoe	0	10	0	14
Unincorporated State Highways	0	4	0	4
County Roadways	0	8	0	16
County Total	**0**	**25**	**0**	**35**

2.6.2 Education Programs

School Districts, Police Departments, and the California Highway Patrol have been the primary organizations responsible for improving bicycle safety conditions in California. Despite their efforts, the lack of education for bicyclists, especially younger children, is a leading cause of accidents. For example, the most common type of reported bicycle accident in California involves a younger person (between eight and 16 years of age) riding on the wrong side of the road during the evening hours. Studies of accident locations around California consistently show the greatest concentration of accidents is directly adjacent to elementary, middle and high schools. In addition, many less-experienced adult bicyclists are unsure how to negotiate intersections and make turns on city streets.

The El Dorado County Sheriff's Department and the California Highway Patrol are the primary organizations performing bicycle education activities in western El Dorado County. The two organizations frequently work with the American Automobile Association (AAA) or State Farm Insurance groups to conduct bicycle rodeos. The curriculum is provided by the insurance companies.

Summary of Bicycle Education Programs, El Dorado County Western Slope

Agency	Contact Person	Programs Offered
El Dorado County Sheriff – Placerville Office	Deputy Steve Klang – School Resources Officer Deputy Klang is a P.O.S.T. (Peace Officers Standard Training) certified bicycle instructor. Phone Number: 530-621-4003 x4126	The Sheriff's Office will conduct safety programs upon request. Generally at Schools, Church's and Scout events. The 2-hour program includes: 1. General knowledge of the bike 2. Mechanical safety 3. Basic laws, age appropriate 4. Actual riding skills event
California Highway Patrol (CHP)	Dan Stark – Public Information Officer 3031 LoHi Way Placerville 95667-1417 530-622-1110	Conducts Bicycle Rodeos upon request. The CHP generally tries to ensure that at least 1 Bicycle Rodeo is conducted each year. The Bicycle Rodeo has four phases: 1. Registration 2. Bike Inspection 3. Safety and Helmets 4. Obstacle Course The CHP also distribute safety information at events such as "Kids Expo" and County Fair.

Special events such as "Bike to Work Day" encourage people to try bicycle commuting and provide bicycle products, information, equipment, and educational resources to bicyclists. In 2003, El Dorado County held their first annual Bike to Work Day events in El Dorado Hills and the City of Placerville. The 2003 and 2004 events each had nearly 30 participants and several participants reported that they commute by bicycle on a regular basis.

City of Placerville Mayor Pierre Rivas and El Dorado County Parks and Recreation Commissioner Bob Smart at the 2010 "Great Bike Ride"

In 2005, EDCTC began promoting the Sacramento Region "May is Bike Month" campaign by encouraging residents to register at www.mayisbikemonth.com to log bicycling miles toward the "Million Mile Challenge." The Million Mile Challenge is an effort to collectively log over one million commute, errand, and recreation bicycling miles in the Sacramento Region during May. Several events have been held since 2005 including Bike to Work Day events and the annual "Great Bike Ride" at the El Dorado County Government Center. The Great Bike Ride brings together City Council members, County Supervisors, local government employees and citizens for a lunchtime bike ride along the El Dorado Trail. The event is held in coordination with the 50 Corridor Transportation Management Association during the first week of May to kick of the Regional May is Bike Month Promotion. El Dorado County participation (including the City of Placerville) in the May is Bike Month Campaign is detailed in the table below:

El Dorado County Participation in Annual May is Bike Month Campaign					
Year	Number of Participating Residents	Total Commute Miles Logged	Total Errand Miles Logged	Total Recreation Miles Logged	Total Miles Logged
2006	77	4,476	375	8,604	13,455
2007	207	8,250	623	29,668	45,487
2008	261	16,901	979	36,336	54,524
2009	253	17,123	938	43,987	62,633
2010	333	15,363	1,021	49,379	66,048
Totals	1,131	62,113	3,936	167,974	242,147

The table demonstrates a significant increase in El Dorado County's annual participation in May is Bike Month between 2006 and 2010. Many factors influence the decision to bicycle, and studies show that the primary factor is the availability of safe bicycling facilities. Based on the number of miles of Class I bike path and Class II bike lanes constructed in El Dorado County between 2006 and 2010, the table indicates a strong correlation between improved access to safe bicycle transportation facilities and increased bicycle trips in El Dorado County. The table also shows that compared to 2006, in 2010 the:

- Number of participating residents increased 430%
- Total commute miles logged increased 343%
- Total miles logged increased 490%

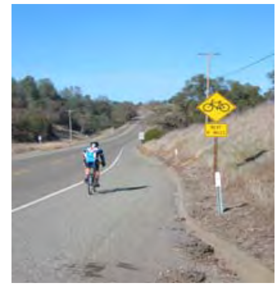
2.6.3 Safety Programs

Bicycle Warning Sign

Share the Road sign

Motorist education on the rights of bicyclists is virtually non-existent. Many motorists mistakenly believe that bicyclists do not have the right to ride in travel lanes and that they should be riding on sidewalks. Many motorists do not understand the concept of 'sharing the road' with bicyclists, or why a bicyclist may need to ride in the travel lane, such as the absence of a shoulder or when pedestrians or vehicles occupy a bike lane.

In El Dorado County, there are a few locations where the bicycle warning sign exists. In some cases the bicycle warning sign (W11-1) is used in conjunction with the share the road message sign (W16-1) to be placed on narrow roads where motorists and bicyclists must share the traffic lane. Some California counties are actively promoting a “Share the Road” campaign and combining the use of signs with other promotional items that increase awareness such as, bumper stickers, special posters, T-shirts and water bottles.



Bicycle Warning Sign on Latrobe Rd

Bicycle Warning Sign Locations in El Dorado County:

- Pleasant Valley Road (Highway 49) near Koki Lane and Union Mine High School
- Latrobe Road near the town of Latrobe and the Amador County Line
- On Highway 49 near the Historic town of Coloma
- On Salmon Falls Road

The goals, objectives, and policies presented in this chapter remain relatively unchanged from the existing goals, objectives, and policies in the 2005 Bicycle Transportation Plan and will help guide the future development of the El Dorado County bicycle transportation system. The goals, objectives, and policies provide the long-term vision and foundation for the plan and were developed to reflect the unique needs of El Dorado County and the latest efforts of neighboring jurisdictions around the region.

3.1 OVERALL GOAL AND VISION STATEMENT

Provide a safe, efficient, and convenient network of bicycle facilities that establish alternative transportation as a viable option in El Dorado County and neighboring regions.

3.1.1 Bicycle Commuting

Goal: Develop a bicycle transportation system that provides a viable alternative to the automobile and enhances the safety and convenience of bicycling to employment centers, schools, residential neighborhoods, campgrounds, parks, commercial and other activity centers in El Dorado County and neighboring jurisdictions.

Objective: *Increase bicycling and walking as a transportation mode to reduce congestion, improve air quality, and improve public health.*

Policy 1A: Maintain an adopted Bicycle Transportation Plan that identifies existing conditions, deficiencies, and future needs. The plan should provide specific recommendations for facilities to be developed in existing, new, and redeveloping areas.

Policy 1B: Develop the proposed bicycle transportation system and update the Bicycle Transportation Plan regularly (every two to five years, as needed).

Policy 1C: Install directional signage to indicate connections to key activity center destinations and regional routes.

Policy 1D: Conform new bikeways to meet or exceed the most recent design standards adopted by Caltrans unless unique, unavoidable circumstances such as topography, historic nature of the county, physical, environmental, or other circumstances create the need for a design exception or other creative solutions.

Policy 1E: Encourage retrofit projects on substandard bikeways in order to conform to the most recent design standards.

Policy 1F: Provide bicycle transportation facilities with all new development.

Policy 1G: Close gaps in the bicycle transportation system to facilitate bicycle commuting.

Policy 1H Provide routes paralleling major arterial routes for long distance bicycle commuting.

Policy 1I Maximize coordination between EDCTC, El Dorado County, the City of Placerville, El Dorado Hills Community Services District, and neighboring jurisdictions on issues of mutual concern.

3.1.2 Safety and Education

Goal: Maximize bicycle safety.

Objective: Improve bicycle education and enforcement and promote bicycle safety and awareness programs.

Policy 2A: Work with local law enforcement, EDCTC, schools, and other agencies to encourage the development of a bicycle education program that is available to all school children in El Dorado County.

Policy 2B: Enhance the visibility and safety of all bicycle crossings in El Dorado County through proper striping of bike lanes at intersections and enhanced visibility of Class I Bike Path Crossings.

Policy 2C: Develop a countywide bike map, bicycling safety publications, and campaigns to encourage safe cycling, prevent wrong way riding, educate local law enforcement about enforcing proper cycling and educate motorists about sharing roads with cyclists.

Policy 2D: Install appropriate signage such as share the road, school crossings, and directional bicycle route signage.

Policy 2E: Establish a plan with specific guidance to contractors and County and City inspectors to address the impact of roadway construction projects on bike lanes and how to safely and conveniently accommodate bicycle traffic through construction zones.

Policy 2F: Develop a system for identifying, evaluating, reporting, and responding to maintenance and safety issues on the existing bicycle transportation system.

3.1.3 Implementation and Maintenance

Goal: Identify detailed and prioritized improvements in the El Dorado County Bicycle Transportation Plan.

Objective: *Implement the priority projects and maintain the system identified in the Bicycle Transportation Plan.*

Policy 3A: Maintain a current list of priority bicycle improvements to be constructed in the short to mid-term.

Policy 3B: Encourage the use of existing natural or manmade corridors such as creeks, powerline corridors, railroad corridors, abandoned ditches and other corridors for future bikeway alignments.

Policy 3C: Review new developments and road projects for consideration of bicycle needs and linkages consistent with this plan. Provide conditions of approval to city and county planning departments.

Policy 3D: Work with Caltrans to provide safe and effective bicycle facilities at all Caltrans maintained facilities including state routes, highways, interchanges, freeways, and park and ride lots.

Policy 3E: Ensure that the County's bikeways are maintained and in good working order.

3.1.4 Land Use Development

Goal: Integrate bicycle and pedestrian planning with other regional and community planning, including land use and transportation.

Objective: *Consider the needs of the bicycle and pedestrian system identified in the El Dorado County Bicycle Transportation Plan when reviewing new development, redevelopment projects, and construction projects, and incorporate those needs into such projects whenever feasible.*

Policy 4A: Examine the adopted Specific Plan and General Plan land use elements to determine areas of potential growth and development in the County. Consider possible impacts any new or re-development projects may have on the bicycle transportation system, including the analysis of a need for through-routes in subdivisions.

Policy 4B: Ensure that bicyclists' needs are incorporated into new developments and subdivisions or commercial areas, including providing access points to existing and proposed Class I bicycle facilities, on-street facilities for bicycles and, whenever feasible, grade separations at roadway crossings where streets cross existing and proposed bikeways.

Policy 4C: Incorporate grassroots planning efforts where appropriate.

3.1.5 Multi-Modal Integration

Goal: Maximize multi-modal connections to the bicycle transportation system.

Objective: *Develop a transportation system that encourages the use of multiple transportation modes.*

Policy 5A: Work with the El Dorado County Transit Authority to install bike lockers and bike racks where appropriate and to maintain and install bike racks on buses.

Policy 5B: Ensure that the countywide bicycle transportation system serves all multi-modal facilities in El Dorado County.

Policy 5C: Encourage the installation of appropriately located bicycle parking and related facilities.

3.1.6 Funding

Goal: Obtain all possible funding for plan implementation.

Objective: *Maximize the amount of public and private funding sources for implementation of the projects within the Bicycle Transportation Plan.*

Policy 6A: Identify current local, regional, state, and federal funding programs (government and non-government), and associated funding requirements and deadlines.

Policy 6B: Develop and maintain a current prioritized list of bicycle improvements, including detailed cost estimates, and identify appropriate funding sources for each proposal.

Policy 6C: Include bicycle transportation improvements in the County's Capital Improvement Program (CIP) and Regional Transportation Plan (RTP). Define the percentage of the CIP that will be dedicated to the development of the bicycle transportation system.

Policy 6D: Encourage multi-jurisdictional funding applications and applications developed through partnerships with community groups.

Policy 6E: Recommend bike improvements or a donation into a bicycle transportation improvement fund for all major residential developments of 25 new dwelling units or more.

3.1.7 Connectivity

Goal: Develop a well-connected bikeway system.

Objective: *Maximize connectivity to promote a comprehensive bikeway network.*

Policy 7A: Include bicycle lanes on collectors and arterials where width of street, traffic volumes, and service to major activity centers are appropriate.

Policy 7B: Develop standards for bike lane consistency at intersections and interchanges.

Policy 7C: Explore and take advantage of opportunities to make consistent bikeway connections between El Dorado County and neighboring jurisdictions.

Policy 7D: Encourage the development of short distance connections within the communities of El Dorado County as well as long distance connections between communities throughout the County and region.

Policy 7E: Protect opportunities for bikeway connections.

Policy 7F: Accommodate the needs of different bicycle user groups.

Policy 7G: Give priority to bike routes that connect new and existing residential areas to employment, education, commercial, and recreation centers.

Policy 7H: Encourage “complete streets” and comply with Caltrans Deputy Directive 64-R1, Complete Streets – Integrating the Transportation System.

3.1.8 El Dorado Trail (Sacramento-Placerville Transportation Corridor [SPTC])

Goal: In usable segments, develop Class I Bike Paths on the El Dorado Trail.

Objective: *Utilize the El Dorado Trail, including the SPTC, as a bicycle transportation corridor where opportunities improve connectivity to the overall county bikeway system, the Folsom Bikeway System, and the American River Bikeway System.*

Policy 8A: Develop the sections of the El Dorado Trail Corridor proposed in the El Dorado County Bicycle Transportation Plan.

Policy 8B: Develop bicycle transportation connections between town centers, activity centers and the El Dorado Trail.

Policy 8C: Utilizing the SPTC, develop a Class I bicycle path connection between the El Dorado Trail, the City of Folsom Bikeway System, and the American River Bikeway System.

4.1 Past Expenditures and Existing Bicycle Facilities

The existing bicycle facilities in El Dorado County are described in the table below. The table includes six segments of class I bike path, and nine segments of class II bike lanes. Various bicycle-related signs exist on roads around the county as well, and they are also included in the table. Since there are a limited number of existing bicycle facilities in El Dorado County, the Project Manager and Bicycle Advisory Committee (BAC) members conducted exhaustive inventories of the roadway shoulder conditions (see section 4.3).

Bike path along the historic Weber Creek Trestle Bridge on the El Dorado Trail.

In order to fulfill the Caltrans requirement for past expenditures on bicycle facilities the table also includes a column with information on cost and funding source. Many bikeway projects were funded as a component of a larger roadway project. For instance, the class II bike lanes on Missouri Flat Road were part of a project to widen the road and a component of the county's Capitol Improvement Program (CIP). The bike lanes were included as a component of the project and paid for from a combination of sources. Other projects, such as the bike path along El Dorado Hills Boulevard, have similar cost breakdowns and were constructed many years ago, which makes funding information difficult to obtain.

Existing El Dorado County Bicycle Facilities

Location	Facility Type	Cost/Funding Source
El Dorado Hills (Map 1)	Class II Bike Lanes on Sophia Parkway	Funded by a developer advance.
El Dorado Hills (Map 1)	Class II Bike Lanes on White Rock Road-Joerger Cut-Off Road to Latrobe Road	
El Dorado Hills (Map 1)	Class II Bike Lanes on White Rock Road – Latrobe Road to Carson Crossing Road	
El Dorado Hills (Map 1)	Class II Bike Lanes on Latrobe Road – Golden Foothill Parkway to Town Center Drive	
El Dorado Hills (Map 1)	Class II Bike Lanes on Green Valley Road – 400 feet west of El Dorado Hills Boulevard to County line	
El Dorado Hills (Map 1)	Class I Bike Path – Near Serrano Parkway to Woedee Drive	Bike Path developed in conjunction with original El Dorado Hills Blvd. widening in the early 1990's, funding information unavailable.
El Dorado Hills (Map 1)	Class I Bike Path – Along Bass Lake Road from Silver Dove Way to Serrano Parkway	
El Dorado Hills (Map 1)	Three Bike Route Signs, one at Harvard Way, two at Governor's Drive Intersection	
Cameron Park (Map2)	Class II Bike Lanes on Cameron Park Drive – Winterhaven Drive to Alhambra Drive	
Cameron Park (Map 2)	Class II Bike Lanes on Green Valley Road – Cameron Park Drive to Pleasant Grove Middle School	2005/2006 BTA Funds: $80,000 TDA: $30,000
El Dorado County near Latrobe (Map 3)	Bicycle Warning Sign on Latrobe Rd	

Existing El Dorado County Bicycle Facilities		
El Dorado County near Diamond Springs (Map 2)	Class II Bike Lanes on Missouri Flat Rd from Highway 50 to Southern Pacific Transportation Corridor (SPTC) Right of Way	Paid for by County TIM fees and developer mitigation fees. Cost breakdown unavailable.
El Dorado County near Diamond Springs (Map 4)	Bicycle Warning Sign near Koki Lane on Highway 49	
El Dorado County near Coloma	Two Bicycle Warning Signs/Share the Road Signs	
El Dorado County near Folsom	Bicycle Warning Sign on Salmon Falls Rd	
El Dorado Trail – near Placerville (Map 4)	Class I Bikeway – Jacquier Rd to Parkway Drive	TEA Funds $388,000 TDA Funds $47,000
El Dorado Trail – near Placerville (Map 4)	Class I Bikeway – Highway 50 Over Crossing	Over Crossing total cost: $1,669,325 TDA Funds $91,000 Exch. TEA Funds $306,238 RSTP Exch. Funds $41,298 State Minor B $12,500 Parks & Rec. Funds: $177,602 Prop. 116: $1,040,686
El Dorado Trail – near Placerville (Map 4)	Class I Bikeway - Parkway Drive to Los Trampas Drive	1.5 mile segment total cost: $671,267 State Proposition 12: $564,000 State Parks RZH Grant: $152,000
El Dorado County near Coloma	Class II Bike Lanes on State Route 49 from Marshall Road to the bridge over the South Fork of the American River	SHOPP funds
El Dorado Trail – near Placerville and Diamond Springs (Map 4)	Class I Bikeway – Forni Road to Missouri Flat Road	2.75 mile segment total cost (includes design and environmental documentation): $2,083,496 State Proposition 40: $315,996 TE Funds: $1,099,000 2007/2008 BTA Funds: $400,000 Exchanged TE Funds: $50,000 Community Enhancement Funds: $200,000 EDC Grant Match: $18,500
El Dorado County Government Center – near Placerville	Bike Racks – Buildings A, B, C, and Sheriff's Building	TDA funds: $2,992
El Dorado Hills Park and Ride	Ten Bike Lockers	$1,050 per locker; TDA funds
Cambridge Park and Ride	Two Bike Lockers	$1,050 per locker TDA funds
El Dorado Transit Facility	Two Bike Lockers	$1,050 per locker TDA funds
Central Transit Center on Commerce Way	Six Bike Lockers; Two Bike Racks	$1,050 per locker TDA funds

4.2 Bicycle Support Facilities

Bicycle support facilities include physical infrastructure designed to support, assist, or accommodate the use of bicycles. Types of support facilities include bike racks, bike lockers and shower facilities. Support facilities are important because potential bicycle commuters may be discouraged if they think their bicycle will be stolen or vandalized if they have to leave it unlocked or out of sight once they reach their destination. The availability of parking is a prerequisite for automobile use – the same holds true for bicycling.

In some cities and counties, installation of secure bicycle parking is required as part of the local transportation system management plans or zoning code. Goal 5 of this plan, – Multi-Modal Planning, Policy C includes a statement to increase the installation of bicycle parking as follows: *Encourage the installation of appropriately located bicycle parking and related facilities.*

An inventory of bike racks and locker facilities was conducted in the western slope of El Dorado County for the purpose of this plan and the details of that inventory are listed below and displayed on the maps included in this document.

Bike Racks

4.2.1 Bike Racks

Bike Racks are present at several schools in El Dorado County. Other locations include:

- Prospector's Plaza Shopping Center (Diamond Springs)
- Central Transit Center (Diamond Springs)
- El Dorado County Government Center (Placerville)
- WalMart (Diamond Springs)
- El Dorado Hills Park and Ride lot (El Dorado Hills)

4.2.2 Bike Lockers

Either El Dorado Transit or Caltrans, depending on the location, maintains bike lockers in El Dorado County. Caltrans maintains bike lockers at the park and ride lot at Cambridge Drive/Highway 50 in Cameron Park. The Caltrans-maintained lockers can be used free of charge, simply by calling Caltrans at 916.859.7965.

Bike Lockers

Caltrans Maintained Bike Lockers

Park and Ride Lot Location	Number of Lockers	Number in use May 2010
Cameron Park – Cambridge Drive/Highway 50	6	4

El Dorado Transit maintains bike lockers at four locations in El Dorado County: El Dorado Hills Park and Ride Lot; the El Dorado Transit Facility, which is a regular bus stop; the park and ride facility at Cambridge Drive/Highway 50 in Cameron Park; and at the Central Transit Center on Commerce Way in Diamond Springs. El Dorado Transit also maintains bike lockers at two locations within the City of Placerville: at the El Dorado County Fairgrounds and at the Placerville Station on Mosquito Road. El Dorado Transit rents out the bike lockers monthly for $5.00 per month with a refundable $20.00 key deposit. The lockers are billed six months in advance – the first bill includes the key deposit and is $60.00. After that, the cost is $30 every six months. El Dorado Transit can be reached at 530.642.5383.

El Dorado Transit Maintained Bike Lockers		
Park and Ride Lot Location	**Number of Lockers**	**Number in use May 2010**
El Dorado County – El Dorado Hills Park & Ride	10	1
El Dorado County – El Dorado Transit Facility	2	1
Cameron Park – Cambridge Drive/Highway 50	2	2
Central Transit Center – Commerce Way	6	0
City of Placerville – El Dorado County Fairgrounds	6	0
City of Placerville – Placerville Station	4	0

4.2.3 Workplace Shower and Locker Facilities

Some large employers provide showers and lockers for employees who wish to bicycle to work. The absence of showers and changing facilities may serve as a barrier to potential bicycle commuters.

DST Output is El Dorado County's largest employer with approximately 1,500 employees in El Dorado Hills. DST is located off Latrobe Road south of Highway 50 and has a showering facility and bike racks for bicycle commuters.

Blue Shield is another very large employer in El Dorado County. Located on Town Center Drive in El Dorado Hills, Blue Shield has approximately 1400 employees and provides bicycle lockers, racks, and showering facilities.

Parks and Recreation sign for shower facility

4.3 Inventory of Shoulder Conditions and Areas of Opportunity

Since there are a limited number of existing bicycle facilities in El Dorado County, the Project Manager and Bicycle Advisory Committee (BAC) members conducted exhaustive inventories of the roadway shoulder conditions. BAC members completed a form *(appendix d)* that explained details of the roadway conditions and often provided photos to assist with the inventory. The inventories were conducted on a vast majority of El Dorado County's roads to determine if there are any areas with four feet or more of existing shoulder. These "areas of opportunity" allow for low cost development of Class II Bike Lanes.

Typical area of opportunity – Green Valley Rd

The existing conditions inventory conducted for this plan resulted in data which can be helpful in determining low cost areas for addition of Class II Bike Lanes, including areas where street lanes can be narrowed together to create more room for bike lanes. The tables included on the following pages show the existing conditions on all roads inventoried. The shaded roadway segments indicate areas of opportunity, where the existing shoulder is either two to four feet wide or greater than four feet. The map set included in this document corresponds with the tables i.e.; the map 1 table corresponds to the existing conditions displayed on map 1.

Table 4-1 Existing Conditions (see chapter 5, map 1)

North El Dorado Hills

STREET NAME	SEGMENT (FROM-TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Green Valley Rd	Malcom Dixon to Pleasant Grove Middle School	North and south side: varying 2' - 3' - 4' wide shoulders, no sidewalks. No signs. No off street parking	New school on Green Valley Rd
Green Valley Rd	Malcom Dixon – Silva Valley Pkwy	4-6' shoulder	
Green Valley Rd	El Dorado Hills Blvd - Silva Valley Pkwy	North and south side: varying 2' - 3' - 4' wide shoulders, no sidewalks. No signs. No off street parking. Curb cuts at corner of EDH Blvd	
Francisco Drive	Sheffield - Green Valley Rd	0-2' shoulder; narrow road	Minor Collector, Marina School and shopping center(s)
Francisco Drive	Green Valley Rd - El Dorado Hills Blvd	No shoulder; narrow road	Separate 3' path on west side
Francisco Drive	EDH Blvd to Jackson Elementary School	Sidewalk on one side, crosswalk, 2-4' shoulder to school with restricted parking during school hours	Access to school, park, NYC trailhead
West El Dorado Hills			
Sophia Parkway	Green Valley Rd -Iron Point Rd	12' bike lane with pavement markings and signage	
Brittany Way	EDH Blvd to Sophia Parkway	No striped shoulder - residential neighborhood. Wide roads that could accommodate a bike lane	Future major collector; Wild Oaks Park, new school, community park, residential, alternate to Green Valley
Olson Lane	EDH Blvd to Gillette to Ridgeview	No striped shoulder - residential neighborhood	Minor Collector, no sidewalk, some steep portions
Ridgeview Drive	Gillette to Wilson	No striped shoulder - residential neighborhood	Minor Collector, no sidewalks, two parks on Ridgeview
Wilson	EDH Blvd to Ridgeview to Montridge	Wide shoulder and some sidewalks on western end, past Ridgeview	Minor Collector, residential neighborhoods to major collectors
Park Drive	Park Dr. to EDH Blvd	No striped shoulder - residential neighborhood	Minor Collector, no sidewalks leads to Brooks School, Fire Station, park, residential
Saratoga Way	El Dorado Hills Blvd - County Line	No shoulder	Future connection to Iron Point Rd.

Areas of Opportunity are shaded

Table 4-1 Existing Conditions (see chapter 5, map 1)			
East El Dorado Hills			
STREET NAME	**SEGMENT (FROM - TO)**	**SHOULDER CONDITION**	**MISCELLANEOUS COMMENTS**
Bass Lake Rd	Green Valley Rd - Parkdale Ln	2-4' shoulder	Near Green Valley Elementary School. A walking path exists on the west side of Bass Lake to Lambeth Dr.
Bass Lake Rd	Parkdale Ln - Serrano Parkway	No shoulder; narrow road	2-4' shoulder near entrance of Woodleigh Ln. Development, and on the east shoulder near Magnolia Hills
Bass Lake Rd	Serrano Parkway - Old Bass Lake Rd	No shoulder; narrow road	High car speeds
Bass Lake Rd	Old Bass Lake Rd to Hwy 50 U.C.	2-4' shoulder	4-6' striped shoulder at bass Lake undercrossing
Old Bass Lake Rd	Bass Lake Rd - Gate	No shoulder; narrow road. Does not appear to be County Maintained.	Closed and gated connection to Cameron Park and Silva Valley Parkway, along Hwy 50 corridor
Country Club Dr	Bass Lake Rd - Tierra de Dios	No shoulder; narrow road	Proposed to be abandoned and converted to Class I bike path
Central El Dorado Hills			
El Dorado Hills Blvd.	Green Valley Rd - Francisco	4-6' northbound shoulder; 2-4' southbound shoulder	Separate 9' path on west side could be a potential Class I by adding pavement markings
El Dorado Hills Blvd.	Francisco - power line easement (except for small stretch from Francisco to Brittany)	2-4' shoulder	Separate 9' path on west side could be a potential Class I by adding pavement markings
El Dorado Hills Blvd.	Power line easement - Governor's Dr	2-4' shoulder	
El Dorado Hills Blvd.	Governor's Dr - Harvard Wy	4-6' shoulder - Bike Route Sign at Governor's Dr.	Potential Class II by adding pavement markings
El Dorado Hills Blvd.	Harvard Wy - Serrano Parkway	4-6' shoulder with Class 1 on east side - Bike Route Sign	Temporary construction barriers near Wilson Wy
El Dorado Hills Blvd.	Serrano Parkway - Hwy 50	4-6' shoulder	Potential Class II by adding pavement markings. No shoulder at Hwy 50 undercrossing
Timberline Ridge Rd	EDH Blvd - Silva Valley Rd	No striped shoulder - residential neighborhood	Minor Collector, no sidewalk. Alternate connection between SV Pkwy and EDH Blvd through residential area
Keswick Way	Charter Way to Silva Valley Pkwy	No shoulder, has sidewalks	Entry to Fairchild Village, Park
Tam O'Shanter Way	St. Andrews to Francisco	No striped shoulder - residential neighborhood	Minor Collector, no sidewalk, Steven Harris parks, Jackson School, New York Creek nature trail, alternate to EDH Blvd.
Harvard Way	El Dorado Hills Blvd - Silva Valley Pkwy	4-6' shoulder; narrows at Clermont; entire length frequently obstructed by parking	Oak Ridge HS, Rolling Hills School, and CSD. Future Class I on north side between EDH Blvd and Clermont

Areas of Opportunity are shaded

Table 4-1 Existing Conditions (see chapter 5, map 1)

Central El Dorado Hills

STREET NAME	SEGMENT (FROM-TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Serrano Parkway	El Dorado Hills Blvd - current terminus	4-6' shoulder	Potential Class II by adding pavement markings
Silva Valley Parkway	Green Valley Rd - Harvard Wy	0-2' shoulder	Major Collector
Silva Valley Parkway	Harvard Wy - Golden Eagle	4-6' shoulder frequently obstructed by parking adjacent to high school in both directions	Silva Valley School & Oak Ridge HS
Silva Valley Parkway	Golden Eagle Ln - Oak Meadow School	4-6' shoulder	Oak Meadow School; Potential Class II by adding pavement markings
South El Dorado Hills			
Tong Rd	Silva Valley Pkwy - Gate	0-2' shoulder; narrow road, no signs, sidewalks, or curbs	Leads to larger collector (Silva Valley Parkway)
Town Center Drive	White Rock Rd - Post Street	No shoulder	Minor Collector, entry to Town Center Shopping Center, Park N Ride, Post Office

South El Dorado Hills

STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Golden Foothill Pkwy	Latrobe Rd - Latrobe Rd	No shoulder	Business park thoroughfare
Latrobe Rd	Hwy 50 - Town Center Drive	2-4' shoulder, generally congested area due to Highway 50 on/off ramps	Bicycle and pedestrian overcrossing being constructed to provide access
Latrobe Rd	Golden Foothill Parkway - Deer Creek	Mostly 4-6' shoulder; Narrows to no shoulder for a portion between Wetsel Oviatt and Deer Creek; narrows to 2-4' shoulder at Investment Blvd.	Potential Class II By adding pavement markings
White Rock Rd	Carson Crossing Road - County Line	No shoulder; narrow road	

Table 4-2 Existing Conditions (see chapter 5, map 2*)*

Cameron Park

STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Country Club Dr.	Tierra de Dios - Cambridge Rd	2-4' shoulder	Shoulder is 4' in most areas
Country Club Dr.	Cambridge Rd - Cameron Park Drive	0-2' shoulder	
Cambridge Rd	Country Club Dr - Green Valley Rd	0-2' shoulder	Major residential collector
Merrychase Dr	Cambridge Rd - Country Club Dr	2-4' shoulder	Two schools & park/skateboard park, parking permitted
Palmer Drive	Cameron Park Drive - End	Wide shoulder, wide road, parking permitted	Nearby activity centers, shopping and business
Cameron Park Drive	Alhambra Drive - Meder Rd	2-4' shoulder	
Cameron Park Drive	Meder Rd - Palmer Drive	2-4' shoulder	

Areas of Opportunity are shaded

Table 4-2 Existing Conditions (see chpater 5, map 2)			
Cameron Park (continued)			
STREET NAME	**SEGMENT (FROM-TO)**	**SHOULDER CONDITION**	**MISCELLANEOUS COMMENTS**
Cameron Park Drive	Palmer Drive - Highway 50 Undercrossing	No shoulder, narrow lanes and lots of turning movements in this area	Elevated walkway on the West side under Highway 50, not very accessible for bikes. Needs striping under Highway 50
Cameron Park Drive	Hwy 50 U.C. - Durock Rd.	No defined shoulder, wide road	Lane width could allow for bike lanes striping
Cameron Park Drive	Hwy 50 Undercrossing	No defined shoulder, wide road	Add sharrows to northbound #1 lane for cyclists turning left onto Country Club Dr.
Coach Lane	Cameron Park Drive - End	No defined shoulder, wide road	Lane width could allow for bike lanes striping
Durock Rd	Cameron Park Drive - South Shingle Rd	0-2' shoulder, most areas. 2-4' near South Shingle and Cameron Park Drive	Class II bike lanes included in S.L.P.P. project near Business Drive
Meder Rd	Ponderosa Rd - Paloran Ct.	No shoulder	
Meder Rd	Paloran Ct. to Cameron Park Drive	2-4' shoulder	Shoulder narrows near Auburn Hills Drive intersection
Shingle Springs			
North Shingle Rd	Green Valley Rd - Sports Field Drive	No shoulder	
North Shingle Rd	Sports Field Dr - Ponderosa	2-4' shoulder	
South Shingle Rd	Durock - South Shingle Ct.	2-4' shoulder	
Cameron Park			
STREET NAME	**SEGMENT (FROM - TO)**	**SHOULDER CONDITION**	**MISCELLANEOUS COMMENTS**
South Shingle Rd	South Shingle Ct. - Brandon Rd	0-2' shoulder	
Ponderosa Rd	North Shingle Rd - where road narrows to two lanes	4-6' shoulder	
Ponderosa Rd	2 lane road section to Meder Rd	No shoulder	Shoulder is obstructed by parking during school hours
Wild Chaparral Dr.	Ponderosa Rd. - Near end	2-4' shoulder	
Mother Lode Drive	South Shingle - SPTC R.O.W.	4-6' near businesses on south side, 2-4' on the north side	
Mother Lode Drive	SPTC R.O.W. - Greenstone	No shoulder	
Mother Lode Drive	Greenstone Rd - Missouri Flat Rd	No shoulder	
Greenstone Rd	Highway 50 - Motherlode Drive	0-2' shoulder	
Rescue			
Green Valley Rd	Cameron Park Dr - Lotus Rd	No shoulder	
Green Valley Rd	Lotus Rd - Greenstone Rd	No shoulder	

Table 4-3 Existing Conditions (see chapter 5, map 3)			
Latrobe Area			
STREET NAME	**SEGMENT (FROM - TO)**	**SHOULDER CONDITION**	**MISCELLANEOUS COMMENTS**
Latrobe Rd	Wetsel Oviatt - Deer Creek	0-2' shoulder, Deer Creek bridge has a 4' shoulder	
Latrobe Rd	Deer Creek - SPTC	0-2' shoulder	
Latrobe Rd	SPTC - County Line	Mostly 0-2' shoulder 2-4' shoulder in some areas	

Areas of Opportunity are shaded

Table 4-3 Existing Conditions (see chapter 5, map 3)			
Latrobe Area			
STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
South Shingle Rd	Latrobe Rd - Brandon Rd	0-2' shoulder	
South Shingle Rd	Brandon Rd - South Shingle Ct.	0-2' shoulder	
South Shingle Rd	Latrobe Rd - County line	0-2' shoulder	
Brandon Rd.	South Shingle Rd - French Creek	No shoulder, low traffic volumes	Popular recreation route
French Creek Rd	Brandon Rd - Mother Lode Dr	No shoulder, low traffic volumes	Popular recreation route

Table 4-4 Existing Conditions (see chapter 5, map 4)			
El Dorado County, near Placerville			
STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Green Valley Rd	Lotus Rd - Greenstone Rd	No shoulder	
Green Valley Rd	Greenstone Rd - Missouri Flat Rd	0-4' shoulder	2-4' from Campus Drive to Missouri Flat
Green Valley Rd	Missouri Flat Rd - Placerville Drive	0-2' shoulder	Add climbing lanes between El Dorado Road and Placerville Drive
Cold Springs Rd	Placerville City Limit - Gold Hill Rd	No shoulder	School
Highway 49	Placerville City Limit - Gold Hill Rd	No shoulder	
Mosquito Rd	Placerville City Limit - Union Ridge Rd.	0-2' shoulder	Add climbing lane on eastbound lane
Smith Flat			
Union Ridge Rd.	Entire length	No shoulder	
Carson Rd	Placerville City limit - Jacquier Rd	No shoulder	
Carson Rd	Jacquier Rd - North Canyon Rd	No shoulder	Add climbing lane to eastbound lane
Carson Rd	North Canyon Rd - Carson Court	No shoulder	Highway 50 intersection needs improved striping
Carson Rd	Carson Court - Barkley Rd	2-4' shoulder	Highway 50 intersection needs improved striping
Diamond Springs			
Missouri Flat Rd	Green Valley Rd - near Plaza Drive	4-6' shoulder	Indian Cr. School, El Dorado Dept of Ed, Green Valley Church, Pioneer Plaza, Folsom Lake College Placerville Campus
Missouri Flat Rd	Forni Road - SPTC R.O.W.	Class II Bike Lanes in front of WalMart (do not meet Caltrans design standards)	Placerville Inn, Herbert Green School, Medical Center, WalMart, Major Assisted Living facility
Missouri Flat Rd	STPC R.O.W. - China Garden Rd	0-2' shoulder	Safety on section from Halyard to China Garden Road could be improved by eliminating the continuous left turn lane and re-striping to include bike lanes.
Missouri Flat Rd	China Garden Rd - Pleasant Valley Rd	2-4' shoulder	More shoulder on the east side near schools, some pinch points
Pleasant Valley Rd	Missouri Flat - Highway 49	2-4' shoulder not well defined, pkg. on street in some areas	Needs improved striping
Pleasant Valley Rd	Highway 49 - Lumpy Lane/Big Cut Rd	4-6' shoulder, almost to Big Cut Rd.	

Areas of Opportunity are shaded

Table 4-4 Existing Conditions (see chapter 5, map 4)

El Dorado County, near Placerville

STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Pleasant Valley Rd	Big Cut Rd - Bucks Bar Rd	0-2' shoulder	
Pleasant Valley Rd	Missouri Flat Rd - Forni Rd	No shoulder	
Pleasant Valley Rd	Forni Rd - Mother Lode Dr	No shoulder, Share the Rd sign near Koki; narrow and little striping through El Dorado	School at Koki Lane, Commercial Dev. at Mother Lode Dr. "Y"
El Dorado Rd	Pleasant Valley - Mother Lode Dr	No shoulder	Commercial dev. At Hwy 50, Mother Lode Dr and Community of El Dorado
El Dorado Rd	Mother Lode - Green Valley	No shoulder	
Mother Lode Dr	Missouri Flat - Greenstone	No shoulder	Placerville Inn, Assisted Living Facility, Park and Ride lot, Community of El Dorado
Forni Rd	Pleasant Valley - Missouri Flat	No shoulder, small segment of 2-4' shoulder near WalMart	Missouri Flat/Forni Rd intersection could be re-striped with bike lanes
Forni Rd	Missouri Flat - Placerville City Limit	No shoulder, small segment of shoulder near Herbert Green school	Missouri Flat/Forni Rd intersection could be re-striped with bike lanes
Enterprise Dr	Entire length	0-2' shoulder	Industrial area, low traffic volumes
Commerce Way	Entire length	No shoulder	Industrial area, Church, El Dorado Transit
Highway 49/Diamond Rd	Placerville City limit - Bradley	0-2' shoulder	
Highway 49/Diamond Rd	Bradley Dr - Pleasant Valley	2-4' near Bradley, narrows to 0-2' and then widens to 4' near Pleasant Valley	Highway 49/Pleasant Valley intersection could be re-striped with bike lanes
Highway 49	El Dorado (Pleasant Valley Rd) - County line	No shoulder	
Lindberg	Forni Rd and Motherlode	Has potential for Class II	Residential collector
Blanchard	Forni Rd and Motherlode	No shoulder	Residential Collector, Crosses SPTC
China Garden	Missouri Flat to Pleasant Valley	No shoulder	Used as short cut
Lime Kiln	China Garden to Highway 49	No shoulder	China Garden to Lime Kiln to 49 is used as a bypass around Diamond Springs
Fowler Drive	South end to Pleasant Valley	No paved shoulders	Residential Collector
Tullis Mine Rd	Entire length	No paved shoulders	Paved and dirt low standard road that connects Pleasant Valley Rd to Patterson through the major part of subdivision (secret route-w/potential)
Patterson Drive	Entire length	Paved shoulders less than 2 feet	Residential Collector
Bell Oak	Entire length	Side walk on w. side	Charles Brown School
Near Bell Oak			Dirt road/trail connector to Union Mine (Secret route used by kids)
Koki Lane	Entire length	Side walk on w. side	Union Mine High School
Oriental	Entire length	No paved shoulders	Connects Pleasant Valley with SPTC
Crystal Blvd	Entire length	No paved shoulders	Residential collector
Cedar Ravine Rd	Placerville City Limit - Pleasant Valley Rd	No shoulder	
Big Cut Rd	Placerville City Limit - Quarry Rd.	No shoulder	Low traffic volumes

Areas of Opportunity are shaded

Table 4-5 Existing Conditions (see chapter 5, map 5)

STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS **COMMENTS**
Camino/Newtown			
Carson Rd	Barkley Rd - Snows Rd	No shoulder	Near Sierra Pacific Industries lumber yard, logging trucks frequently in this area
Carson Rd	Snows Rd - Highway 50	0-2' shoulder	Some shoulder near Hwy 50 undercrossing
Snows Rd	Carson Rd – Newtown Rd	No shoulder	
Newtown Rd	Placerville City Limit – Pleasant Valley Rd	No shoulder	
Pollock Pines			
STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS **COMMENTS**
Pony Express Trail	Carson Rd - Mace Rd	0-2' shoulder	
Pony Express Trail	Mace Rd - Ridgeway	0-2' shoulder	More shoulder in some areas
Pony Express Trail	Ridgeway - Forebay Rd	4' near Ridgeway, 0-2' to Forebay Rd.	
Sly Park Rd	Highway 50 – Mormon Emigrant Trail	0-2' shoulder	Climbing lane from Lakewood Drive to Gold Ridge Trail
Sly Park Rd	Mormon Emigrant Trail – Pleasant Valley Rd	0-2' shoulder	
Mormon Emigrant Trail	Sly Park Rd – Highway 88	2-4' shoulder	Popular recreational route
Starkes Rd	Sly Park Rd – Newtown	0-2' shoulder	
Pleasant Valley/Somerset			
Pleasant Valley Rd	Bucks Bar Rd – Newtown Rd	0-2' shoulder	Add Class II bike lanes between Newtown Road and Mt. Aukum Road/E16
Mt. Aukum Rd	Fairplay Rd – Grizzly Flat Rd	2-4' shoulder on both sides	
Mt. Aukum Rd	Grizzly Flat Rd – Sly Park Rd	2-4' shoulder	The shoulder width varies across either side
Bucks Bar Rd	Pleasant Valley Rd – Grizzly Flat Rd	0-2' shoulder	Needs climbing lane in both directions out of North Fork Cosumnes River
Grizzly Flat			
Grizzly Flat Rd	Mt Aukum Rd – Leoni Rd	0-2' shoulder	
Fairplay			
Omo Ranch Rd	Mt. Aukum Rd – Fairplay Road	0-2' shoulder	
Omo Ranch Rd	Fairplay Rd - Slug Gulch Rd	0-2' shoulder	
Fairplay Rd	Omo Ranch Road to Mt. Aukum Rd	0-2' shoulder	
Slug Gulch Rd	Entire Length	0-2' shoulder	
Perry Creek Rd	Entire Length	0-2' shoulder	

Areas of Opportunity are shaded

Table 4-6 Existing Conditions (see chapter 5, map 6)

STREET NAME	SEGMENT (FROM - TO)	SHOULDER CONDITION	MISCELLANEOUS COMMENTS
Coloma/Lotus			
Cold Springs Rd	Placerville - Gold Hill Rd	No shoulder	
Cold Springs Rd	Gold Hill Rd - Highway 49	No shoulder	
Gold Hill Rd	Entire Length	No shoulder	
Thompson Hill Rd	Entire Length	No shoulder	
Lotus Rd	Highway 49 - Luneman Rd	2-4' shoulder, 4-6' on north side	
Lotus Rd	Luneman Rd – Weber Creek Bridge	No shoulder	
Lotus Rd	Weber Creek Bridge – Stagecoach Road	2-4' shoulder	Mark pavement for bike lanes
Lotus Rd	Stagecoach Road – Green Valley Road	No shoulder	
Highway 49	Marshall Rd - American River	Currently no shoulder, will be Class II as part of Caltrans project	
Highway 49	American River - Cold Springs Rd	No shoulder, share the road signs exist	Through Historic State Park
Highway 49	Cold Springs Rd - Placerville	No shoulder	
Bacchi Rd	Entire Length	No shoulder	
Cool			
STREET NAME	**SEGMENT (FROM - TO)**	**SHOULDER CONDITION**	**MISCELLANEOUS COMMENTS**
Salmon Falls Rd	Highway 49 - Green Valley Road	0-2' shoulder	Popular Recreation Ride, ties to geotourism, Coloma recreation and wineries
Rattlesnake Bar Rd	Entire Length	No shoulder	Recreation access
Highway 49	County Line - Cool	No shoulder	
Highway 49	Cool - Northside School	0-2' shoulder	Need improved school access
Highway 49	Northside School - Marshall Rd	0-2' shoulder	Popular Recreation Ride
Highway 193	Highway 49 - Greenwood Rd	No shoulder	
Pedro Hill Rd	Entire Length	No shoulder	
Greenwood/Georgetown/Garden Valley			
Marshall Rd	Highway 49 - Prospector Rd	No shoulder	
Marshall Rd	Prospector Rd - Garden Valley Rd	No shoulder	
Marshall Rd	Garden Valley Rd - Highway 193	No shoulder	
Prospector Rd	Entire Length	No shoulder	
Greenwood Rd	Marshall Rd - Highway 193	No shoulder	
Graybar Mine Rd	Entire Length	No shoulder	
Highway 193	Chili Bar - Garden Valley Rd	No shoulder	
Highway 193	Garden Valley Rd - Georgetown	No shoulder	
Highway 193	Through Georgetown	No shoulder	
Highway 193	Georgetown - Greenwood Rd	No shoulder	

Areas of Opportunity are shaded

The purpose of this chapter is to describe the proposed bicycle transportation facility improvements for El Dorado County. Included is a discussion of the process used to develop the proposed improvements, as well as a discussion of how the bicycle facilities interface with other transportation modes and activity centers. Chapter 6 includes information on implementation and a discussion of funding opportunities and current design standards.

The information presented in this chapter is the result of planning efforts of the El Dorado County Bicycle Advisory Committee, the El Dorado County Transportation Commission Technical Advisory Committee, the El Dorado Hills Bicycle, Pedestrian, and Trails Advisory Committee, interested members of the public, and the El Dorado County Transportation Commission staff.

Public comments were solicited during the months of June and July 2010. Each comment submitted to EDCTC is included with a response in the Appendix F of this document.

5.1 Ultimate Bicycle Transportation System

Chapter three of this document describes the Goals, Objectives, and Policies that were applied during the development of the proposed bikeway system. The Goals, Objectives, and Policies were developed to address the following areas pertaining to bicycle transportation:

1. Bicycle Commuting
2. Safety and Education
3. Implementation and Maintenance
4. Land Use Development
5. Multi-Modal Integration
6. Funding
7. Connectivity
8. The El Dorado Trail

A specific goal in the development of the proposed bicycle transportation system is to fulfill the concepts presented in the Goals, Objectives, and Policies section. The following criteria were used for the development of the proposed bicycle transportation system:

1. **Bicycle Commuting** – Develop a bikeway system that is conducive to bicycle commuting, by providing connections to major activity centers and multi-modal transportation facilities. Develop a bicycle transportation system that makes the bicycle a convenient transportation mode by including the installation of bicycle parking facilities and locker/shower facilities where feasible.

2. **Safety** – The system should provide the highest level of safety possible while eliminating major safety concerns, such as narrow roadways without shoulders or bike lanes.

3. **Land Use Development** – Examine areas of potential growth and development in the County. Consider possible impacts any new or redevelopment projects may have on the bicycle transportation system.

4. **Multi-Modal Integration** – The system should provide connections to multi-modal centers to encourage use of combined transportation modes.

5. **Connectivity** – The system should be well connected and balanced throughout all portions of the western El Dorado County population centers and neighboring regions.

6. **The El Dorado Trail** – The system should lay out a strategy for the development of the El Dorado Trail. The emphasis for developing a Class I Bikeway on the El Dorado Trail should be in areas that provide a transportation benefit.

7. **On Street Bikeways** – Class II Bike Lanes should be provided as the preferred on-street bikeway facility. However, in some locations a bicycle boulevard may be the preferred on-street bikeway facility. Class III Bike Routes should only be used when Class II Bike Lanes are not feasible. Class III Bike Routes should only be selected if they have particular advantages when compared with other alternative alignments. Bike routes should be selected with consideration given to traffic volumes, car speeds, and the specific needs of bicyclists.

The tables in sections 5.9-5.13 of this chapter provide a list and description of the proposed bicycle transportation system that resulted from the planning process. The map set corresponds to the tables, i.e., Table 1 displays the projects shown on Map 1. Additionally, the column for "bicycle facility" is color coded with the type of facility on the map(s). The projects are broken down into tiers, tier 1 being the highest priority for improvement and so on. In many cases, the tier 1 improvements are also "areas of opportunity" as described in Chapter 4.

5.1.1 Rural Roadways and Bicycle Facilities

Using the criteria listed in the section above, the Bicycle Advisory Committee (BAC) determined that the proposed system presented in the map set best fulfills all of the criteria. Ultimately, the developed system will help to improve bicycling in El Dorado County. The group also recognized that El Dorado County has a high number of two-lane arterials that extend to the more remote areas of the County. In order to address the present and future needs of bicyclists traveling on the more rural roads of the County, the BAC would like to include the following recommendation:

Recommendation: ***The County should recognize that the arterial road system is part of the established regional transportation network, and as such is a part of the Bicycle Transportation System. Any discretionary improvement or development that impacts these roads should include the addition of Class II Bike Lanes – even for short segments.***

The County recognizes that existing development along these two-lane arterials as well as terrain constraints may limit the feasibility of adding standard, 4-foot Class II Bike Lanes and design exceptions or other creative solutions may be needed to address the need for improved bicycling facilities. These rural roads are predominantly used for recreational cycling. However, new development along these roads could result in increased numbers of commute bicyclists. A list of some of the more commonly used roads is presented below:

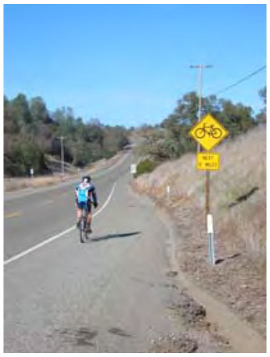
- Deer Valley Road
- Green Valley Road (from Cameron Park Drive to Missouri Flat Road)
- Lotus Road
- Salmon Falls Road

- Marshall Road
- Ponderosa Road
- North Shingle Road
- South Shingle Road
- Pleasant Valley Road
- Mother Lode Drive
- Highway 49/Highway 193 *(Caltrans jurisdiction)*

The roads listed above often carry fairly high traffic volumes (>5,000 vehicles per day) as well as frequent high car speeds. The recommendation encourages the County to improve the roads as new development occurs. If a segment of one of these rural arterials is developed with Class II Bike Lanes, the County can determine if there is a need to make a connection to the overall bikeway system.

Motorist education on the rights of bicyclists is virtually non-existent. Many motorists mistakenly believe that bicyclists do not have the right to ride in travel lanes and that they should be riding on sidewalks. Many motorists do not understand the concept of 'sharing the road' with bicyclists, or why a bicyclist may need to ride in the travel lane if there is no useable shoulder or bike lane.

In El Dorado County, there are a few locations where the bicycle warning sign exists. In some cases the bicycle warning sign (W11-1) is used in conjunction with the share the road message sign (W16-1) to be placed on narrow roads where motorists and bicyclists must share the traffic lane. It is proposed that the bicycle warning sign (W11-1) be used in conjunction with the share the road message sign (W16-1)and be placed at key bicycle safety locations on the following roads:



Bicycle Warning / Share the Road sign on Latrobe Road

- French Creek Road
- Old Frenchtown Road
- Prospectors Road
- Cedar Ravine
- Mormon Emigrant Trail

5.2 Major Activity Centers

The proposed bicycle transportation system will provide bicycle facilities to the major activity centers in the population centers of El Dorado County and along some of the major arterials that connect the communities of the County. Activity centers include residential neighborhoods, schools, regional parks, shopping centers, employment centers, government centers, park and ride lots, transit centers, and other recreational destinations. Maps 1-6 display the major activity centers of El Dorado County. Some of the major activity centers shown on the maps include:

- Folsom Lake College - El Dorado Center
- El Dorado Hills Town Center
- El Dorado Hills Business Park
- The City of Placerville
- Coloma State Park
- Prospectors Plaza near Placerville
- Diamond Springs / El Dorado

5.3 Multi-Modal Centers

Placerville Station Multi-Modal Center in Placerville

The bicycle transportation system will also provide connections to some of the multi-modal centers and regional neighbors of the county. El Dorado Transit provides bicycle racks on all of their fixed route buses. The El Dorado Commuter Bus connection to downtown Sacramento is an extremely popular commute mode in El Dorado County, and commuters frequently use the bicycle in combination with the bus. The following table lists some of the existing multi-modal centers in El Dorado County:

Existing Multi-Modal Centers	Location	Amenities
El Dorado Hills Park and Ride Lot	White Rock Road and Latrobe Road	Bike lockers, commuter bus service to Sacramento, park and ride
Cameron Park-Cambridge Road Park and Ride Lot	Cambridge Road in Cameron Park	Bike lockers, commuter bus service to Sacramento, park and ride
Placerville Station Multi-Modal Center	Mosquito and Clay Streets in the City of Placerville	Bike lockers, bike racks, restrooms, El Dorado Transit bus stop, park and ride
Central Park and Ride	Commerce Way between Enterprise Drive and Pleasant Valley Road in Diamond Springs	Bike lockers, commuter bus service to Sacramento, park and ride
El Dorado County Fairgrounds Commuter Bus Stop, Placerville	Armory Way in the City of Placerville	Bike lockers, commuter bus stop and park and ride

The El Dorado Hills Park and Ride Lot serves as the primary multi-modal center in El Dorado County. The El Dorado Hills Park and Ride provides bike lockers and a bike rack, and is served by the El Dorado Transit Commuter Bus. The Placerville Station in the City of Placerville also serves as a multi-modal center.

5.4 Regional Connections

The City of Folsom and Sacramento County border the western portion of El Dorado County, with the City of Folsom lying north of Highway 50, and Sacramento County to the South. The City of Folsom has a considerable number of large employers and a vast bikeway network. For this reason, El Dorado County bicyclists are insisting on improved bicycle connections to Folsom. At the present time, Highway 50 is the primary connection to Folsom with only two other alternatives available to bicyclists – White Rock Road and Green Valley Road. Both of the available options require bicyclists to travel a considerable distance away from the Highway 50 corridor and therefore are less than ideal for commute purposes. The proposed bicycle transportation system includes both improvements to the existing connections to Folsom, as well as additional, more direct connections.

El Dorado County is bordered to the north by Placer County, and the only existing connection to Placer County is via Highway 49. Highway 49 is an extremely narrow, rural road that travels through the North Fork of the American River Canyon between Cool and Auburn. Currently there are a number of commuters who live in El Dorado County and travel Highway 49 to reach Interstate 80. The topographic and geographic constraints along the Highway 49 corridor between Cool and Auburn prevent this plan from proposing any bikeway connections. However, if a major change were to occur in the travel patterns between Cool and Auburn (i.e. the construction of a canyon bridge) it would be important to consider the needs of bicyclists.

The southern border of El Dorado County and the connection with Amador County is met with similar challenges to that of the north. Highway 49 near Amador County has many of the same topographic constraints that it has near Placer County, but not quite as extreme. There is much less frequent commuter travel between El Dorado and Amador Counties as well. Latrobe Road is another connector to Amador County, and like Highway 49, commuter traffic is minimal. The same principal applies to the connection into Amador County as in Placer County – if a major change were to occur in the travel patterns between the two counties, the needs of bicyclists should be considered.

5.5 Connections to the Lake Tahoe Basin

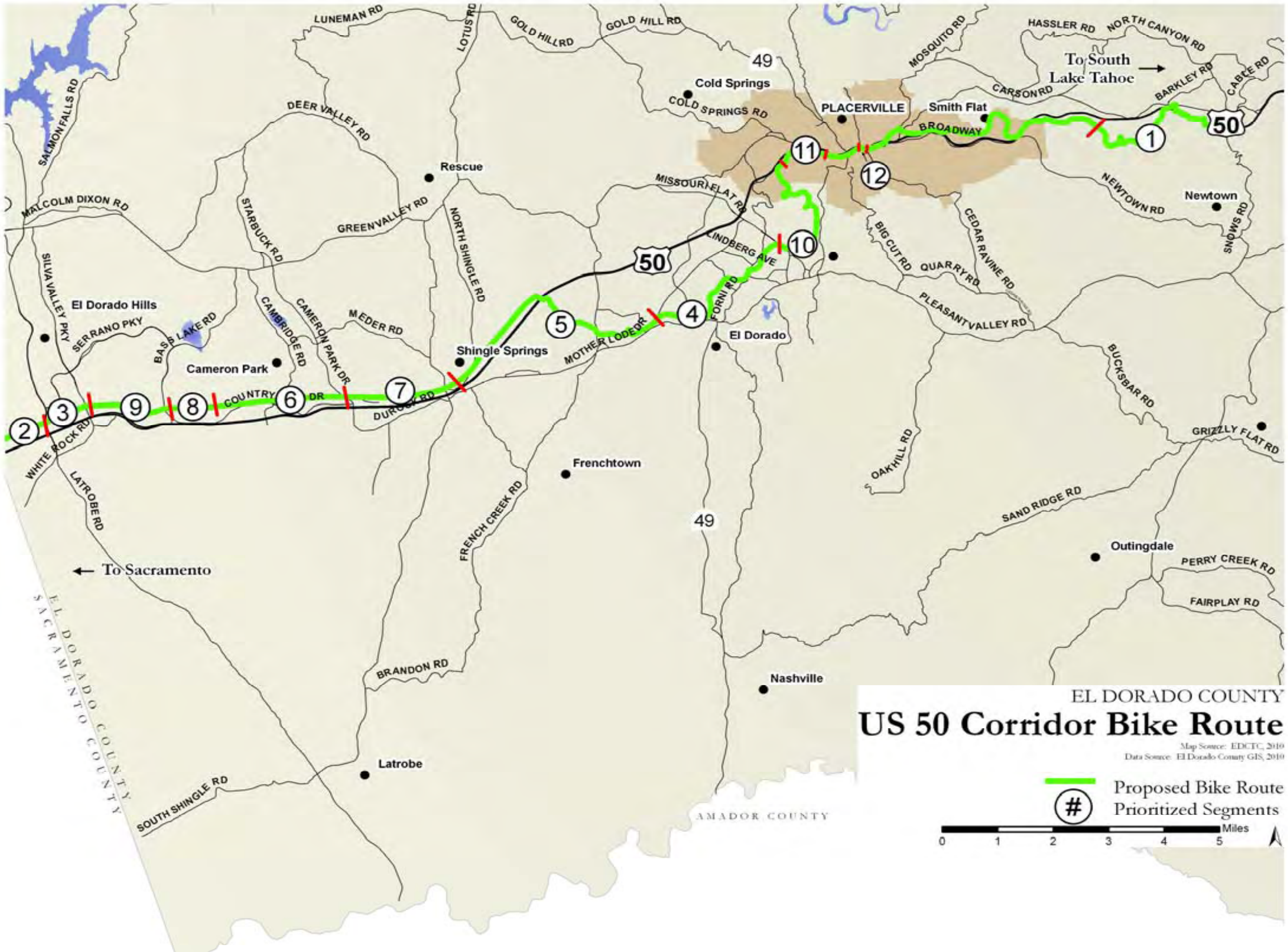
The emphasis of the Bicycle Transportation Plan is to make bicycle transportation connections throughout the west slope of El Dorado County. There are some existing connections to the Lake Tahoe Basin, but the use is primarily recreational and, therefore, not included in this plan. If El Dorado County should choose to further explore bikeway connections to the Lake Tahoe Basin, an alignment from the Cross State Bicycle Route Study – Bay Area to Lake Tahoe should be adopted as a part of this Bicycle Transportation Plan.

In 2008 El Dorado County completed the El Dorado Trail Extension Evaluation Project that considered potential alignments for extending the El Dorado Trail from Halcon Road in Camino Heights east to the site of the former Brockless Bridge over the South Fork of the American River near Pacific House. From there, the proposed El Dorado Trail alignment would cross the South Fork of the American River via a new Brockless Bridge and follow the historic Pony Express Trail and the Sayles Canyon Trail to Echo Summit and a connection to South Lake Tahoe. An alternate transportation route would follow Mormon Immigrant Trail to Highway 88 and follow it to Highway 89 over Luther Pass and into South Lake Tahoe.

5.6 The US 50 Corridor Bike Route – Camino to Folsom

The US 50 Corridor Bike Route is a concept for system of predominantly Class I and Class II bicycle facilities combined with Class III facilities that combine to form a continuous bicycle transportation corridor parallel to US 50 from Camino to El Dorado Hills. The route would utilize the proposed and existing Class I bike path on the El Dorado Trail from Camino to Shingle Springs. The route would leave the El Dorado Trail and follow Mother Lode Drive to Ponderosa Road and cross US 50 at the Ponderosa Road Interchange, and continue to Cameron Park via Wild Chaparral and the proposed Class I bike path connection to Palmer Drive. The proposed route would then follow Country Club Drive to Old Bass Lake Road and the proposed Class I bike path segments to El Dorado Hills. The area between Wild Chaparral and Palmer Drive is controlled by the Bureau of Land Management (BLM) and is the site of rare plant preserve. Prior to development of the proposed Class I bike path connecting Wild Chaparral and Palmer Drive, discussions with BLM would need to occur regarding environmental issues and the feasibility of the proposed project. A prioritized list of usable segments of Class I and Class II bike path are proposed in the table below and the route is depicted on Map 5.1 below the table:

Prioritized list of Proposed Class I and Class II Segments of the US 50 Corridor Bike Route				
Priority	**Segment**	**Distance**	**Cost Estimate**	**Discussion**
1	Extend existing Class I at Los Trampas Drive to Snows Road in Camino	3 miles	$1.2 Million	Right-of-way purchase required from existing off-street trail terminus near Highway 50 to Snows Road. Would provide a connection into Camino and reduce the need for a grade separated crossing of Highway 50 at the existing trail terminus
2	Class II bike lanes – Extension of Saratoga Way to connection with Iron Point Road	0.5 miles	$150,000	Provides connection to Folsom. Could also be accomplished with a Class I bike path.
3	Class I bike path – Silva Valley Parkway to El Dorado Hills Blvd.	8 miles	$3.2 Million	Provides connection from Silva Valley Parkway to Town Center via the proposed pedestrian overcrossing.
4	Class I bike path - Missouri Flat Road to Mother Lode Drive in El Dorado (map 4)	3 miles	$1.2 Million	Completes the Class I bike path connection
5	Class I bike path - Mother Lode Dr in El Dorado to Mother Lode Drive in Shingle Springs (maps 4 & 2)	4.75 miles	$1.9 Million	Completes the connection between Placerville, Diamond Springs, El Dorado, and Shingle Springs.
6	Class II bike lanes – Country Club Drive from Cameron Park Drive to Tierra de Dios.	3 miles	$1.2 Million	Provides a connection to El Dorado Hills via Country Club Drive and Old Bass Lake Road
7	Class I bike path connection: Wild Chaparral Drive to Palmer Drive	2.5 miles	$1 Million	Provides a connection from Shingle Springs to Cameron Park
8	Class I bike path – Tierra de Dios to Old Bass Lake Road	0.9 miles	$25,000	Would utilize existing Country Club Drive as a Class I bike path once Country Club Drive is realigned
9	Class III bike route on Tong Road, Class III bike route on Old Bass Lake Road	1 mile	$150,000	Would provide a connection between Silva Valley Parkway and Bass Lake Road
10	Over Crossing of Missouri Flat Road	200 feet	$1 million	Provides a safe and direct crossing of Missouri Flat Road
11	Class I bike path – Forni Road / Lower Main St. to Ray Lawyer Dr.	1 mile	$400,000	Within the City of Placerville
12	Class I bike path – Clay Street to Bedford Street	.25 miles	$205,000	Within the City of Placerville; fully funded



Map 5.1: US 50 Corridor Bike Route

5.7 The El Dorado Trail

The El Dorado Trail concept is for a trail that spans the entire length of El Dorado County from the western county line to the Lake Tahoe Basin. The current alignment of the El Dorado Trail includes two railroad rights-of-way, the Michigan-California railroad right-of-way, and the Sacramento-Placerville Transportation Corridor.

Developed segment of the El Dorado Trail near Placerville

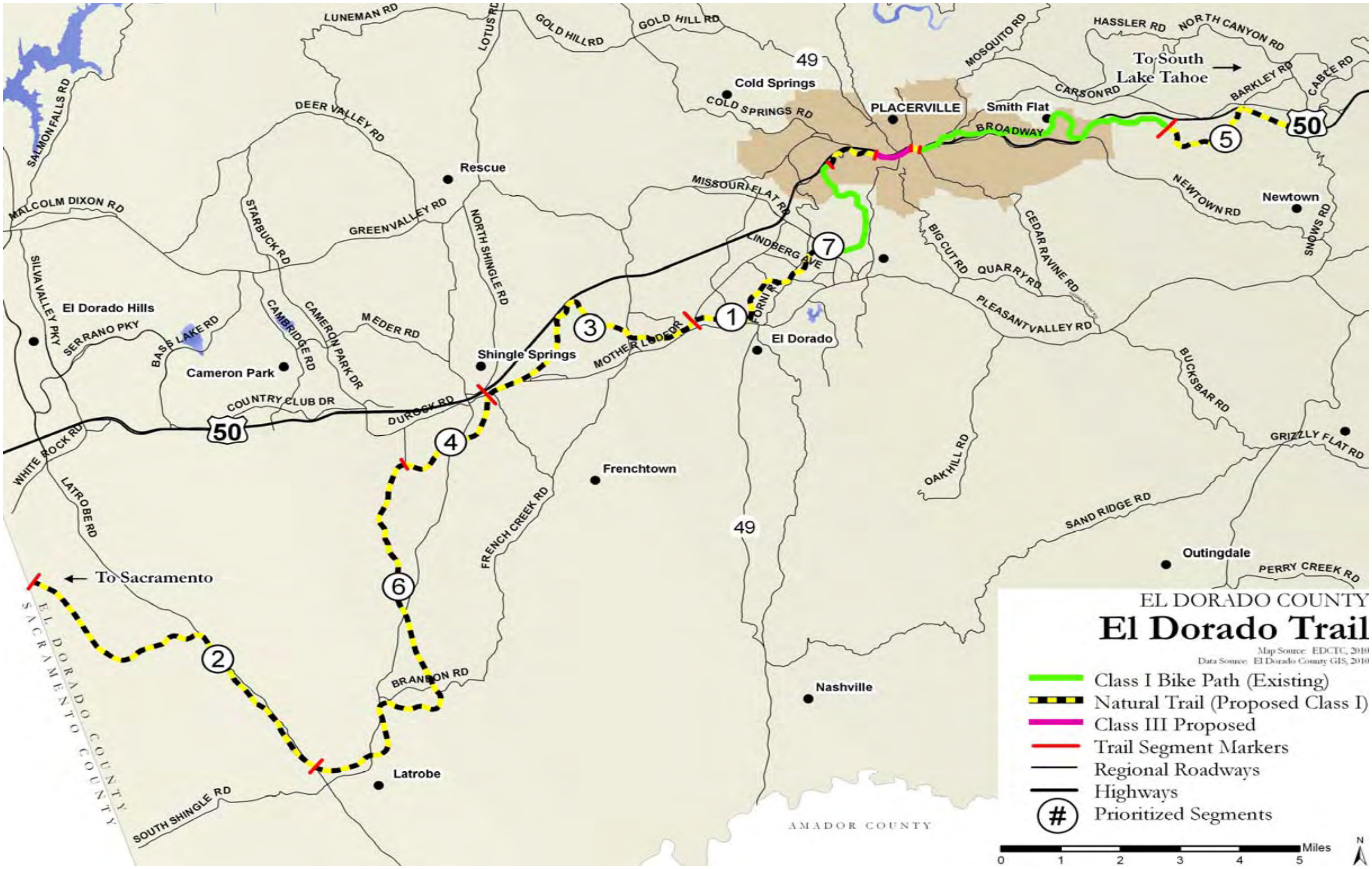
The Michigan-California railroad right-of-way extends from Camino to Placerville. Currently, the right-of-way is developed with a segment of improved dirt trail and nearly four miles of Class I bike path from Camino Heights to Placerville.

In 1996 the Sacramento-Placerville Transportation Corridor (SPTC) Joint Powers Authority, including members from El Dorado County, the City of Folsom, Sacramento County, and Sacramento Regional Transit purchased the SPTC from the Southern Pacific Railway Corporation. The purchase was made under the protection of the "rails-to-trails" provision of the National Trails System Act, which preserves the rail corridor from becoming abandoned. A master plan was developed for the SPTC that covers the former Southern Pacific railroad corridor from the western El Dorado County line near Latrobe to the City of Placerville at Ray Lawyer Drive. The 28 miles of preserved corridor is planned for use as an alternative transportation corridor with multiple uses including bicycle, pedestrian and equestrian trails, excursion trains, and utility easements. The combined Michigan- California and SPTC segments provide a trail corridor that extends from the western El Dorado County line near Latrobe to Camino. An alignment for the remaining trail connection from Camino to Lake Tahoe has not been formally determined. However, El Dorado County did complete an easement study in 2008 which identified potential trail alignments between Halcon Road in Camino Heights and Pacific House.


An undeveloped segment of the SPTC with track still in place

The SPTC portion of the El Dorado Trail is included as a proposed Class I Bike Path in this plan. The vision for the SPTC Corridor as described in the SPTC Master Plan under the sub-title "Guidelines for Corridor Uses," includes three types of trails: 1) 'natural' or hiking/bike trails, 2) improved trails, and 3) paved trails. The SPTC plan also includes a provision for the operation of an excursion train. It is anticipated that the SPTC will be opened and developed with 'natural' or off street hiking/bike trails first, until funding is available for development of paved Class I bike paths. A prioritized list of usable segments of Class I bike path are proposed in the table below:

Prioritized list of Proposed Class I Segments of the El Dorado Trail				
Priority	**Segment**	**Distance**	**Cost Estimate**	**Discussion**
1	Missouri Flat Road to Mother Lode Drive in El Dorado (map 4)	3 miles	$1.2 Million	The segment from Missouri Flat to Oriental Road is an open natural trail for off street use
2	Latrobe to Sacramento County/City of Folsom (map 3)	7 miles	$2.8 Million	Provides an off street connection to the City of Folsom, and ultimately to the American River Parkway
3	Mother Lode Dr in El Dorado to Mother Lode Drive in Shingle Springs (maps 4 & 2)	4.75 miles	$1.9 Million	Completes the connection between Placerville, Diamond Springs, El Dorado, and Shingle Springs.
4	Mother Lode Drive in Shingle Springs to Shingle Lime Mine Road	2.5 miles	$1 Million	Provides a connection from Shingle Springs to Cameron Park
5	Extend existing Class I at Los Trampas Drive to Snows Road in Camino	3 miles	$1.2 Million	Right-of-way purchase required from existing off-street trail terminus near Highway 50 to Snows Road. Would provide a connection into Camino and reduce the need for a grade separated crossing of Highway 50 at the existing trail terminus
6	Shingle Lime Mine Road to Latrobe Road	8 miles	$3.2 Million	Completes El Dorado Trail from Camino to El Dorado County / Sacramento County Line
7	Over Crossing of Missouri Flat Road	200 feet	$1 Million	Provides a safe and direct crossing of Missouri Flat Road



Map 5.2: El Dorado Trail – Existing and Proposed Improvements

5.8 Marketing Strategy

El Dorado County first participated in the Statewide Bike to Work Day promotion in 2003. Events were held in 2003 and 2004 in both El Dorado Hills and the City of Placerville and annually in the City of Placerville since 2005. The events were designed to encourage new bicyclists to ride to work and to support to those who regularly ride to work. The encouragement is provided in the form of an "Energizer Station" located strategically along primary bicycle commute routes. Bicyclists can stop by the Energizer Station for free coffee, bagels, bicycle products and brochures and information on bicycle commuting. For the past two years, the event was coordinated with the 50 Corridor Transportation Management Associations and included the City of Folsom.

Recommendation: ***Continue to promote the annual Bike to Work day event in both El Dorado Hills and the City of Placerville. As the events become more successful, begin to add Energizer Stations in other communities.***

Bicycle maps have proven to be excellent tools for distributing information about cycling. A bicycle map is a good way to disseminate information about preferred bicycle routes to destinations like schools, libraries, parks, shopping centers, employment centers, multi-modal centers, and park and ride lots. Additionally, the map could display some of the character and attractions of El Dorado County and provide information about bicycle safety and commute tips.

Recommendation: ***Develop a Countywide bicycle map.***

5.9 Education Improvements

Programs that teach existing and potential bicyclists, young and old, about the fundamentals of bicycle riding are important to establishing good riding habits. Currently, El Dorado County schools can request a bicycle-riding safety presentation from either the Sheriff's Office or the California Highway Patrol. There are no regularly scheduled bicycle education activities in El Dorado County.

Recommendation: ***Continue and expand the existing Police Department bicycle education program for school children in El Dorado County. Ensure the program receives adequate funding and develop regularly scheduled activities so each school visited annually or semi-annually.***

5.10 Recommended Bicycle Support Facilities for El Dorado County

- Bike racks in the El Dorado Hills Town Center
- Bike racks in the Village Center shopping center in El Dorado Hills
- Bike racks at all schools and parks
- Bike racks at all government centers, libraries, courthouses, and park and ride lots
- Bike racks at all grocery stores and shopping centers

5.11 Proposed Improvements – Map 1 – El Dorado Hills Area

Table 5-1a: TIER 1 Proposed Improvements (see map 1)

ROADWAY, ROUTE or PROJECT NAME	SEGMENT	SEGMENT DISTANCE (miles)	BIKEWAY FACILITY
El Dorado Hills Blvd Bike Lanes	Phase 1: Saratoga Way to Governor Dr./St. Andrews	1.7	Class II Bike Lanes
El Dorado Hills Blvd Bike Path	Phase 1: Sign and stripe existing Class I Paths in two locations: 1) From Harvard Way to St. Andrews 2) From Governors Dr. to Francisco Dr.	1.5	Class I Bike Path
El Dorado Hills Blvd Bike Path	Phase 2: Utilizing an existing golf cart undercrossing of Serrano Parkway, extend the bike path from the current terminus at Serrano Parkway to El Dorado Hills Village Center Shopping Center	.5	Class I Bike Path
Harvard Way Bike Path	From Clermont Road to El Dorado Hills Boulevard	.5	Class I Bike Path
Tong Road – EDH to Old Bass Lake Road Connection	Phase 1: EDH to Old Bass Lake Road Connection Entire Length	.5	Class III Bike Route
El Dorado Hills SMUD Trail	Within the SMUD power line easement between Silva Valley Parkway and El Dorado Hills Boulevard	.6	Class I Bike Path
Old Bass Lake Road – EDH to Bass Lake Connection	Phase 1: EDH to Bass Lake Connection Entire Length	1	Class III Bike Route
Old Bass Lake Rd - EDH to Bass Lake Connection	Phase 1: EDH to Bass Lake Connection Between gates, using existing roadway as Class I Path	.5	Class I Bike Path
Parallel to Highway 50 on the north side -EDH to Bass Lake Connection	Phase 2: EDH to Bass Lake Connection From Silva Valley Parkway to El Dorado Hills Village Center Shopping Center at El Dorado Hills Boulevard	.75	Class I Bike Path
Saratoga Way Extension	Class II bike lanes on extension of Saratoga Way to Iron Point Road (alternatively construct a Class I bike path prior to construction of extension of Saratoga Way to Iron Point Road)	.5	Class II Bike Lanes
Green Valley Road Bike Lanes	El Dorado Hills Boulevard to Pleasant Grove Middle School	7	Class II Bike Lanes
White Rock Road	Entire Length, to County Line	1	Class II Bike Lanes
Silva Valley Parkway	Entire Length	4	Class II Bike Lanes
Highway 50 over or undercrossing	Crosses Caltrans facility (US 50) North/South between the El Dorado Hills Town Center and El Dorado Hills Village Center	.25	Class I Bike Path – grade separated overcrossing
Saratoga Way	Class II bike lanes on the extension of Saratoga Way	1	Class II Bike Lanes

Table 5-1b: TIER 2 Proposed Improvements (see map 1)

ROADWAY, ROUTE or PROJECT NAME	SEGMENT	SEGMENT DISTANCE (miles)	BIKEWAY FACILITY
El Dorado Hills Blvd Bike Lanes	Phase 2: Governors Dr./St. Andrews to Green Valley Road	1.5	Class II Bike Lanes
El Dorado Hills SMUD Trail	Within the SMUD power line easement between El Dorado Hills Boulevard and Sophia Parkway	1.2	Class I Bike Path
Latrobe Road	Highway 50 to Deer Creek	2.5	Class II Bike Lanes
Valley View Bike Paths	Along Valley View parkway to schools, parks and village center	1.5	Class I Bike Path
Valley View Parkway	Entire Length	1.5	Class II Bike Lanes
Harvard Way	Entire Length	.5	Class II Bike Lanes
Francisco Drive	Green Valley Road to El Dorado Hills Boulevard	.5	Class II Bike Lanes
Ambiance Drive	Sophia Parkway to Brittany Way	1	Class II Bike Lanes
Brittany Way	Ambiance Drive to El Dorado Hills Boulevard	.5	Class II Bike Lanes
Through El Dorado Hills Town Center	Through entire commercial center	1	Class II Bike Lanes
Serrano Parkway	Entire Length	3.5	Class II Bike Lanes
Saratoga Way	Entire Length	1	Class II Bike Lanes

Table 5-1c: TIER 3 Proposed Improvements (see map 1)

ROADWAY, ROUTE or PROJECT NAME	SEGMENT	SEGMENT DISTANCE (miles)	BIKEWAY FACILITY
Village Center Drive	Entire Length	.5	Class II Bike Lanes
Windplay Road	Entire Length	.25	Class II Bike Lanes
Golden Foothill Parkway	Entire Length	2	Class II Bike Lanes
Sheffield Drive	Entire Length	1	Class III Bike Route
Francisco Drive	Sheffield Dr. to Green Valley Road	1.5	Class III Bike Route
Lakehills Drive	Sheffield Drive to El Dorado Hills Boulevard	1	Class III Bike Route

5.11.1 Challenges in the El Dorado Hills Area, Map 1


Class I terminus at Serrano Parkway

1. **Class I Terminus at Serrano Parkway**
   The current southern terminus of the existing bike path on the east side of El Dorado Hills Boulevard meets a sidewalk near Serrano Parkway. Southbound bicyclists are forced to ride on the sidewalk for a short distance until they reach the intersection of Serrano Parkway and El Dorado Hills Boulevard. At this point the tendency for most southbound cyclists would be to continue on the same sidewalk to the likely destination point, El Dorado Hills Town Center. Wrong way riding is an extremely common type of bicycling accident, and it should be prevented whenever possible.

   Potential Solutions:
   - ***a. Phase 1: Complete the segment of bike path to Serrano Parkway, directing cyclists into the intersection to cross with the signal and utilize a Bike Lane on El Dorado Hills Boulevard.***
   - ***b. Utilizing the existing golf cart undercrossing of Serrano Parkway, extend the bike path all the way to El Dorado Hills Village Center Shopping Center on the east side of El Dorado Hills Boulevard.***

2. **Tong Road/Old Bass Lake Road Route**
   Tong Road and Old Bass Lake Road are currently dead end roads blocked by gates. If there were a through route, the gradual grade would provide a direct connection between Cameron Park and El Dorado Hills. The existing road looks strikingly similar to a Class I Bike Path. The old Clarkville Wagon Road alignment near the creek could also be used as the location for a Class I bike path between Silva Valley Parkway and Bass Lake Road.


Gate at Tong Road


Old Bass Lake Road – a proposed through route

   Potential Solution:
   - ***a. Open the existing roadway for use as a Class I Bike Path.***

3. **El Dorado Hills Grade Separated Crossing of Highway 50**
   The existing El Dorado Hills Boulevard interchange is a significant barrier to bicycle/pedestrian travel between two major activity centers in El Dorado Hills: El Dorado Hills Village Center Shopping Center and El Dorado Hills Town Center. The interchange is currently being redesigned to carry higher traffic volumes. Due to the constraints of the environment surrounding the interchange, there will be considerable challenges in accommodating bicycle and pedestrian traffic.

   Potential Solution:
   - ***a. Construct a Highway 50 overcrossing between the two activity centers. El Dorado County Department of Transportation has completed environmental documentation for a bicycle and pedestrian overcrossing.***

4. **Parallel bike path north of Highway 50, Tong Road/Silva Valley Parkway to El Dorado Hills Village Center Shopping Center**

The proposed bike path will make two connections, one to the proposed overcrossing and another to Tong Road/Silva Valley Parkway. A developer and Caltrans currently own the right of way. If the existing culvert under Highway 50 were developed as an undercrossing, the route would need to be in place to provide access to the undercrossing.

5. **Re-striping the "Pork Chop" at Serrano Boulevard and El Dorado Hills Boulevard**
   El Dorado Hills Boulevard has existing four-foot shoulders. Adding bike lane striping and signage to the existing shoulder would be a low cost improvement. If the bike lane striping were to be added, the existing "pork chop" at the free right turn exit to Serrano Parkway would have to be re-striped.

"Pork Chop" free right turn at El Dorado Hills Blvd/Serrano Pkwy

5.12 Proposed Improvements Map 2 – Cameron Park/Shingle Springs Area

Table 5-2a: TIER 1 Proposed Improvements (see map 2)

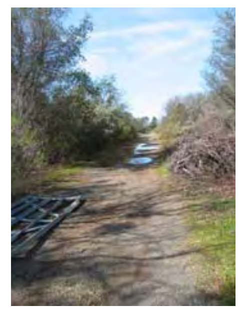
ROADWAY, ROUTE or PROJECT NAME	SEGMENT	SEGMENT DISTANCE (miles)	BIKEWAY FACILITY
Bass Lake Road	Entire Length	3.5	Class II Bike Lanes
Cameron Park Drive	Entire Length	3	Class II Bike Lanes
Country Club Drive	Phase 1: Cambridge Road to Cameron Park Drive	1.5	Class II Bike Lanes
Cambridge Drive	Country Club Drive to Merrychase Drive	.5	Class II Bike Lanes
Cambridge Drive	Merrychase Drive to Green Valley Road	3	Class II Bike Lanes
Meder Road	Phase 1: Cameron Park Drive to Paloran Court	1	Class II Bike Lanes
Palmer Drive	Entire Length	.5	Class II Bike Lanes
Coach Lane	Entire Length	.75	Class II Bike Lanes
Palmer Drive Bike Path Connection	From Wild Chaparral Drive to Palmer Drive	.25	Class I Bike Path
Old Bass Lake Road	Entire Length	1	Class III Bike Route
Durock Road	Entire Length	2	Class II Bike Lanes
Ponderosa Road	Highway 50 to Meder Road	.75	Class II Bike Lanes

Table 5-2b: TIER 2 Proposed Improvements (see map 2)

ROADWAY, ROUTE or PROJECT NAME	SEGMENT	SEGMENT DISTANCE (miles)	BIKEWAY FACILITY
Country Club Drive	Phase 2: Bass Lake Road to Cambridge Road	2	Class II Bike Lanes
Green Valley Road	Cameron Park Drive to Lotus Road	5	Class II Bike Lanes
Meder Road	Phase 2: Paloran Court to Ponderosa Road	1	Class II Bike Lanes
Cambridge Drive	Merrychase to Crazy Horse Road	.25	Class II Bike Lanes
Mother Load Drive	Highway 50 to French Creek	.5	Class II Bike Lanes
Castana Drive	Entire Length	.5	Class III Bike Route
Covello Circle	Castana Drive to end on eastern side	.25	Class III Bike Route
Cameron Park – Bass Lake Bike Path connection	Covello Circle to Magnolia Hills Development at Summer Drive	1	Class I Bike Path
SPTC – El Dorado Trail	Phase 3: Mother Lode Dr in El Dorado to Mother Lode Dr in Shingle Springs	4.75	Class I Bike Path
Lotus Road	Green Valley Road to Highway 49	3	Class II Bike Lanes

Table 5-2c: TIER 3 Proposed Improvements (see map 2)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
South Shingle Road	SPTC to Highway 50	.75	Class II Bike Lanes
Wild Chaparral Dr	Ponderosa Road to end	.75	Class II Bike Lanes
North Shingle Road	Ponderosa Road to Sports Field Dr	.5	Class II Bike Lanes
Oxford Road	Entire Length	.5	Class III Bike Route
Merrychase Drive	Entire Length	.75	Class III Bike Route
Shingle Lime Mine Road	Durock Road to SPTC	.5	Class III Bike Route
SPTC – El Dorado Trail	Mother Lode Drive in Shingle Springs to Shingle Lime Mine Road	2.25	Class I Bike Path

5.12.1 Challenges in the Cameron Park/Shingle Springs Area



Dead end at Wild Chaparral Drive

1. **US 50 Corridor Bike Route: Class I Bike Path connection from Wild Chaparral Drive to Palmer Drive.**
   A Class I bike path connecting Wild Chaparral Drive to Palmer Drive would be a key segment in the US 50 Corridor Bike Route between Camino, Placerville, Cameron Park, and El Dorado Hills. The proposed route would utilize the Class I bike path system on the El Dorado Trail between Camino and Shingle Springs, then cross US 50 at the Ponderosa Road Interchange, and continue to Cameron Park via Wild Chaparral, the proposed Class I bike path connection, and Palmer Drive. The proposed route would then follow Country Club Drive to Old Bass Lake Road and the proposed Class I bike path segments to El Dorado Hills. The area between Wild Chaparral and Palmer Drive is controlled by the Bureau of Land Management (BLM) and is the site of a rare plant preserve. Prior to development of the proposed Class I bike path discussions with BLM would need to occur regarding environmental issues and the feasibility of the proposed project.

5.13 Proposed Improvements Map 3 – Latrobe Area

Table 5-3a: TIER 1 Proposed Improvements (see map 3)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Latrobe Road Bike Lanes	Investment Boulevard to Deer Creek/SPTC	3	Class II Bike Lanes
SPTC/El Dorado Trail	Phase 3: Latrobe Road to County Line	6	Class I Bike Path

Table 5-3b: TIER 2 Proposed Improvements (see map 3)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Latrobe Road Bike Lanes	South Shingle to SPTC	1	Class II Bike Lanes
South Shingle Road	Latrobe Road to School	1	Class II Bike Lanes
Latrobe Road	SPTC to El Dorado County / Amador County Line	3	Class II Bike Lanes

Table 5-3c: TIER 3 Proposed Improvements (see map 3)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
SPTC/El Dorado Trail	Phase 7: Shingle Lime Mine Road to Latrobe Road	8	Class I Bike Path

5.14 Proposed Improvements Map 4 –Diamond Springs/El Dorado Area, Greater Placerville Area, Smith Flat, Gold Hill

Table 5-4a: TIER 1 Proposed Improvements (see map 4)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Missouri Flat Road Bike Lanes	Phase 1: Campus Drive to existing Class II on the south side of Highway 50	2	Class II Bike Lanes
Missouri Flat Road Bike Lanes	Phase 2: SPTC near Wal-Mart to Pleasant Valley Road	1	Class II Bike Lanes
Missouri Flat Road Bike Path	Class I bike path on the north side of Missouri Flat road from Perks Court to Forni Road	.25	Class I Bike Path
Jaquier Road	Placerville City limit to Carson Road	1	Class II Bike Lanes
Pleasant Valley Road Bike Lanes	Phase 1: Big Cut Road to Missouri Flat Road	2	Class II Bike Lanes
Pleasant Valley Road Bike Lanes	Phase 2: Missouri Flat Road to Mother Lode Drive	3	Class II Bike Lanes
Pleasant Valley Road Bike Lanes	Phase 3: Big Cut Road to Cowboy Trail	5.5	Class II Bike Lanes
Mother Lode Drive Bike Lanes	Phase 1: Missouri Flat Road to Lindberg Ave	1	Class II Bike Lanes
Enterprise Drive	Entire Length	1	Class II Bike Lanes
Gold Hill Road	Highway 49 to Lotus Road	4	Class III Bike Route
Commerce Way	Entire Length	.5	Class II Bike Lanes
SPTC – El Dorado Trail	Phase 1: Missouri Flat Road to Mother Lode Drive in El Dorado	3	Class I Bike Path

Table 5-4b: TIER 2 Proposed Improvements (see map 4)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Forni Road	Missouri Flat Road to Enterprise Drive	1	Class II Bike Lanes
Mother Lode Drive Bike Lanes	Phase 2: Lindberg Ave to Pleasant Valley Road	2	Class II Bike Lanes
Carson Road	Jaquier Rd to Larsen Drive	4.5	Class II Bike Lane on climbing shoulder
Newtown Road Bike Lanes	Parkway Drive to Pleasant Valley Road	5	Class II Bike Lanes
Highway 49	Placerville to Gold Hill Road	3	Class II Bike Lanes
Big Cut Road	Pleasant Valley Road to the City of Placerville	3	Class III Bike Route
Fort Jim Road	Entire Length	2	Class III Bike Route
Lindberg Ave	Mother Lode Drive to Forni Road	1	Class III Bike Route
SPTC – El Dorado Trail	Phase 3: Mother Lode Dr in El Dorado to Mother Lode Dr in Shingle Springs	4.75	Class I Bike Path

Table 5-4c: TIER 3 Proposed Improvements (see map 4)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Mother Lode Drive Bike Lanes	Phase 3: Pleasant Valley Road to South Shingle Road	4	Class II Bike Lanes
Highway 49	Pleasant Valley Road to Union Mine Road	.5	Class II Bike Lanes
Lindberg Ave	Mother Lode Drive to Forni Road	1	Class III Bike Route
Patterson Drive	Pleasant Valley Road to Crusader Rd	.75	Class III Bike Route
Crusader Rd/Cash Boy Road/Crystal Dr/Tullis Mine Road	Patterson Drive to Pleasant Valley Road	1	Class III Bike Route
Zandonnella Rd	Entire Length (Possible climbing lane in lieu of Pleasant Valley Rd.)	1	Class III Bike Route
Union Mine Road	Entire Length	4	Class III Bike Route
SPTC – El Dorado Trail	Phase 4: Mother Lode Dr in Shingle Springs to Shingle Lime Mine Road	2.5	Class I Bike Path
SPTC/El Dorado Trail	Phase 5: Halcon Road to Snows Road in Camino (Part of proposed alignment may be within Caltrans right of way south of US50)	2.2	Class I Bike Path

5.14.1 Challenges in the Diamond Springs/El Dorado Area

1. **Bike Path parallel to Pleasant Valley Road / State Route 49**
   Provide new bicycle access to Charles Brown Elementary School and Union Mine High School by providing a combination of Class I and Class II bicycle facilities parallel to Pleasant Valley Road/State Route 49 from Fowler Lane in Diamond Springs to the town of El Dorado. The proposed facilities will minimize the need for bicyclists to utilize this section of Pleasant Valley Road / State Route 49 as they ride to and from school. Caltrans strongly supports the development of parallel transportation facilities to State Route 49 that will alleviate congestion in the Diamond Springs/El Dorado area.

5.15 Proposed Improvements Map 5 – Camino/Pollock Pines/Fairplay

Table 5-5a: TIER 1 Proposed Improvements (see map 5)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Pleasant Valley Road	Cowboy Trail to Sly Park Road	3.5	Class II Bike Lanes
Carson Road	Jaquier Rd to Larsen Drive (on climbing shoulder)	4.5	Class II Bike Lane on climbing shoulder
SPTC/El Dorado Trail	Los Trampas Drive to Halcon Road in Camino Heights	1	Class I Bike Path
E 16 / Mt Aukum Rd	Mountain Creek Middle School to Fairplay Road / Pioneer Park	.5	Class II Bike Lanes

Table 5-5b: TIER 2 Proposed Improvements (see map 5)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Snows Road	Carson Road to Fuji Court	.75	Class II Bike Lanes
Pony Express Trail	Carson Road to Sly Park Road	6	Class II Bike Lanes

Table 5-5b: TIER 2 Proposed Improvements (see map 5)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Newtown Road Bike Lanes	Parkway Drive to Pleasant Valley Road	5	Class II Bike Lanes
Sly Park Road	Mormon Emigrant Trail to Highway 50	4.5	Class III Bike Lanes
Carson Road	Snows Road to Pony Express Trail Road	.5	Class III Bike Route
Mt Aukum Road	Fairplay Road to Blackhawk Lane	6.5	Class III Bike Route
Mt. Aukum Road	Fairplay Road to Mountain Creek School/Pioneer Creek School	1	Class III Bike Route
Fairplay Road	Mt. Aukum Road to Unser Way/Pioneer Park	.5	Class III Bike Route
Mt Aukum Road	Blackhawk Lane to Fairplay Road	6.5	Class III Bike Route

Table 5-5c: TIER 3 Proposed Improvements (see map 5)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Sly Park Road	Mormon Emigrant Trail to Pleasant Valley Road	6	Class III Bike Route
Happy Valley Road/Cutoff	Mt. Aukum to Happy Valley Cutoff to Mt. Aukum Road	1.5	Class III Bike Route
Grizzly Flat Rd	Glen Drive to Sciaroni Road	.5	Class II Bike Lanes
Sciaroni Road/Tyler Road	Grizzly Flat Road to Grizzly Pines School	.5	Class II Bike Lanes
Fairplay Road	Pioneer Park to Omo Ranch Road	4.2	Class III Bike Route
SPTC/El Dorado Trail	Phase 5: Halcon Road to Snows Road in Camino (Part of proposed alignment may be within Caltrans right of way south of US50)	2.2	Class I Bike Path

5.16 Proposed Improvements Map 6 – The Divide Georgetown/Cool/Coloma

Table 5-6a: TIER 1 Proposed Improvements (see map 6)			
ROADWAY, ROUTE or PROJECT NAME	**SEGMENT**	**SEGMENT DISTANCE (miles)**	**BIKEWAY FACILITY**
Highway 193	Highway 49 to Auburn Lake Trails in Caltrans right of way	2	Class II Bike Lanes
Lotus Road Bike Lanes	Phase 1: Gold Hill Road to Highway 49 (with emphasis on Highway 49 to Bassi Road)	3	Class II Bike Lanes
Gold Hill Road (also map 4)	Highway 49 to Lotus Road	4	Class III Bike Route
Northside School to Highway 193/49 intersection	Northside School to Highway 193/49 intersection on west side of Highway 49	.75	Class I Bike Path
Highway 193/49 intersection to Auburn Lake Trails	Highway 193/49 intersection on east side of Highway 193 to Auburn Lake Trails entrance	1	Class I Bike Path
Prospector Road	Entire length	2.5	Class III Bike Route
Marshall Road Bike Lanes	Top of Prospector Road to Black Oak Mine Road	3	Class II Bike Lanes
Marshall Road	Black Oak Mine Road to Highway 193	4	Class III Bike Route

Table 5-6b: TIER 2 Proposed Improvements (see map 6)

ROADWAY, ROUTE or PROJECT NAME	SEGMENT	SEGMENT DISTANCE (miles)	BIKEWAY FACILITY
Highway 49	Cold Springs Road to Cool	11	Class II Bike Lanes
Highway 49 (also map 4)	Placerville to Gold Hill Road	3	Class II Bike Lanes
Lotus – Coloma Bike & Pedestrian Bridge	Beach Court in Coloma to Henningsen Lotus Park	.5	Class I Bike Path
Highway 193	In Caltrans SR 193 right of way from Auburn Lake Trails to Wentworth Springs Road	11	Class II Bike Lanes
Lotus Road Bike Lanes	Phase 2: Green Valley Road to Gold Hill Road	3	Class II Bike Lanes
Highway 193	Through Georgetown	1	Class II Bike Lanes
Garden Valley Road	Near schools in Garden Valley	1	Class II Bike Lanes
Marshall Road	Highway 49 to Prospector Road	.5	Class II Bike Lanes
Marshall Road	Near Schools in Garden Valley	1	Class II Bike Lanes
Marshall Road	Through Georgetown	1	Class II Bike Lanes

6.1 Bikeway Cost Estimates

The table below provides conceptual cost estimates for the construction of bikeway facilities in El Dorado County. These cost estimates are based on costs experienced in the development of past projects in El Dorado County, as well as costs experienced in various California communities. These cost estimates should only be used to develop generalized construction cost estimates and project prioritization. More detailed estimates should be developed after preliminary engineering.

El Dorado County Bikeway Cost Estimates

Facility Type	Estimated Cost Per Mile
CLASS I BIKE PATH	
• Cost to grade and pave an 8-foot wide surface with 2-foot graded shoulders on each side. (Does not include amenities such as landscaping, lighting, irrigation, phones etc.)	$400,000
CLASS II BIKE LANES	
• Signing and striping only with minor shoulder improvement: Cost to install pavement striping, markings, and signs on both sides of an existing 4-foot roadside shoulder	$25,000
• Signing and striping plus major shoulder improvement: Cost to install 4-foot strips of pavement, pavement striping, markings and signs on both sides of a roadway	$300,000
CLASS III BIKE ROUTE	
• Signing only	$3,000
• Signing plus moderate shoulder improvement: Cost to install 2-3 foot strips of pavement, a 6-inch fog line and signs on both sides of the roadway	$150,000

6.2 Priority Project List

Priority routes were selected based on anticipated use, type of facility, connectivity, and potential improvements for safety. Tier 1 of the proposed project list in Chapter 5 represents the highest priority projects for implementation. The projects listed below were identified as the highest priority of all the Tier 1 projects (not in priority order).

- **Silva Valley Parkway Bike Lanes**: Class II Bike Lanes on Silva Valley Parkway from the newly constructed connection with White Rock Road to Green Valley Road.

- **El Dorado Hills Boulevard Bike Path – Phase 1:** Sign and stripe existing Class I Paths in two locations: 1) From Harvard Way to St. Andrews, 2) From Governors Drive to Francisco Drive

- **El Dorado Hills to Bass Lake Connection – Phase 1:** Class III Bike Route on Tong Road, Class III Bike Route on Old Bass Lake Road, use existing roadway as Class I Bike Path between gates from Tong to Old Bass Lake Road

- **El Dorado Hills to Folsom Connection:** Class II bike lanes on the extension of Saratoga Way to Iron Point Road (alternatively, construct a Class I bike path prior to construction of the extension of Saratoga Way to Iron Point Road)

- **Green Valley Road Bike Lanes –** Class II Bike Lanes from El Dorado Hills Boulevard to Pleasant Grove Middle School

- **Bass Lake Road Bike Lanes –** Class II Bike Lanes from Green Valley Road to Highway 50

- **Northside School Bike Path and Class II Bike Lanes –** Class I Bike Path from Northside School in Cool to Highway 49/193 intersection and from Highway 49/193 intersection to Auburn Lake Trails. Class II Bike Lanes on Highway 193 from Highway 49 to the Community of Auburn Lake Trails.

- **Highway 50 Grade Separated Crossing in El Dorado Hills –** Overcrossing from El Dorado Hills Village Center Shopping Center to El Dorado Hills Town Center

- **SPTC-El Dorado Trail –** Class I Bike Path from Missouri Flat Road to Mother Lode Drive in El Dorado

6.3 Bikeway System Funding Needs

The bikeway system funding needs are displayed below. The highest priority Tier 1 improvements are included as well as the entire proposed system. Due to variations in costs of Class II Bike Lanes, the cost estimates assumed Class II at $175,000 per mile. The Class III Bike Routes proposed in this plan are generally included for their existing potential as a bike route. No additional improvement is required so bike route costs are assumed at $5000 per mile.

Tier 1 Proposed Bikeways Cost Estimate Summary		
Facility Type	Miles Proposed	Approximate Funding Need
Class I Bike Path	16.85	$6.74 Million
Class II Bike Lanes	64.2	$11.24 Million
Class III Bike Route	18.5	$92,500

El Dorado County Overall Bikeway System Cost Estimate Summary		
Facility Type	Miles Proposed	Approximate Funding Need
Class I Bike Path	49.2	$19.68 Million
Class II Bike Lanes	157.7	$27.56 Million
Class III Bike Route	72.45	$362,250

6.4 Funding Sources

Implementation of the proposed bikeway system will require funding from local, State and Federal sources and coordination with other agencies and entities. In some cases, portions of the proposed system will be completed as part of future development, road widening and construction projects. For those portions that will rely on other funding mechanisms, the following discussion provides descriptions of the most common funding sources for bikeway projects.

6.4.1 Federal Sources

Federal transportation funds are distributed through the Federal Transportation Act for the 21st Century. The programs are distributed over a six-year period and are historically known as ISTEA, TEA-21, TEA-3 or SAFETEA, and SAFETEA-LU. SAFETEA-LU was extended through December 31, 2010, and reauthorization is expected to occur in 2011. For El Dorado County, applicable federal programs include the following:

- Regional Surface Transportation Program (RSTP)
- Congestion Mitigation and Air Quality (CMAQ)
- Transportation Enhancement (TE or "STIP TE")
- Safe Routes to School
- Section 402 (Safety) Funds
- Scenic Byways Funds
- Public Lands Highway Funds

Federal funding is administered through the State and regional governments, in this case, the El Dorado County Transportation Commission (EDCTC). Most of the funding programs are transportation oriented with an emphasis on reducing auto trips and providing a multi-modal connection. Funding criteria includes completion and adoption of a bicycle transportation plan, costs, and benefits of the implemented system (in some cases quantification of reduced vehicle trips and reduction in air pollution), public support for the project, California Environmental Quality Act (CEQA) compliance, and commitment of local resources. In most cases, federal funding will provide matching grants of 80 to 90 percent.

Of the above listed programs, RSTP, TE, and CMAQ are formula-based and received with each authorization of federal transportation funding. RSTP is distributed based on a road mileage formula, and CMAQ is distributed as a 'fair and equitable share' via SACOG. In fiscal year 2008/09 EDCTC received $845,032 in RSTP funds and no TE funds. In fiscal year 2009/10 EDCTC received $926,887 in RSTP and no TE funds. The other sources listed above are competitive, grant-type programs for which applicants are selected on the project's ability to meet the criteria of the program.

Other federal funding sources include the following:

- National Recreational Trails Fund
- Land and Water Conservation Fund Program (administered locally by the California Department of Parks and Recreation, Local Assistance)
- Recreation and Public Purposes Act (Bureau of Land Management)
- Schools and Road Grants to States (United States Forest Service)

6.4.2 State Sources

The following sources provide funding that is applicable to bikeway facilities. Such facilities also benefit and are used by other non-motorized user groups.

Bicycle Transportation Account – The State Bicycle Transportation Account (BTA) is an annual program for bicycle projects. Available as competitive-based grants to jurisdictions, the emphasis is on projects that benefit bicycling for commute purposes. The BTA provides State funding for projects that improve safety and convenience for bicycle commuters. Streets and Highways Code Section 893 describes the types of projects eligible for BTA funds. The Bicycle Facilities Unit in the Office of Local Programs administers the BTA program in cooperation with the office of Local Assistance in each Caltrans District. Cities and Counties are eligible to apply for BTA funds and may apply on behalf of an agency that is not a city or county for construction of a bicycle project that benefits commute bicycling.
To be eligible for BTA funds, cities and counties must have the following:

1. The governing body of a city or county must adopt the Bicycle Transportation Plan (BTP) by resolution or certify that it is current and complies with Streets and Highways Code Section 891.2.
2. The city or county must submit the BTP to the appropriate Metropolitan Planning Organization (MPO) or Regional Transportation Planning Agency (RTPA) for review and approval for compliance with Streets and Highways Code Section 891.2 and the regional transportation plan (RTP).
3. Following regional approval, the city or county must submit the resolution adopting the BTP and the letter of approval from the MPO/RTPA to the Caltrans Bicycle Facilities Unit (BFU).
4. BTP adoption establishes eligibility for five consecutive BTA funding cycles. Example: BTPs adopted in 2008 and submitted December 1, 2008; with an application for 2009/2010 BTA funding would establish eligibility for state fiscal years 2009/2010, 2010/2011, 2011/2012, 2012/2013, and 2013/2014. The state fiscal year begins on July 1 and ends on June 30 of the following year.

BTA projects must be in compliance with the applicable provisions of the California Environmental Quality Act by the BTA application submittal date. The lead agency is responsible for preparing the required environmental documentation and submitting it with the application.

Section 893.6 of the Streets and Highways Code specifies that no agency may receive more than 25 percent of the total funds transferred into the BTA in a single fiscal year. Section 891.4(b) requires local agencies to fund at least ten percent of the total project cost. Applications should be submitted only for projects where the right-of-way will be clear prior to award of contract and where cooperative agreements with other groups such as railroads, utility districts, flood control districts, coastal commissions etc., will be completed prior to award of contract.

Applications must include a description of the project and an estimate of project costs including preliminary and construction engineering, right-of-way, and construction. The estimate should include only those items for which the local agency intends to claim reimbursement. A detailed estimate is not necessary, but the Bicycle Facilities Unit needs enough information to ensure that the proposed project is consistent with the program guidelines. *Under state law, BTA projects must conform to the minimum design standards for bikeways in Chapter 1000 of the Highway Design Manual.*

Local Transportation Fund (LTF) – Under Article 3 of the Transportation Development Act (TDA), up to two percent of the LTF allocation to cities and counties can be used for bicycle and pedestrian projects. Revenues to the LTF program are derived from a quarter cent of the statewide sales tax. These funds are distributed through the El Dorado County Transportation Commission to the local jurisdictions. Between 2004 and 2011 EDCTC has apportioned between $51,000 and $75,000 annually in TDA LTF Article 3 funds.

In September of 2007, EDCTC adopted guidelines for the use of TDA LTF Article 3 set aside funding. EDCTC refers to the funding as *TDA Article 3 Pedestrian and Bicycle Funding* and the adopted Rules and Regulations for use of the funds are listed below, in priority order.

1. Projects shall be:
   - Included in an adopted Bicycle Transportation Plan, Non-Motorized Transportation Plan, Transit Plan, or Pedestrian Plan, as applicable
   - Endorsed by a Council or Board, as applicable
2. The primary use of this fund source shall be as matching funds for projects that are either grant funded or have a significant contribution by a local agency, i.e. Bicycle Transportation Account Funding, or other fund source.
3. The funding may be used to augment ongoing construction projects, i.e. a road rehabilitation or construction project that requires additional funding for bicycle, pedestrian facilities, or signage.
4. The funding may be used to for minor bicycle and pedestrian projects as follows:
   - For installation of bicycle racks or lockers
   - For installation of bicycle and pedestrian signage for bicycle routes, school zones and park and ride lots
   - For crosswalk striping, pedestrian refuges, minor bicycle lane striping
   - For maintenance of existing bicycle or pedestrian facilities
5. The funding may be used to supplement moneys from other sources to fund bicycle safety education programs.

AB 2766 – Motor vehicle registration surcharge fees are available for bicycle and pedestrian projects that can improve air quality. The El Dorado County Air Pollution Control District allocates these funds for El Dorado County.

Environmental Enhancement and Mitigation Program (EEM) – Bicycle projects can qualify for EEM funds if they meet the program's requirements. Any non-profit organization can sponsor projects, which are submitted to the State Resources Agency for evaluation in June/July of each year.

Flexible Congestion Relief Program (FCR) – Bicycle projects are eligible to compete for FCR funds. Projects must provide congestion relief and they must be included in an approved Regional Transportation Improvement Program. Local agencies must submit projects for FCR funding to EDCTC.

6.4.3 Local Sources

A variety of local sources are available for funding bikeway facilities, however, their use is often dependent on political support.

New Construction – Future road widening and construction projects are one means of developing on-street and separated bikeways. To ensure that roadway construction projects provide these facilities when needed, roadway design standards need to include minimum cross-sections that have sufficient pavement for on-street bikeways and the review process for new development should include input pertaining to consistency with the proposed bikeway system. Future development in El Dorado County will contribute to the implementation of new bikeway facilities if discretionary development projects are conditioned and roadway project designs are specifically required to include bikeway facilities.

Traffic Impact Mitigation Fees – Another potential local source of funding is developer impact fees, which are typically tied to trip generation rates and traffic impacts produced by the proposed development. Road right-of-way amenities that are bicycle friendly can be constructed incidental to other road improvements done to accommodate increased vehicle traffic. Additionally, a developer may reduce the number of trips (and hence impacts and cost) by paying for on and off-street bikeway improvements which will encourage residents to bicycle rather than drive.

Assessment Districts – Different types of assessment districts can be used to fund the construction and maintenance of bikeway facilities. Examples include Mello-Roos Community Facility Districts, Infrastructure Financing Districts (SB 308), Open Space Districts, or Lighting and Landscaping Districts. These types of districts have specific requirements relating to their establishment and use of funds.

Other Sources – Local sales taxes, developer or public agency land dedications, private donations, and fund-raising events are other local options to generate funding for bikeway projects. Creation of these potential sources usually requires substantial local support.

6.5 Maintenance of Bikeways

Maintenance of bikeways is an important element of an effective bicycle transportation system. Roadway debris, including gravel and glass, is typically 'swept' by passing cars onto the roadway shoulder or bike lane making them almost unusable by bicyclists. Without routine sweeping and maintenance, bicyclists are often forced to ride closer to the travel lane to avoid accidents and flat tires.

Class I at El Dorado Hills Boulevard – in need of maintenance

Under Article 3 of the Transportation Development Act (TDA), up to two percent of the LTF allocation to cities and counties can be used for bicycle and pedestrian projects, and this funding source can be used to maintain bikeways. Unfortunately, there are few other regional, state, and federal grants available for maintenance. Even if a grant could be used to buy capital equipment like a sweeper, many cities and counties lack the funds to perform the service.

Class I segments of trail should be maintained using standard pick-up trucks on the pathway itself. Class I bike path maintenance includes cleaning, resurfacing and re-striping the asphalt path, repairs to crossings, cleaning drainage systems, trash removal and landscaping. Underbrush and weed abatement should be performed once in the late spring and again in mid-summer.

Recommendation: ***Develop a bikeway maintenance reporting system, including a telephone number and/or email address listed on available maps and other documents that assures that reported maintenance problems are responded to within 48 hours.***

Recommendation: ***Street sweeper operators should ensure that bike lanes and shoulder areas of roadways are swept as part of routine street sweeping operations.***

Maintenance of bike lanes and roadway shoulders during construction periods has been identified as a particular concern of El Dorado County bicyclists. Roadway shoulders are often cluttered with dirt and gravel, and right of way on the shoulder is frequently obstructed by pylons and vehicular warning signage associated with construction projects. Shoulders and bike lanes need to be both maintained as a through right-of-way and kept clean from debris. The following recommendation is provided for maintaining roadway shoulders and bike lanes during construction periods:

Recommendation: ***Ensure that all construction projects adjacent to a roadway maintain both a clean swept shoulder and a through right-of-way for bicycles.***

Recommendation: ***Require all new construction projects to pay for street sweeping in the immediate vicinity as needed to keep streets and shoulders free of debris.***

6.6 Bikeway Design Standards

The most commonly used bikeway design standards are contained in the Caltrans Highway Design Manual, Chapter 1000 – Bikeway Planning and Design, dated September 1, 2006. The Caltrans standards are based largely on standards developed by the American Association of State Highway and Transportation Officials (AASHTO). The Manual of Uniform Traffic Control Devices, Federal Highway Administration, 2009, contains standards for bikeway signing. Detailed descriptions of the four types of bikeways identified in the Caltrans design standards are listed below, followed by a typical cross section of the three primary bikeways.

Recommendation: ***All bicycle facilities should conform to Caltrans Highway Design Manual Chapter 1000, and the Manual of Uniform Traffic Control Devices for Streets and Highways published by the Federal Highway Administration.***

All Class II Bike Lanes should generally conform to the design recommendations in Chapter 1000 of the Caltrans Highway Design Manual. Caltrans provides recommended intersection treatments in Chapter 1000 including bike lane turn ‘pockets’ and signal loop detectors. The El Dorado County Department of Transportation should develop a protocol for application of these recommendations, so that improvements can be funded and made as part of regular improvement projects (see figures in appendix a).

Recommendation: ***Signal loop detectors should be considered for all arterial/arterial/collectors, and collector/collector intersections.***

The location of the detectors should be identified by a stencil of a bicycle and the words 'Bicycle Detector'.

Recommendation: ***Bike lane pockets (min. 4' wide) between right-turn lanes and through lanes should be provided wherever available width allows, and right turn volumes exceed 150 motor vehicles/hour.***

The following is the description of the four classifications of bikeways as included in the Caltrans Highway Design Manual:

Shared Roadway (No Bikeway Designation)

Most bicycle travel in the State now occurs on streets and highways without bikeway designations. This probably will be true in the future as well. In some instances, entire street systems may be fully adequate for safe and efficient bicycle travel and signing and striping for bicycle use may be unnecessary. In other cases, routes may be unsuitable for bicycle travel, and it would be inappropriate to encourage additional bicycle travel by designating the routes as bikeways. Finally, routes may not be along high bicycle demand corridors, and it would be inappropriate to designate bikeways regardless of roadway conditions (e.g., on minor residential streets).

Many rural highways are used by touring bicyclists for intercity and recreational travel. In most cases, it would be inappropriate to designate the highways as bikeways because of the limited use and the lack of continuity with other bike routes. However, the development and maintenance of four-foot paved roadway shoulders with a standard four-inch edge stripe can significantly improve the safety and convenience for bicyclists and motorists along such routes.

Class I Bikeway (Bike Path)

Generally, bike paths should be used to serve corridors not served by streets and highways or where wide right of way exists, permitting such facilities to be constructed away from the influence of parallel streets. Bike paths should offer opportunities not provided by the road system. They can either provide a recreational opportunity or, in some instances, serve as direct high-speed commute routes if cross flow by motor vehicles and pedestrian conflicts can be minimized. The most common applications are along rivers, ocean fronts, canals, utility right of way, abandoned railroad right of way, within college campuses, or within and between parks. There may also be situations where such facilities can be provided as part of planned developments. Another common application of Class I facilities is to close gaps to bicycle travel caused by construction of freeways or because of the existence of natural barriers (rivers, mountains, etc.).

Class II Bikeway (Bike Lane)

Bike lanes are established along streets in corridors where there is significant bicycle demand and where there are distinct needs that can be served by them. The purpose should be to improve conditions for bicyclists in the corridors. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. An even more important reason for constructing bike lanes is to better accommodate bicyclists through corridors where insufficient room exists for safe bicycling on existing streets. This can be accomplished by widening the pavement to provide the minimum 4-foot shoulders or by reducing the number of roadway lanes where possible or prohibiting parking on given streets where feasible in order to delineate bike lanes. In addition, other things can be done on bike lane streets to improve the situation for bicyclists that might not be possible on all streets (e.g., improvements to the surface, augmented sweeping programs, special signal facilities, etc.). Generally, striping alone will not measurably enhance bicycling.

Class III Bikeway (Bike Route)
Bike routes are shared facilities which serve either to:

(a) Provide continuity to other bicycle facilities (usually Class II bikeways); or
(b) Designate preferred routes through high demand corridors.

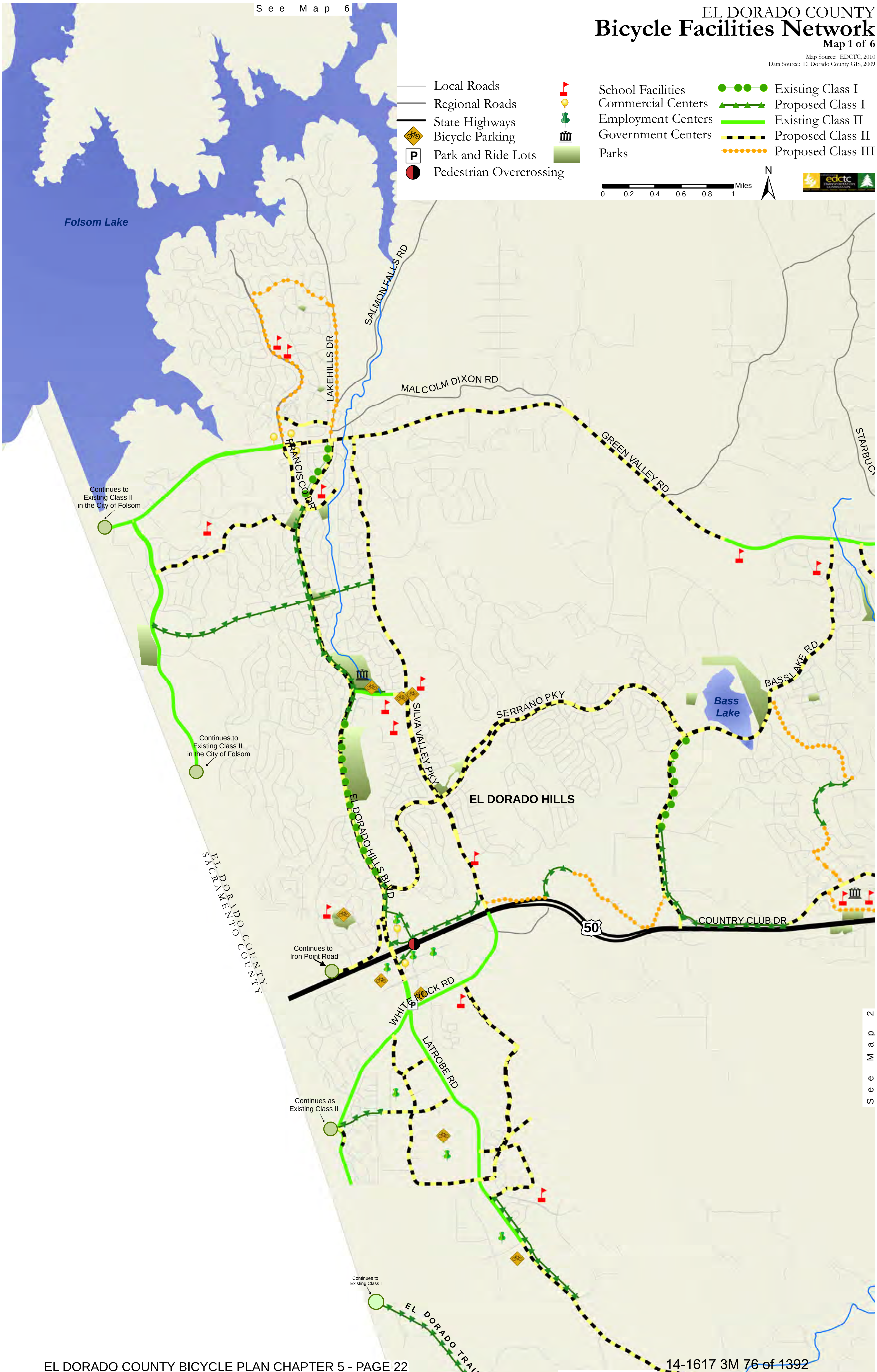
As with bike lanes, designation of bike routes should indicate to bicyclists that there are particular advantages to using these routes as compared with alternative route alignments. This means that responsible agencies have taken actions to assure that these routes are suitable as shared routes and will be maintained in a manner consistent with the needs of bicyclists. Normally, bike routes are shared with motor vehicles. The use of sidewalks as Class III bikeways is strongly discouraged.

Selection of Bicycle Facilities
It is emphasized that the designation of bikeways as Class I, II, and III should not be construed as a hierarchy of bikeways or that one is better than the other. Each class of bikeway has its appropriate application. In selecting the proper facility, an overriding concern is to assure that the proposed facility will not encourage or require bicyclists or motorists to operate in a manner that is inconsistent with the rules of the road.

An important consideration in selecting the type of facility is continuity. Alternating segments of Class I and Class II (or Class III) bikeways along a route are generally incompatible, as street crossings by bicyclists are required when the route changes character. Also, wrong-way bicycle travel will occur on the street beyond the ends of bike paths because of the inconvenience of having to cross the street.

Appendix A includes design diagrams from the *Caltrans Highway Design Manual, Chapter 1000, Bikeway Planning and Design* and the *Manual of Uniform Traffic Control Devices (MUTCD), Part 9, Traffic Controls for Bicycle Facilities.* Both of these documents are available online, the Highway Design Manual at http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm and the MUTCD at http://mutcd.fhwa.dot.gov/.

Attachment #3


See Map 6
EL DORADO COUNTY
Bicycle Facilities Network
Map 1 of 6
Map Source: EDCTC, 2010
Data Source: El Dorado County GIS, 2009
Local Roads
Regional Roads
State Highways
Bicycle Parking
Park and Ride Lots
Pedestrian Overcrossing
School Facilities
Commercial Centers
Employment Centers
Government Centers
Parks
Existing Class I
Proposed Class I
Existing Class II
Proposed Class II
Proposed Class III
Miles
0 0.2 0.4 0.6 0.8 1
N
Folsom Lake
SALMON FALLS RD
LAKEHILLS DR
MALCOLM DIXON RD
GREEN VALLEY RD
FRANCISCO DR
STARBUCK
Continues to Existing Class II in the City of Folsom
Continues to Existing Class II in the City of Folsom
SILVA VALLEY PKY
SERRANO PKY
BASS LAKE RD
Bass Lake
EL DORADO HILLS
EL DORADO HILLS BLVD
EL DORADO COUNTY
SACRAMENTO COUNTY
Continues to Iron Point Road
50
COUNTRY CLUB DR
WHITE ROCK RD
LATROBE RD
See Map 2
Continues as Existing Class II
Continues to Existing Class I
EL DORADO TRAIL
See Map 3

Attachment #4

Final Corridor Analysis Report

GREEN VALLEY ROAD

El Dorado County, California

October 2014

Prepared for:

County of El Dorado
Community Development Agency
Department of Transportation
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KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

MOVING**FORWARD**THINKING™

Final Corridor Analysis Report

Green Valley Road

El Dorado County, California

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Project No. 17805

October 2014

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PART A: EXECUTIVE SUMMARY

Traffic operations and safety has been the subject of public inquiries during open forums at the Board of Supervisors meetings and discussions at the El Dorado County Transportation Commission (EDCTC). El Dorado County has prepared this Corridor Analysis Report for Green Valley Road to examine operational and safety issues that exist on this roadway between the County line on the west and Lotus Road to the east within El Dorado County. The purpose of the study is to identify potential short-term improvements that may be implemented to improve operating and safety conditions for all users and modes of travel along the corridor. It should be acknowledged that any potential improvement to the Green Valley Road corridor may require the appropriate environmental documentation. All improvements identified in this report are “considerations” and “options”. The improvements are also independent of each other. Their outcomes in improving roadway conditions vary extensively, and therefore, further engineering evaluation should be conducted to examine feasibility of these improvements.

STUDY AREA

The study corridor spans approximately 11 miles of a predominantly rural area that includes two suburban unincorporated communities; El Dorado Hills, and Cameron Park. Green Valley Road is a two-lane arterial starting in the City of Folsom, which transitions to a four-lane roadway 260 feet west of Sophia Parkway. The four-lane roadway extends to Francisco Drive, then transitions back to a two-lane rural arterial east of Francisco Drive. The corridor remains a two-lane roadway until the end of the study area at Lotus Road. The study area was comprised of 16 intersections and 11 roadway segments.

CAPITAL IMPROVEMENT PROGRAM (CIP)

Since the implementation of the County’s 2004 General Plan, several CIP projects to improve Green Valley Road’s traffic conditions have been completed within the study area, as follows:

- CIP #72354: Widening of Green Valley Road in the commercial area. Completed in December 2004
- CIP #73312: Green Valley Road/Silva Valley Parkway signalization including widening for construction of left-turn lanes and sidewalks. Completed in February 2007.
- CIP #72355: Widened portion of Green Valley Road between the County Line and Francisco Drive. Completed in September 2007.

There are also several other projects programmed along the corridor which are listed in the County’s Current Year, 5-Year, 10-Year, and 20-Year CIP (see Part C: Key Findings and Improvement Considerations). In addition, the City of Folsom has received a grant to widen Green Valley Road to four-lanes from East Natoma Street to Sophia Parkway. Construction for that project is tentatively scheduled to begin in 2017.

ANALYSIS METHODOLOGY

A field visit with El Dorado County staff was performed on April 28, 2014, with two follow-up field visits to collect inventory of roadway and intersection characteristics. In addition, the field visits also included the following facilities:

- **Speed Limit Signs:** an inventory of speed signs along the corridor was gathered;
- **Private Driveways:** an inventory of sight distance observations and measurements was gathered for the private property accesses between Loch Way and Bass Lake Road;
- **Bicycle Facilities:** an inventory of type and extent of bicycle facilities on the corridor was gathered.
- **Pleasant Grove Middle School:** traffic circulation issues in the vicinity of Pleasant Grove Middle School was observed and pick-up and drop-off activities were surveyed;
- **Purple Place Retail Center:** an inventory of its driveways and associated issues was gathered;

In order to perform operations analysis, the weekday AM (6:30 to 9:30) and PM (3:30 to 6:30) peak period turning movement counts were performed on May 6, 2014 (Tuesday) at the study intersections. School afternoon peak period (1:30 to 3:30 PM) turning movement counts were also performed on May 6, 2014 at the selected intersections. Roadway segment data were collected from May 3, 2014 to May 11, 2014 to capture a full week. Since the equipment at two segments malfunctioned in May, the data was re-collected from August 23, 2014 to August 29, 2014. The segment data included traffic counts, classification counts and speed measurements. Traffic data and field reconnaissance was used to perform operations analysis at the study locations. The methodologies used to analyze intersection and roadway segment operations are outlined in the Transportation Research Board's *Highway Capacity Manual*, 2010 version (HCM 2010). All operational analysis was performed using the County's standard procedures and methodologies. The study locations were analyzed using the Level of Service (LOS) standards outlined in the County's General Plan Policy *TC-Xd*.

FINDINGS: TRAFFIC OPERATIONS

Intersection and roadway segment traffic conditions were evaluated based on operational analysis and field observations. Key findings and improvement considerations are presented below.

- The **Green Valley Road/El Dorado Hills Boulevard/Salmon Falls Road intersection** does not meet the County's LOS E threshold during the afternoon school peak hour. The County's CIP project, which is currently being processed to modify alignment of the northbound and southbound approaches at the El Dorado Hills Boulevard/Salmon Falls Road intersection will allow for protected left-turn phasing at these approaches. As a result, the overall intersection delay would reduce and LOS would meet County's threshold.
- The SimTraffic analysis indicated that the average delay at **the Green Valley Road/Pleasant Grove Middle School signalized intersection** currently operates at LOS E in the AM peak hour, exceeding the County's LOS D threshold. The critical movements, i.e. westbound Green Valley Road left-turn and through movements operate at LOS F and LOS D respectively. The

westbound left-turn queues at the primary western school access extend beyond the newly constructed Silver Springs Parkway. A range of improvements may be considered to enhance the school's internal circulation to alleviate queues and deficient operations at this intersection in the AM peak hour. It should be noted that El Dorado County has no jurisdiction over the school property.

- The other study intersections also meet the County's operational standards during the study peak hours. All study segments meet the County's operational standard, with most operating at LOS D or better during the AM and PM peak hours.
- Field observations and operational analysis reported extensive vehicular queues between Francisco Drive and El Dorado Hills Boulevard/Salmon Falls Road, primarily in the westbound direction in the AM peak and eastbound direction in the PM peak hour. While signal coordination and Time of Day timings plans would slightly improve the LOS, it would result in reduction of spillback issues arising from closely spaced intersections.
- The operational analysis indicates that the estimated queues at the following movements exceed the storage capacity, and thereby potentially block the adjacent through lanes. Left-turn lane pocket may be extended to provide sufficient storage at these movements.
    - Northbound Silva Valley Parkway left-turn lane at Green Valley Road
    - Westbound Green Valley Road left-turn lane at Pleasant Grove School Signalized Access
    - Northbound Cambridge Road left-turn lane at Green Valley Road
    - Westbound and northbound left-turn lanes at Green Valley Road/Cameron Park Drive intersection.

FINDINGS: SPEED LIMIT SIGNS AND SURVEYS

Speed surveys observed 85th percentile speeds exceeding the posted speed limits on the following study segments by more than 5 miles per hour (mph).

- #2 Sophia Parkway to Francisco Drive – observed speeds were approximately 9-10 mph higher than the posted speed of 50 mph.
- #5 Silva Valley Parkway to Malcolm Dixon Road – observed speeds in the westbound direction were nearly 9 mph higher than the prima facie speed of 55 mph.
- #7 Deer Valley Road (West) to Bass Lake Road – observed speeds in the westbound direction were 6 mph higher than the prima facie speed of 55 mph.

There are no signs on the corridor to make motorists aware of impending downstream speed reduction or transition areas except for the one present just west of Bass Lake Road in the eastbound direction. Speed transition zone treatments could increase motorists' awareness of the context environment and potentially reduce the prevailing speeds. Treatment applications could include installing traffic signs such as W3-5, automated speed feedback signs, gateway features such as sign stating "Welcome to El Dorado Hills", and traverse rumble strips. California Highway Patrol and El Dorado County Sheriff have programs that utilize portable speed feedback trailers as "public education." These speed feedback trailers are available for County use upon request.

In addition, key intersections along the above-mentioned segments could be subject to those improvements that have potential to reduce the prevailing speeds. Traffic calming strategies such as: 1) lane narrowing concept on the major road approach with pavement markings and rumble strips; 2) major road approach splitter islands and/or approach curvature; and, 3) minor road approach splitter island should be considered. The intent of these lane narrowing concepts is to increase visibility of the intersection, reduce vehicle speeds on the major road approach, and thereby potentially reduce crashes.

FINDINGS: CRASH ANALYSIS

Over the three-year study period, 158 total crashes were reported within the study area, Green Valley Road from the County line to the Lotus Road intersection.. Of the 158 reported crashes, 44 percent resulted in an injury and 4 percent resulted in a fatality. A total of 81 crashes occurred along a roadway segment (i.e. at least 250 feet away from a major intersection). There were more severe crashes reported along the segments than at the intersections within the study area. Rear-end, broadside and fixed-objected were predominant crash types, accounting for approximately 75 percent of all reported crashes. Approximately 70 percent of crashes along the corridor cited “unsafe speed”, “unsafe turning movement” and “Did not yield right of way” as the contributing factors for crashes.

The segment between El Dorado Hills Boulevard and Silva Valley Parkway reported the highest crash rate of 1.22 crashes per million vehicle miles along the corridor. Similarly, the Cameron Park Drive and Ponderosa Road intersection reported the highest crash rate of 0.83 per million entered vehicles along the corridor. None of the study intersections or segments exceeds the County’s benchmark of average crash rates. Therefore, the County is not required to take further actions. However, considerations are proposed to improve traffic operations, reduce speeds and enhance safety in the corridor to potentially reduce crashes and their severity.

FINDINGS: BICYCLE FACILITIES

Class II bicycle lanes are present between the El Dorado/Sacramento County line and Francisco Drive, Pleasant Grove Middle School and Cameron Park Drive/Starbuck Road, and in the vicinity of Deer Valley Road (West). As such, there are gaps in the bicycle lanes along the corridor. The current bicycle lane pavement markings are infrequent along the corridor and are not marked at the far side of all study intersections along the corridor. The signage to mark the beginning and end of the bike lane is inconsistent. Only a few bicyclists were seen using the existing bicycle facilities. Some bicyclists were also observed to share the travel lane with motorists between the El Dorado Hills and Cameron Park communities.

The County’s 5-year CIP (#72309) project to install an 8-foot wide Class II bikeway between Loch Way and Pleasant Grove Middle School western entrance would enhance bicycle facilities in the rural region. In addition, Class II bicycle lanes between Francisco Drive and Loch Way would provide a continuous facility from the County Line on the west to Cameron Park Drive, and connect the El Dorado Hills and

Cameron Park communities with another mode of transport. The appropriate signage and markings could be provided to increase motorist's awareness for presence of the bicycle lanes. Longitudinal rumble strips could be considered along the outside edge line to augment safety of the bicyclists on the high speed rural segments.

FINDINGS: PRIVATE DRIVEWAYS

A number of privately owned driveways exhibited insufficient intersection sight distance (ISD)[1] and stopping sight distance[2] (SSD) based on the California *Highway Design Manual*. It should be noted that the County does not improve private driveways. Any improvements, such as trimming vegetation, providing delineators to define turning radius are the responsibility of the private property owner. County could consider constructing dedicated left-turn lanes at the higher volume driveways and roadways to increase the stopping sight distance. In addition, installing an 8-foot wide shoulders or bicycle lanes (as described above) could improve the motorist's ability to avoid a crash.

FINDINGS: PLESANT GROVE MIDDLE SCHOOL

The school provides two pick-up/drop-off areas for parents and a designated turnout for the school buses. Since a higher number of motorists access the school from the east in the morning, the western drop-off area is used more frequently than the eastern. As a result, vehicles stack up on the western driveway, as well as in the pass-by lane adjacent to the western drop-off lane. The eastern drop-off area is relatively underutilized, possibly influenced by the current closure of the eastern driveway. While County staff have modified the signal timing of the Pleasant Grove Middle School access to provide a longer green time for the westbound Green Valley Road left-turn phase (current timing sheets provide a maximum of 25 seconds of green time), queues are formed. During the field reviews that were conducted in Spring of 2014, the observed queues extended beyond the newly constructed Silver Springs Parkway. As such, extensive queues at the westbound Green Valley Road left-turn lane not only block adjacent through lane, but also prevents side-street motorists from turning left and right onto Green Valley Road. Circulation and operational issues were predominantly observed at the time of drop-off and typically last for approximately 15-20 minutes.

Although El Dorado County has no jurisdiction over the school site layout, the following improvements could be considered to improve traffic circulation within the school site:

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[1] Intersection Sight Distance is also referred to as Corner Sight Distance. It is the clear line of sight in feet between the driver of a vehicle waiting at the crossroad (stop control) and the driver of an approaching vehicle on the major uncontrolled street.

[2] Stopping Sight Distance is defined as the distance needed for drivers to see an object on the roadway ahead and bring their vehicles to safe stop without colliding with the object.

- Appoint traffic monitors in the morning school peak hour to regulate the traffic flow;
- Modify pavement markings and curbs on the western driveway to clarify utilization of the pass-by lane to motorists;
- Complete a sidewalk along the eastern driveway to provide pedestrians with a continuous sidewalk between Green Valley Road and school property;
- Manage peak travel demand. Some measures include staggering school start times, expanding existing bus service, awarding incentives for those children that carpool to school, etc.

FINDINGS: CUT-THROUGH TRAFFIC

Origin-destination (OD) data was collected using the Bluetooth™ technology enabled BlueMAC readers. BlueMAC readers were deployed at five locations to capture origin-destinations and route patterns on Allegheny Road and Salmon Falls Road. The analysis captured the origin destination data collected between Friday, May 2, 2014 and Tuesday, May 13, 2014. Four OD pairs were evaluated for the Allegheny Road cut through route: South Silva Valley Parkway to North Salmon Falls Road, South Silva Valley Parkway to Francisco Drive, East Green Valley Road to North Salmon Falls Road and East Green Valley Road to Francisco Drive. Cut-through traffic using Allegheny Road during the AM and PM peak periods ranged from 10 percent to 23 percent between the OD pairs, with the Silva Valley Parkway to Francisco Drive OD pair registering the highest proportion (23 percent) of cut through traffic in the AM peak. Two OD pairs were examined for the Salmon Falls Road cut-through traffic: South Silva Valley Parkway to Francisco Drive and East Green Valley Road to Francisco Drive. Cut-through traffic using Salmon Falls Road during the AM and PM peak periods ranged from 0 to 22 percent between the OD pairs, with the Silva Valley Parkway to Francisco Drive OD pair registering the highest proportion (23 percent) of cut through traffic in the PM peak.

Operational considerations discussed earlier could reduce the cut-through traffic on Allegheny Road and Salmon Falls Road. Enforcement and education could be used as a tool that deters motorists from driving behavior that violates existing regulations for driving maneuvers and excessive speed. Physical traffic calming measures such as rumble strips, chicane or lane narrowing could be considered. These measures are implemented in order to reduce speeds through an area, reducing the attractiveness of these streets in terms of travel time.

Part B: Introduction

PART B: INTRODUCTION

El Dorado County has prepared this Corridor Analysis Report for Green Valley Road to examine operational and safety issues that exist on this roadway between the County line on the west and Lotus Road to the east within El Dorado County. The purpose of the study is to identify potential short-term improvements that may be implemented to improve operating and safety conditions for all users and modes of travel in the corridor. It should be acknowledged that any potential improvement to the Green Valley Road corridor may require the appropriate environmental documentation. All improvements identified in this report are "considerations" and "options". The improvements are also independent of each other. Their outcomes in improving roadway conditions vary extensively, and therefore, further engineering evaluation should be conducted to examine feasibility of these improvements.

STUDY BACKGROUND

Traffic operations and safety has been the subject of public inquiries during open forum at the Board of Supervisors meetings and discussions at the El Dorado County Transportation Commission (EDCTC). The Board of Supervisors directed County staff to move forward with a Corridor Analysis for Green Valley Road in July of 2013. Additional public input on the scope of the study was received at the Board of Supervisors meeting in October of 2013. The breadth of analysis presented herein is the direct result of the public comments and County staff's recommendations. Findings of this study will be brought forward and discussed at the public workshop and Board of Supervisors meeting to be held in the fall/winter of 2014 (dates to be determined).

STUDY CORRIDOR CONTEXT

Green Valley Road extends from the Sacramento County/City of Folsom and traverses through the unincorporated County of El Dorado ending at Placerville Drive in the City of Placerville. The study corridor spans approximately 11 miles of a predominantly rural area that includes two suburban unincorporated communities; El Dorado Hills, and Cameron Park. Green Valley Road is a two-lane arterial starting in the City of Folsom, which transitions to a four-lane roadway 260 feet west of Sophia Parkway. The four-lane roadway extends to Francisco Drive, then transitions back to a two-lane rural arterial east of Francisco Drive. The corridor remains a two-lane roadway until the end of the study area at Lotus Road.

Several Capital Improvement Program (CIP) projects have been completed along the Corridor. There are also several other projects programmed along the corridor which are listed in the County's Current Year, 5-Year, 10-Year, and 20-Year CIP (see Part C: Key Findings and Improvement Considerations). In addition, the City of Folsom has received a grant to widen Green Valley Road to four-lanes from East Natoma Street to Sophia Parkway. Construction for that project is tentatively scheduled to begin in 2017.

STUDY AREA

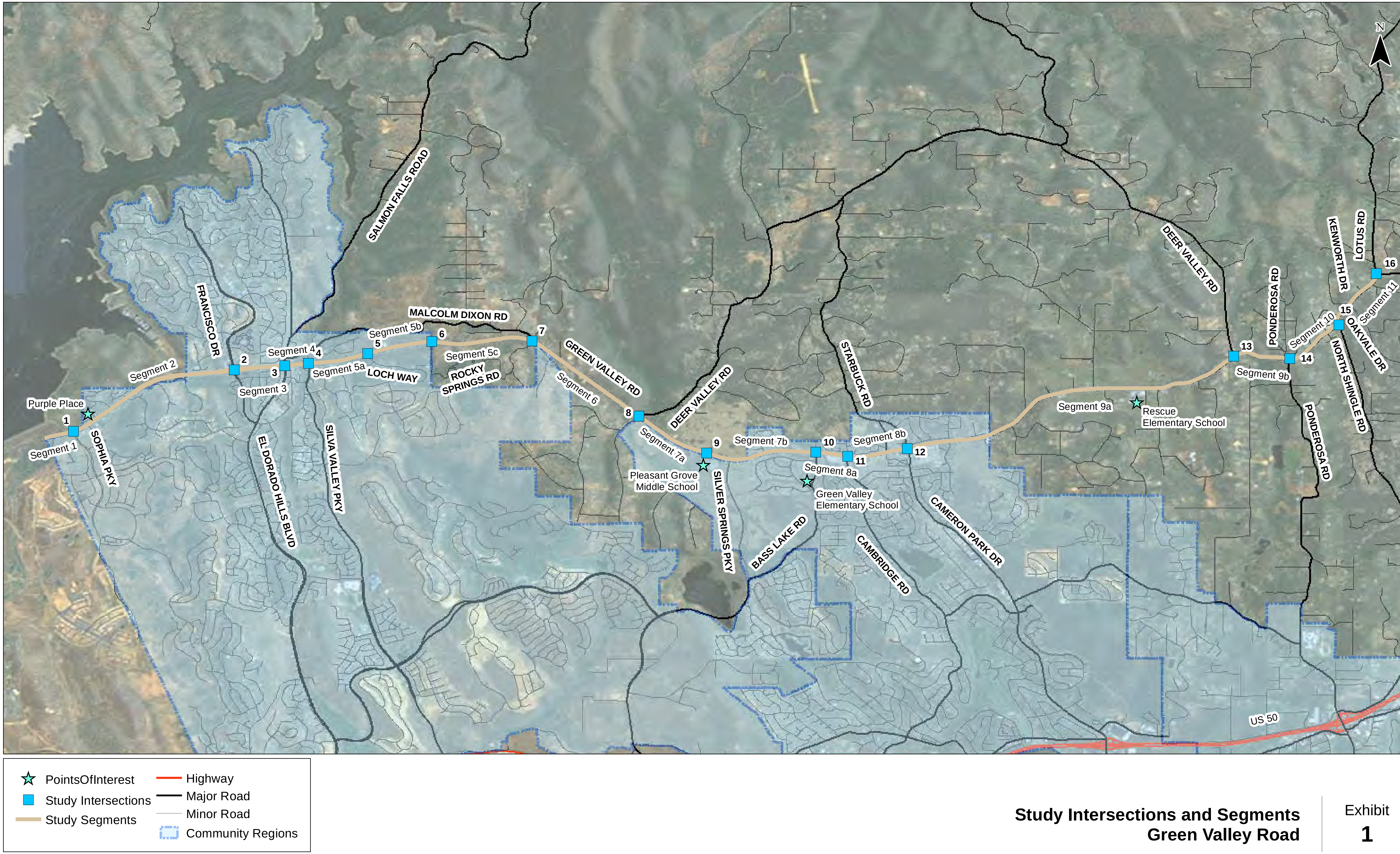
Study locations are listed below and shown in Exhibit 1.

Intersections:

1. Green Valley Road at Sophia Parkway
2. Green Valley Road at Francisco Drive
3. Green Valley Road at El Dorado Hills Boulevard/Salmon Falls Road
4. Green Valley Road at Silva Valley Parkway/Allegheny Road
5. Green Valley Road at Loch Way
6. Green Valley Road at Rocky Springs Road/Steves Way
7. Green Valley Road at Malcolm Dixon Road
8. Green Valley Road at Deer Valley Road (West)
9. Green Valley Road at Pleasant Grove Middle School (Main Access)
10. Green Valley Road at Bass Lake Road
11. Green Valley Road at Cambridge Road/Peridot Drive
12. Green Valley Road at Cameron Park Drive/Starbuck Road
13. Green Valley Road at Deer Valley Road (East)
14. Green Valley Road at Ponderosa Road (East)
15. Green Valley Road at North Shingle Road
16. Green Valley Road at Lotus Road

Roadway Segments:

1. El Dorado/Sacramento County Line/City of Folsom to Sophia Parkway
2. Sophia Parkway to Francisco Drive
3. Francisco Drive to El Dorado Hills Boulevard/Salmon Falls Road
4. El Dorado Hills Boulevard/Salmon Falls Road to Silva Valley Parkway/Allegheny Road
5. Silva Valley Parkway/Allegheny Road to Malcolm Dixon Road
6. Malcolm Dixon Road to Deer Valley Road (West)
7. Deer Valley Road (West) to Bass Lake Road
8. Bass Lake Road to Cameron Park Drive
9. Cameron Park Drive to Ponderosa Road (East)
10. Ponderosa Road (East) to North Shingle Road
11. North Shingle Road to Lotus Road



Study Intersections and Segments
Green Valley Road

Exhibit
1

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ANALYSIS APPROACH

This section briefly describes the technical approach and analysis methods used to examine current traffic operations and safety on the Green Valley Road corridor.

Field reconnaissance was undertaken and traffic data was collected to ascertain the operational characteristics of each of the study area intersections and roadway segments. Field visits were performed to collect data on physical features, measurements, and inventory of corridor characteristics. Weekday AM (6:30 to 9:30) and PM (3:30 to 6:30) peak period turning movement counts were performed on May 6, 2014 (Tuesday) at the study intersections. School afternoon peak period (1:30 to 3:30 PM) turning movement counts were also performed on May 6, 2014 at the selected intersections. Roadway segment data were collected from May 3, 2014 to May 11, 2014 to capture a full week. The segment data included traffic counts, classification counts and speed measurements.

The methodologies used to analyze intersection and roadway segment operations are outlined in the Transportation Research Board's *Highway Capacity Manual*, 2010 version (HCM 2010). All operational analysis was performed using the County's standard procedures and methodologies. General Plan Policy *TC-Xd* provides Level of Service (LOS) standards for the County operated and maintained roadways and intersections, as follows:

Level of Service (LOS) for County-maintained roads and state highways within the unincorporated areas of the county shall not be worse than LOS E in the Community Regions or LOS D in the Rural Centers and Rural Regions except as specified in Table TC-2. The volume to capacity ratio of the roadway segments listed in Table TC-2 shall not exceed the ratio specified in that table.

Community Region and rural area boundaries along the corridor is illustrated in Exhibit 1.

Crash data and reports were collected and analyzed along the study corridor over a three-year study period (2011–2013). These reports were used in conjunction with field observations, traffic (including speeds) conditions and physical features at the study locations to identify crash related patterns. Crash rates were calculated using the methodologies adopted by the County. The crash rate at the intersection and roadway is based on annual average crashes per Million Entering Vehicles (MEV) and Million Vehicle Miles (MVM) respectively. 1.0 crash per MEV for the intersections and 1.7 crashes per MVM for segments are the benchmarks used by the County. Any site with a crash rate above these benchmarks will be considered for additional action.

REPORT ORGANIZATION

The remainder of the report is organized into the following three sections:

Part C (Key Findings and Improvement Considerations) – identifies Key Findings and presents improvement considerations related to traffic operations, safety and physical features.

Part D (Technical Data and Analysis) – describes analysis methodologies, key assumptions, data collection and field review summary and analysis results.

Technical Appendix (provided under separate cover) – provides traffic counts data, analysis inputs and output worksheets.

Part C: Key Findings and Improvement Considerations

PART C: KEY FINDINGS AND IMPROVEMENT CONSIDERATIONS

TRAFFIC OPERATIONS

This section identifies existing traffic operational findings and deficiencies, and develops the improvement considerations. A detailed technical data, analysis and results are contained in *Part D* of this report.

All improvements identified in this section are “considerations” and “options”. The improvements are also independent of each other. Their outcomes in improving roadway conditions vary extensively, and therefore, further engineering evaluation should be conducted to examine feasibility of these improvements.

Key Findings

Intersection operations analysis indicated that the Green Valley Road/El Dorado Hills Boulevard/Salmon Falls Road intersection does not meet the County’s Level of Service (LOS) threshold during the afternoon school peak hour, although this intersection meets the County threshold during the weekday AM and PM peak hours. The other study intersections currently meet the County’s operational standards during the study peak hours. Based on SimTraffic analysis, the Pleasant Grove Middle School signalized access operates at LOS E during the AM peak hour, exceeding the County’s LOS policy.

Roadway segment analysis indicates that all study segments meet the County’s operational standard, with most operating at LOS D or better during the AM and PM peak hours. The segment between the County line and Sophia Parkway operates at LOS E in each direction. The westbound segment between Francisco Drive and El Dorado Hills Boulevard operates at LOS E during the AM peak hour.

Operations analysis indicates that during the AM peak hour the westbound queues at the El Dorado Hills Boulevard intersection can reach lengths of 1,000 feet, which spillback into the Silva Valley Parkway intersection. Similarly, the eastbound queues at the Silva Valley Parkway in the PM peak can extend back into the El Dorado Hills Boulevard intersection. Consistent with the field observations, operational analysis reported extensive queuing between Francisco Drive and El Dorado Hills Boulevard. Operational analysis also indicates extensive queuing at several left-turn lanes at the intersections. Left-turn queues that exceed the available storage can potentially block the adjacent through lane. This can cause “lane starvation” where available through movement capacity is not fully utilized. Intersections and movements where queues exceed the storage capacity are listed below:

- #3 El Dorado Hills Boulevard/Salmon Falls Road eastbound left-turn lane
- #4 Silva Valley Parkway northbound left-turn lane
- #9 Pleasant Grove School Access intersection’s westbound left-turn lane
- #11 Cambridge Road northbound left-turn lane

- #12 Cameron Park Drive/Starbuck Road intersection's westbound and northbound left-turn lanes

The westbound left-turn queues at the primary access to Pleasant Grove Middle School were observed to exceed the available storage in the AM peak hour. The queues were observed to block the newly constructed Silver Springs Parkway and Travois Circle east of the school. The operational analysis indicates that the westbound left-turn movement operates at LOS F in the AM peak. The operational issues and associated improvement considerations specific to the Pleasant Grove Middle School are discussed later in this report, while the technical data and analysis are contained in *Part D*.

Based on speed surveys, observed 85th percentile speeds[3] on six segments, as identified below, exceeded the posted speed limits:

- #1 County Line to Sophia Parkway – observed speeds were approximately 3 to 5 miles per hour (mph) higher than the posted speed of 50 mph.
- #2 Sophia Parkway to Francisco Drive – observed speeds were approximately 9-10 mph higher than the posted speed of 50 mph.
- #5 Silva Valley Parkway to Malcolm Dixon Road – observed speeds in the westbound direction were nearly 9 mph higher than the prima facie speed of 55 mph.
- #7 Deer Valley Road (West) to Bass Lake Road – observed speeds in the eastbound and westbound directions were 3 and 6 mph higher respectively relative to the prima facie speed of 55 mph.
- #9 Cameron Park Drive to Ponderosa Road – observed speeds were approximately 2-4 mph higher than the posted speed of 50 mph.
- #10 Ponderosa Road to North Shingle Road – observed speeds were approximately 4 mph higher in both directions relative to the posted speed of 40 mph.

Given that the prevailing speeds are directly related with safety, a detailed discussion of prevailing speeds, potential issues and improvement considerations is in the *Safety and Physical Feature* section of this report.

Programmed Improvements

The following capacity related projects are included on Green Valley Road in the County's 2014 Capital Improvement Program (CIP):

- CIP # 72309: Class II Bikeway (Current year project) – Loch Way to Pleasant Grove Middle School. Install striping and stencils to existing pavement with minor asphalt patching as needed.

[3] The 85th percentile speed is the speed which 85% of the vehicles are not exceeding. California Vehicle Code specifies setting the speed limit at the 85th percentile speed.

- CIP #73151 (5-year project): Install traffic signal interconnection to coordinate three traffic signals on Green Valley Road at the intersections of Francisco Drive, El Dorado Hills Boulevard, and Silva Valley Parkway. Minor widening at the El Dorado Hills Boulevard intersection will also allow for protected left-turn phasing on the northbound and southbound approaches. This project is in the process of being completed; however signal coordination was not activated at the time of this study.
- CIP #76114 (5-year project): Install improvements at the Green Valley Road/Deer Valley Road (West) intersection. This project was recently completed.
- CIP #76107 (5-year project): Construct new Silver Springs Parkway and connect with Green Valley Road. Install a signal at the Silver Springs Parkway and Green Valley Road intersection. The signal portion of the project is completed.
- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes.
- CIP #GP178 (20-year project): Widen Green Valley Road between Francisco Drive and El Dorado Hills Boulevard/Salmon Falls Road from two lanes to four lanes, including curb, gutter and sidewalk.
- CIP #GP179 (20-year project): Widening Green Valley Road from Deer Valley Road (East) to Lotus Road to two 12-foot lanes, with the addition of six left-turn pockets.

In addition to these improvements, the City of Folsom is currently preparing engineering and construction documents for the federally-funded project to widen Green Valley Road from East Natoma Street in Folsom to Sophia Parkway in El Dorado Hills. Approximately 1,100 feet of this widening project falls within El Dorado County. Construction is tentatively scheduled to begin in 2017.

Improvement Considerations

The following considerations have potential to improve traffic operations along the corridor:

CIP Project Implementation

The County's CIP project #73151, which is currently being processed to install traffic signal interconnect and modify alignment of the northbound and southbound approaches at the El Dorado Hills Boulevard/Salmon Falls Road intersection will allow for protected left-turn phasing at these approaches. As a result, the overall intersection delay would reduce and LOS would meet County's threshold. By eliminating north-south split signal phasing, the estimated queues at the eastbound left-turn lane would be accommodated within the currently available storage.

Signal Coordination

Given that a coordinated signal system allows vehicles to continuously advance along the coordinated street with minimum stops and delays, coordinating the Francisco Drive, El Dorado Hills Boulevard and Silva Valley Parkway intersections along Green Valley Road for purposes of improving operations along the corridor was examined as part of this study.

In addition to the realignment improvement at the El Dorado Hills Boulevard intersection, signal coordination was evaluated for the weekday AM, PM, and afternoon school peak hours. It was determined that during the AM peak hour, coordination would minimally improve the operational performance of these three intersections (i.e. slight reduction delay with no effect on the LOS). During the PM peak hour, coordination was shown to improve the El Dorado Hills Boulevard intersection performance from LOS E to LOS D, while delays at the other two intersections would experience minimal change. Under the school peak hour conditions, signal coordination would improve LOS at the El Dorado Hills Boulevard intersection from LOS F to LOS D, which meets the County's standard. By improving the progression of vehicles to better match the respective "green times" of each intersection and developing Time of Day (TOD) coordination plans during the peak hours, signal coordination would also result in reduction of spillback issues arising from closely spaced intersections.

Extension of Left-turn Lanes

Based on the traffic operations analysis, the following intersections shall be considered for the left-turn lane storage increases to accommodate the queues and reduce the possibility of queue spillback into adjacent upstream intersections:

- #4 Silva Valley Parkway/Allegheny Road: extend left-turn pocket to provide 320 feet of storage for the northbound Silva Valley Parkway approach. Extension of this lane may not be feasible given the presence of the left-turn lane for Highland Hills Drive.
- #11 Cambridge Road: extend the left-turn pocket to provide 200 feet of storage at the Cambridge Road northbound left-turn lane. Extension of this lane may not be feasible given the presence of the left-turn lane for the shopping center.
- #12 Cameron Park Drive: extend the left-turn lane to provide 230 feet of storage at the westbound Green Valley Road approach and 350 feet of storage at the northbound Cameron Park Drive approach.

These distances are approximate and should be verified prior to any improvement projects. Exhibit 2 and Exhibit 3 depict the improvement considerations related to traffic operations.

Improvement Considerations - Traffic Operations
Francisco Drive to Silva Valley Parkway
Green Valley Road

Exhibit
2

Note: All referenced improvements are considerations and options for the corridor.

Improvement Considerations - Traffic Operations
Cambridge Road to Cameron Park Drive
Green Valley Road

Exhibit
3

Note: All referenced improvements are considerations and options for the corridor.

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KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: GCS WGS 1984

SAFETY AND PHYSICAL FEATURES

This section summarizes key findings of safety and physical features at the study locations, and develops related improvement considerations. The detailed technical data, analysis and results are contained in *Part D* of this report. As described later in the report, none of the study intersections or segments exceeds the County's benchmark of average crash rates. Therefore, the County is not required to take further actions; however, improvements suggested in this section should be considered to enhance safety in the corridor. The suggested improvements are not necessarily cumulatively needed to potentially enhance safety. Additional engineering assessment shall be conducted to verify feasibility of considerations outlined in this section.

Study Segments

Segment #1: County Line to Sophia Parkway

Programmed Improvements

- Widening from two to four lanes with turn lanes as needed (from East Natoma Street in the City of Folsom to Sophia Parkway in El Dorado County).

Key Findings

- Unsafe left-turning movement into the Green Valley Nursery and Landscape using a median refuge marked by double yellow markings.

Improvement Considerations

- Install a physical barrier (raised median) between Sophia Parkway and Shadowfax Lane for proper access to the Green Valley Nursery and Landscape.

Segment #2: Sophia Parkway to Francisco Drive

Programmed Improvements

- None.

Key Findings

- A total of 22 crashes (the highest among the segments) occurred. These were predominately injury and fatality crashes.
    - o Six of the 22 reported crashes reported "did not yield right of way" as a contributing factor.
    - o Four of the 22 crashes reported "unsafe speed" as a contributing factor, while three registered "unsafe turning movement" as a contributing factor.

  - o Rear-end was the predominant type of crash, followed by broadside and fixed object crash types.
  - o Four of the 22 crashes occurred at night.
- Observed 85th percentile speeds reported to be 60 mph, exceeding the posted speed limits by 10 mph.
- Intersection sight distance at the western Purple Place access looking east is limited. Similarly, intersection sight distance at the eastern access looking west is limited.

Improvement Considerations

- Install a dynamic warning sign upstream of the westbound approach at the Mormon Island Drive intersection. Through sensors in the pavement, these signs are activated by the vehicles that exceed a predetermined speed limit (or posted limit) or by potential vehicle conflicts at the intersection. Exhibit 4 and Exhibit 5 are some examples of dynamic warning signs as outlined in the NCHRP Report 613[4]. This treatment is estimated to achieve a speed reduction ranging from 4 to 7 mph, although the benefits may diminish over time as the motorists become aware of the presence and purpose of these signs. Local law enforcement agencies, California Highway Patrol and El Dorado County Sheriff, have programs that utilize speed feedback trailers as "public education." These speed feedback trailers are available for public use upon request. An example of a speed feedback trailer is shown in Exhibit 6.

Exhibit 4. Speed Feedback Sign

[4] National Cooperative Highway Research Program (NCHRP) Report 613: Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections, Transportation Research Board, Washington D.C., 2008.

Exhibit 5. Dynamic Warning Sign

Exhibit 6. Speed Feedback Trailer

Source: http://www.ru2systems.com/products/radartrailers/

- Increase speed enforcement along this segment for a period of time.
- Install high friction pavement/surface, although this consideration alone may not be sufficient to reduce speeds along the segment. This treatment tends to cause a reduction in average speeds along the segment.
- Consider installation of an acceleration and deceleration lane at each Purple Place business driveway, consistent with the County's design standards. Acceleration/deceleration lane

provides motorists with an opportunity to speed up or slow down in a space not used high-speed through traffic.

- Install a raised median along this segment with provision of left-turn pockets at the unsignalized cross streets and driveways.

Segment #3: Francisco Drive to El Dorado Hills Boulevard/Salmon Falls Road

Programmed Improvements

- CIP #GP178 (20-year project): Widen Green Valley Road between Francisco Drive and El Dorado Hills Boulevard/Salmon Falls Road from two lanes to four lanes, including curb, gutter and sidewalk.

Key Findings

- Shoulders are inconsistent on both sides of the roadway. Shoulders at east end of the segment are narrow, particularly on the south side.
- There are no bicycle facilities[5] (i.e., Class II lanes or paths).
- There are gaps in pedestrian facilities (i.e., sidewalks) along this segment.
- Three of four crashes recorded along this segment occurred during at night. The segment does not have street lighting on either side.

Improvement Considerations

- Increase pedestrian connectivity by extending the sidewalk on the north side and connect it with the El Dorado Hills Boulevard/Salmon Falls Road intersection.
- Install an 8-foot wide Class II bikeway in each direction.
- Appropriate Landscape and Lighting district could install lighting along the segment on one or both sides of the roadway.

Segment #4: El Dorado Hills Boulevard to Silva Valley Parkway

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes.

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[5] Bicycle facilities include Class I, Class II or Class II bicycle lanes. Class I provides a separated right of way for the exclusive use of bicycles and pedestrians with minimal cross-flow. Class II provides a stripped lane for bicyclists on the street or highway adjacent to auto travel lanes. Class II provides for shared use portion of the roadway with pedestrian or auto traffic.

Key Findings

- The segment reported the highest crash rate of 1.22 crashes per million vehicle miles along the corridor. However, this rate does not meet the County's benchmark to warrant for further evaluation.
- Most of the crashes that occurred along this segment were attributed to unsafe speeds; although the speed surveys did not reveal excessive speeding along the segment.
- Five of the seven crashes occurred during at night. The segment does not have light poles on either side.
- There are no bicycle or pedestrian facilities (i.e. Class II lanes, sidewalks) along the segment.

Improvement Considerations

- Install an 8-foot wide Class II bikeway in each direction.
- Increase pedestrian connectivity by providing a sidewalk on the north side of the road, consistent with Segment #3.
- Appropriate Landscape and Lighting district could install lighting along the segment on one or both sides of the roadway.

Segment #5: Silva Valley Parkway /Allegheny Road to Malcolm Dixon Road

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes.
- CIP #72309: Class II Bikeway (Current year project) – Loch Way to Pleasant Grove Middle School.

Key Findings

- Multiple private driveways along this segment have limited intersection and stopping sight distance due to vegetation, hillside, and roadway characteristics (horizontal and vertical curvatures).
- There are no bicycle facilities along the segment, although bicyclists were observed.
- Six of the nine reported crashes on this segment were a result of unsafe turning movements.
- Five of the nine reported crashes involved roadway departure and resulted in a fixed object (e.g. trees, pole, signs, etc.) crash.
- This segment had the highest proportion of roadway departure crashes during at night.
- This segment exhibited the greatest differential between the posted speed (55 mph which is the "maximum speed limit" for a local roadway CVC 22349) and 85th percentile speed (64 mph). This segment is the longest stretch (1.6 miles) of Green Valley Road without any posted speed limit signs except for a sign in each direction just east of the Silva Valley Parkway intersection. This is a prima facie speed limit (55 mph), thus it is not signed at a certain interval (CVC 22349).

Improvement Considerations

The first two Improvements recommended at the Loch Way, Rocky Springs Road/Steves Way and Malcolm Dixon Road intersections are likely to reduce speeds on this segment. In addition, intersection improvement considerations are included in the next section.

- Install a speed limit sign in each direction along the corridor, preferably between Loch Way and Malcolm Dixon Road. Local law enforcement may place a speed trailer at 3 – 6 month intervals for public “speed education.”
- Increase speed enforcement along this segment for a period of time.
- Additional considerations for this segment are discussed in the *Speed Limit Signs* section.
- Upgrade existing shoulders to 8-foot wide shoulders for the entire segment. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.
- Construct a Class II bicycle lane in each direction along the segment (CIP #72309). The striping of a Class II bicycle lane can give the appearance of a narrower auto lane. Narrower lanes have been shown to encourage decreased automobile speeds.

Segment #6: Malcolm Dixon Road to Deer Valley Road (West)

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes.
- CIP #72309: Class II Bikeway (Current year project) – Loch Way to Pleasant Grove Middle School.

Key Findings

- Half of the reported crashes involving animals on the entire study corridor occurred on this segment; although, “Deer Crossing” signs are posted along this segment.
- There are no Class II bicycle lanes along the segment with the exception of the eastern segment near Deer Valley Road (West) intersection which has a Class II bike lane in each direction.
- Multiple access points along the segment have limited stopping and intersection sight distances due to vegetation and the horizontal and vertical curvature of the roadway.

Improvement Considerations

- Widen roadway to include bicycle lanes or a multi-use path along the roadway in line with the more rural character of the area.
- Upgrade existing shoulders to 8-foot wide shoulders for the entire segment. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.

Segment #7: Deer Valley Road (West) to Bass Lake Road

Programmed Improvements

- CIP #72309: Class II Bikeway (Current year project) – Loch Way to Pleasant Grove Middle School.

Key Findings

- There are no bicycle facilities east of the Pleasant Grove School's western access.
- Private accesses just east of Deer Valley Road (West) have limited stopping and intersection sight distances due to vegetation and the horizontal and vertical curvature of the roadway.
- The segment had multiple vulnerable road user crashes, including two bicycle crashes and one pedestrian crash.

Improvement Considerations

- Widen roadway to include Class II bicycle lanes or a multi-use side path along the roadway in line with the more rural character of the area.
- Request the Rescue School District improve circulation within the Pleasant Grove Middle School to reduce queue spillbacks during the AM peak. This improvement is further discussed in the *Pleasant Grove Middle School* section.
- Install a speed limit sign east and west of the Deer Valley Road (West) intersection in each direction.
- Upgrade existing shoulders to 8-foot wide shoulders for the entire segment. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.

Segment #8: Bass Lake Road to Cameron Park Drive/Starbuck Road

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

- Sidewalk on the south side is discontinuous.

Improvement Considerations

- Install sidewalks in gap areas to provide continuous sidewalk on the south side of this segment.
- Upgrade existing shoulders to 8-foot wide shoulders for the entire segment. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.

Segment #9: Cameron Park Drive/Starbuck Road to Ponderosa Road

Programmed Improvements

- CIP #GP179 (20-year project): Widen Green Valley Road from Deer Valley Road (East) to Lotus Road to provide two 12-foot lanes, with addition of six left-turn pockets.

Key Findings

- Half of the reported crashes caused an injury. There were 2 fatalities in 3 years.
- Fixed-object crashes were the predominant crash type. All the fixed-objected crashes were due to departing the roadway. Approximately 20 percent of the reported crashes occurred on wet roadway surface conditions.
- "Unsafe turning movement" and "unsafe speed" were the top two contributing factors of crashes, although the speed surveys did not reveal excessive speeding along the segment.
- This segment has narrow roadway with no shoulder in either direction east of Crowdis Lane.

Improvement Considerations

- Install raised or post mounted delineators[6] along the edge of the pavement, especially at horizontal curves and near intersections with minor streets. An example of post mounted delineators is illustrated in Exhibit 7.

Exhibit 7. Post Mounted Delineator Example

[6] Delineators are guidance devices and beneficial at locations where the alignment might be confusing or unexpected to motorists.

Source: www.pexco.com

- Install an 8-foot wide shoulder in each direction. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.
- Consider providing a left-turn lane at those collector or local street intersections that present sight distance and safety concerns along the segment. These streets may include: La Crescenta Drive, Ulenkamp Road, and Deer Valley Road (East).
- Install advance intersection warning signs (W2 series) on Green Valley Road for each of the major side-street intersections to alert motorists about the upcoming intersection and potential conflicts.

Segment #10: Ponderosa Road to North Shingle Road

Programmed Improvements

- CIP #GP179 (20-year project): Widen Green Valley Road from Deer Valley Road (East) to Lotus Road to provide two 12-foot lanes, with addition of six left-turn pockets.

Key Findings

- There are no shoulders in either eastbound or westbound direction.
- Observed 85th percentile speed on this segment was recorded to be 5 mph over the posted speed limit.

Improvement Considerations

- Supplement the posted speed limit sign (R2-1) just west of North Shingle Road in the westbound direction with an automated speed feedback sign. Local law enforcement may place a speed trailer at 3 – 6 month intervals for public "speed education."
- Install an 8-foot wide shoulder in each direction. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.

Segment #11: North Shingle Road to Lotus Road

Programmed Improvements

- CIP #GP179 (20-year project): Widen Green Valley Road from Deer Valley Road (East) to Lotus Road to provide two 12-foot lanes, with addition of six left-turn pockets.

Key Findings

- Observed 85th percentile speed in the westbound direction was recorded to be 10 mph over the posted speed limit. Likewise, the eastbound speeds were approximately 5 mph over the posted limit.

- No shoulders or bike lanes are present east of Kenworth Drive/Oakvale Drive.

Improvement Considerations

- Supplement the posted speed limit signs (R2-1) on this segment with an automated speed feedback sign. Local law enforcement may place a speed trailer at 3 – 6 month intervals for public "speed education."
- Install an 8-foot wide shoulder or Class II bike lanes east of Kenworth Drive/Oakvale Drive in each direction. Shoulders can act as an acceleration and deceleration area at the private driveways, with the potential to improve sight distance.

Study Intersections

Intersection #1: Green Valley Road & Sophia Parkway

Programmed Improvements

- Widen Green Valley Road from East Natoma Street in Folsom to Sophia Parkway in El Dorado Hills to provide two travel lanes in each direction. SACOG Project Green Valley Road (SAC21280).

Key Findings

- A total of 15 crashes (the highest among the study intersections), predominantly rear-end and broadside.
    - Nine of the 15 reported collisions reported unsafe speeds as a contributing factor.
    - Two resulted from red-light violations.
    - Most of crashes occurred during daylight.
- A dedicated Class II bike lane, connecting the existing Class II bike lane on the upstream segment is not provided on any of the approaches.

Improvement Considerations

- Add a signal head for the westbound through movement on the signal pole in the southeast corner of the intersection. This treatment has the potential to augment motorists' reaction time when the signal is red.
- Install a dynamic warning sign upstream of the eastbound and westbound approaches. These signs are activated by the vehicles that exceed a predetermined speed limit (or posted limit) or by potential vehicle conflicts at the intersection. Exhibit 4 and Exhibit 5 are some examples of

dynamic warning signs as outlined in the NCHRP Report 613[7]. Local law enforcement may place a speed trailer at 3 – 6 month intervals for public "speed education."

- Install a Class II bike lane on the northbound Sophia Parkway and eastbound Green Valley Road approaches in accordance with the County's design standards.

Intersection #2: Green Valley Road & Francisco Drive

Programmed Improvements

- No programmed improvements have been identified.

Key Findings

- A dedicated Class II bike lane is not provided on the eastbound approach.
- Pedestrian curb ramps on the southwest and southeast corners are not ADA compliant. There are no sidewalks on the west side of Francisco Drive.
- Higher proportion of nighttime crashes relative to daytime crashes.

Improvement Considerations

- Provide sidewalk facilities on the east of Francisco Drive north of the intersection.
- Improve southwest and southeast corners with ADA compliant ramps.
- Appropriate Landscape and Lighting district could install street lighting east of the intersection on the south side where a lane drop occurs.
- Install a Class II bike lane on the eastbound and westbound Green Valley Road approaches.

Intersection #3: Green Valley Road & El Dorado Hills Boulevard/Salmon Falls Road

Programmed Improvements

- CIP #GP178 (20-year project): Widen Green Valley Road between Francisco Drive and El Dorado Hills Boulevard/Salmon Falls Road from two lanes to four lanes, including curb, gutter and sidewalk. This project is anticipated to add an additional eastbound and westbound through lane at this intersection.

Key Findings

- Pedestrian landings at all four corners are not ADA compliant and do not provide detectable[8] warnings.

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[7] National Cooperative Highway Research Program (NCHRP) Report 613: Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections, Transportation Research Board, Washington D.C., 2008.

- There are no sidewalks at this intersection.

Improvement Considerations

- Install ADA compliant curb ramps at all four corners.
- Provide a sidewalk at the northwest corner of the intersection.

Intersection #4: Green Valley Road & Silva Valley Parkway/Allegheny Road

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes. This project is anticipated to add an additional eastbound and westbound through lane at this intersection.

Key Findings

- Only the southwestern corner has detectable warnings and pedestrian access to the corner.
- There are no sidewalks approaching the corners except one on the west side of Silva Valley Parkway.

Improvement Considerations

- Install curb ramps and detectable warnings consistent with ADA guidelines.

Intersection #5: Green Valley Road & Loch Way

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes. This project is anticipated to add an additional eastbound and westbound through lane at this intersection.

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[8] Detectable warnings are an Americans with Disabilities Act (ADA) requirement in the current Americans with Disabilities Act Accessibility Guidelines (ADAAG) for the use of detecting the boundary between the sidewalk and the street. Placing a detectable warning at the bottom of a curb ramp identifies the transition between the sidewalk and the street for people with vision impairments.

Key Findings

- Intersection sight distance looking west is somewhat limited by continuously growing vegetative foliage.
- While motorists wait for an acceptable suitable gap to turn left into Loch Way, trailing vehicles pass by them using the shoulder on the right. Vehicle skid marks were seen on the roadway surface.
- Higher than posted speeds were observed passing through this intersection.

Improvement Considerations

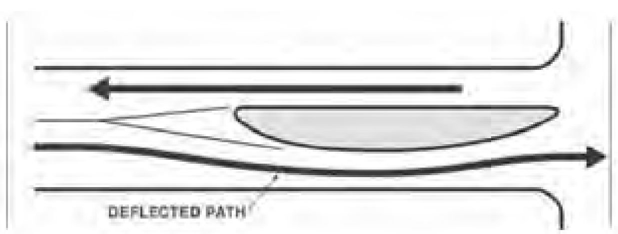
- Widen Green Valley Road approaches to accommodate a minimum of 8-foot wide Class II bike lane or shoulder. This improvement can also improve intersection sight distance.
- Trim and maintain vegetation to improve intersection sight distance.
- Widen Green Valley Road from Loch Way to the church access to the east to provide back-to-back left-turn lanes.
- Traffic calming strategies such as: 1) Lane narrowing concept on the major road approach with pavement markings and rumble strips in the center island; and, 2) Minor road approach splitter island may be considered. The intent of the lane narrowing concept is to increase visibility of the intersection, reduce vehicle speeds on the major road approach, and thereby potentially reduce crashes. The intent of the minor road approach splitter island is to increase visibility of the intersection, improve traffic control compliance and thereby potentially reduce crashes. Exhibit 8 and Exhibit 9 illustrate these two concepts.

Exhibit 8. Major Road Lane Narrowing Concept

Exhibit 9. Minor Road Splitter Island Concept

- Green Valley Road west of this intersection transitions from a rural to suburban area. The speed limit west of this intersection drops from 55 mph to 50 mph; however, drivers may not be recognizing their prevailing speeds even after passing this intersection from the east. In order to increase driver awareness of this transition, major road approach splitter islands and/or approach curvature can be considered on the higher speed roadway. The intent is to slow vehicles before they reach the new speed zone or different corridor context. Exhibit 10 illustrates this concept. This concept can be implemented on the westbound approach of this intersection.

Exhibit 10. Roadway Approach Curvature/Splitter Island



Source: NCHRP 613, Exhibit 4-18

Intersection #6: Green Valley Road & Rocky Springs Road/Steves Way

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes. This project is anticipated to add an additional eastbound and westbound through lane at this intersection.

Key Findings

- The intersection does not have stop bars and stop signs on both the Rocky Springs Road and Steves Way approaches, as neither are County maintained roads.
- Due to the horizontal curvature of the roadway and overgrown foliage, the Rocky Springs Road approach has limited intersection sight distance looking east and west.
- Higher than posted speeds were observed passing through this intersection.
- Rocky Springs Road and Steve's Way are not County maintained roadways.

Improvement Considerations

- Widen Green Valley Road approaches to accommodate a minimum of 8-foot wide Class II bike lane or shoulder.
- Private property owners install and maintain stop signs and bars at the side street approaches
- Install post-mounted delineators (type "E") at all four corners to better define the intersection.

Intersection #7: Green Valley Road & Malcolm Dixon Road

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes. This project is anticipated to add an additional eastbound and westbound through lane at this intersection.

Key Findings

- Stopping sight distance is limited to motorists approaching from the east due to the horizontal curvature of the roadway and overgrown tree branches.
- There are no advance intersection warnings signs (W2 series) or street name signs in either direction along Green Valley Road.

Improvement Considerations

- Widen Green Valley Road approaches to accommodate a minimum of 8-foot wide Class II bike lane or shoulder. This improvement can improve intersection sight distance, and allows motorists to decelerate while making right-turn into the side street.
- Re-align Malcolm Dixon Road to form a standard right-angle intersection.
- Install advance intersection warning signs (W2 series) or street name signs on the Green Valley Road approaches.
- Widen the eastbound approach to provide a left-turn lane on Green Valley Road. This will allow vehicles to slow down safely to turn onto Malcolm Dixon Road.
- Consider the lane narrowing concept or splitter island concept on the major road approaches, as described for the Loch Way intersection.

- Upgrade post-mounted delineators (Type "E") at the intersection to better define the turning radius.

Intersection #8: Green Valley Road & Deer Valley Road (West)

Programmed Improvements

- CIP #GP159 (10-year project): Widen Green Valley Road between El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) from two lanes to four lanes. This project is anticipated to add an additional eastbound and westbound through lane at this intersection.

Key Findings

- Four of the seven collisions at the intersection resulted in an injury. One resulted in a fatality and was caused by an unsafe turning movement by an impaired driver.
- Most collisions were rear-end (4) or fixed object collisions (2) and the contributing causes were primarily unsafe speeds (4) and unsafe turning movements (2).

Improvement Considerations

- This intersection was recently improved with the provision of turning lanes, bike lanes and delineation. Intersection traffic and crash data should be monitored to gauge if these improvements result in operational and safety benefits.

Intersection #9: Green Valley Road & Pleasant Grove Middle School Access

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

- The County has no jurisdiction over the school site.
- In the AM peak, left-turn queues at the westbound Green Valley Road approach block the adjacent through lane and extend beyond the new Silver Springs Parkway.
- There are no bicycle facilities west of the intersection.
- Both pedestrian ramps on the south side of the intersection do not have detectable warnings.

Improvement Considerations

- Install ADA compliant pedestrian ramps at the southeast and southwest corners.

- Rescue School District should improve internal circulation of the Pleasant Valley Middle School to prevent extensive queue spillback on Green Valley Road. Specific recommendations are described in the *Pleasant Grove Middle School* section.

Intersection #10: Green Valley Road & Bass Lake Road

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

- Pedestrian ramps at all four corners of the intersection do not have detectable warnings.

Improvement Considerations

- Install ADA compliant pedestrian ramps at all four corners.

Intersection #11: Green Valley Road & Cambridge Road/Peridot Drive

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

- Three of four crashes occurred at night, however, there were no trends in the crash data and overhead street lighting is provided at the intersection.

Improvement Considerations

- None.

Intersection #12: Green Valley Road & Cameron Park Drive/Starbuck Road

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

- Eight of the 15 crashes at the intersection were broadside/turning movement crashes. Of those broadside crashes, seven occurred on the south leg of the intersection, which could be influenced by the business accesses along Cameron Park Drive. The northbound Cameron Park Drive left-turn serves 207 and 275 vehicles in the weekday AM and PM peak hours respectively.

- Ten of the 15 crashes cited "crossed double yellow line" as a contributing factor.
- The northbound Cameron Park Drive and westbound Green Valley Road left-turn lanes are 9-10 feet wide, potentially contributing to the crash trends at this intersection.

Improvement Considerations

- Prohibit left-turn movements from the strip mall located in the southeast corner of this intersection by constructing a raised median on the northbound Cameron Park Drive and westbound Green Valley Road approaches.
- Widen northbound Cameron Park Drive and westbound Green Valley Road left-turn lanes to 11 feet and allow U-turns from these lanes to access the strip mall in the southeast corner. The southeast and southwest corners would be modified to increase the turning radius to accommodate California legal size trucks. In addition, departure lanes at the south and east legs should provide wide shoulders or an extra lane for the U-turning vehicles. A detailed analysis should be performed to assess the feasibility of this recommendation.

Intersection #13: Green Valley Road & Deer Valley Road (East)

Programmed Improvements

- CIP #GP179 (20-year project): Widen Green Valley Road from Deer Valley Road (East) to Lotus Road to provide two 12-foot lanes, with addition of six left-turn pockets.

Key Findings

- Stopping sight distance for the westbound vehicles is limited due to horizontal curvature.
- There are insufficient delineators to define intersection alignment and corners.

Improvement Considerations

- Construct a left-turn pocket on the eastbound Green Valley Road approach to separate the turning vehicles from the through lane.
- Install an 8-foot wide shoulder on the eastbound and westbound Green Valley Road approaches. Shoulders can act as an acceleration and deceleration area, with the potential to improve sight distance.
- Install post-mounted delineators (Type "E") to define intersection radius to motorists.

Intersection #14: Green Valley Road and Ponderosa Road (East)

Programmed Improvements

- CIP #GP179 (20-year project): Widen Green Valley Road from Deer Valley Road (East) to Lotus Road to provide two 12-foot lanes, with addition of six left-turn pockets.

Key Findings

- The crash rate at this intersection is the highest (0.83 crashes per MEV) among all study intersections.
- Four of the five crashes that occurred at this intersection reported a fatality or an injury. One of the two fatality crashes involved Driving under Influence (DUI), and second resulted from a tree branch falling on the car (force majeure).
- Observed 85th percentile speed east of this intersection was recorded to be five miles per hour over the posted speed limit. Unsafe speeds were cited as the contributing factor for two of the five crashes at the intersection.
- No shoulders or bike lanes are provided.
- This intersection is located at a vertical crest and on the horizontal curve, resulting in highly restrictive intersection and stopping sight distances.

Improvement Considerations

- Add a westbound left-turn lane to separate motorists turning left from the through lane.
- Realign Ponderosa Road (South) opposite to Ponderosa Road (North) to eliminate two offset intersections.
- Reconstruct the intersection with flat grades on the approaches and evaluate intersection control options.

Intersection #15: Green Valley Road & North Shingle Road

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

- The improvement of this intersection was completed within the past 2 years.

Improvement Considerations

- None.

Intersection #16: Green Valley Road & Lotus Road

Programmed Improvements

- No improvements have been identified in the County's 2014 CIP.

Key Findings

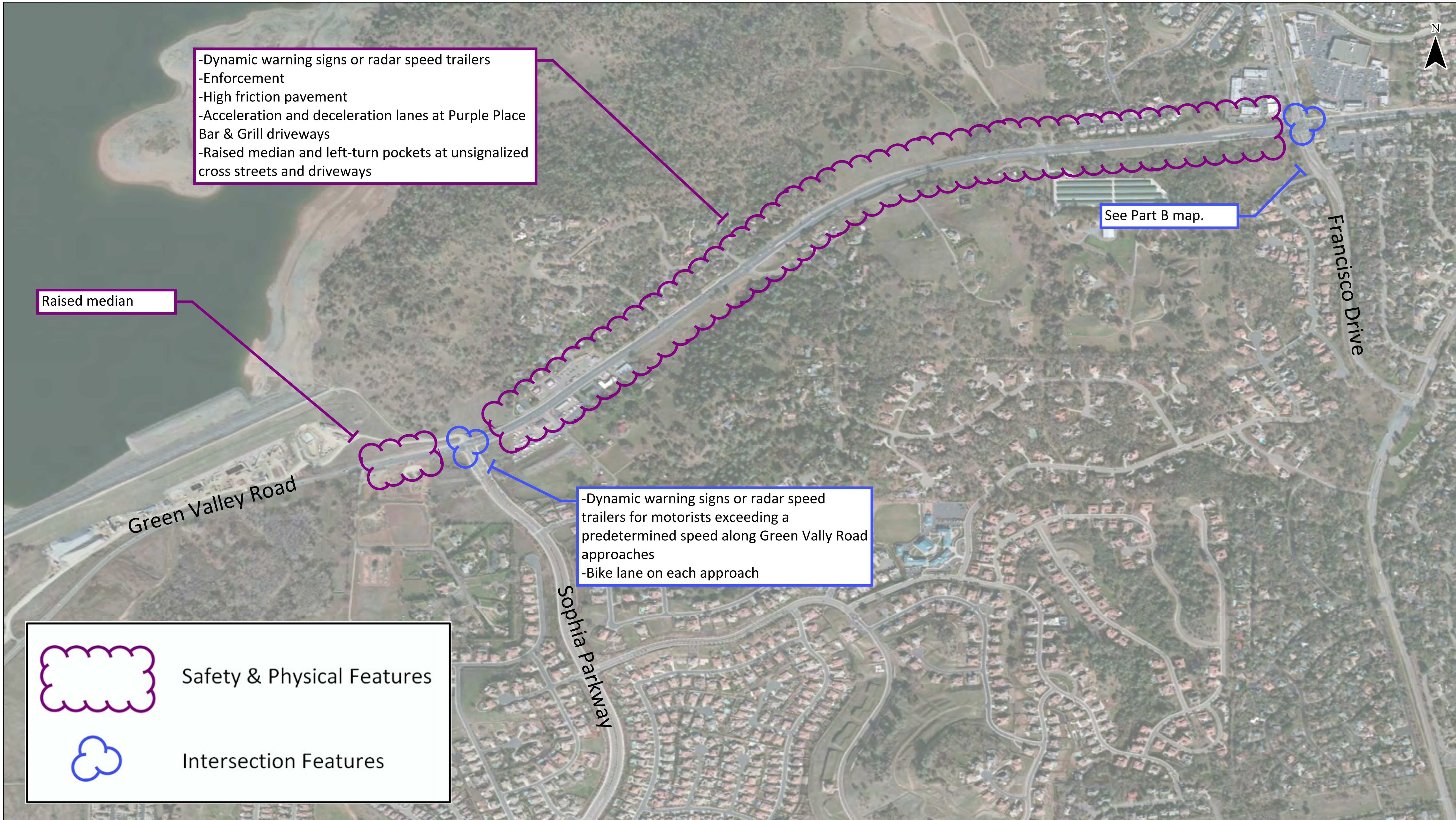
- None.

Improvement Considerations

- None.

The improvement considerations summarized above are displayed in Exhibit 11 through Exhibit 16.

Exhibit 11. Safety and Physical Features Improvement Considerations - A



Improvement Considerations - Part A
Green Valley Road

Exhibit
11

Note: All referenced improvements are considerations and options for the corridor.

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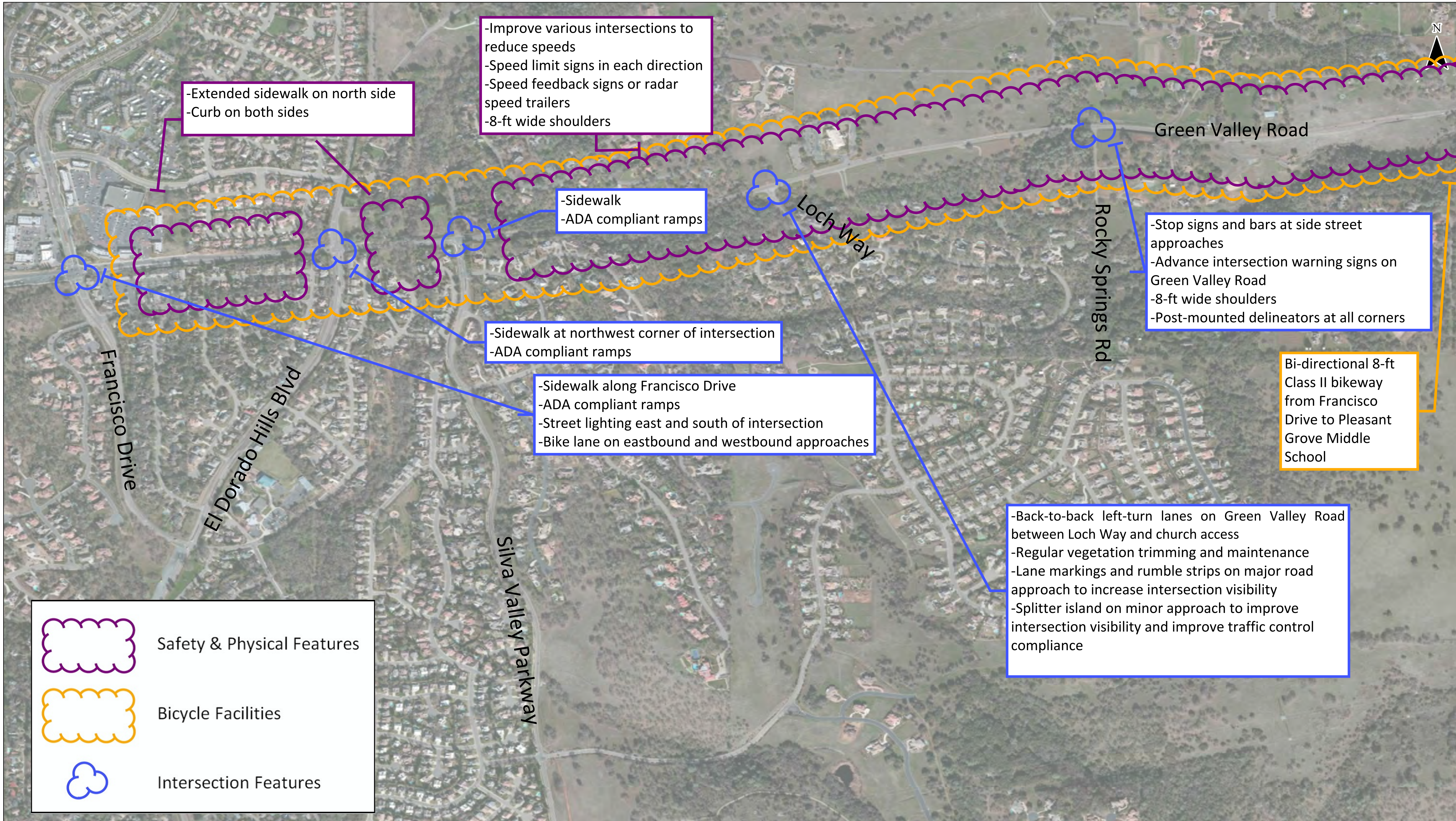
Kittelson & Associates, Inc.
Transportation Engineering/Planning

Coordinate System: GCS WGS 1984



Improvement Considerations - Part B
Green Valley Road

Exhibit
12

Note: All referenced improvements are considerations and options for the corridor.

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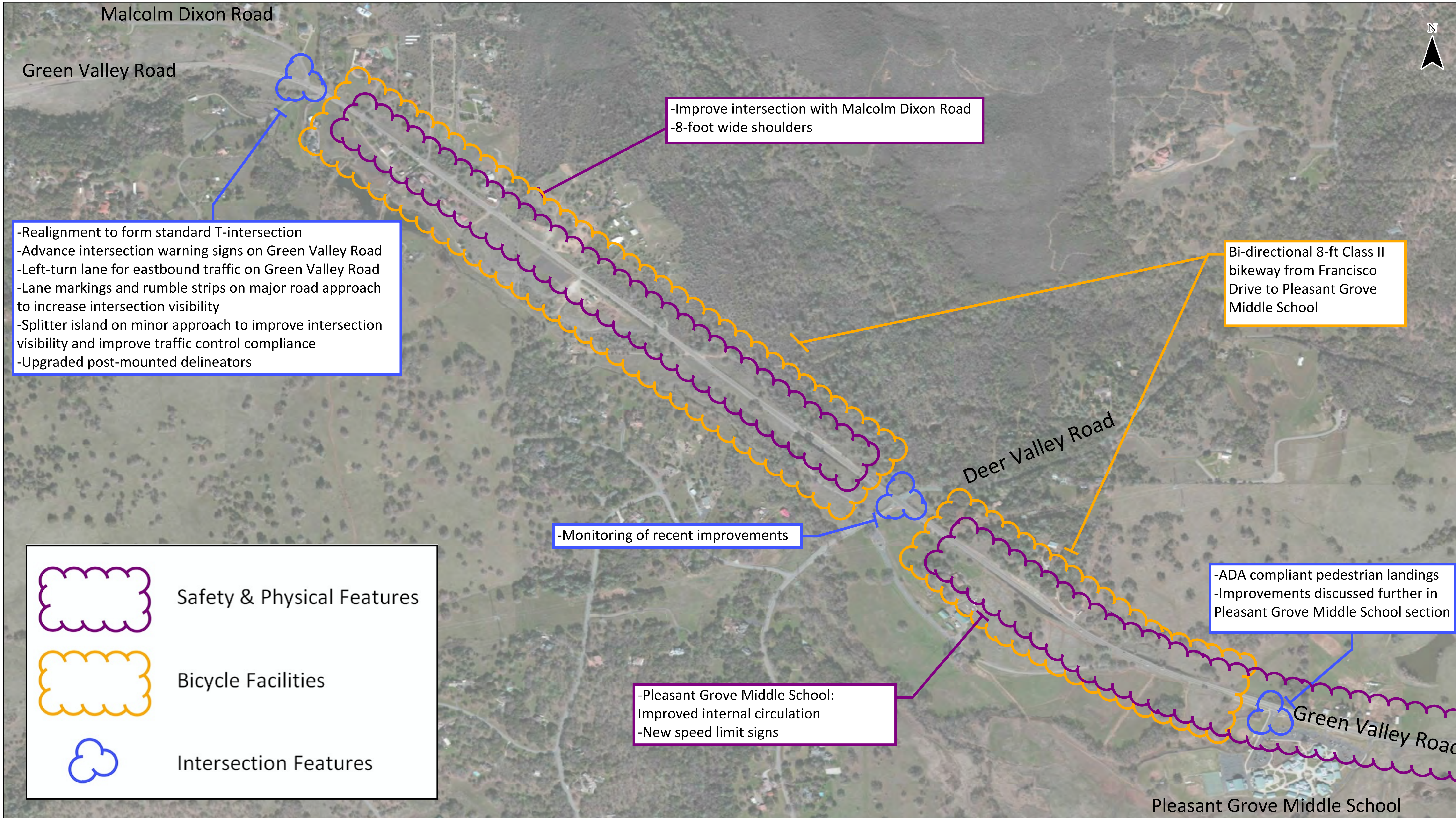
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: GCS WGS 1984



Improvement Considerations - Part C
Green Valley Road

Exhibit
13

Note: All referenced improvements are considerations and options for the corridor.

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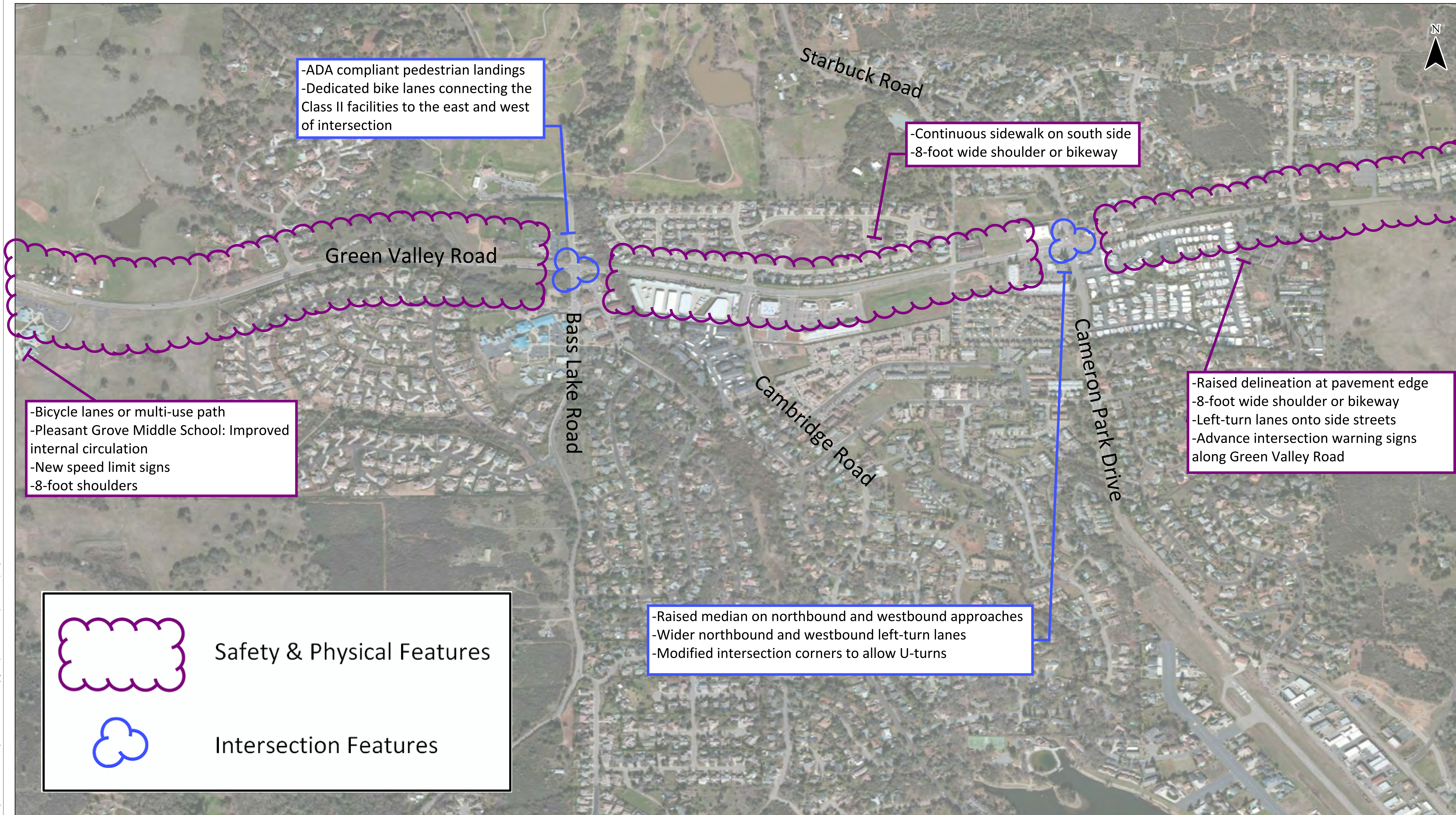
Kittelson & Associates, Inc.
Transportation Engineering/Planning

Coordinate System: GCS WGS 1984



Improvement Considerations - Part D
Green Valley Road

Exhibit **14**

Note: All referenced improvements are considerations and options for the corridor.

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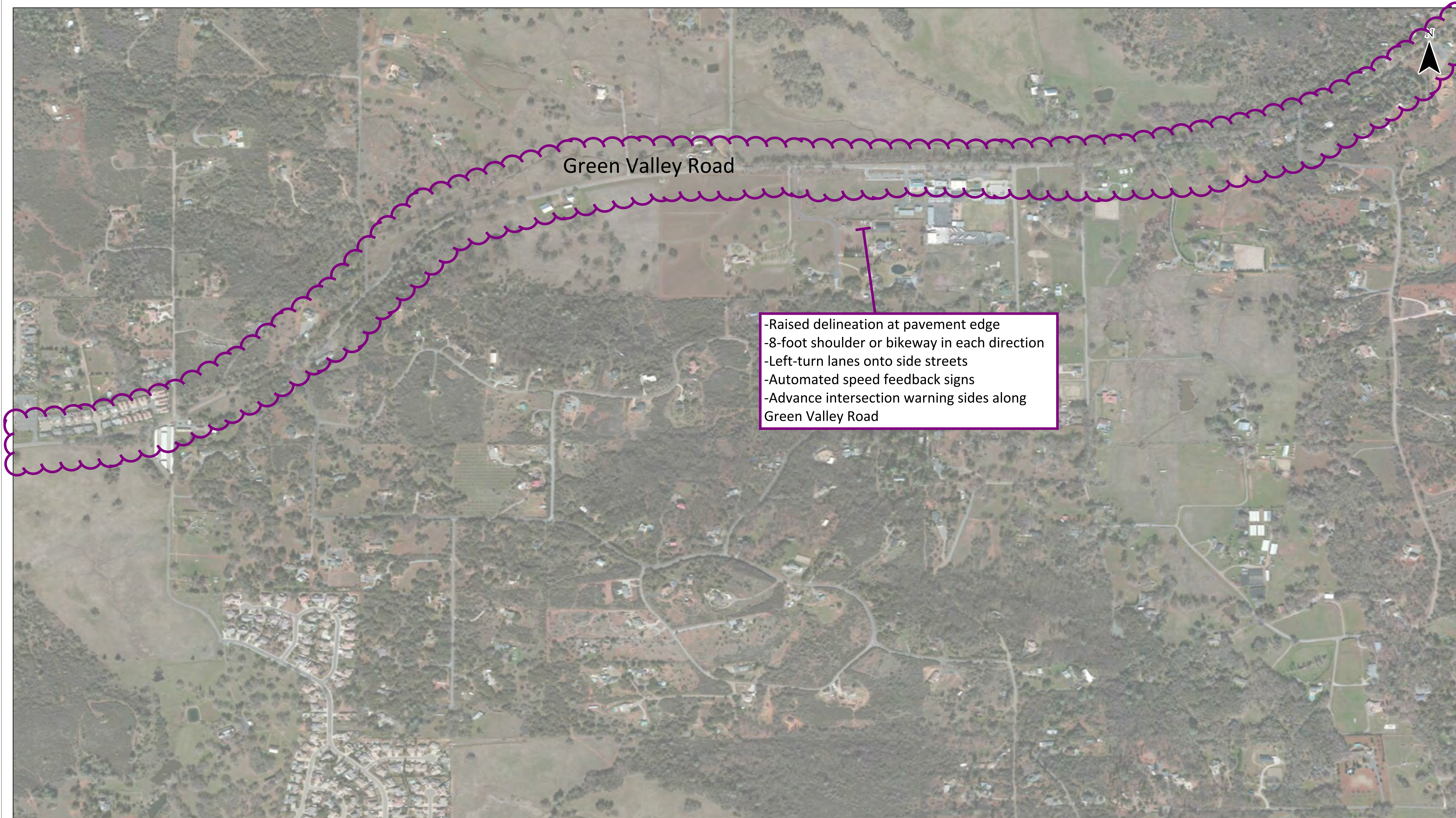

Improvement Considerations - Part E
Green Valley Road

Exhibit
15

Note: All referenced improvements are considerations and options for the corridor.

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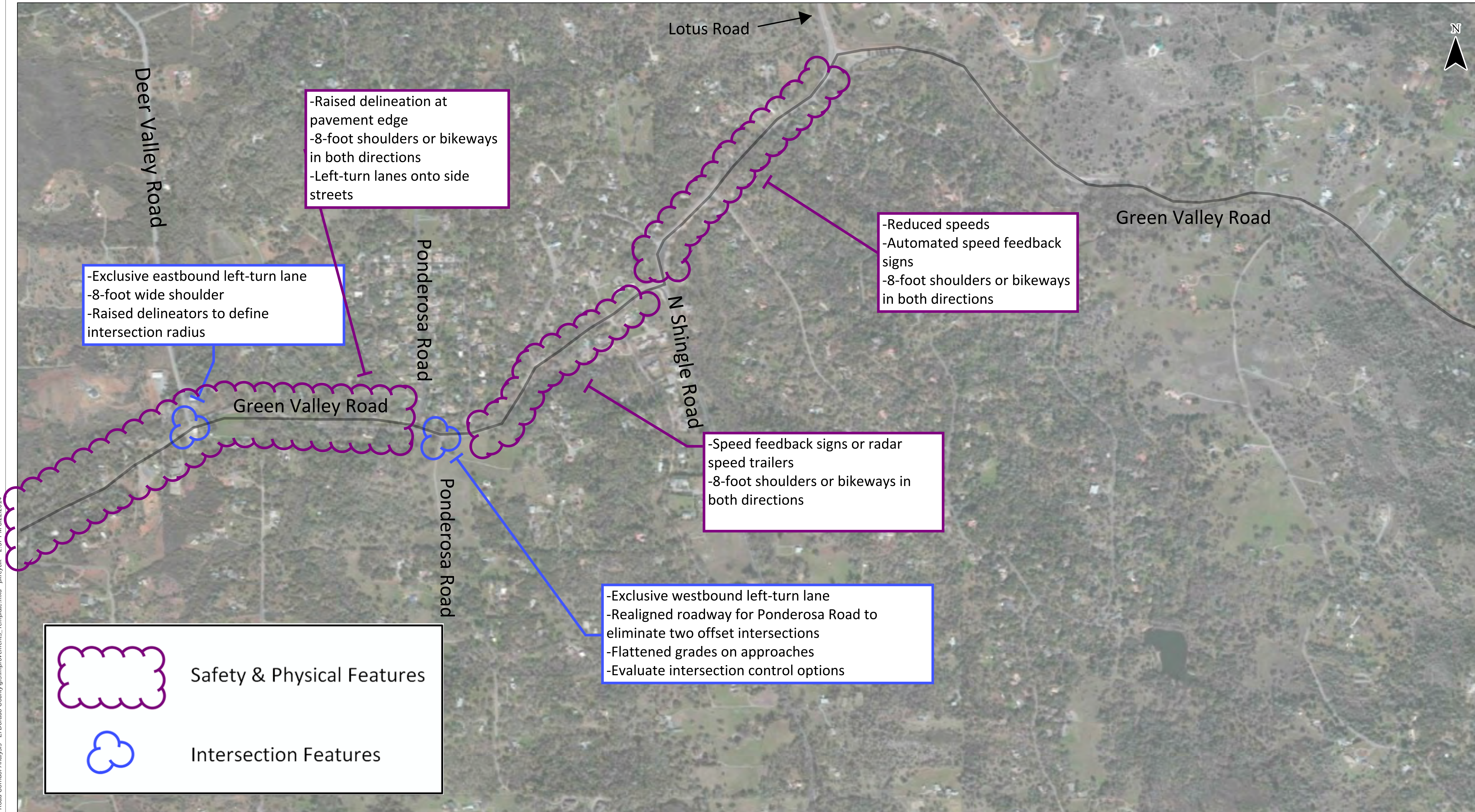
Coordinate System: GCS WGS 1984



Improvement Considerations - Part F
Green Valley Road

Exhibit
16

Note: All referenced improvements are considerations and options for the corridor.

BICYCLE FACILITIES

This section summarizes key findings and identifies improvement considerations to make bicycle facilities safer.

Key Findings

Field observations of bicycle facilities along the corridor noted existing gaps in the bicycle lanes along Green Valley Road on the following two segments:

- Francisco Drive to west of Deer Valley Road (West); and,
- East of Deer Valley Road (West) to the Pleasant Grove Middle School Access.

Field observations noted that the current bicycle lane pavement markings are infrequent along the corridor and are not marked at the far side of all study intersections along the corridor. The signage to mark the beginning and end of the bike lane is inconsistent. Given that Green Valley Road is primarily an arterial with the posted speed of 40-55 mph; bicyclists may feel vulnerable to the high-speed vehicles. Only a few bicyclists were seen using the existing bicycle facilities. Some bicyclists were also observed to share the travel lane with motorists between El Dorado Hills and Cameron Park.

Programmed Improvements

CIP #72309 (five-year project): The roadway segment between Loch Way and Pleasant Grove Middle School western entrance is currently programmed for an 8-foot bicycle lane on each side of the roadway.

Improvement Considerations

The following considerations have the potential to improve bicycling conditions along the corridor:

Fill Gaps in Bicycle Facilities

Fill existing gaps in bicycle lanes along Green Valley Road to provide a more consistent bicycling environment. Bicycle lanes should be 8-feet wide to provide adequate separation from motor vehicles and reduce the potential for collisions. Current gaps (excluding programmed improvements) include:

- Francisco Drive to Loch Way

Paint Bicycle Markings & Signage

The existing bicycle lane markings should be re-painted at a regular interval to increase driver awareness of the facility and cyclists. Additionally, bicycle lane markings should be painted at the far end of all intersections and major access points where bicycle lanes are present to alert drivers entering the roadway with the bicycle facilities. The beginning and end of the separated bike lane shall be facilitated with the standard signage.

Multi-Use Path

The provision of a multi-use path in lieu of the currently programmed CIP project may be considered. A multi-use path is physically separated from motor vehicle traffic, and can be either within the roadway right-of-way or within an independent right-of-way. Given the high prevailing speeds along Green Valley Road, bicyclists may feel safer in the multi-use paths than the Class II bike lanes. Multi-use pathways can include bicycles as well as pedestrians. Generally, multi-use paths can be safer for the recreational bicyclists. Alternatively, longitudinal rumble strips could be considered along outside the edge line to augment safety of the bicyclists on the high speed rural segments.

PRIVATE DRIVEWAYS

This section summarizes key findings and identifies considerations to improve access to private properties along the corridor. It is important to note that the County does not maintain private driveways and is not responsible for any improvements on private property.

Key Findings

Initial intersection sight distances (ISD) and stopping sight distances (SSD) were evaluated at the private property driveways on Green Valley Road between Sophia Parkway and Bass Lake Road, with more detailed measurements collected at locations where limited sight distances were perceived based on visual observations. Field observations confirmed that a number of locations along the study corridor had limited ISD and/or SSD due to vegetation, horizontal curves, vertical curves, and other obstructions. A complete list of driveways exhibiting sight distance limitations is provided in *Part D* of this report.

Improvement Considerations

To address intersection and stopping sight distance deficiencies, the following improvements shall be considered:

- Private property owners are responsible for trimming and maintaining overgrown foliage that impede sight distances at access points and intersections;
- Provide at least 8-foot wide shoulders and/or bicycle lanes, particularly in areas with a high density of driveways (such as, between Malcolm Dixon Road and Deer Valley Road (West) to increase driver's field of view and improve the motorists ability to avoid a crash. Wider shoulders can be utilized as acceleration and declaration lanes; and,
- Private property owners should better define radius and frontage of driveways through improved driveway aprons[9] on their private property accesses.
- Add exclusive turn lanes at the high volume driveways and roadways. For example, provision of back-to-back left-turn lanes at Loch Way and the church's access will separate out vehicles waiting for an acceptable gap to turn left into the site.

[9] Area at the beginning of a private driveway with a curb cut in the sidewalk or beyond the edge line.

PLEASANT GROVE MIDDLE SCHOOL

This section summarizes key findings and identifies considerations to improve traffic circulation into and out of Pleasant Grove Middle School. It should be noted that El Dorado County has no jurisdiction over the school site layout.

Key Findings

Pleasant Grove Middle School is located along Green Valley Road between Silver Springs Parkway and Deer Valley Road (West). Field observations during the weekday AM and afternoon school peak hours at Pleasant Grove Middle School, in the Spring of 2014, identified a number of operational and circulation issues at the access points and within the internal circulation of the school. The westbound left-turn queues at the primary western school access extend beyond the newly constructed Silver Springs Parkway. Queue lengths sometimes reach Bass Lake Road which is three-quarters of a mile east of the primary school access. Internal circulation and high demand over a short period of time are primary factors contributing to extensive queues on Green Valley Road during weekday mornings.

According to Rescue Union School District Superintendent and staff, additional internal striping has been added to the school site and the westbound left-turn queues in the AM peak have noticeably decreased.

Detailed field observations are discussed under *Part D* of this report.

Improvement Considerations

The following considerations have the potential to improve traffic operations and internal circulation at Pleasant Grove Middle School:

Traffic Monitors

According to school staff, there is a team of traffic monitors to help direction vehicular traffic within the site. However, the monitors primarily work in the afternoon school peak hour. The school could also designate and train traffic monitors who would ensure that no queuing would occur at the western access during the AM peak hour. They would also ensure that student pick-up and drops offs would not occur in undesignated areas, such as at the pass-by lane at the western drop-off, or at red-curbed area. Traffic monitors should be trained to safely install temporary traffic control devices within the site. A minimum of two monitors should be recruited. A monitor could be placed west of the western drop-off to direct drivers to the available space in the western drop-off area. Another monitor could be stationed at the end of the western drop-off location to efficiently direct motorists to the eastern drop-off as well as to help motorists exit the site.

Internal Striping and Curb Improvements

Adjust the curb island and striping of the access road to clarify and encourage use of the eastern drop-off location. Restriping the current internal left-turn for the drop-off zone to direct motorists to the eastern drop-off zone and restriping the current through-only lane to a through-left lane to allow more efficient use of the drop-off zones and help prevent queues from forming where motorists cannot access the eastern drop-off zone.

Eastern Access

The right-out exit on the eastern end of the parking lot was observed to be closed. School staff has indicated that the driveway's grade is too steep to allow vehicular traffic. As such, the driveway was closed and will remain as an emergency vehicle access only. Vehicles exiting the site can continue to use the middle access.

The school is planning to construct a sidewalk along the eastern driveway to provide pedestrians with a continuous sidewalk into and out of the school property.

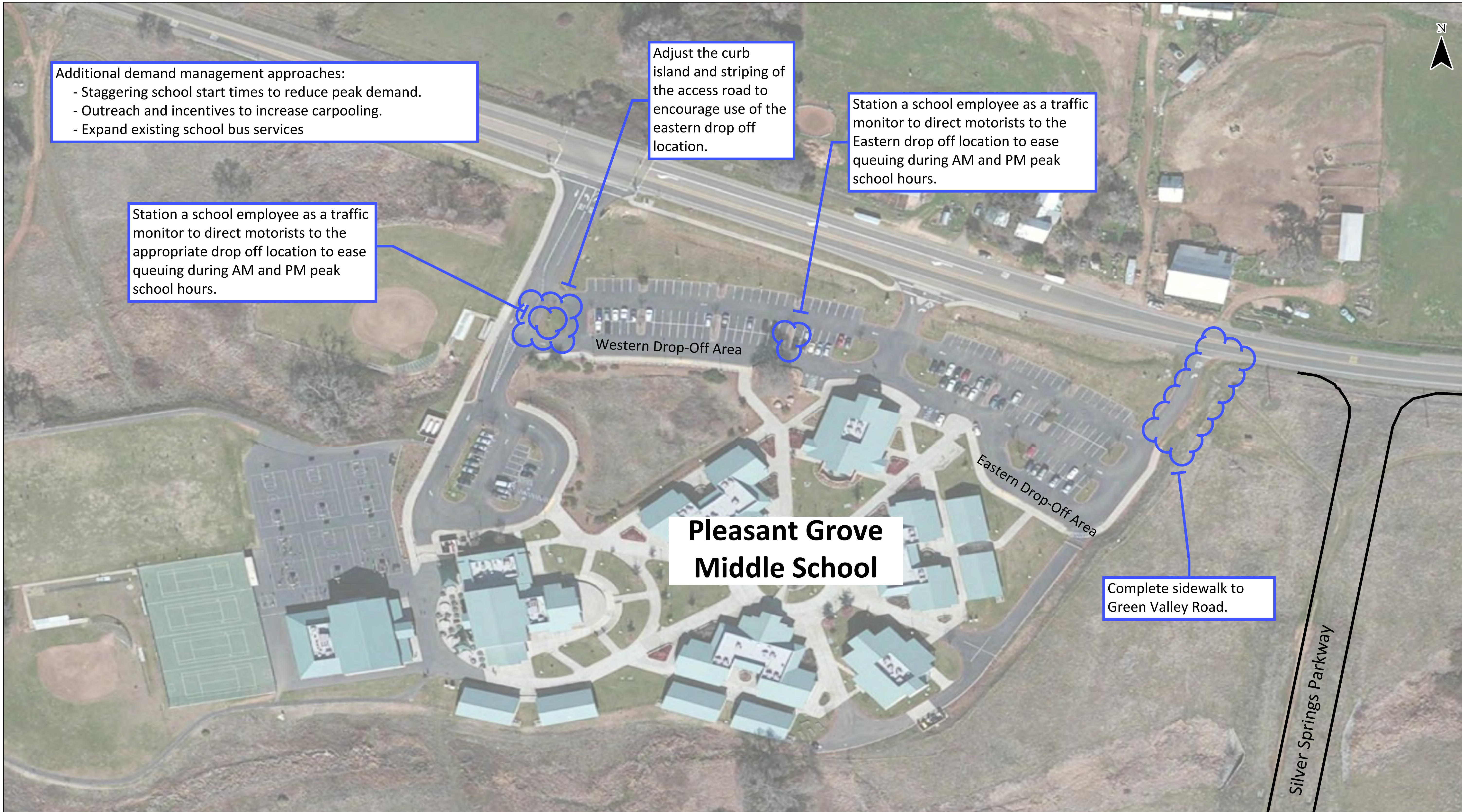
Demand Management

Implementing staggered class start times by grade level would spread the peak traffic demand of the school. This would serve to reduce the operational and safety issues caused by extensive vehicular queuing during school start time. Establishing two separate start times with a 15-30 minute gap between would reduce the peak 15-minute demand. As a result, the traffic generated by the school could be dispersed over an hour period. Circulation of traffic on-site will improve with the peak hour spreading.

The school could also explore demand management approaches to reduce the number of vehicles accessing the school. This could include an outreach effort with parents to encourage carpooling. The school could also assist by helping match parents and children willing to carpool through a ride-matching program. This program could also include incentives, such as monthly raffles for carpooling students, to encourage more participation. The school bus services could be expanded to decrease the vehicular traffic in and out of the school.

The school's recent efforts at demand management have proven successful. According to school officials, bus ridership increased significantly since last year.

Pleasant Grove Middle School improvement considerations are shown in Exhibit 17.



Improvement Considerations
Pleasant Grove Middle School
Green Valley Road

Exhibit 17

Note: All referenced improvements are considerations and options for the school site.

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SPEED LIMIT SIGNS

This section summarizes key findings and identifies considerations to increase driver awareness of the posted speeds along the corridor.

Key Findings

The posted speeds along the study corridor vary from 40 mph to 55 mph, with speeds reducing to 25 mph through the Pleasant Grove Middle School and Rescue Elementary School area during the peak school hours (when children are present). Locations of posted speed limit signs throughout the corridor are shown in Exhibit 40 under *Part D* of this report.

The observed 85th percentile speeds were 9 mph above the posted speed limit in the westbound direction on Segment #5 (Silva Valley Parkway to Malcom Dixon Road), the highest along the corridor. A section of Green Valley Road between Loch Way and Silver Springs Parkway which measures approximately 3.2 miles long has no speed limit signs. This is a prima facie speed limit (55 mph), thus it is not signed at a certain interval (CVC 22349).

There are no signs to make motorists aware of impending downstream speed reduction or transition areas. The only sign in the study corridor that marks a speed transition is installed just west of Bass Lake Road for the eastbound vehicles.

Barring the segment between new Silver Springs Parkway and Cameron Park Drive, the County has recently upgraded the speed limit signs on Green Valley Road to provide higher retro-reflectivity. The segment between Silver Springs Parkway and Cameron Park Drive is slated for retro-reflectivity upgrades in the winter of 2014/2015.

Improvement Considerations

The following considerations have the potential to reduce speeding along the corridor:

Speed Limit Sign Locations

Additional speed limit signs should be installed in the 3.2 mile long segment between Loch Way and Silver Springs Parkway. To better ensure speed adherence by motorists, speed limit signs should be located on both sides of Green Valley Road along the horizontal curve near the Malcolm Dixon Road intersection, as well as at the Deer Valley Road (West) intersection. The following additional measures should also be considered.

Speed Transition Zone

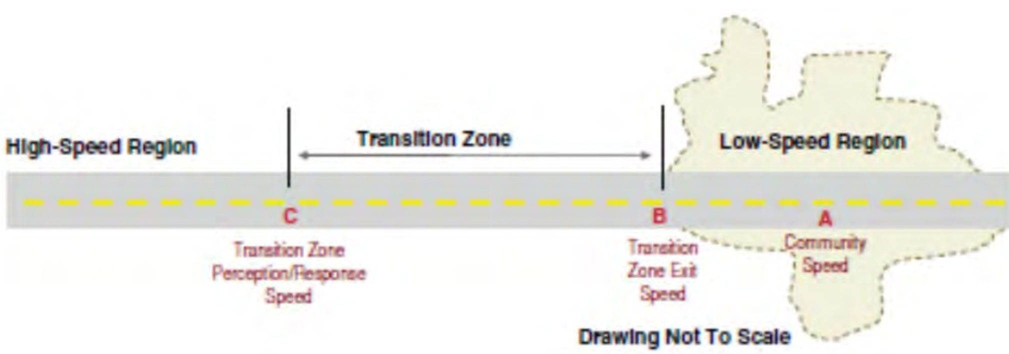
NCHRP Report 613[10] suggests speed limit signs should be located at the points of transition from one speed limit to another, showing the next speed limit for drivers continuing downstream. Signs shall also be installed beyond major intersections. Speed limit signs upstream of an intersection may also be necessary to establish a transition zone for drivers to adjust their speeds to the target speed. Speed limit signs are also recommended to be placed at other locations where it is necessary to remind motorists of the limit that is applicable, such as upstream of the horizontal and vertical curves in the roadway.

The following three speed transition zones shall be enhanced with the appropriate treatments identified in this section:

- Westbound direction between Malcolm Dixon Road and Silva Valley Parkway
- Eastbound direction between Silver Springs Parkway and Bass Lake Road
- Eastbound near Rescue Elementary School

Exhibit 18 illustrates the conceptual layout of different speed zones, including the transition zone along a rural roadway.

Exhibit 18. Speed Zones along the Rural Roads



Source: NCHRP Report 737: Design Guidelines for High-Speed to Low-Speed Transition Zones for Rural Highways

Treatment applications could include:

- Traffic signs consistent with the California MUTCD[11], as shown in Exhibit 19.

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[10] NCHRP Report 613, Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections. Transportation Research Board, Washington D.C., 2008.

[11] Manual of Uniform Traffic Control Devices, 2012 Edition

Exhibit 19. Reduced Speed Signs

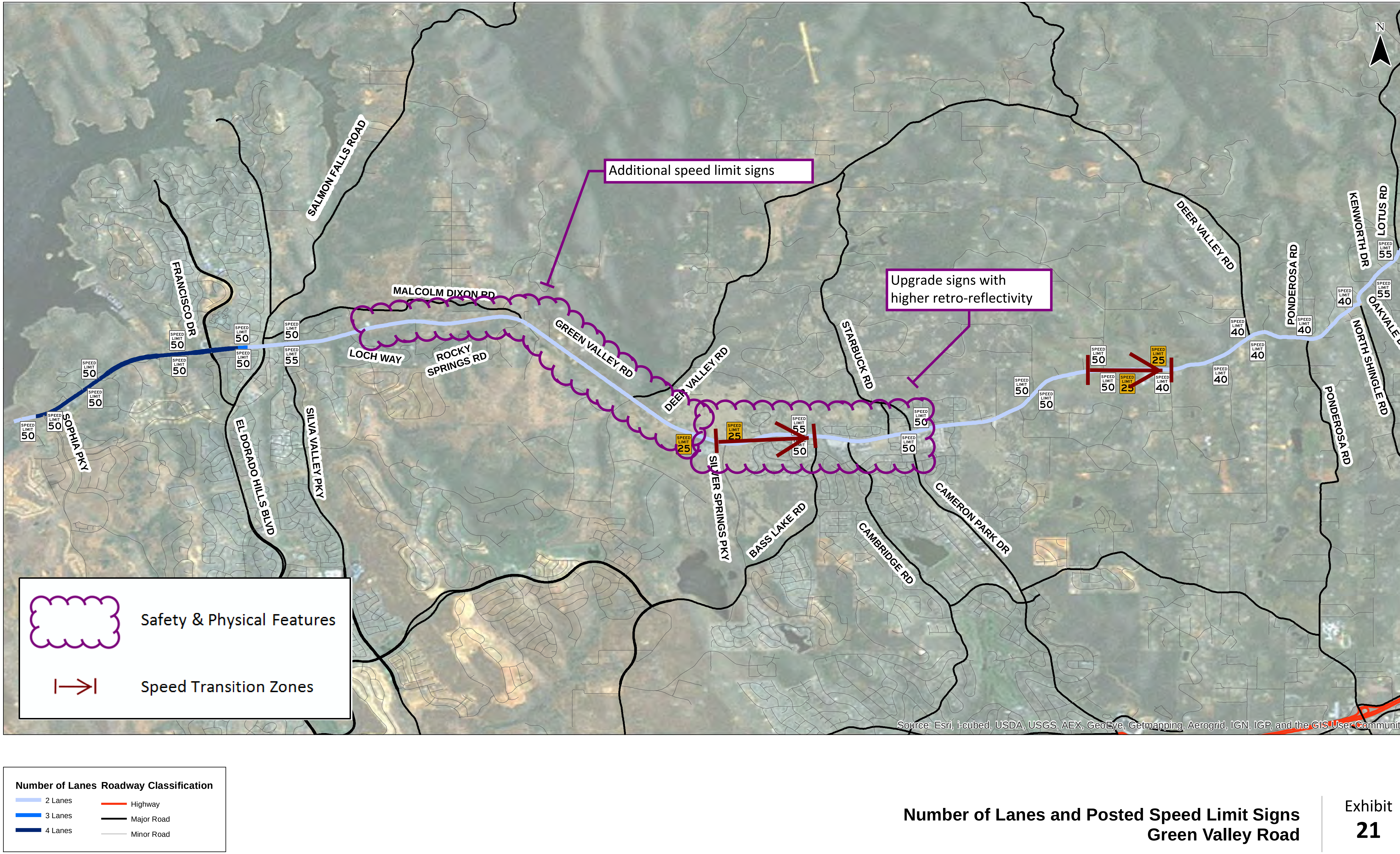
Source: California MUTCD

- Automated speed feedback signs, as shown in Exhibit 4.
- Gateway treatments such as a sign stating "Welcome to El Dorado Hills", "Welcome to Cameron Park" and "Welcome to Rescue". A physical sign or landmark may increase driver awareness for change in environment and corridor context. These signs should be installed in the speed transition zones.
- Transverse rumble strips, as shown in Exhibit 20 below. Rumble strips, or raised pavement markers may be placed in the travel lanes perpendicular to the direction of travel to alert drivers of a change in the environment or corridor context. They may also be installed from higher to lower speed zones.

Exhibit 20. Traverse Rumble Strip Example

Source: NCHRP Report 737

Exhibit 21 illustrates potential considerations to improve speed signs and zones along the corridor.



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Number of Lanes and Posted Speed Limit Signs
Green Valley Road

Exhibit
21

Kittelson & Associates, Inc.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: GCS WGS 1984

CUT-THROUGH TRAFFIC

This section summarizes key findings and identifies considerations to minimize the cut-through traffic on Allegheny Road and Malcolm Dixon Road within the El Dorado Hills community.

Key Findings

During the morning and afternoon commute peak hours, Green Valley Road occasionally becomes congested and motorists cut-through neighborhoods to avoid delays on the arterials. Origin-destination data was collected using Bluetooth technology. BlueMAC readers were deployed at five locations to capture cut-through traffic on Allegheny Road and El Dorado Hills Boulevard north of Green Valley Road. It should be noted that there are no published guidelines to gauge whether the recorded cut-through traffic is considered significant and what treatments could be implemented. A detailed description of the methodology used to capture cut-through traffic and analysis results is discussed in *Part D* of this report.

Cut-through traffic using Allegheny Road during the weekday AM peak period (7-9 AM) averaged 18 percent of the total traffic that has Silva Valley Parkway as an origin and Salmon Falls Road or Francisco Drive as a destination. Similarly, 14 percent of the traffic with Green Valley Road on the east as an origin and Salmon Falls Road or Francisco Drive as destination cut through using Allegheny Road. The AM peak period had the highest percentage of cut-through traffic.

Cut-through traffic using Allegheny Road during the weekday PM peak period (4-6 PM) averaged 14 percent of the total traffic that has Silva Valley Parkway as an origin and Salmon Falls Road or Francisco Drive as a destination. Similarly, 10 percent of the traffic with Green Valley Road on the east as an origin and Salmon Falls Road or Francisco Drive as destination cut through using Allegheny Road. The AM peak period had the highest percentage of cut-through traffic.

Improvement Considerations

The following considerations have the potential to reduce cut-through traffic along the corridor:

Signal Operations

Operational considerations discussed in the *Traffic Operations* section above would reduce queue lengths and improve overall corridor performance between Francisco Drive and El Dorado Hills Boulevard. These improvements could reduce the demand for cut-through traffic on Allegheny Road.

Education and Enforcement

Enforcement is a tool that deters motorists from driving behavior that violates existing regulations for driving maneuvers and excessive speed. The neighborhood watch is another tool or an educational program which requires the involvement and commitment from the neighborhood. As part of this program, neighborhood residents will receive a flyer informing them about traffic issues in their community and the need for their participation to relieve the concerns.

Physical Controls

Physical traffic calming measures would physically guide or restrict all or selected movements along Allegheny Road and Malcolm Dixon Road could be considered as well. Generally, these measures are implemented in order to reduce speeds through an area, reducing the attractiveness of these streets in terms of travel time. A list of these measures is shown below:

- Median barriers
- Forced turn channelization
- Diverters
- Single lane slow points
- Chicane
- Rumble strips

While the other measures could involve significant cost, rumble strips on the local roads are popular and low-cost physical control to curtail speeds and decrease attractiveness. Rumble strips create an area with an uncomfortable roadway surface which may influence motorists to drive slower. Installing a rumble strip each on Allegheny Road and Malcolm Dixon Road will likely reduce attractiveness of these roads being used as cut-through route.

FINANCING STRATEGY

This section provides "planning level" cost estimates for the operational and safety improvements, and identifies potential funding resources to fund improvements in the study corridor.

Cost Estimates

Generalized planning level cost estimates for each of the improvement considerations listed in this section were developed to provide "ball park" and "per unit" cost estimates. Table 1 provides the planning level and per unit cost estimates of the identified improvements. Worksheets to illustrate cost estimates for each component are provided in Appendix 1.

These cost estimates were based on the reasonable linear foot and square foot cost estimates for roadway reconstruction and a cost samples of like improvement types. The rates typically include construction costs including roadway, curbs, sidewalk, striping, signage, drainage and minor earthwork. It doesn't include major earthwork, major structures and right-of-way costs. Actual costs for implementing the identified improvements will vary by location and the unique circumstances at each location, e.g., right-of-way constraints and costs, underground utilities, etc. In particular, the widening and realignment improvements could vary significantly depending on the length and width of new roadway.

Table 1. Planning Level (per Unit) Cost Estimates of Improvements

Improvement	Candidate Location	Unit of Measure ($)	Per Unit Cost ($)
Signal Coordination[1]	Intersection 2; Intersection 3; Intersection 4	LS[4]	$ 5,000 - 50,000
Raised Median[2]	Segment 1; Segment 2; Intersection 12	LF[5]	$ 476.31
Sidewalks[2]	Segment 3; Segment 4; Segment 8; Intersection 2; Intersection 3	LF	$ 498.56
Class II bike lanes[2]	Segment 3; Segment 4; Segment 5; Segment 6; Segment 7; Intersection 1; Intersection 2; Intersection 5; Intersection 6; Intersection 7	LF	$ 239.72
Widening shoulder (not including acquisition of ROW)[2]	Segment 5; Segment 6; Segment 7; Segment 9; Segment 10; Segment 11; Intersection 13	LF	$ 509.06
Left-turn lane/pockets[2]	Segment 9; Intersection 3; Intersection 4; Intersection 5; Intersection 7; Intersection 11; Intersection 12; Intersection 13; Intersection 14	LF	$ 643.54
Minor street realignment (not including ROW)[2]	Intersection 7; Intersection 14	LF	$ 1,518.33
Widen vehicle travel lane width[2]	Intersection 12	LF	$ 414.83
ADA compliant ramps[3]	Intersection 2; Intersection 3; Intersection 4; Intersection 9; Intersection 10	EA[6]	$ 4,800.00
Automated speed feedback sign[1]	Segment 2; Segment 10; Segment 11	EA	$ 2,000 - 10,000
Lighting[2]	Segment 3; Segment 4; Intersection 2	LS	$ 24,400.00
Speed limit sign[1]	Segment 5; Segment 7	EA	$ 1,000.00
Advanced intersection warning signs[1]	Intersection 6; Intersection 7	EA	$ 5,000 - 15,000
Dynamic warning signs[1]	Segment 9; Intersection 1;	EA	$ 10,000 - 25,000
Post mounted delineators[1]	Segment 9; Intersection 6; Intersection 7; Intersection 13	EA	$ 55.00

Notes: [1] Source: *Low-Cost Enhancements for Stop-Controlled and Signalized Intersections,* U.S. Department of Transportation, Federal Highway Administration, May 2009; [2] Includes the estimated roadway item construction costs, 40% contingency of construction costs, and capital costs equaling 50% of estimated construction costs; [3] Source: *ADA Curb Ramp & Sidewalk Improvement Program,* Prepared for Unified Government by GBA Architects and Engineers, April 2011, includes the average total for design, construction, and inspection; [4] LS = Lump Sum; [5] LF = Linear Foot; [6] EA = Each.

Funding Resources

The following potential funding resources can be considered:

- There may be spots or improvement projects that could be added to the existing plans and bundled into a number of consolidated application requests. If possible, the improvements should be integrated with the County's CIP projects. For example, County's CIP project of widening Green Valley Road from El Dorado Hills Boulevard/Salmon Falls Road and Deer Valley Road (West) could include provision of Class II bike lanes, wide shoulders, as well as left-turn pockets at key intersections.
- Active Transportation Program grant, especially for those projects that are designed to improve pedestrian and bicycle facilities.
- Highway Safety Improvement Program grant, especially for those projects that have potential to reduce severe crashes.
- Safe Route to School grant, primarily to improve circulation of all modes of transport within the Pleasant Grove Middle School

NOISE ANALYSIS

The Noise Report prepared by Rincon Consultants is attached in Appendix 2.

Part D: Technical Data, Analysis and Results

PART D: TECHNICAL DATA, ANALYSIS AND RESULTS

FIELD REVIEW AND OBSERVATIONS

A field visit with El Dorado County staff was performed on April 28, 2014, with two follow-up field visits to collect site distance and roadway measurements, and inventory intersection and corridor characteristics. Key observations from the field visits for each study location are summarized below.

Study Segments Observations

This section summarizes key characteristics and field observations on roadway segments.

Segment #1: County Line to Sophia Parkway

Key characteristics and observations on this segment include:

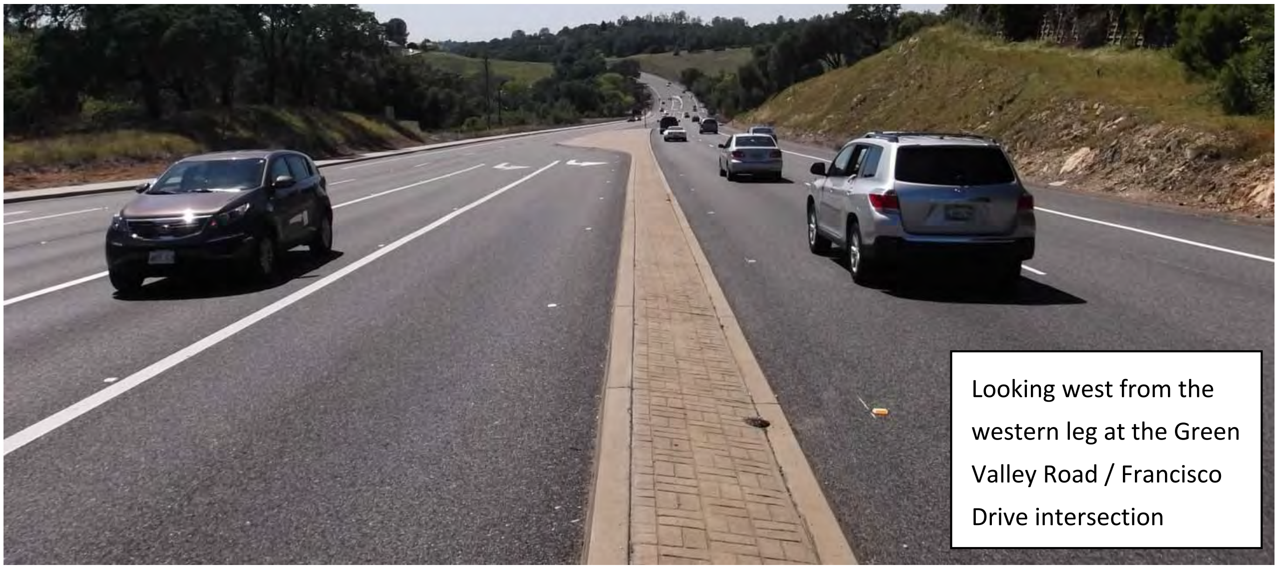
- The 0.21-mile long undivided segment provides one travel lane in each direction with the posted speed limit of 50 mph.
- Green Valley Road widens to four lanes approximately 250 feet west of the Sophia Parkway intersection.
- The typical cross-section provides two 12-foot travel lanes with 8-foot paved bike lanes/shoulder on both sides.
- There is no sidewalk on either side of this segment.
- A 100-foot long westbound left-turn pocket is provided for the Shadowfax Lane inbound vehicles.
- The segment is uninterrupted with the exception of Shadowfax Lane and the Green Valley Nursery.
- A continuous Class II bike lane is provided on the north side, whereas on the south side a bike lane ends just east of Shadowfax Lane.
- Green Valley Road west of Shadowfax Lane has a passing zone, established by broken single-yellow pavement markings.
- Observations indicate that motorists inappropriately use the paved median shelter between Sophia Parkway and Shadowfax Lane to turn left into the Green Valley Nursery (see picture below).

Looking west from the western leg of the Green Valley Road / Sophia Parkway intersection

Segment #2: Sophia Parkway to Francisco Drive

Key characteristics and observations on this segment include:

- The 1.35-mile long divided segment provides two travel lanes in each direction with the posted speed limit of 50 mph.
- The typical cross-section provides four 12-foot travel lanes with a 6 to 16-foot raised median or center left-turn lane.
- A Class II bike lane is provided on the north and south sides.
- Sidewalk on the north side starts at the Sophia Parkway intersection and ends at the Lakeridge Oaks Drive/Mormon Island Drive intersection. The southern sidewalk begins at the Lakeridge Oaks Drive/Mormon Island Drive intersection, connects with a trail east of the Miller Road intersection, and resumes east of the Miller Road intersection.
- The western segment is interrupted with two consecutive commercial driveways on either side of the roadway.
- Due to 3% to 5% downgrade in the westbound direction (see picture below), vehicles were observed to travel at speeds that exceeded the posted speed limit.



Segment #3: Francisco Drive to El Dorado Hills Boulevard/Salmon Falls Road

Key characteristics and observations on this segment include:

- The 0.36-mile long segment provides one or two travel lanes in each direction with the posted speed limit of 50 mph.
- Green Valley Road narrows to two lanes approximately 850 feet east of the Francisco Drive intersection.
- The typical cross-section provides two 12-foot travel lanes with a 3 to 8-foot wide shoulder on each side.
- The south side has no sidewalk, whereas the sidewalk on the north side ends near the eastern property line of the Safeway plaza.
- The segment is interrupted with a driveway access to the Safeway plaza on the north side and two retail driveways on the south side.
- There are no bike lanes on this segment.
- Beyond the shoulder on the north side, a clearance zone[12] of 8 to 12 feet is present (see picture below on the left). This area may be used to provide recovery of errant vehicles that may run off the road. On the south side, private properties are situated approximately 18 to 20 feet from edge of the shoulder. The area beyond the shoulder on the south side is occupied with vegetation and trees (see picture below), presenting limited recovery opportunities for errant vehicles.

[12] Clearance zone is the unobstructed, traversable areas provided beyond the edge of the through traveled lane.

Segment #4: El Dorado Hills Boulevard/Salmon Falls Road to Silva Valley Parkway/Allegheny Road

Key characteristics and observations on this segment include:

- The 0.17-mile long segment provides one travel lane in each direction with the posted speed limit of 50 mph.
- The typical cross-section provides two 12-foot travel lanes with a 3 to 6-foot wide shoulder on each side.
- The area beyond shoulders is recessed on both sides and occupied with trees and vegetation. A continuous curb is provided on either side of Green Valley Road to prevent errant vehicles from running off the road (see pictures below).

- There are no bike lanes or sidewalks on this segment.
- This segment is uninterrupted.

Segment #5: Silva Valley Parkway/Allegheny Road to Malcolm Dixon Road

Key characteristics and observations on this segment include:

- The 1.66-mile long undivided segment provides one travel lane in each direction with the posted speed limit of 55 mph.
- The typical cross-section provides two 12-foot travel lanes with a 3 to 7-foot wide shoulder on each side. The road provides narrower shoulders west of Loch Way on both sides.
- Beyond the shoulders, the clearance zone is generally not present on both sides and is occupied with vegetation. When the area beyond the shoulder is recessed, curbs and pole-mounted delineators are installed on either side of the segment.
- There are no bike lanes or sidewalks on this segment.
- This segment is interrupted with Loch Way and a number of private property driveways.
- East of Loch Way, this segment provides a westbound passing zone, established by broken and solid yellow pavement markings.

Segment #6: Malcolm Dixon Road to Deer Valley Road (West)

Key characteristics and observations on this segment include:

- The 1.04-mile long undivided segment provides one travel lane in each direction with the posted speed limit of 55 mph.
- The typical cross-section provides two 12-foot travel lanes with a 3 to 8-foot wide shoulder on each side.
- Beyond the shoulders, the clearance zone is generally not present on both sides and is occupied with vegetation. When the area beyond the shoulder is raised, curbs are installed on either side of the roadway.
- There are no sidewalks on this segment. A Class II bike lane is provided on both sides of the roadway within 800 feet of the Deer Valley Road (West) intersection.
- This segment is interrupted by multiple private property driveways on both sides.
- Grades are typically range from 1% to 4% on this segment.

Segment #7: Deer Valley Road (West) to Bass Lake Road

Key characteristics and observations on this segment include:

- The 1.42-mile long undivided segment provides one travel lane in each direction. The posted speed limit in the westbound direction is 55 mph. In the eastbound direction, this segment has posted speed limit of 55 mph west of Silver Springs Parkway and 50 mph between Silver Springs Parkway and Bass Lake Road. In the vicinity of Pleasant Grove Middle School, the reduced speed of 25 mph is enforced when children are present.
- The typical cross-section west of Pleasant Grove School provides two 12-foot travel lanes with a 6 to 8-foot wide shoulder in each direction. A Class II bike lane is provided on each side of the

roadway within 800 feet of the Deer Valley Road (West) intersection and east of Pleasant Grove Middle School.

- Curbs and post-mounted delineators are installed on the north side to prevent errant vehicles from running off the road.
- Continuous sidewalk is provided on the south side between Pleasant Grove School and Bass Lake Road.
- This segment is interrupted by multiple private property driveways on the north side.
- Roadway grade ranges from 0% to 4% on this segment.

Segment #8: Bass Lake Road to Cameron Park Drive

Key characteristics and observations on this segment include:

- The 0.67-mile long segment provides one travel lane in each direction with the posted speed limit of 50 mph.
- The typical cross-section provides two 12-foot travel lanes with a 6-foot wide Class II bike lane in each direction.
- This segment provides variable medians. A 5-foot wide painted median is installed between Bass Lake Road and Cambridge Road. The segment between Cambridge Road and Cameron Park Drive accommodates five left-turn pockets, as well as provides a 10-foot wide painted median. A 370-foot long raised median is installed west of the Cameron Park Drive intersection.
- Sidewalk is provided intermittently on the south side. There is no sidewalk on the north side.
- This segment is interrupted by multiple commercial driveways on both sides.

Segment #9: Cameron Park Drive to Ponderosa Road

Key characteristics and observations on this segment include:

- The 3.04-mile long undivided segment provides one travel lane in each direction with the posted speed limit of 50 mph west of the Rescue Elementary School. The posted speed drops to 40 mph east of the Rescue Elementary School. In the vicinity of the school, the reduced speed of 25 mph is enforced when children are present.
- Within the Cameron Park area, the typical cross-section includes two 12-foot travel lanes with a 6-foot wide shoulder on each side. Within the rural area (east of Cameron Park), the segment provides two 10- to 11-foot wide travel lanes with either soft (containing gravel, sand, etc.) shoulder or no shoulder (see picture below).

- There are no bike lanes or sidewalks on this segment.
- An intermittent clearance zone of 2 to 10 feet is present beyond the shoulder on each side. This area may not be sufficient to provide a recovery area for the errant vehicles that may run off the road given the property lines or fences that are placed at the edge of clearance zone.
- This segment is interrupted with multiple private property driveways on both sides.

Segment #10: Ponderosa Road to North Shingle Road

Key characteristics and observations on this segment include:

- The 0.49-mile long undivided segment provides one travel lane in each direction with the posted speed limit of 40 mph.
- This segment provides two 10-11 foot wide travel lanes with either soft (containing gravel, sand, etc.) or no shoulder on either side (see below).

- There are no bike lanes or sidewalks on this segment.

- An intermittent clearance zone of 2 to 8 feet is present beyond the shoulder on each side. This area may not be sufficient to provide a recovery area for the errant vehicles that may run off the road given the property lines or fences that are placed at the edge of clearance zone.
- This segment is interrupted by multiple private property driveways on both sides.
- Grade ranges from 0% to 5% on this segment.

Segment #11: North Shingle Road to Lotus Road

Key characteristics and observations on this segment include:

- The 0.57-mile long undivided segment provides one travel lane in each direction with the posted speed limit of 55 mph.
- This segment provides two 11 to 12 foot wide travel lanes in each direction with no shoulders, except for those installed in the vicinity of the North Shingle Road and Lotus Road intersections.
- There are no bike lanes or sidewalks on this segment.
- This segment is interrupted by multiple private property driveways on both sides.
- Grade ranges from 1% to 4% on this segment.

Study Intersection Observations

This section summarizes key characteristics and field observations at intersections.

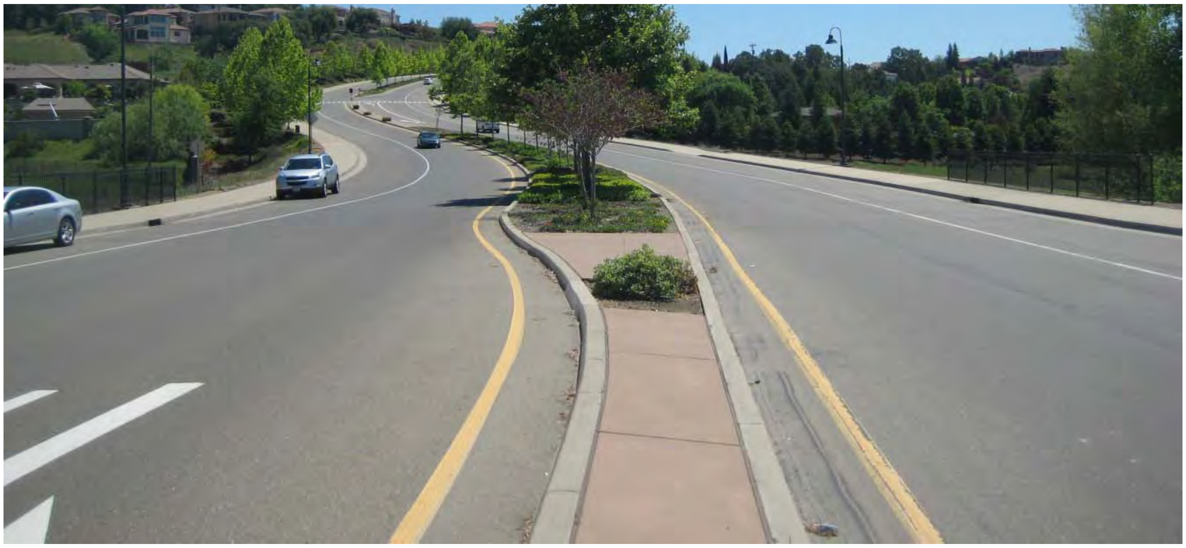
Intersection #1: Green Valley Road at Sophia Parkway

The Sophia Parkway intersection is a four-legged signalized intersection. Exhibit 22 shows an aerial of this intersection.

Exhibit 22. Green Valley Road and Sophia Parkway Intersection

Key characteristics at the intersection include:

- A large number of pedestrians and bicyclists negotiate this intersection to access the Browns Ravine Recreation Area trails on the north side of Green Valley Road. This often leads to pedestrian conflicts with right-turning vehicles from Sophia Parkway. A "Yield to Pedestrians" sign is posted on the signal pole to educate motorists about an impending conflict with pedestrians within the crosswalk.
- Sophia Parkway provides wide shoulders south of Green Valley Road. These shoulders are being utilized as an on-street parking area by the motorists who typically park their cars and walk or bike to the Browns Ravine Recreation Area.



- To access ongoing construction activity at the nearby Folsom Lake Dam (see picture below), a significant volume of heavy-duty trucks utilize this intersection.

- Class II bicycle lanes are provided on both sides of the east and south legs of this intersection. A Class II bicycle lane is available in the westbound direction on the west leg.
- No sidewalk is provided on the west and north legs of the intersection.
- Pedestrians are prohibited from crossing Green Valley Road on the west leg.
- Continuous sidewalks are present south and east of the intersection on both sides of the road.

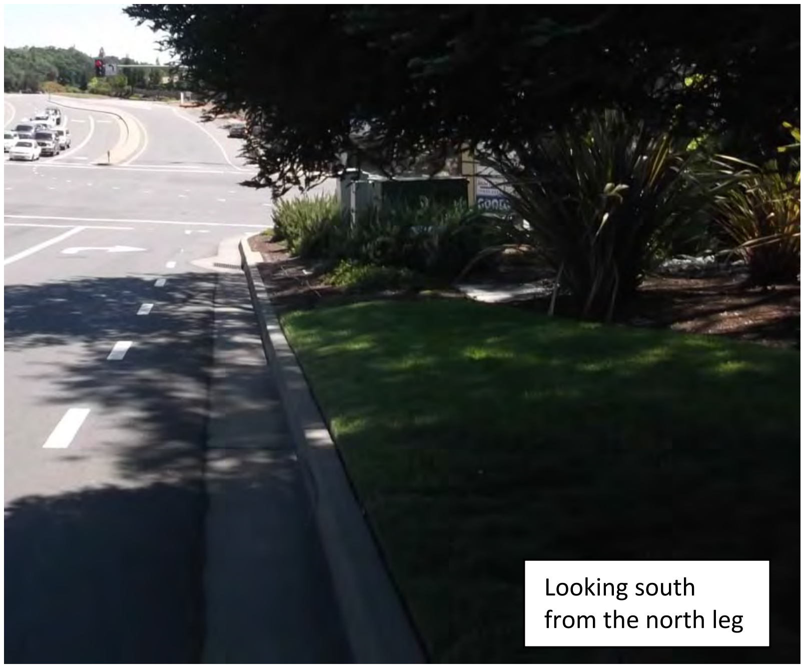
Intersection #2: Green Valley Road at Francisco Drive

The Francisco Drive intersection is a four-legged signalized intersection. Exhibit 23 shows an aerial of this intersection.

Exhibit 23. Green Valley Road and Francisco Drive Intersection

Key characteristics at the intersection include:

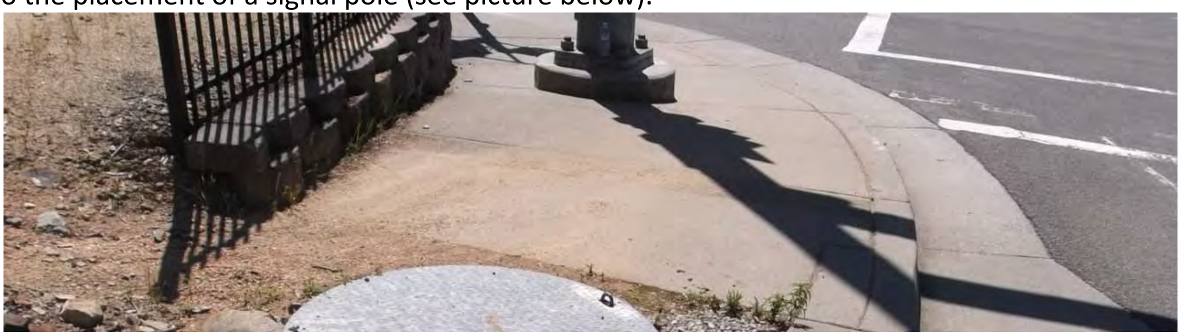
- Pedestrians and bicyclists use this intersection to access the market and village center on the north side of Green Valley Road.
- There are a large number of U-turns from the westbound left-turn lane of Green Valley Road. The majority of U-turn vehicles exited the Safeway shopping center from the driveway located approximately 480 feet east of this intersection. Some U-turns were also destined to the shopping center located in the southeast corner of this intersection.
- There are no sidewalks approaching the northwest corner of the intersection (see picture below).



- Sidewalk is not present along the west side of Francisco Drive to the south of the intersection (see picture below).

- Sidewalk is terminated from southeast corner of this intersection to the east (see picture below).

- Sidewalk in the southeast corner does not provide adequate clear width per ADA guidelines due to the placement of a signal pole (see picture below).



- Curb ramps in the southeast and southwest corners do not have detectable warning[13].
- Pedestrians are prohibited from crossing Green Valley Road on the west leg.
- A Class II bike lane is provided on either side of Green Valley Road to the west of this intersection. However, the stripped bike lane is dropped on the eastbound approach of this intersection to accommodate the right-turn lane. Similarly, a Class II bike lane is provided on

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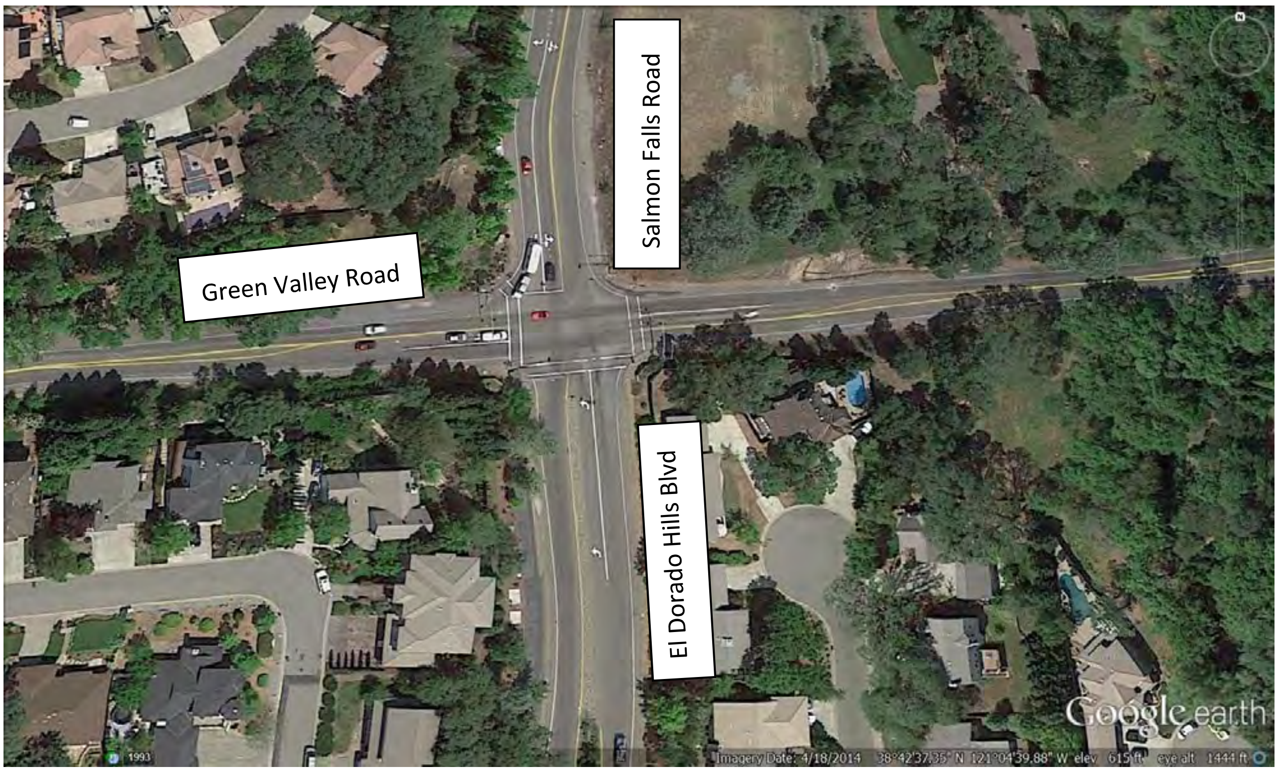
[13] Detectable warnings are an Americans with Disabilities Act (ADA) requirement in the current Americans with Disabilities Act Accessibility Guidelines (ADAAG) for the use of detecting the boundary between the sidewalk and the street. Placing a detectable warning at the bottom of a curb ramp identifies the transition between the sidewalk and the street for people with vision impairments.

both sides of Francisco Drive north of Green Valley Road without a dedicated bike lane on the southbound approach. Bike lanes do not exist to the east and south of this intersection.

Intersection #3: Green Valley Road at El Dorado Hills Boulevard/Salmon Falls Road

The El Dorado Hills Boulevard intersection is a four-legged signalized intersection. Exhibit 24 shows an aerial of this intersection.

Exhibit 24. Green Valley Road and El Dorado Hills Boulevard/Salmon Falls Road Intersection



Key characteristics at the intersection include:

- The northbound and southbound approaches at this intersection operate with split phasing. That means all movements originating from one direction followed by all movements from the opposing direction.
- Pedestrians and bicyclists cross this intersection north-south. Residents north of this intersection navigate through this intersection to access an elementary school to the south.
- Traffic occasionally backs up on both the eastbound and westbound Green Valley Road approaches during the AM, midday and PM peak periods, but clears over one or two signal cycles.
- A pedestrian path is present on the west side of El Dorado Hills Boulevard south of this intersection.
- Pedestrian crossing is prohibited across the north leg of the intersection.

- There are numerous ADA concerns with no detectable warnings at any corner of the intersection, and a lack of pedestrian facilities at each corner (see figure below).

Intersection #4: Green Valley Road at Silva Valley Parkway/Allegheny Road

The Silva Valley Parkway intersection is a four-legged signalized intersection. Exhibit 25 shows an aerial of this intersection.

Exhibit 25. Green Valley Road and Silva Valley Parkway/Allegheny Road Intersection

Key characteristics at the intersection include:

- Neighborhood residents are concerned about cut-through traffic to Salmon Falls Road via Allegheny Road to avoid the El Dorado Hills Boulevard/Salmon Falls Road intersection.
- Pedestrian crossings on Green Valley Road are common.
- There are no sidewalks approaching the intersection other than a pedestrian path approaching the intersection from nearby Timberline Ridge Court.
- Only the southwestern corner of the intersection has been improved to be consistent with ADA guidelines, the other corners lack detectable warnings and pedestrian access to the corner.
- Pedestrian crossings are prohibited across the east leg of the intersection.
- A pedestrian path is present on the west side of El Dorado Hills Boulevard south of this intersection (see picture below).

Intersection #5: Green Valley Road at Loch Way

The Loch Way intersection is a three-legged intersection with stop-control on the minor (Loch Way) approach. Exhibit 26 shows an aerial of this intersection.

Exhibit 26. Green Valley Road and Loch Way Intersection

Key characteristics at the intersection include:

- There are no pedestrian or bicycle facilities at the intersection.
- A photo of the driver's eye view from the stop bar looking west indicates that the Intersection sight distance could be improved by trimming back vegetation (see picture below).

- Trailing vehicles pass around the leading vehicle(s) that are stopped waiting for an acceptable gap to make a left-turn movement into Loch Way. Vehicle skid marks were observed at the intersection.
- In-curb delineators are provided on the entry and exit radius to define the intersection for drivers at night.
- An advance intersection warning sign is provided in the eastbound and westbound direction.
- Loch Way serves residential neighborhoods south of Green Valley Road.
- The grades for the eastbound and westbound approaches are 2.3% upgrade and 3.6% downgrade respectively.
- Observations indicated no apparent stopping sight distance limitations at this intersection.

Intersection #6: Green Valley Road at Rocky Springs Road/Steve's Way

The Rocky Springs Road/Steve's Way intersection is a four-legged offset intersection with assumed stop-control on the minor approaches. Exhibit 27 shows an aerial of this intersection. This is not a County maintained intersection.

Exhibit 27. Green Valley Road and Rocky Springs Road/Steve's Way Intersection

Key characteristics at the intersection include:

- The intersection does not have a marked stop bar or a stop sign on both Rocky Springs Road and Steve's Way as they are private roads.

- Both Rocky Springs Road and Steve's Way provide local access to a small number of single family residences.

- There are no bicycle or pedestrian facilities on any approach to the intersection.
- There are no advanced intersection warning signs in either direction.
- Due to the horizontal curvature of the roadway and overgrown foliage, the Rocky Springs Road approach has limited intersection sight distance looking east and west.
- The grade for both eastbound and westbound approaches is over 3%.
- There are opportunities to provide delineation to better define the intersection for motorists.

Intersection #7: Green Valley Road at Malcolm Dixon Road

The Malcolm Dixon Road intersection is a three-legged intersection with the stop-control on the minor approach. Exhibit 28 shows an aerial of this intersection.

Exhibit 28. Green Valley Road and Malcolm Dixon Road Intersection

Key characteristics at the Green Valley Road and Malcolm Dixon Road intersection include:

- Due to the wide curve combined with an upgrade on Malcolm Dixon Road, vehicles typically slow down to make a left-turn onto Malcolm Dixon Road. This can present safety issues for the trailing motorists (see picture below).

- There are no pedestrian or bike facilities at the intersection.
- Observations indicate the intersection has limited stopping sight distance for vehicles approaching from the east due to the horizontal curvature and overgrown tree branches. Sight distance could be improved by trimming overgrown tree branches.
- The shoulder in the northwest quadrant of the intersection is narrow and contains gravel.
- Post-mounted delineators are provided in the northwest and northeast corners to define the intersection radius. However, there are opportunities to improve them.
- There are no advance intersection warning signs.

Intersection #8: Green Valley Road at Deer Valley Road (West)

The Deer Valley Road (West) intersection is a four-legged intersection with the stop-control on minor approaches. This intersection was recently improved with the addition of turn lanes and bike lanes on Green Valley Road. Exhibit 29 shows an aerial of this intersection.

Exhibit 29. Green Valley Road and Deer Valley Road (West) Intersection

Key characteristics at the intersection include:

- Stopping sight distances and intersection sight distances were determined to be acceptable based on criteria contained in the most recent version of Caltrans *Highway Design Manual* (HDM).
- The roadway has grades of over 3% on the east, west, and south leg of the intersection.
- New Class II bike lanes are provided on Green Valley Road.

- Post-mounted delineators are installed at all four corners to define the intersection radius.

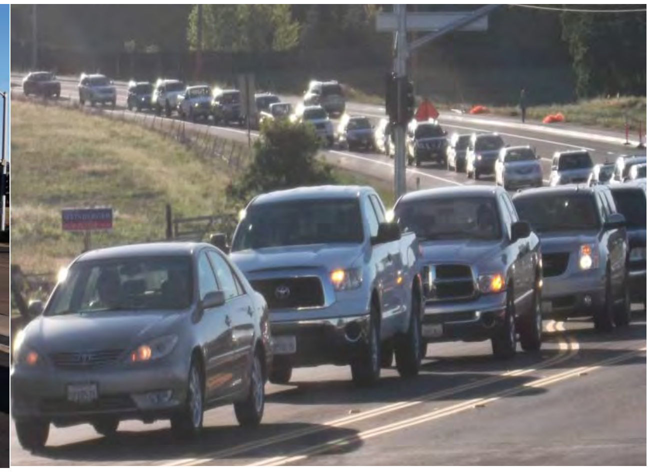
Intersection #9: Green Valley Road at Pleasant Grove Middle School

The Pleasant Grove Middle School main access intersection is a three-legged signalized intersection. Exhibit 30 shows an aerial of this intersection. A detail discussion related to school traffic is included in the *Pleasant Grove Middle School* section.

Exhibit 30. Green Valley Road and Pleasant Grove Middle School Intersection

Key characteristics, as observed in the Spring of 2014, at the intersection include:

- There are significant operational issues at the intersection, which serves as the primary entrance to Pleasant Grove Middle School during the AM peak hour.
    - o Most the school traffic travels to/from the east (Cameron Park).
    - o 10-12 cars stack up internally for the drop-off activity. This prevents left-turning vehicles and right-turning vehicles from Green Valley Road from entering the school driveway despite a very long left-turn phase. This leads to queues of 25+ vehicles on Green Valley Road (see pictures below).



- Westbound vehicles can't access the secondary drop-off due to the driveway geometrics and striping along Green Valley Road. Vehicles accessing the school using the primary access were unable to drive down to the secondary drop-off area to the east due to not only internal queuing, and possibly the current closure of the eastern right-out exit (see pictures below).

- Drivers leaving during the AM and PM peak are primarily turning right out.

  - o Westbound left-turn queues at the school access during the AM peak may lead to operational issues at the newly opened Silver Springs Parkway signalized intersection, as the demand of Silver Springs Parkway grows. The motorists would be unable to turn left out of Silver Springs Parkway when the downstream queues block their receiving lane. Similarly, access to the westbound Green Valley Road left-turn lane at Silver Springs Parkway could be restricted as a result of queues in the adjacent through lane.
- There are Class II bicycle lanes on both sides of the east leg but no bicycle facilities to the west of the intersection;
- There are sidewalks on both the east and west legs on the southern side of the intersection but no pedestrian facilities on the northern side of the road;
- Pedestrians are prohibited from crossing on the west leg;
- Pedestrians accessing the school typically come to/from the east and use the most-easterly driveway to access the school site. Therefore there is little pedestrian activity at this intersection.

Intersection #10: Green Valley Road at Bass Lake Road

The Bass Lake Road intersection is a four-legged signalized intersection. Exhibit 31 shows an aerial of this intersection.

Exhibit 31. Green Valley Road and Bass Lake Road Intersection

Key characteristics at the intersection include:

- The intersection has a fair amount of pedestrian activity given Green Valley Elementary School is located just south of the intersection and Pleasant Grove Middle School is west of the intersection.
- The northwest corner of the intersection presents ADA concerns and does not have sidewalks from either approach.
- Pedestrian crossings are prohibited across the west leg of the intersection.
- The northbound and southbound approaches operate with split signal phasing. That means, all movements originating from one direction followed by all movements from the opposing direction.
- There are Class II bicycle lanes on Green Valley Road in both directions approaching and departing the intersection.

Intersection #11: Green Valley Road at Cambridge Road/Peridot Drive

The Cambridge Road/Peridot Drive intersection is a four-legged signalized intersection. Exhibit 32 shows an aerial of this intersection.

Exhibit 32. Green Valley Road and Cambridge Road/Peridot Drive Intersection

Key characteristics at the intersection include:

- There are Class II bicycle lanes on Green Valley Road in both directions approaching and departing the intersection but no bicycle facilities on Cambridge Road or Peridot Drive.

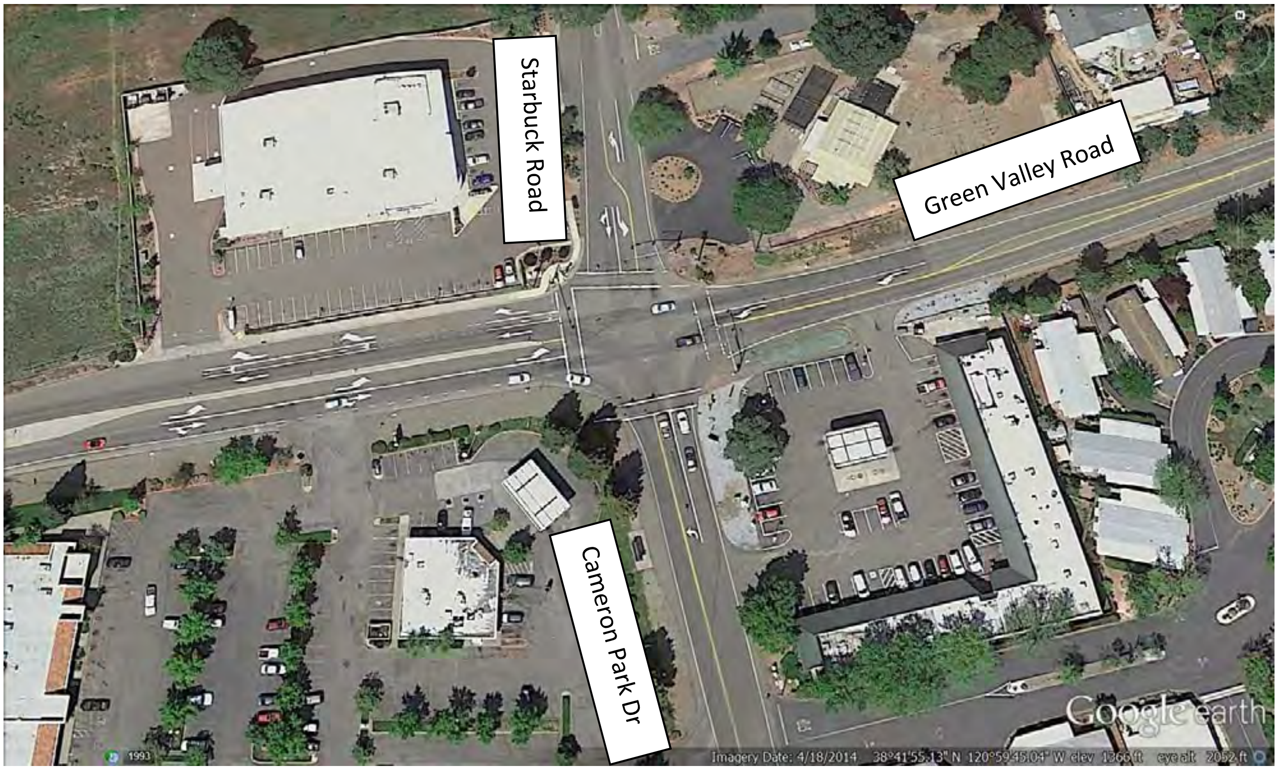
- While the corners of the intersection have been improved and are ADA compliant, there are no sidewalks approaching or departing the intersection on the north side of Green Valley Road. Minimal asphalt paths are provided on the west side of Cambridge Road and the south side of the Green Valley Road approach (see picture below).

- Some pedestrian activity occurs from residents from neighborhoods accessing nearby stores and schools.
- The northbound and southbound approaches operate with split signal phasing.
- Pedestrian crossings are prohibited across the west leg of the intersection.

Intersection #12: Green Valley Road at Cameron Park Drive/Starbuck Road

The Cameron Park Drive/Starbuck Road intersection is a four-legged signalized intersection. Exhibit 33 shows an aerial of this intersection.

Exhibit 33. Green Valley Road and Cameron Park Drive/Starbuck Road Intersection



Key characteristics at the intersection include:

- East of the intersection, Green Valley Road narrows and loses shoulders on both sides.
- There are Class II bicycle lanes on the west leg of the intersection, but no bicycle facilities on any of the other approaches.
- There are sidewalks in the northwest quadrant. The other corners have either no pedestrian facilities or very poorly maintained asphalt paths that are not ADA compliant.
- There is a bus stop on the west side of the Cameron Park Drive approach with no sidewalk (see picture below).

Intersection #13: Green Valley Road at Deer Valley Road (East)

The Deer Valley Road (East) intersection is a three-legged intersection with stop-control on the minor approach. Exhibit 34 shows an aerial of this intersection.

Exhibit 34. Green Valley Road and Deer Valley Road (East) Intersection

Key characteristics at the intersection include:

- Advance intersection warning signs are installed in both directions on Green Valley Road.
- Green Valley Road is approximately 21-22 feet wide at the intersection.
- The bridge on Deer Valley Road approaching the intersection is narrow at 19 feet across with signs of vehicles scraping the bridge sides in the past (see picture below).

- There are no shoulders on any approach of this intersection.
- Observations indicate that the stopping sight distance for the southbound motorists is limited due to horizontal curvature (see figure below).

- There are no bicycle or pedestrian facilities on any approach.

- The westbound Green Valley Road approach has approximately 1.9% upgrade, while the eastbound approach is relatively flat with 0.7% downgrade.
- There are opportunities to provide delineation to define the intersection radius for drivers.
- A guard rail is provided on the north side of Green Valley Road on the east leg.

Intersection #14: Green Valley Road at Ponderosa Road

The Ponderosa Road intersection is a three-legged intersection with stop-control on the minor approach. Exhibit 35 shows an aerial of this intersection.

Exhibit 35. Green Valley Road and Ponderosa Road Intersection

Key characteristics at the intersection include:

- Ponderosa Road (West) is located approximately 285 feet east of Ponderosa Road (East). As such, north and south Ponderosa Road creates an offset intersection with Green Valley Road.
- There is no shoulder along Green Valley Road or Ponderosa Road approaching or departing the intersection (see figure below).

- A traverse rumble strip is installed on the westbound approach to help reduce speeds and increase driver's awareness of the upcoming intersection.
- A vertical crest at the intersection contributes to highly restricted intersection and stopping sight distances at both intersections on Green Valley Road. Green Valley Road has 4.4% and 6.7% grades east and west of this intersection respectively (see figure below).

- Due to the vertical crest and horizontal curvature, several drivers were observed to correct their path of travel once reaching the crest to follow the curve of the road. Chevron signs have been provided to negotiate the path.
- There are no bicycle or pedestrian facilities on any approach of this intersection.
- Green Valley Road is approximately 20-21 feet wide at this intersection.
- Advance intersection warning signs, speed advisory signs, as well as chevron signs are provided on Green Valley Road.
- Delineators are provided in the southwest and southeast corners to define intersection radius. However, there are opportunities to improve them.

Intersection #15: Green Valley Road at North Shingle Road

The North Shingle Road intersection is a three-legged signalized intersection. Exhibit 36 shows an aerial of this intersection.

Exhibit 36. Green Valley Road and North Shingle Road Intersection

Key characteristics at the intersection include:

- Green Valley Road narrows and loses shoulders west of this intersection which is warned by a traffic sign.
- Pedestrian crossings are prohibited on the north leg of the intersection.
- There are no sidewalks on any approach to the intersection beyond a small ADA compliant landing at the corners (see picture below).

- There are no bicycle facilities on any approach to the intersection.
- Shoulders are provided on each leg of this intersection.
- Southbound right-turn signal operates with an overlap phase with the eastbound left-turns.

Intersection #16: Green Valley Road at Lotus Road

The Lotus Road intersection is a three-legged intersection with stop-control on the westbound Green Valley Road approach. Exhibit 37 shows an aerial of this intersection.

Exhibit 37. Green Valley Road and Lotus Road Intersection

Key characteristics at the intersection include:

- There are no bicycle or pedestrian facilities on any approach to the intersection;
- Observations indicated that the intersection sight distance from the westbound Green Valley Road approach looking right is limited due to horizontal curvature (see picture below).

- Observations indicated that the southbound Lotus Road has limited stopping sight distance due to the horizontal curvature and overgrown tree branches. Sight distance could be improved by trimming tree branches.
- One or two post-mounted delineators are installed in the northeast and southeast corners to define the intersection radius for drivers.

Field Review: Private Driveways

It should be noted that the County does not improve private driveways. Any improvements are the responsibility of the private property owner. During the field visits, an inventory of private property driveways on Green Valley Road between Sophia Parkway and Bass Lake Road was performed. A cursory evaluation of intersection sight distance (ISD)[14] and stopping sight distance[15] (SSD) was also performed at these driveways, whereas detailed measurements were collected at the locations with apparent intersection and stopping sight distance issues. Sight distance in and out of these driveways was assessed based on the latest version of the California *Highway Design Manual*[16]. The measured and/or observed sight distances were evaluated against the criteria contained in the referenced document and included in Table 2.

Table 2. Sight Distance Criteria

Design Speed (mph)	Intersection Sight Distance (ft)	Stopping Sight Distance (ft)
25	275	150
30	330	200
35	385	250
40	440	300
45	495	360
50	550	430
55	605	500
60	660	580
65	715	660
70	770	750

Source: California Highway Design Manual, 2012

A total of 36 actively used driveway access points were identified and inventoried. The location of these driveways is shown in Exhibit 38. Driveways with identified sight issues are summarized below.

[14] Intersection Sight Distance is also referred to as Corner Sight Distance. It is the clear line of sight in feet between the driver of a vehicle waiting at the crossroad (stop control) and the driver of an approaching vehicle on the major uncontrolled street.

[15] Stopping Sight Distance is defined as the distance needed for drivers to see an object on the roadway ahead and bring their vehicles to safe stop without colliding with the object.

[16] *Highway Design Manual.* California Department of Transportation (2012)

Limited Intersection Sight Distance

The following access points had identified intersection sight distance issues:

- **The Purple Place Retail Center:** the eastern access has limited sight distance looking west, and the western access has limited sight distance looking east. The retaining walls and a vertical curve are primarily contributing factors limiting the sight distance for right and left out movements.
- **1072 Green Valley Road:** ISD is limited in both directions due to vegetation.
- **1530/1532/1540 Green Valley Road:** Line of sight for the right-turning vehicles looking west is limited due to the horizontal and vertical curvature of the road.
- **1680 Green Valley Road:** Line of sight to the east and west is limited due to vegetation and a horizontal curve. Trimming of the vegetation could improve ISD to the west, and all sight distances were acceptable when the vehicle position was moved to 10 feet from the edge of the roadway.
- **1840 Green Valley Road Home and Eastern Strawberry Entrance:** Line of sight to the west from both the 1840 Green Valley Road home access and the second entrance to the strawberry stand (coming from the west) is limited due to vegetation but could be improved with tree removal by the private property owner. ISD to the east is limited from the home driveway due to the vertical crest of the road.
- **1855 Green Valley Road:** ISD is limited in both directions due to vegetation to the west and vertical curvature to the east. ISD to the west for the unmarked access across the street is also limited due to vertical curvature.
- **Lexi Way:** ISD to the east is restrictive due to the vertical crest in the roadway.
- **1870/1880 Green Valley Road:** ISD to the east was extremely limited due to the vertical crest in the roadway.
- **1901 Green Valley Road:** ISD is poor in both directions due to the hillside, vegetation, and vertical and horizontal curvature.
- **Unknown Driveway (Lion Entrance):** ISD is limited to the west because of horizontal and vertical curves and vegetation.
- **1937 Green Valley Road:** ISD is limited to the east because of vegetation, but would be improved with the trimming.
- **1960 Green Valley Road:** ISD is limited in both directions due to the vertical crest in the road and vegetation.
- **2001 Green Valley Road:** ISD is poor to the west due to vegetation, hillside, and vertical curvature. ISD is limited to the east due to the vertical curve of the roadway.
- **2020 Green Valley Road:** ISD is limited to the west because of a vertical crest in the roadway.
- **2045/2046 Green Valley Road:** ISD is limited to the west because of a vertical crest in the roadway.
- **2321 Green Valley Road:** ISD is limited to the west due to the vertical curve in the road, and poor to the east due to vegetation and combined vertical and horizontal curvature. Trimming of vegetation will likely not improve ISD.

- **Driveway east of 2801 Green Valley Road:** ISD is limited to the east because of the hillside, but improves by reducing the setback distance to 10 feet from the edge of pavement.

Limited Stopping Sight Distance

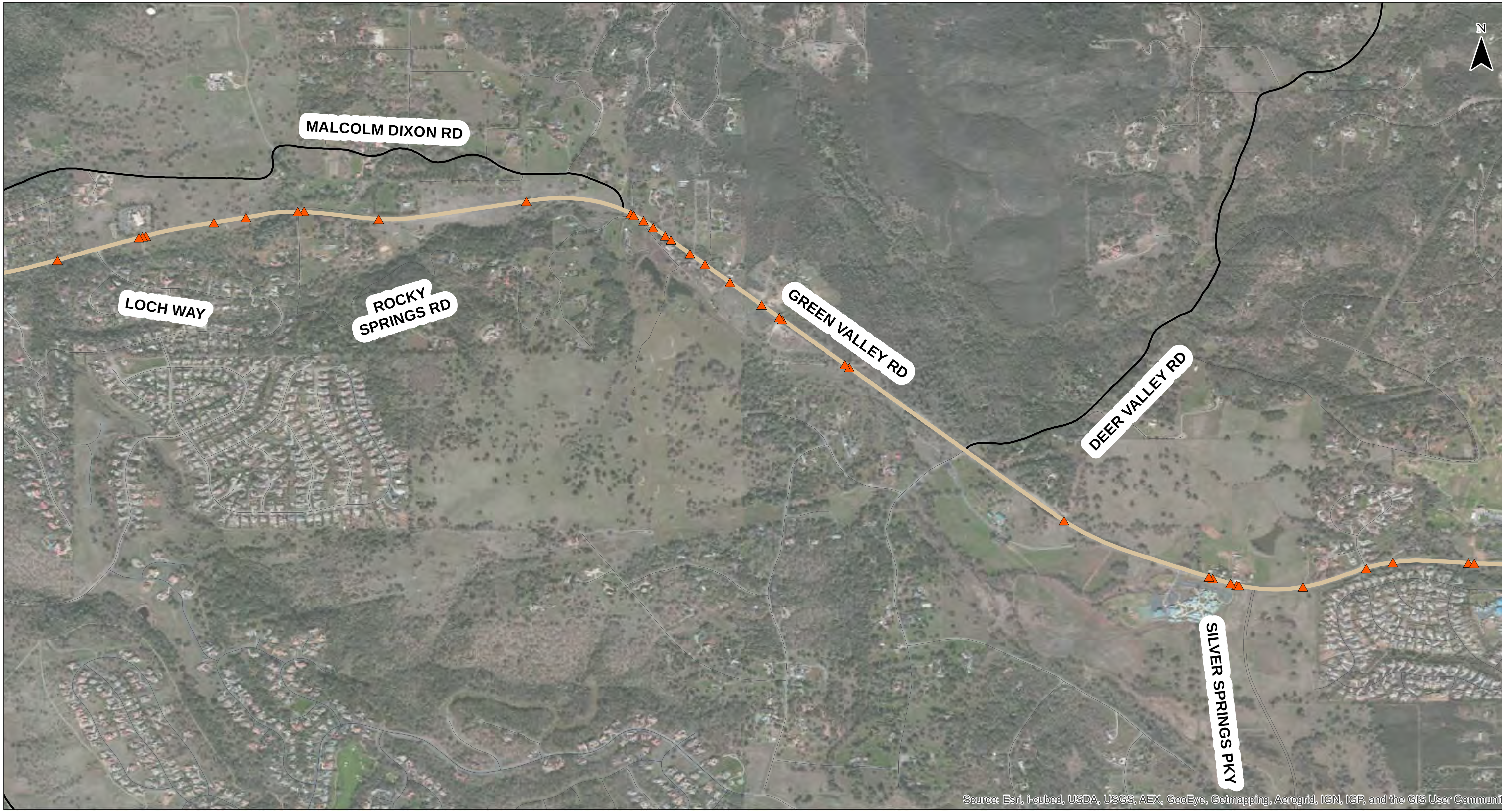
The following access points were identified with the stopping sight distance issues:

- **1530/1532/1540 Green Valley Road:** SSD for eastbound approaching vehicles was limited due to the horizontal and vertical curvature of the road.
- **1680 Green Valley Road:** Stopping sight distance for eastbound approaching vehicles was limited due to the horizontal and vertical curvature of the road.
- **1870/1880 Green Valley Road:** SSD for westbound vehicles approaching the driveway from the east was poor due to the vertical crest in the roadway.
- **1901 Green Valley Road:** SSD is limited for westbound approaching vehicles due to the hillside, vegetation, and horizontal curvature.
- **1960 Green Valley Road:** SSD is limited for westbound approaching vehicles because of vertical curvature and vegetation.
- **2001 Green Valley Road:** SSD is limited for westbound approaching vehicles because of vertical curvature and vegetation.
- **2321 Green Valley Road:** SSD is limited for westbound approaching vehicles due to the vertical crest in the road.
- **Travois Circle:** SSD is limited for westbound approaching vehicles due to the horizontal curve of the roadway.

The Purple Place Retail Center

The Purple Place Retail Center is located on the north side of Green Valley Road east of Sophia Parkway. In the westbound direction, Green Valley Road provides a 2% to 3% downgrade near The Purple Place. Motorists traveling in the westbound direction and wanting to enter The Purple Place Retail Center must decelerate to negotiate tight right-turn radii at the driveway. As a result, trailing motorists in the outside lane either slow down or move into the adjacent lane. This could potentially reduce roadway capacity and pose safety issues. Corner sight distance at the western driveway looking east was observed to be limited, primarily due to a horizontal curve. The eastern driveway has limited corner sight distance looking west due to a retaining wall.

Weekday AM and PM peak hour traffic volumes indicate that the western driveway was used more frequently relative to the eastern driveway.



Driveways and Access Points
Study Segments
Highway
Major Road
Minor Road

Driveways and Access Points
Green Valley Road

Exhibit
38

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KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Coordinate System: GCS WGS 1984

Field Review: Pleasant Grove Middle School

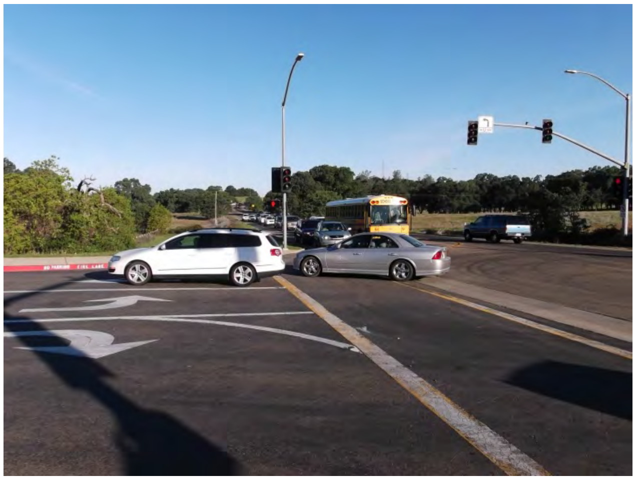
Pleasant Grove Middle School is served by a signalized full-access driveway (western), a right-in/right-out (RIRO) access (middle) and a right-out only access (eastern). Field observations were collected during the school AM and PM peak hours, in the Spring of 2014. During the field visit, the eastern right-out only driveway was closed.

The school provides two pick-up/drop-off areas for parents. The western area is located in front of the play area and eastern area is in front of the school building. The western drop-off area provides a 170-foot long curbside lane, while the eastern area has curbside space of equal length to accommodate loading/unloading vehicles. After loading/unloading, vehicles typically exit the site by either turning around the parking spaces to the north returning to the primary access driveway or by continuing towards the RIRO driveway. The western drop-off area also provides a pass-by lane which allows vehicles to move past the stopped vehicles and access the eastern drop-off area and parking lot. The western drop-off area was observed to be utilized more frequently and heavily relative to the eastern, potentially causing some internal circulation issues which ultimately propagate onto Green Valley Road. School circulation provides a one-way counter-clockwise flow around the parking spaces. A dedicated pick-up/drop-off area as well as bus turnout is provided for the school buses which is located in the southwest of the school site.

Parents, students and employees were observed accessing the school by walking. A continuous sidewalk with appropriate ramps is provided on the south side of Green Valley Road to safely cross the conflicting traffic. However, the site has no internal path or marked crosswalks to direct pedestrian flows to/from the Green Valley Road sidewalk at the RIRO driveway. The sidewalk along the eastern edge of the school site does not extend to connect with the Green Valley Road sidewalk. There were no monitors in the AM peak to direct students and parents to loading/unloading activities.

Operational Observations:

- Most the motorists access the school from the east. Given the western drop-off area is closer to the primary school access, a higher number of parents use this location. Approximately 10 to 12 vehicles were observed to queue up in this area occupying not only the assigned drop-off lane, but also the adjacent pass-by lane. Approximately 10 to 12 vehicles were observed to queue up in the driveway blocking the access the Green Valley Road (see figure below). These queues can also delay the buses from accessing their assigned loading/unloading area.




- When the internal circulation activities peak, parents were observed using the pass-by lane at the western drop-off location as well as parking areas. Some parents were also observed to park vehicles and walk their kids to the curbside.
- The eastern drop-off area is relatively underutilized (see picture below). Use of the eastern drop-off location is also possibly influenced by the current closure of the eastern right-out exit only driveway.

- Some vehicles were using the “red-curbed zone” (where drop-off activities are not allowed) to unload kids.
- Most of traffic exits the school by turning right at the RIRO driveway. Motorists destined to the west must use the signalized driveway.
- While County staff have modified the signal timing of the Pleasant Grove Middle School access to provide a longer green time for the westbound Green Valley Road left-turn phase (current timing sheets provide a maximum of 25 seconds of green time), there are still significant operational issues at this intersection. The westbound Green Valley Road left-turn queues at the

primary school access extend beyond the newly constructed Silver Springs Parkway. The queues lengths sometimes reach Bass Lake Road (see pictures below) which is three-quarters of a mile east of the primary school access. According to Rescue Union School District Superintendent and staff, additional internal striping has been added to the school site since the field review and the westbound left-turn queues in the AM peak have noticeably decreased.


- Circulation and operational issues were predominantly observed at the time of drop-off and typically last for approximately 15-20 minutes.
- Finally, with the recent opening of Silver Springs Parkway, there is a potential that parents would drop-off children at the bus pullout located just south of Green Valley Road. Traffic counts were taken in the AM peak period at the intersection to assess potential vehicles accessing Silver Springs Parkway for the drop-off activities. Seven vehicles accessed Silver Springs Parkway and four vehicles turned onto Green Valley Road from Silver Spring Parkway, potentially representing some vehicles using the newly opened roadway for the school drop-off.

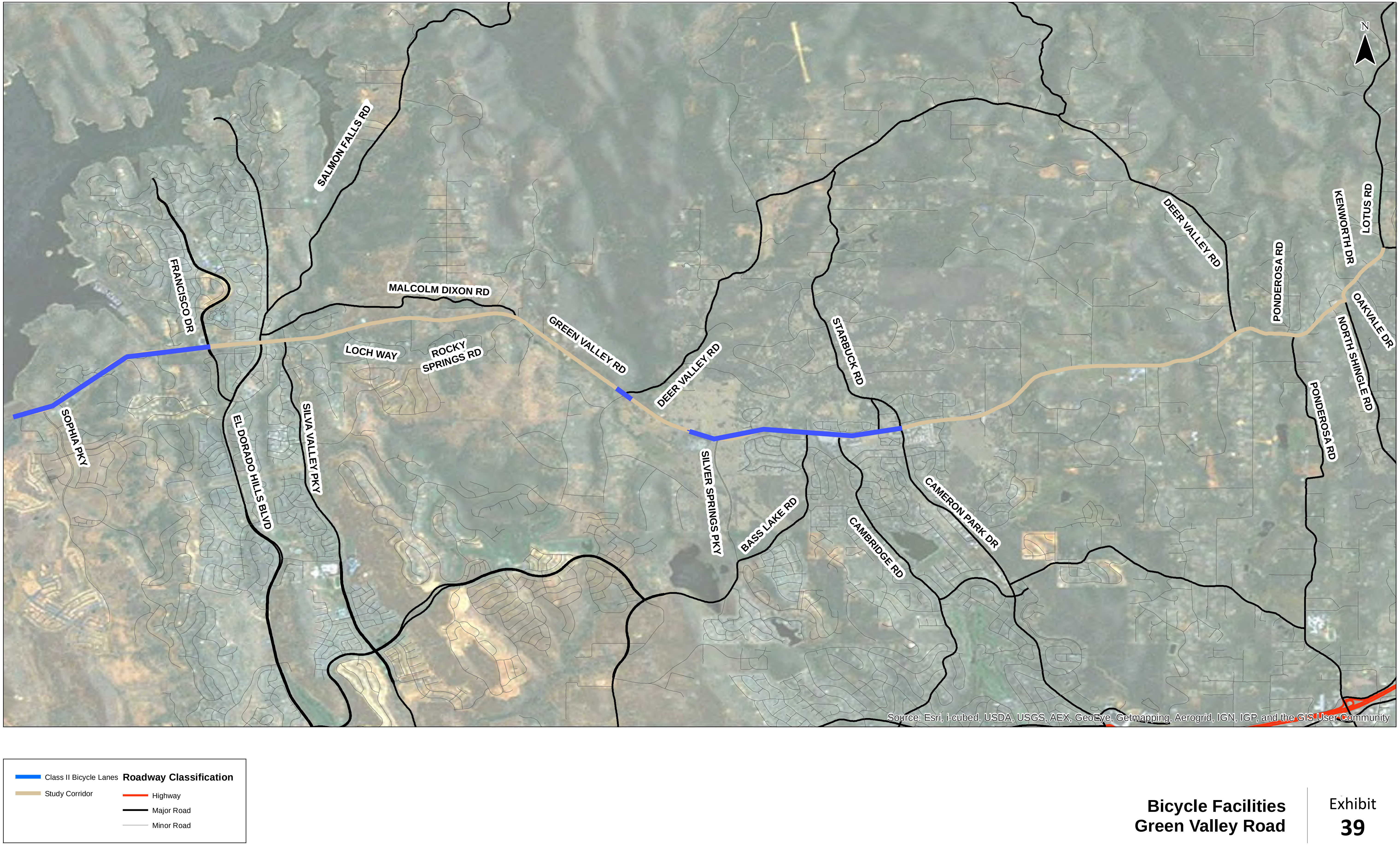
Field Review: Bike Facilities

Class II bicycle lanes are present along portions of the corridor including:

- Westbound:
    - From Cameron Park Drive/Starbuck Road to the Pleasant Grove Middle School main access;
    - From east of Deer Valley Road (West) to west of Deer Valley Road (West); and,
    - From Francisco Drive to the El Dorado/Sacramento County Line.
- Eastbound:
    - From the El Dorado/Sacramento County Line to west of Sophia Parkway;
    - From east of Sophia Parkway to Francisco Drive;
    - From west of Deer Valley Road (West) to east of Deer Valley Road (West); and,
    - From the Pleasant Grove Middle School primary access to Cameron Park Drive/Starbuck Road.

Bike facilities along the corridor are shown in Exhibit 39.

Recreational bicyclists were observed in the above-mentioned Class II bike lanes along the study corridor at different times of the day. Bicyclists were also observed to share the travel lane with motorists from Silva Valley Parkway to Deer Valley Road (West), and from Cameron Park Drive to Ponderosa Road. Bicycle signs marking beginning and end of Class II lanes were inconsistent throughout the corridor. Field observations noted that bicycle lane pavement markings are infrequent along the corridor and are not marked at the far side of all study intersections along the corridor.



Bicycle Facilities
Green Valley Road

Exhibit
39

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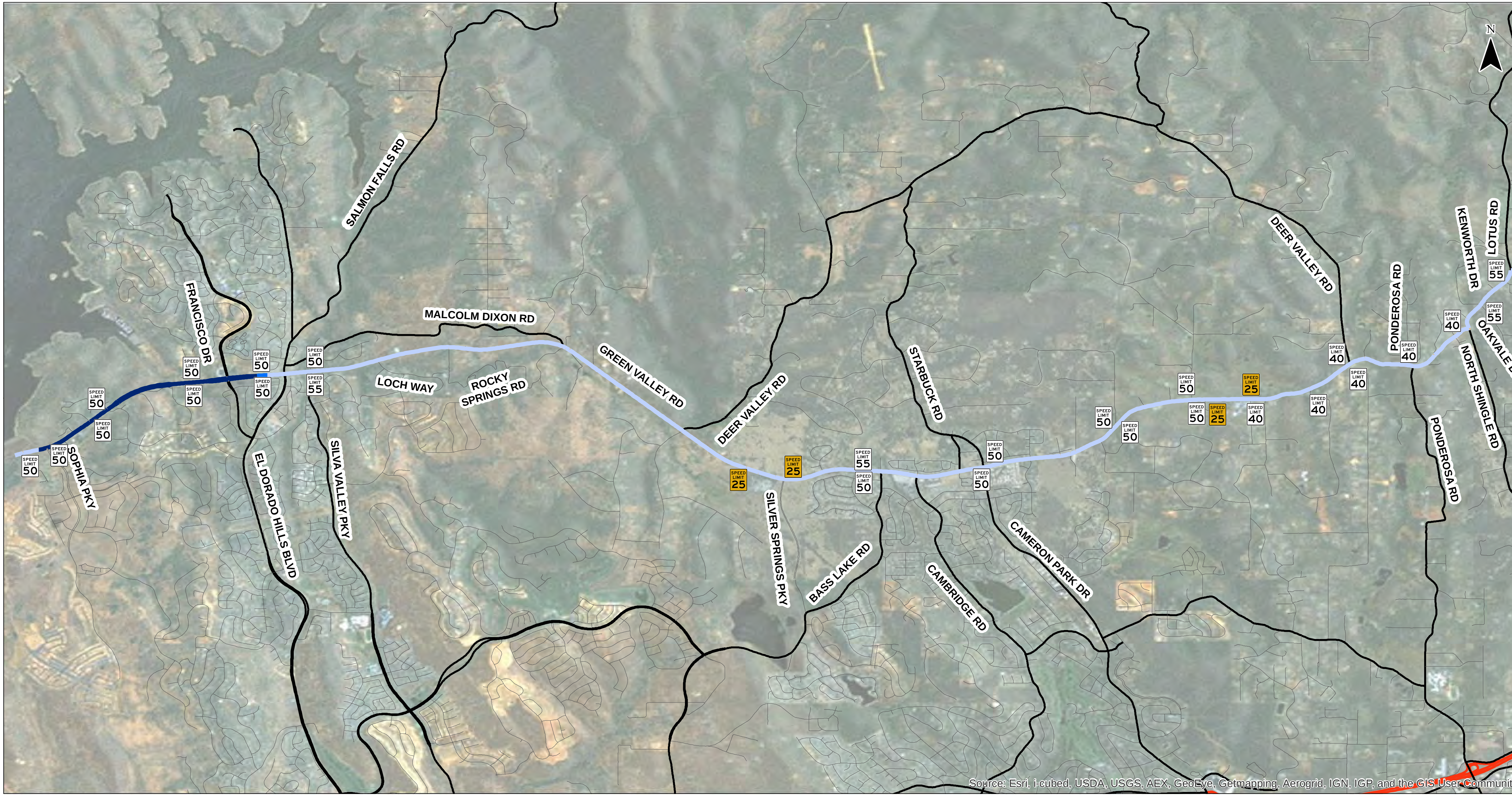
Kittelson & Associates, Inc.
Transportation Engineering/Planning

Coordinate System: GCS WGS 1984

Field Review: Speed Limit Signs

Location and placement of speed limit signs were inventoried and observed. Exhibit 40 illustrates posted speed limits and sign locations in the study corridor. The posted speed limit in the study corridor ranges from 40 to 55 mph; although the corridor should provide adequate signage to mark transition from one speed limit to another. The only segment that provides such transitional treatment is eastbound Green Valley Road just west of Bass Lake Road. When children are present in the vicinity of Pleasant Grove Middle and Rescue Elementary schools, an advisory speed limit of 25 mph is enforced. Barring the segment between Silver Springs Parkway and Cameron Park Drive, the County has recently upgraded the speed limit signs on Green Valley Road to provide higher retro-reflectivity. The County is scheduled to add new retro-reflectivity signage between Silver Springs Parkway and Cameron Park Drive in winter of 2014/2015.

There are no speed limit signs between Silva Valley Parkway and newly constructed Silver Springs Parkway. This is a prima facie speed limit (55 mph), thus it is not signed at a certain interval (CVC 22349). This section of Green Valley Road is approximately 3.2 miles long with several private driveways and minor-street stop controlled intersections.



Number of Lanes and Posted Speed Limit Signs
Green Valley Road

Exhibit
40

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Coordinate System: GCS WGS 1984

CRASH DATA AND STATISTICS

This subsection summarizes crash data, analysis and results at the study locations.

Historical Crash Data and Descriptive Statistics

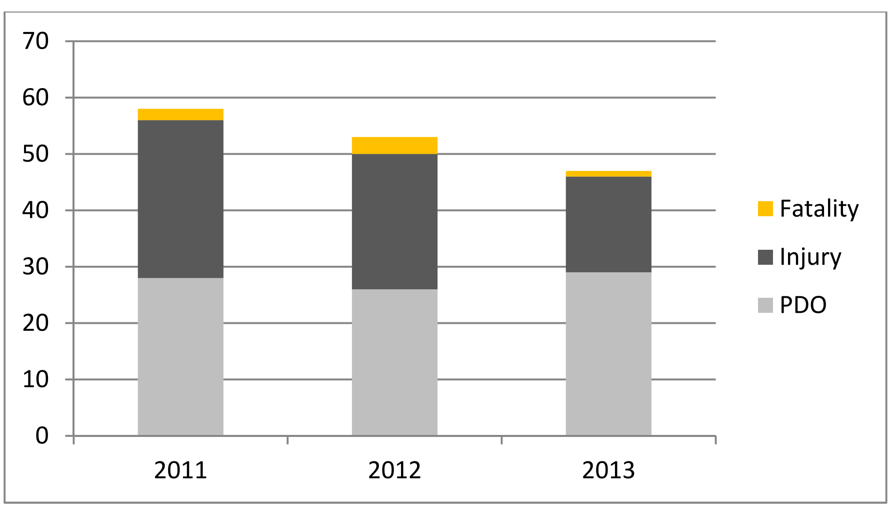
KAI obtained crash data and crash reports along the study corridor of Green Valley Road in El Dorado County over a three-year study period (2011–2013). The crash data and reports were used to conduct a review of the crash history along the study corridor throughout the study period. KAI summarized the crash history and identified characteristics such as: severity (fatal, injury, or property damage only), year and month, collision type, lighting conditions, number of vehicles involved, and frequency by location.

Overall Corridor Trends and Data

Over the study period (January 1, 2011 to December 31, 2013), 158 crashes were reported along the Green Valley Road study corridor. The study corridor spans approximately 10.85 miles along Green Valley Road, from the El Dorado County line to the intersection at Lotus Road.

Of the 158 reported crashes that occurred during the study period, 52 percent resulted in property damage only (PDO), 44 percent resulted in an injury, and four percent resulted in a fatality. Crash severity by year throughout the study period is presented in Exhibit 41. A total of 69 injury crashes, resulting in 113 injuries, and six fatal crashes, resulting in seven fatalities, were reported over the study period.

Exhibit 41. Crash Severity by Year (2011 - 2013)

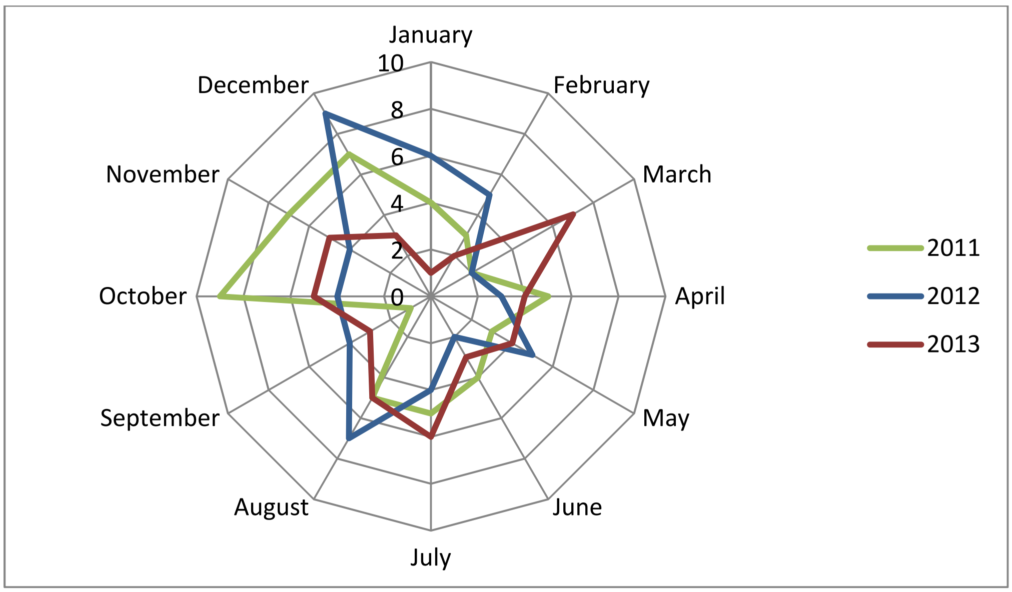


From 2011 to 2013, reported crashes decreased 19 percent along the study corridor. A total of 58 and 53 crashes were reported in the year 2011 and 2012 respectively. The total number of reported crashes reduced to 47 in the year 2013. In 2013, there were also fewer injury and fatality crashes than those reported in 2011 and 2012. In 2011 and 2012, half (50 percent) of the reported crashes had an injury involved, whereas approximately one-thirds of reported crashes had an injury in 2013. The number of injury crashes decreased by 39 percent, while property damage only crashes increased by roughly 4 percent between 2011 and 2013. Each of three years reported at least one fatality with 2012 registering three fatalities.

Crash Frequency by Month

The crash frequency by year and month is shown Exhibit 42. The crash data does not show a consistent trend during the months throughout the study period. Each year experienced a different peak month for crashes. There were no apparent crash patterns from the crash data to suggest that time of year factors into the frequency and severity of the crashes along the study corridor.

Exhibit 42. Crash Frequency by Month (2011 – 2013)



Crash Type

In addition to identifying when crashes occurred throughout the corridor, KAI also reviewed the type of collisions that occurred and considered trends in contributing factors. Table 3 summarizes the collision types within the study corridor.

Table 3. Frequency by Crash Type

Crash Type	Frequency	Percentage
Head-on	4	3%
Sideswipe	8	5%
Rear-end	52	33%
Broadside	31	20%
Fixed-object	31	20%
Overturned	5	3%
Pedestrian	4	3%
Bicycle	6	4%
Animal	6	4%
Parked Vehicle	0	0%
Snow Removal Equipment	0	0%
Other	5	3%
Motorcycle	6	4%
School bus	0	0%

Rear-end crashes were the most frequent crash type (33 percent) throughout the study corridor; with approximately 50 percent of rear-end crashes occurring within the influence area of an intersection[17] (within 250 feet of an intersection). Broadside crashes, generally defined as turning movement and angle crashes, accounted for 20 percent of all crashes along the study corridor. Approximately two-thirds of the broadside crashes occurred within an intersection's influence area.

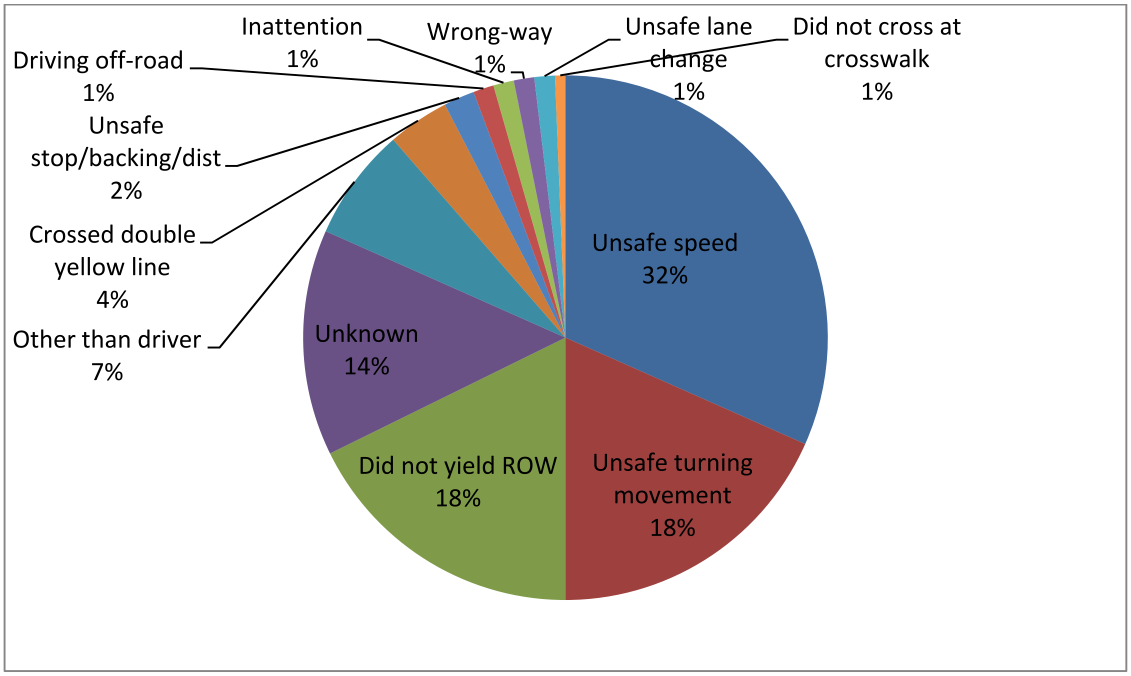
Twenty percent of crashes were fixed-object. Fixed-object crashes, as well as overturned vehicles were included in the analysis of the "Roadway Departure Crashes" section below. Crashes that involved a pedestrian and/or bicycle accounted for seven percent of reported crashes.

Contributing Factors

The crash data provided by the County of El Dorado included the contributing factors for each of the reported crashes. The contributing factors included in the crash reports were used to analyze crash data to identify areas along the study segment that may benefit from improvement. Exhibit 43 provides an overview of the contributing factors for the reported crashes along the Green Valley Road corridor.

[17] Crash data provided at each intersection determined the influence area.

Exhibit 43. Corridor-Wide Contributing Factors of Crashes (2011 - 2013)



The crash data includes 12 contributing factors for crashes along the corridor. Approximately one-third of crashes along the corridor cited “unsafe speed” as a contributing factor for the crash. Unsafe speed was cited as the contributing factor for approximately 70 percent of all reported rear-end crashes, the most common crash type. “Unsafe turning movement” and “Did not yield right of way (ROW)” accounted for 36 percent of reported crashes. These crashes generally involved vehicles making left or right turns at intersections. “Other than driver” is noted as a crash factor when the police officer determined that the crash was unavoidable or did not result from the driver’s fault. Eighty percent of the “Other than driver” crashes note hitting an animal as a factor contributing to the incident. Contributing factors of crashes on the roadway segments and at the intersections are discussed further in the Contributing Factors by Location section of the report.

Roadway Departure Crashes

Twenty-nine percent (46 crashes) of all reported crashes along the corridor were single vehicle crashes, meaning another vehicle was not involved in the incident. Of the 46 single vehicle crashes, roughly three-quarters of them involved roadway departures, resulting in fixed object collisions and/or overturned vehicles. Forty-four percent of the roadway departure crashes resulted in injury.

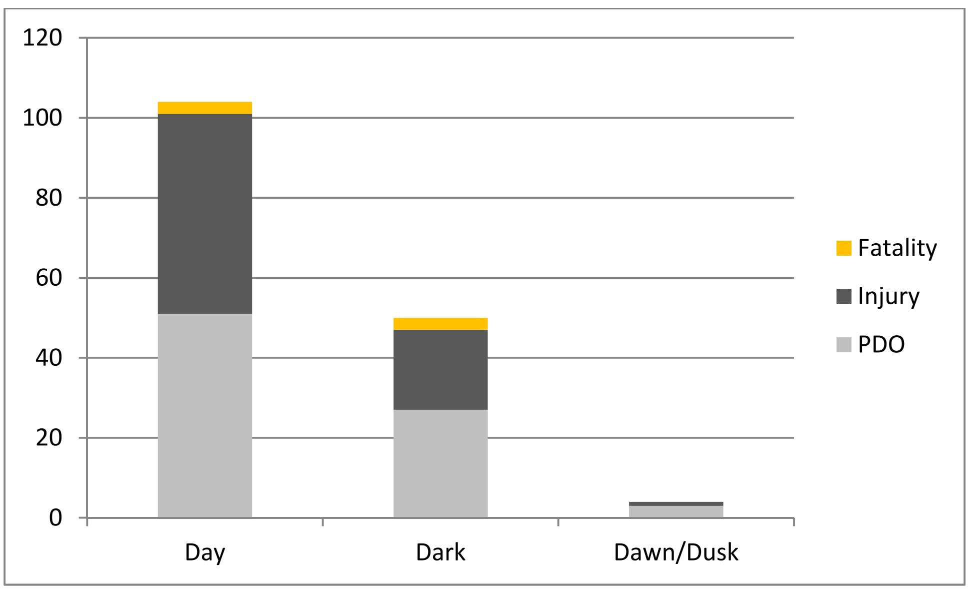
A total of 17 alcohol-related crashes were reported during the study period. Crash reports indicate that approximately one-third of the roadway departure crashes involved alcohol and nearly 60 percent of all crashes involving alcohol resulted in a roadway departure crash. In addition, wet or icy/snowy pavement conditions were cited in one-quarter of the roadway departure crashes.

Lighting

Approximately one-third of the reported crashes on the corridor occurred in non-daylight lighting conditions (dawn, dusk or dark), as seen in Exhibit 44. When considering roadway segments exclusively, the percentage of non-daylight crashes increases to 40 percent. Although the majority of crashes typically occurred in daylight condition, the crashes occurring during non-daylight hours were spread throughout the study corridor. However, there is a concentration of non-daylight crashes that occurred on the eastbound and westbound approaches of the Green Valley Road/El Dorado Hills Boulevard/Salmon Falls Road intersection.

During field studies, KAI observed the corridor and the surrounding area was dark in the evening, with the exception of the Sophia Parkway and Francisco Drive intersections. The majority of the roadway segments and intersections are unlighted in particular the unsignalized intersections. Light poles were observed at select intersections, positioned to illuminate the minor approach and pedestrian crosswalk. Light poles are present at the these intersections: Sophia Parkway, Francisco Drive, El Dorado Hills Boulevard/Salmon Falls Road, Silva Valley Parkway/Allegheny Road, Pleasant Grove School Access, Silver Springs Parkway/Bass Lake Road, Cambridge Road, Cameron Park Drive, and North Shingle Road.

Exhibit 44. Crashes by Lighting Conditions (2011 – 2013)



Location Specific Crash Data Trends and Patterns

This section presents the crash data and observations at the study intersections and study segments.

Severity, Frequency and Rate by Location

Green Valley Road corridor crash data was reviewed and analyzed by KAI on a corridor wide level, as well as by intersection and roadway segment. Table 2 categorizes the crashes by severity that occurred along the study roadway segments. A total of 81 crashes or approximately 51 percent of all crashes along the corridor occurred on roadway segments. The crash rate[18] is calculated based on annual average crashes per Million Vehicles Miles (MVM). The County has a threshold of 1.7 crashes per MVM for the segment to be considered for further evaluation and possible treatments[19]. As illustrated in Table 4, none of the roadway segments exceeded that threshold during the study period. The locations with the highest crash rates are El Dorado Hills Boulevard to Silva Valley Parkway (1.22 crashes per MVM), Cameron Park Drive to Ponderosa Road (0.90 crashes per MVM) and Malcom Dixon Road to Deer Valley Road (West) (0.65 crashes per MVM). The segment of Sophia Parkway to Francisco Drive had the highest number of crashes, however it also serves the highest amount of traffic, and therefore the crash rate is lower than other locations with fewer crashes. The Sophia Parkway to Francisco Drive segment registered more severe crashes than PDO crashes in the study period.

Table 3 categorizes all of the crashes that occurred within the intersection influence area of study intersections along the Green Valley Road corridor. Overall, approximately 49 percent of crashes occurred at study intersections along the corridor. The crash rate is calculated based on annual average crashes per Million Entering Vehicles (MEV). Intersections with crash rates above 1.0 crash per MEV are considered for further evaluation[20]. As illustrated in Table 5, none of the study intersections exceeded that threshold during the study period. The locations with the highest crash rates are Cameron Park Drive (0.83 crashes per MEV), Ponderosa Road (0.83 crashes per MEV), and Deer Valley Road (West) (0.52 crashes per MEV) intersections. While the Sophia Parkway intersection recorded the highest number of crashes, it also serves a high number of vehicles; therefore the crash rate is lower than other locations with fewer crashes. The Ponderosa Road intersection had a higher proportion of severe crashes than the other study intersections.

Crash frequency alone is often inadequate when comparing multiple intersections or prioritizing locations for improvement. Crash rates can be a useful tool to determine how a specific intersection or segment compares to the average on the roadway network. However, using a crash rate alone to identify potential safety issues has a disadvantage: lower volume sites tend to experience a higher crash rate and higher volumes may reflect a lower crash rate.

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[18] The ratio of crash frequency (crashes per year) to vehicle exposure (number of vehicles entering the intersection or segment) results in a crash rate.

[19] Annual Accident Location Study, El Dorado County – Department of Transportation prepared on May 18, 2012

[20] Annual Accident Location Study, El Dorado County – Department of Transportation prepared on May 18, 2012

Table 4. Crash Severity and Frequency by Segment

Segment	No. of Crashes	Corridor Percent	PDO	Injury	Fatal	Crash Rate per MVM
1. County Line to Sophia Parkway	1	1%	0	1	0	0.18
2. Sophia Parkway to Francisco Drive	22	14%	8	12	2	0.60
3. Francisco Parkway to El Dorado Hills Boulevard	4	3%	2	2	0	0.64
4. El Dorado Hills Boulevard to Silva Valley Parkway	7	4%	4	3	0	1.22
5. Silvia Valley Parkway to Malcom Dixon Road	7	4%	4	3	0	0.33
6. Malcom Dixon Road to Deer Valley Road (W)	8	5%	6	2	0	0.65
7. Deer Valley Road (W) to Bass Lake Road	8	5%	3	5	0	0.49
8. Bass Lake Road to Cameron Park Drive	2	1%	0	2	0	0.23
9. Cameron Park Drive to Ponderosa Road	19	12%	9	9	1	0.90
10. Ponderosa Road to N Shingle Road	1	1%	1	0	0	0.42
11. N Shingle Road to Lotus Road	2	1%	2	0	0	0.40
ENTIRE CORRIDOR	81	51%	39	39	3	0.51
Source: Kittelson & Associates						

Table 5. Crashes at Study Intersections

Green Valley Road Intersection with	No. of Crashes	Corridor Percent	PDO	Injury	Fatal	Crash Rate per MEV
1. Sophia Parkway	15	9%	10	5	0	0.38
2. Francisco Drive	8	5%	7	1	0	0.19
3. El Dorado Hills Boulevard/Salmon Falls Road	6	4%	4	2	0	0.19
4. Silva Valley Parkway/Allegheny Road	0	0%	0	0	0	0.00
5. Loch Way	2	1%	0	2	0	0.15
6. Rocky Springs Road/Steve's Way	1	1%	0	1	0	0.08
7. Malcom Dixon Road	3	2%	2	1	0	0.23
8. Deer Valley Road (West)	7	4%	2	4	1	0.52
9. Pleasant Grove School Access	2	1%	1	1	0	0.15
10. Bass Lake Road	1	1%	0	1	0	0.05
11. Cambridge Road/Peridot Drive	4	3%	4	0	0	0.24
12. Cameron Park Drive	15	9%	12	3	0	0.83
13. Deer Valley Road (East)	2	1%	0	2	0	0.30
14. Ponderosa Road	5	3%	1	2	2	0.83
15. North Shingle Road	4	3%	1	3	0	0.37
16. Lotus Road	2	1%	1	1	0	0.17
ENTIRE CORRIDOR	77	49%	45	29	3	0.27
Source: Kittelson & Associates						

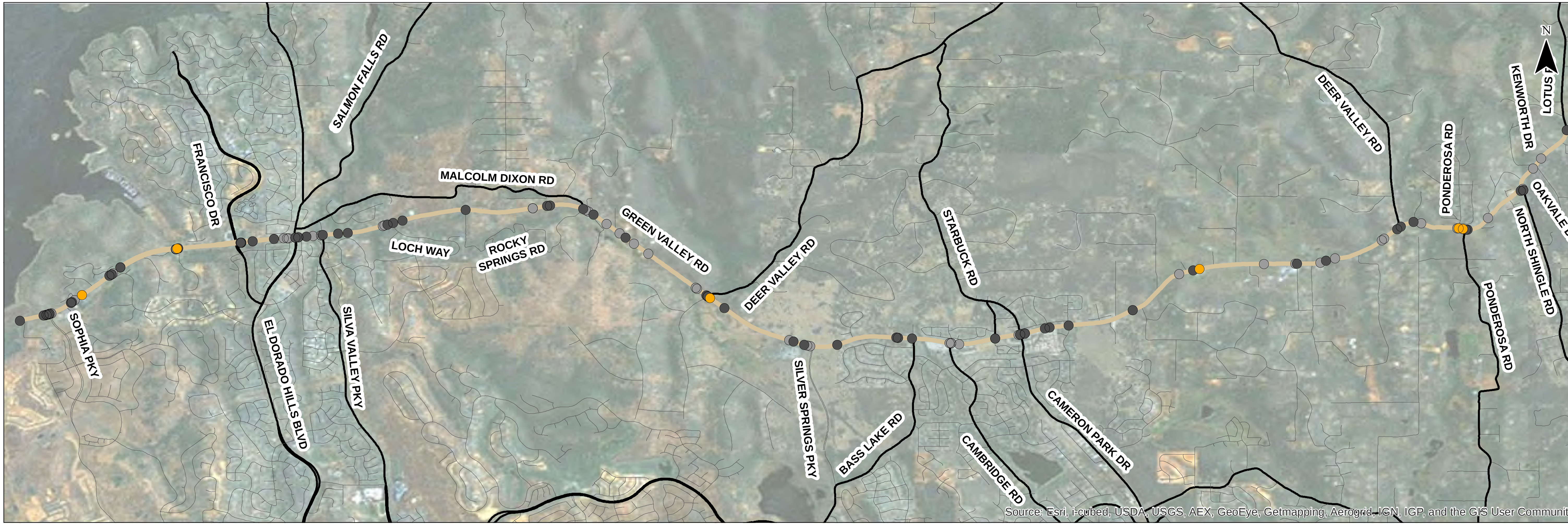
There are two separate corresponding locations along the study corridor that have a higher than average crash frequency than the rest of the corridor: Sophia Parkway to Francisco Drive and Cameron Park Drive to Ponderosa Road. In addition, fatal crashes were reported at these segment locations as well.

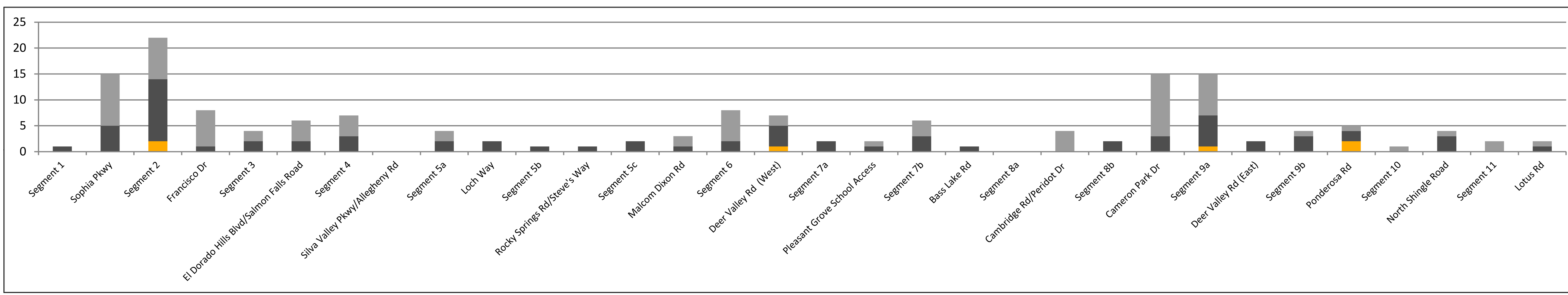
Crash frequency and crash severity (property damage only, injury crash, and fatality) is plotted by location in Exhibit 45. Segments #5, 7, 8 and 9 were divided into smaller sub-segments to enable review of crashes that occurred between the study intersections. Sub-segments are referred to by letter (e.g., Segment #5b).

On the west side of the study corridor, the roadway segment east of Sophia Parkway to west of the Francisco Drive intersection (Segment #2) had 22 reported crashes throughout the study period. Additionally, there were 15 crashes reported at the Sophia Parkway intersection, five of which were reported as injury crashes. Along Segment #2, 22 crashes were reported, two of which involved a fatality and twelve of which resulted in injuries. Segment #2 also had the highest mid-week (Tuesday-Thursday) average daily traffic (ADT) of 26,300 vehicles.

On the east side of the Green Valley Road corridor reported crashes were concentrated at the Cameron Park Drive intersection (Intersection #12) and the roadway segment between Cameron Park Drive and Deer Valley Road (East) (Segment #9a). There were a total of 30 crashes at these two locations, with 15 reported crashes at Intersection #12 and 15 reported crashes along Segment #9a. Two-thirds of the crashes at these two locations were reported as property damage only, with one fatal crash reported along Segment #9a.

Overall, 51 percent (81 crashes) of all crashes were reported along the roadway segments and 49 percent (77 crashes) of crashes were reported at study intersections along the Green Valley Road study corridor. Approximately 60 percent of injury crashes were reported along the roadway segments, while the majority (54 percent) of property damage only crashes occurred at the study intersections along the study corridor. Two of the six fatal crashes occurred at the intersection of Green Valley Road/Ponderosa Road (Intersection #14) and on the segment between Sophia Parkway and Francisco Drive each. One of the two fatality crashes at the Ponderosa Road intersection involved Driving under Influence (DUI), and second resulted from fall of a tree branch on the car.





Collisions by Severity

- Fatal
- Injury
- PDO

- Study Corridor
- Major Road
- Minor Road

Crash Frequency and Severity
Green Valley Road
2011 - 2013

Exhibit
45

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Coordinate System: GCS WGS 1984

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Crash Type by Location

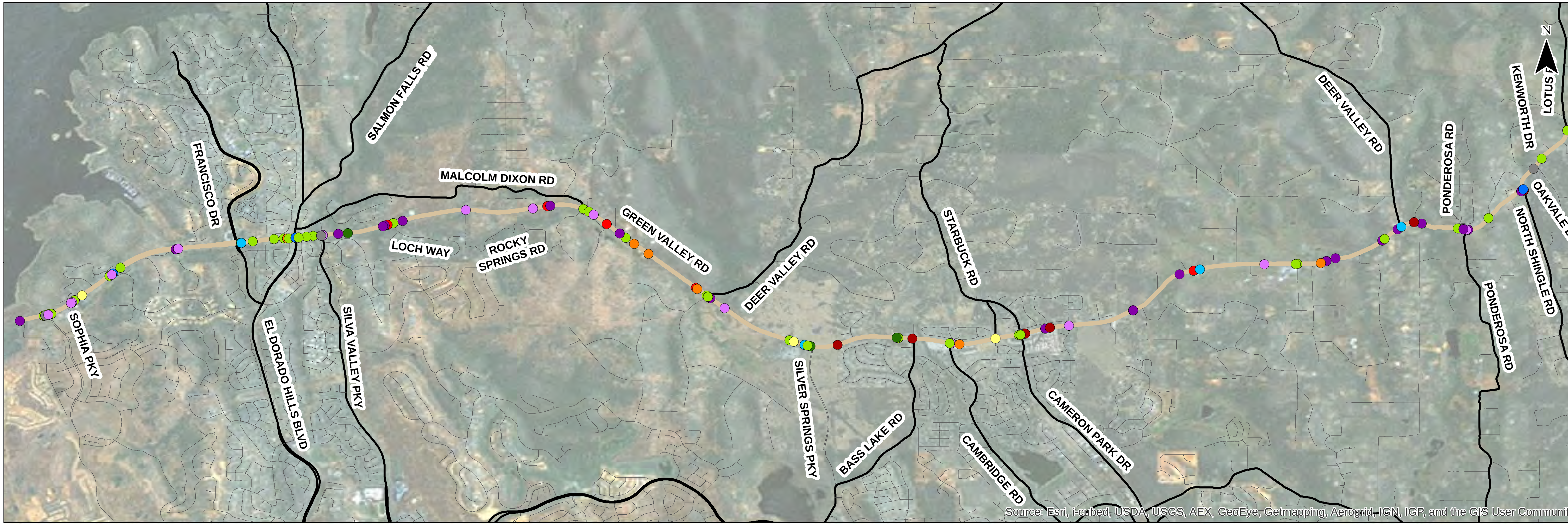
There were three crash types that accounted for nearly three-quarters of the crashes along the Green Valley Road study corridor. One-third of crashes were reported as rear-end crashes, followed by 20 percent broadside or turning collision crashes, and 20 percent fixed-object crashes. The study intersections accounted for 52 percent of rear-end crashes, 58 percent of broadside crashes, and 65 percent of the fixed-object crashes occurred between the study intersections. Crash type by location along the Green Valley Road study corridor is illustrated in Exhibit 46. In addition to the plots of crash type by location, the exhibit provides a bar chart with overall crash type statistics at each study intersection and roadway segment.

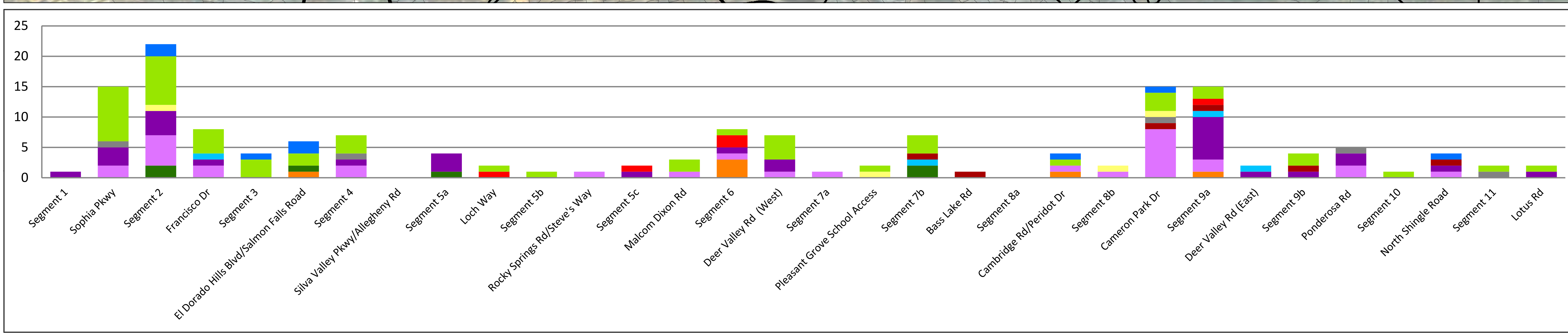
The Sophia Parkway intersection accounted for approximately 32 percent of rear-end crashes along the corridor. This intersection carries the highest ADT along the corridor. Eight of the nine rear-end crashes that occurred at the Sophia Parkway intersection cited unsafe speed as the contributing factor. The Francisco Drive and Deer Valley Road (West) intersection reported four rear-end crashes each. Two of the four rear-end crashes that occurred at the Francisco Drive reported unsafe speed as the contributing factor, while all four rear-end crashes at the Deer Valley Road (West) intersection cited unsafe speed as the contributing factor.

Segment #2 (east of Sophia Parkway to west of Francisco Drive) accounted for approximately 22 percent of broadside crashes along the corridor. This segment carries the highest ADT along the corridor. Segment #2 is one of the few roadway segments that include a two-way left-turn lane. This allows vehicles to make permitted left-turns across oncoming traffic to access commercial properties and residential development on either side of Green Valley Road. Three of the five broadside crashes that occurred along this segment involved left-turns from minor streets or driveways where the two-way left-turn lane is present. Each of those crashes reported a failure to yield right-of-way as the contributing factor of the crash. The highest concentration (25 percent) of broadside crashes occurred at the Cameron Park Drive intersection. The intersection includes left-turn lanes and a protected signal phase on each approach. The southbound approach has a business access driveway within the intersection influence area. Seven of the eight broadside crashes occurred on the south leg of the intersection, potentially influenced by the business driveways that feed onto Cameron Park Drive

The roadway segment #9 (from Cameron Park Drive to Ponderosa Road) accounted for 25 percent of the fixed-object crashes along the study corridor. This roadway segment has two undivided travel lanes, with unpaved shoulders in either direction between Crowdis Lane and Ponderosa Road. Guard rails along the side of the road are intermittently placed throughout the segment. In addition to the fixed-object crashes, this segment also had one animal-related crash. Crash reports did not specify the type of objects that were struck by vehicles.

There were six animal-related crashes reported along the corridor; half of them occurred on roadway Segment #6. This is roughly a one mile segment east of the Malcom Dixon Road intersection to west of the Deer Valley Road (West) intersection. Segment #6 provides one lane in each direction with open fields and undeveloped land on either side of the roadway.





Collisions by Crash Type

- Head-on
- Sideswipe
- Rear-end
- Broadside
- Fixed object
- Overturned
- Pedestrian
- Bicycle
- Motorcycle
- Animal
- Other
- Study Corridor
- State Route 50
- Major Road
- Minor Road

Crashes by Types
Green Valley Road
2011 - 2013

Exhibit
46

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Coordinate System: GCS WGS 1984

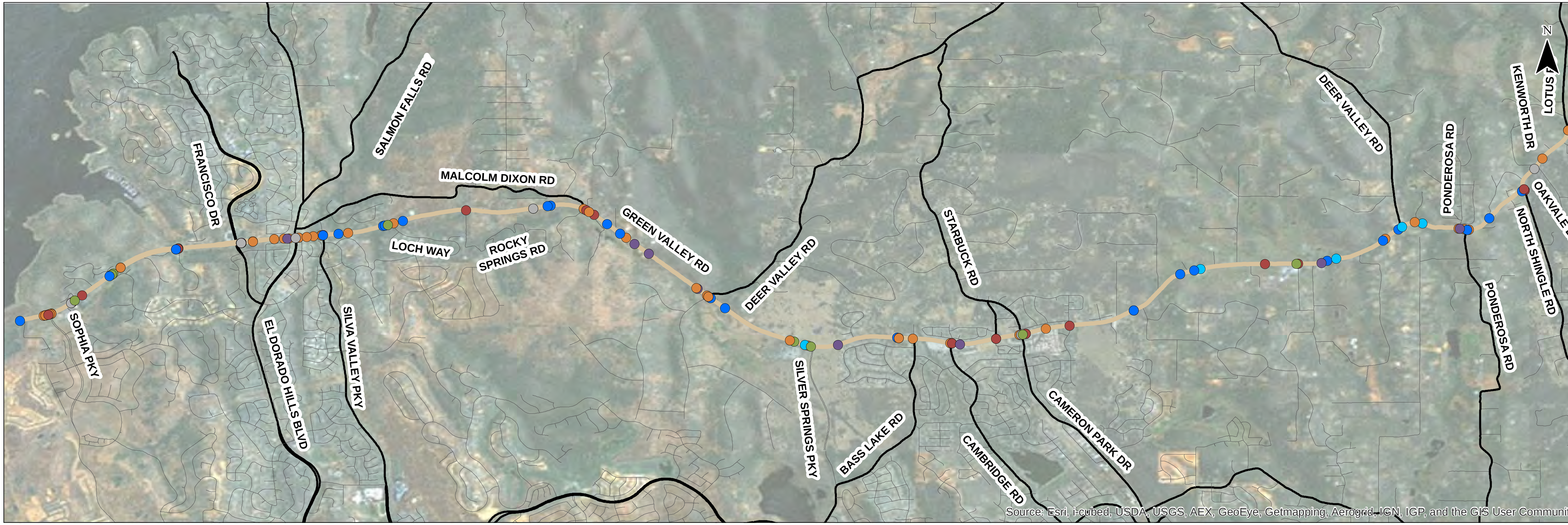
Contributing Factors by Location

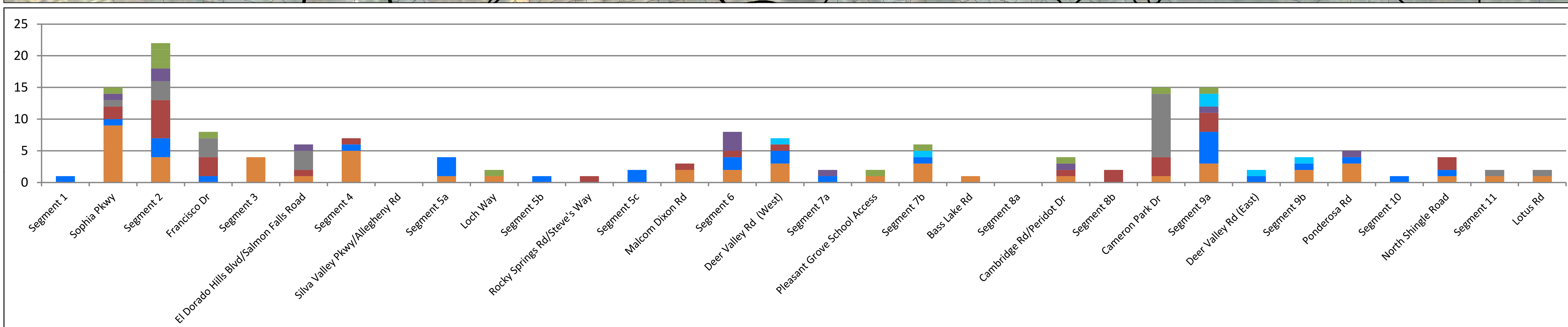
Exhibit 47 shows each location of a crash by its contributing factor along the Green Valley Road corridor. Approximately one-third of crashes cited unsafe speed as a contributing factor of an incident. The Sophia Parkway intersection accounted for a total of nine of those crashes which is the most at any intersection or roadway segment. The 85th percentile speed east of this intersection was recorded as 60 miles per hour (mph) in both directions. Most of the crashes on Segment #2, #3 and #4, which experienced higher traffic volumes relative to other study segments, cited unsafe speed as one of the top contributing factor.

The other top contributing factors were “unsafe turning movement” and “did not yield Right of Way (ROW)”. Segment #2 also recorded six crashes where the driver did not yield ROW. It is also the only segment with a continuous two-way left-turn lane for the majority of the segment. Drivers that did not yield ROW accounted for 18 percent of crashes along the corridor.

Crashes that cited unsafe turning movements as a contributing factor for an incident also accounted for 18 percent of the crashes along the corridor. Segment #5 (east of Silva Valley Parkway to west of Malcom Dixon Road) and Segment #9 (east of Cameron Park Drive to west of Deer Valley Road (East)) recorded nearly 30 percent (11 crashes) of crashes with unsafe turning movements as a contributable factor of the crash. These roadway segments are similar in that they have one travel lane in each direction and no exclusive right or left-turn lanes for vehicles entering or departing Green Valley Road onto or from local streets.

The contributing factor of 14 percent of crashes along the corridor was cited as unknown. While this amount of unknown factors is not unusual considering the amount of crash data provided, it is worth noting that approximately 71 percent or 10 of the unknown factors for a crash occurred at the Cameron Park Drive intersection. Of those ten collisions, seven were classified as broadside crashes on the south leg of the intersection.





Contributing Factor

- Unsafe Speed
- Did Not Yield ROW
- Unsafe Turning Movement
- Crossed Double Yellow Line
- Other Than Driver
- Other Factor
- Unknown Factor
- Study Corridor
- State Route 50
- Major Road
- Minor Road

Crashes by Contributing Factor
Green Valley Road
2011 - 2013

Exhibit
47

Kittelson & Associates, Inc.
Transportation Engineering/Planning

Coordinate System: GCS WGS 1984

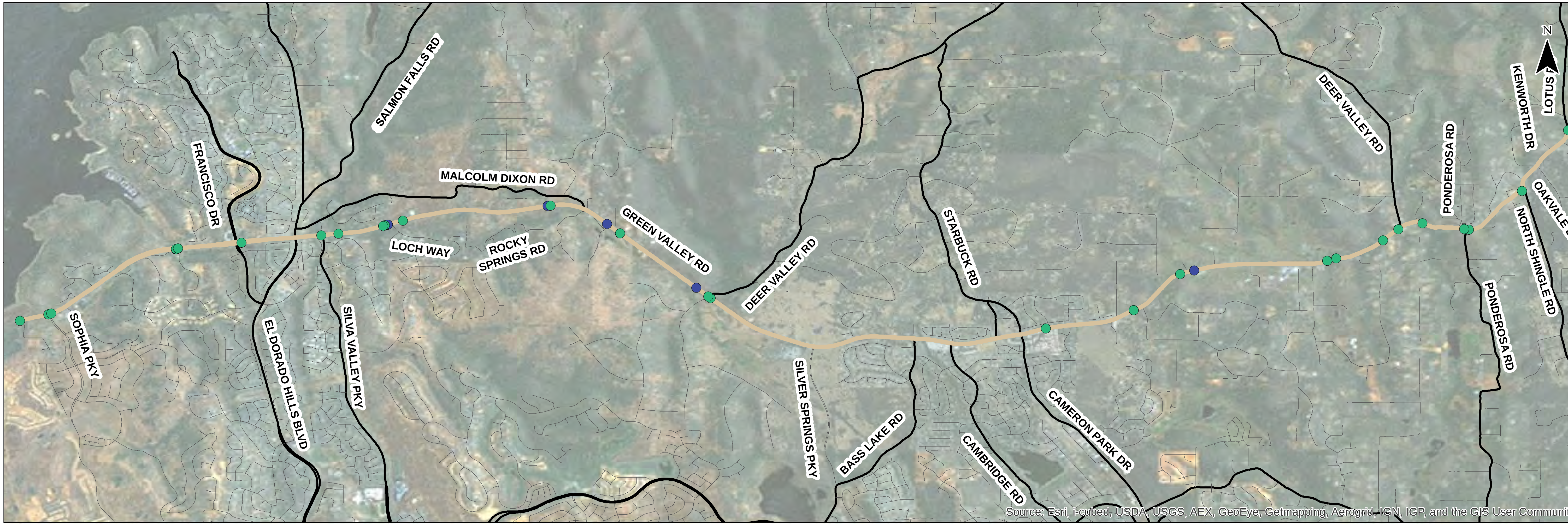
Roadway Departure Crashes

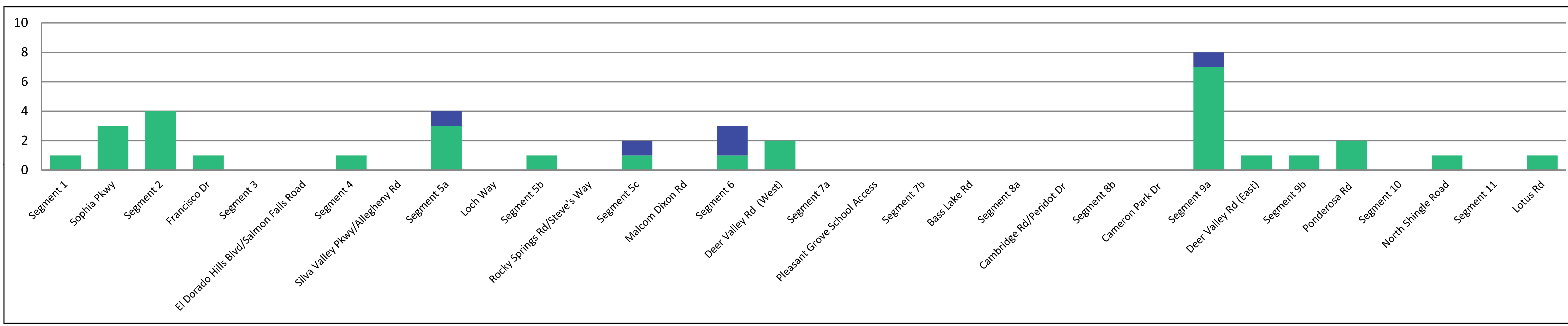
As mentioned previously, twenty-nine percent (46 crashes) of the reported crashes along the corridor were single vehicle crashes. Of the 46 single vehicle crashes, roughly three-quarters of them involved roadway departures resulting in fixed object collisions and/or overturned vehicles. Exhibit 48 displays roadway departure crashes resulting in fixed-object collisions or overturned vehicles by their location.

Approximately one-quarter of roadway departure crashes occurred on Segment #9 (from east of Cameron Park Drive to west of Ponderosa Road). Segment #5 (from Silva Valley Parkway to west of Malcom Dixon Road) and Segment #2 (from east of Sophia Parkway to west of Francisco Drive) recorded five and four roadway departure crashes respectively. Five of seven roadway departure crashes on Segment #5 occurred at night.

Lighting Incidents by Location

Exhibit 49 illustrates the crashes along the corridor by natural lighting conditions. Approximately 65 percent of reported crashes occurred during the day. Of the crashes that did occur at night, 62 percent of them occurred on roadway segments where street lighting was not present. Segment #9 had eight crashes at night, the most at any intersection or roadway segment along the corridor. The highest concentration of non-daylight crashes occurred on the eastbound and westbound approaches of the Green Valley Road/El Dorado Hills Boulevard/Salmon Falls Road intersection. Although there are overhead street lights, crash data does not provide enough evidence to suggest that lighting was a contributing factor on the cause of a crash. Crash data indicates that fifteen of the 36 roadway departure crashes (42 percent) occurred at night.





Roadway Departure Collisions

- Fixed object
- Overturned
- Study Corridor
- Major Road
- Minor Road

Roadway Departure Crashes
Green Valley Road
2011 - 2013

Exhibit

48

Coordinate System: GCS WGS 1984

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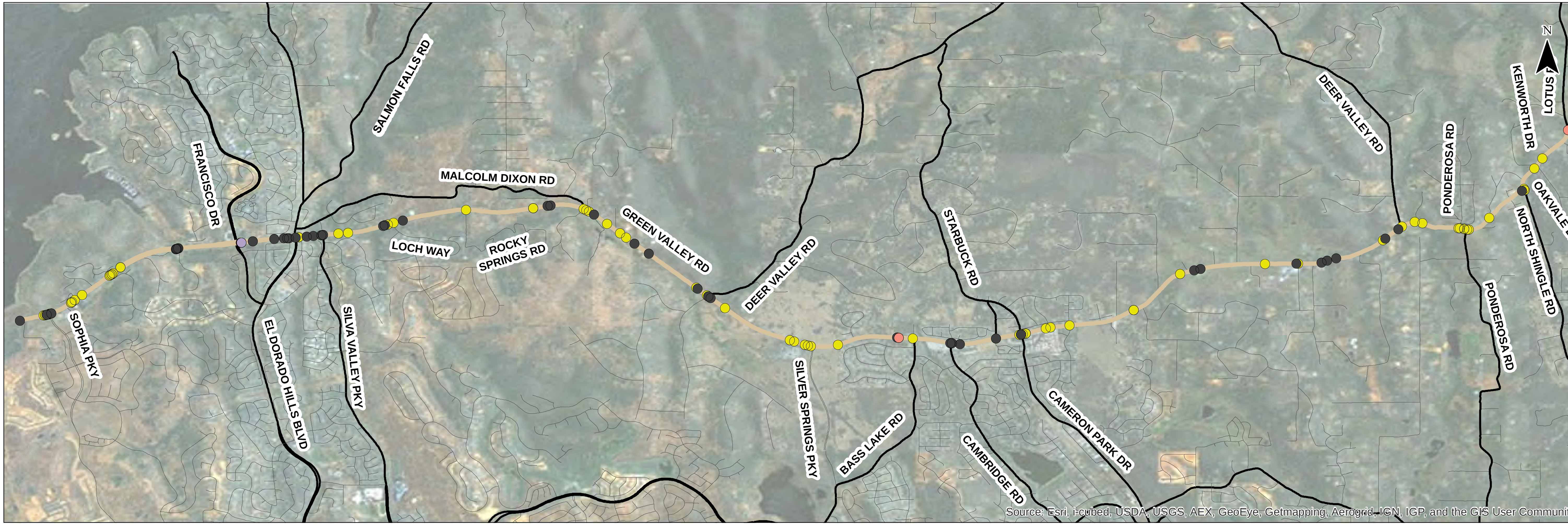

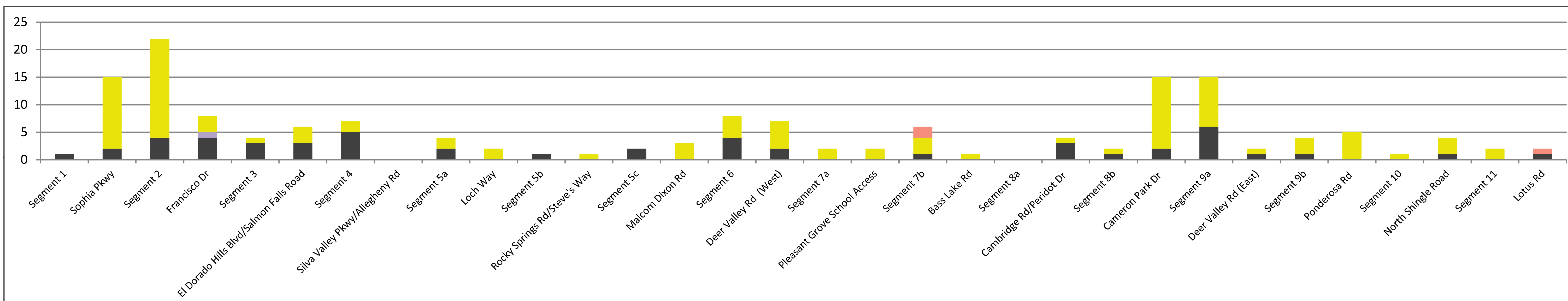

Collisions by Time of Day

- Dawn
- Dusk
- Dark
- Day

- Study Corridor
- Major Road
- Minor Road

Crashes by Time of Day
Green Valley Road
2011 - 2013

Exhibit
49

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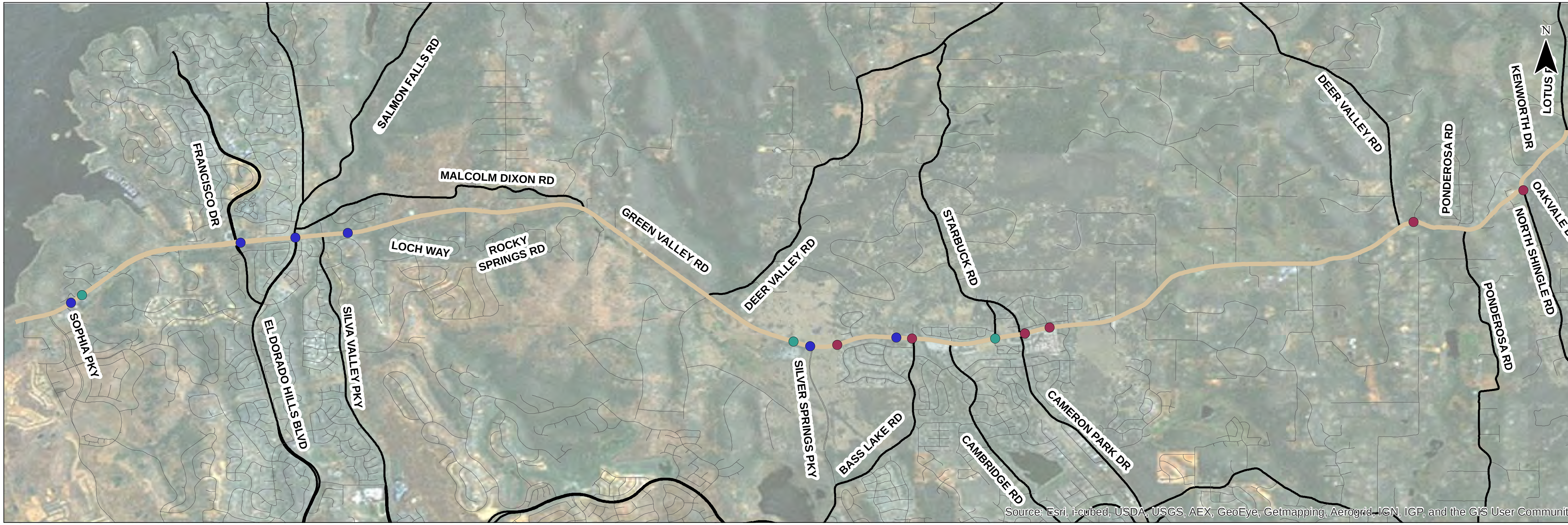
Coordinate System: GCS WGS 1984

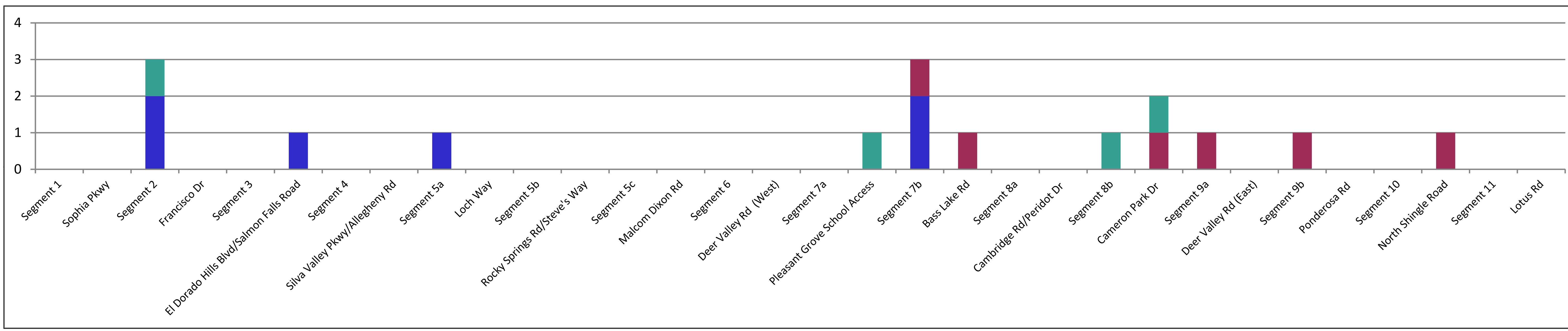
Vulnerable Road User Crashes

Vulnerable road user crashes are defined as crashes that involved pedestrians, bicycles, and motorcycles. There were a total of 16 crashes involving vulnerable road users which accounted for approximately 10 percent of all reported crashes along the corridor. There were two crashes involving bicycles on Segment #7, as well as a pedestrian related crash at the Pleasant Grove School Access. There is a note in the police report which indicated that the pedestrian-related incident at the Pleasant Grove School Access did not use a designated crosswalk on Green Valley Road. The remaining pedestrian incidents note that a contributing factor was the motorist did not yield right-of-way to the pedestrian. Four of the six motorcycle incidents reported unsafe speed as a contributing factor. Each of these six motorcycle crashes occurred during dry and daylight conditions. Each of the six motorcycle crashes occurred on the eastside of the corridor, between Pleasant Grove Middle School and Lotus Road.

Five of the six bicycle crashes occurred along Segments #2, #5, and #7. Bike lanes are present in both directions along Segments #2 and #7. Bike lane signs do not exist along Segment #5, however, approximately five- to seven-foot wide shoulder on either side of Green Valley Road can accommodate bicyclists. Exhibit 50 illustrates the crashes along the Green Valley Road corridor that involved vulnerable road users.

Exhibit 50. Vulnerable Roadway User Crashes by Location





Vulnerable Road User Collisions

- Pedestrian
- Bicycle
- Motorcycle

- Study Corridor
- Major Road
- Minor Road

Crashes by Vulnerable Road User
Green Valley Road
2011 - 2013

Exhibit
50

Coordinate System: GCS WGS 1984

H:\projfile\17805 - Green Valley Road Corridor Analysis - El Dorado County\gis\VulnerableRoadUsersV2.mxd - mbraughton - 1:12 PM 8/21/2014

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

TRAFFIC OPERATIONS ANALYSIS

This subsection summarizes traffic data collection, historical traffic count data, operational analysis methodology and results at the study locations.

Analysis Methodology

Field reconnaissance was undertaken to ascertain the operational characteristics of each of the study area intersections and roadway segments. Roadway operations are typically governed by, and most constrained at, intersections. The measure of effectiveness commonly used to determine the quality or level of service (LOS) experienced by motorists at intersections is average control delay. The methodology used to analyze intersection LOS is outlined in the Transportation Research Board's Highway Capacity Manual, 2010 version (HCM 2010). LOS is a qualitative measure of driver satisfaction and is quantitatively expressed by the level of delay and congestion experienced by motorists using an intersection. LOS is designated by the letters A through F, with A being the best condition and F being the worst (high delay and congestion).

Signalized Intersections Analysis

Signal-controlled intersections were analyzed using the operational methodology outlined in the HCM 2010, Chapter 18. This procedure calculates the average control delay per vehicle at a signalized intersection, and assigns a LOS designation based upon the delay. The SYNCHRO 8.0 software package was used to perform LOS analysis. Intersection geometrics were based on aerial imagery and field observations. Peak hour traffic volumes were based on empirical traffic counts collected during May 2014 while school was in session. Peak hour factors (i.e., the ratio of total hourly volume to the peak 15-minute flow rate within the hour) were calculated for each intersection approach using the traffic count data. Heavy vehicle percentages were based on vehicle classification counts and were applied for each movement. Bicycle and pedestrian counts were used, with a minimum of two pedestrians per approach per peak hour. Signal phasing and timings were based on current timing sheets provided by El Dorado County.

Unsignalized Intersections Analysis

Two-way stop-controlled intersections were analyzed utilizing the methodology outlined in the HCM 2010, Chapter 19. This method calculates average delay per vehicle for each major street movement and minor street left-turn movements - based on the availability of adequate gaps in the main street through traffic. At intersections with minor street stop control, most of the major street traffic experiences little or no delay, and by definition have acceptable conditions. The major street left-turn movements and the minor street movements are all susceptible to delay of varying degrees. Generally, the higher the major street traffic volumes, the higher the delay for the minor movements.

Intersection geometrics and traffic control data were gathered using aerial imagery and field observations. Peak hour traffic volumes were observed and entered according to the peak hours studied for each intersection. Peak hour factors for each intersection and peak period were calculated based on traffic counts and applied to each approach at the intersection. Heavy vehicle percentages were also calculated based on traffic counts and were applied for each movement. Counted bicycle and pedestrian volumes were used.

Table 6 shows the intersection LOS criteria for signalized and unsignalized intersections according to the HCM 2010.

Table 6. LOS Criteria for Signalized and Unsignalized Intersections

	Average Delay (sec/veh)		
LOS	Signalized	Unsignalized	Description
A	< 10.0	< 10.0	Very Low Delay: This occurs when progression is extremely favorable and most vehicles arrive during a green phase. Most vehicles do not stop at all.
B	>10.0 & <20.0	>10.0 & <15.0	Minimal Delays: This generally occurs with good progression, short cycle lengths, or both. More vehicles stop than at LOS A, causing higher levels of average delay.
C	>20.0 & <35.0	>15.0 & <25.0	Acceptable Delay: Delay increases due to only fair progression, longer cycle lengths, or both. Individual cycle failures (*to service all waiting vehicles*) may begin to appear at this level of service. The number of vehicles stopping is significant, though many still pass through the intersection without stopping.
D	>35.0 & <55.0	>25.0 & <35.0	Approaching Unstable/Tolerable Delays: The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	>55.0 & <80.0	>35.0 & <50.0	Unstable Operation/Significant Delays: These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.
F	>80.0	>50.0	Excessive Delays: This level, considered to be unacceptable to most drivers, often occurs with oversaturation (i.e., when arrival flow rates exceed the capacity of the intersection). It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Source: *Highway Capacity Manual,* Transportation Research Board, Washington D.C, 2010

Roadway Segment Analysis

Roadway segment LOS was determined using the methodology for multilane highways and two-lane highways outlined in the HCM 2010, Chapters 14 and 15. For multilane highways the calculation of the density of the traffic stream determines level of service. Density measures the proximity of vehicles to each other in the traffic stream.

For two-lane highways, the level of service calculation is dependent on the class of the roadway. Class I two-lane highways are highways where motorists expect to travel at high speeds. Class II two-lane highways are lower speed highways and serve scenic routes or areas of rugged terrain. Class III two-lane highways serve moderately developed areas with higher densities of local traffic and roadside access. Roadway segments along Green Valley Road are made up of Class II and Class III two-lane highways. For Class II highways, LOS is determined based on the percent time spend following (PTSF). This measure is calculated as the percentage of vehicles traveling at headways of less than three seconds. For Class III highways, the percent of free-flow speed is used to determine LOS. This measure represents the ability of vehicles to travel at the posted speed limit.

Table 7 and Table 8 show the segment LOS criteria for multilane highways and two-lane highways, respectively, according to the HCM 2010.

Table 7. LOS Criteria for Multilane Highway Segments

<table>
<tr><th>LOS</th><th>Free Flow Speed (mi/h)</th><th>Density (pc/mi/ln)</th></tr>
<tr><td>A</td><td>All</td><td>>0 -11</td></tr>
<tr><td>B</td><td>All</td><td>>11-18</td></tr>
<tr><td>C</td><td>All</td><td>>18-26</td></tr>
<tr><td>D</td><td>All</td><td>>26-35</td></tr>
<tr><td rowspan="4">E</td><td>60</td><td>>35-40</td></tr>
<tr><td>55</td><td>>35-41</td></tr>
<tr><td>50</td><td>>35-43</td></tr>
<tr><td>45</td><td>>35-45</td></tr>
<tr><td rowspan="5">F</td><td colspan="2">Demand Exceeds Capacity</td></tr>
<tr><td>60</td><td>>40</td></tr>
<tr><td>55</td><td>>41</td></tr>
<tr><td>50</td><td>>43</td></tr>
<tr><td>45</td><td>>45</td></tr>
<tr><td colspan="3">Source: Highway Capacity Manual, Transportation Research Board, Washington D.C, 2010</td></tr>
</table>

Table 8. LOS Criteria for Two-Lane Highway Segments

LOS	Class II Highways: Percent Time Spent Following (%)	Class III Highways: Percent Free-Flow Speed (%)
A	0-40	>91.7
B	>40-55	>83.3-91.7
C	>55-70	>75.0-83.3
D	>70-85	>66.7-75.0
E	>85	0-66.7

Source: *Highway Capacity Manual,* Transportation Research Board, Washington D.C., 2010

Thresholds of Significance

Circulation Policy TC-Xd of the El Dorado County General Plan provides level of service standards for County-maintained roads and state highways as follows:

> *Level of Service (LOS) for County-maintained roads and state highways within the unincorporated areas of the county shall not be worse than LOS E in the Community Regions or LOS D in the Rural Centers and Rural Regions except as specified in Table TC-2. The volume to capacity ratio of the roadway segments listed in Table TC-2 shall not exceed the ratio specified in that table. Level of Service will be as defined in the latest edition of the Highway Capacity Manual (Transportation Research Board, National Research Council) and calculated using the methodologies contained in that manual. Analysis periods shall be based on the professional judgment of the Department of Transportation which shall consider periods including, but not limited to, Weekday Average Daily Traffic (ADT), AM Peak Hour, and PM Peak hour traffic volumes.*

As such, intersections and segments in the community region will be evaluated against LOS E threshold, while those in rural region will be against LOS D.

Existing and Historical Traffic Data

Intersection and roadway segment counts were collected to evaluate the existing traffic conditions. Weekday AM (6:30 to 9:30) and PM (3:30 to 6:30) peak period turning movement counts were performed on May 6, 2014 (Tuesday) at the study intersections. School afternoon peak period (1:30 to 3:30 PM) turning movement counts were also performed on May 6, 2014 at the selected intersections. Peak hour[21] within these count periods varies by intersection; although, traffic volumes at the study intersections generally peaked for an hour between 7:00 and 8:30 in the weekday morning and 4:45 and 6:00 in the weekday afternoon.

Roadway segment data were collected from May 3, 2014 to May 11, 2014 to capture a full week. The segment data included traffic counts, classification counts and speed measurements. The road tubes that capture volume and speed data malfunctioned at Segment #7 and 9. Therefore, the traffic data collected in May was discounted. Once the Rescue School District and Folsom Lake College resumed in August, traffic data was re-collected at these two locations from August 23, 2014 to August 29, 2014.

The raw traffic data is provided in Appendix 3.

No major incidents or construction closures appeared during the data collection efforts that could have affected the traffic patterns along Green Valley Road. A traffic signal at the Silver Springs Parkway and Green Valley Road intersection was activated on May 28, 2014.

[21] Highest hourly volumes within the count period.

Historical traffic data was obtained from the County of El Dorado from 2010 to 2014. These counts were provided for study roadway segments and intersections along the Green Valley Road corridor to analyze five year trends in average daily traffic (ADT) and turning movement volumes along the Green Valley Road corridor. In addition to the counts provided by the County of El Dorado, KAI collected segment and intersection traffic counts during the first week of May 2014. These counts were used in conjunction with the historical counts to calculate the 2014 ADT along the study corridor. The comparison of existing 2014 data with historical counts was used to verify that existing counts accurately reflected growth and historical trends. This was done to ensure that the new counts were representative and identify discrepancies for further review. The 2014 counts collected by KAI also included westbound and eastbound speeds along each of the study segments. A summary of the analysis of the corridor's counts and speeds are presented below.

Historical Roadway Counts Summary

Historical counts provided by the County of El Dorado were collected during the summer and winter months from 2010 to 2014. The majority of the counts were collected during January and July. Not all count data was available for each identified study segment, and some counts were only provided during one time of the year. Counts were averaged based on the historical count data that was provided. The 2014 ADT also include the counts collected by KAI.

The historical counts included vehicular volumes for one week during each of the data collection periods. This allowed KAI to calculate a mid-weekday, weekly, and weekend average. Mid-week days include Tuesday, Wednesday, and Thursday and generally represent the highest ADT during the week. Weekly data includes the entire week, while weekend data includes only Saturday and Sunday. Table 9 summarizes the data that was collected and provided for each of the study segments. Segment data that includes at least one year of historical data was used to calculate the percent change in ADT relative to 2014. It should be noted that the historical count data was not available for Segment #5 (east of Silva Valley Parkway to west of Malcolm Dixon Road) and Segment #6 (east of Malcolm Dixon Road to Deer Valley Road (West)). As a result, the 2014 data for Segment #5 and 6 were excluded from the calculation of average ADTs.

The traffic conditions along the corridor vary from one end to the other. Overall, the 2014 ADT on the study segments match fairly closely with the historical data, verifying trends. In some cases, the 2014 ADT reflects a positive growth compared to the historical data, while for some other cases 2014 data indicates a slight decline in traffic volumes. All the data being compared were not collected in the same month, and therefore, small deviation from a year to another is plausible. Average mid-week and weekly traffic volumes in 2014 slightly declined relative to historical data at two segments: Sophia Parkway to Francisco Drive, and Cameron Park Drive to Ponderosa Road. Weekly and weekend average ADT in 2014 also experienced mixed growth (i.e. positive or negative) relative to previous years data.

Table 9. ADT along Green Valley Road Corridor (2010 - 2014)

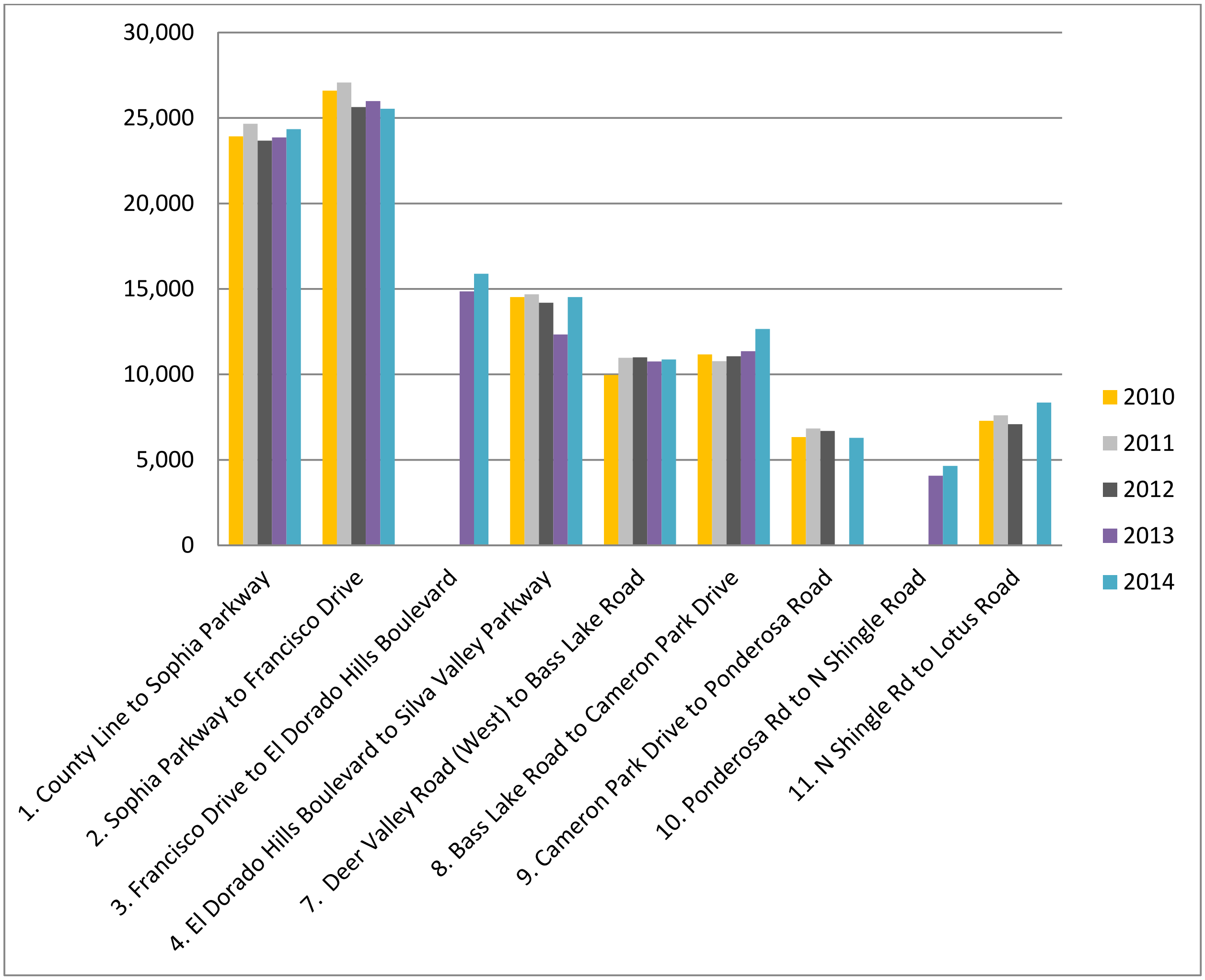
Segment	Duration	Average Daily Traffic					Percent Change in 2014 from Prior Years			
		2010	2011	2012	2013	2014	2010	2011	2012	2013
1. County Line to Sophia Parkway	Mid-Weekday Avg	23,926	24,666	23,671	23,862	24,346	1.8%	-1.3%	2.9%	2.0%
	Weekly Avg	22,874	23,370	22,697	22,475	23,884	4.4%	2.2%	5.2%	6.3%
	Weekend Avg	20,115	20,162	19,913	19,470	21,469	6.7%	6.5%	7.8%	10.3%
2. Sophia Parkway to Francisco Drive	Mid-Weekday Avg	26,600	27,080	25,640	25,987	25,539	-4.0%	-5.7%	-0.4%	-1.7%
	Weekly Avg	25,161	25,610	24,675	25,881	25,001	-0.6%	-2.4%	1.3%	-3.4%
	Weekend Avg	21,946	21,830	21,782	21,699	22,861	4.2%	4.7%	5.0%	5.4%
3. Francisco Drive to El Dorado Hills Boulevard	Mid-Weekday Avg	-	-	-	14,857	15,889	-	-	-	7.0%
	Weekly Avg	-	-	-	14,467	15,871	-	-	-	9.7%
	Weekend Avg	-	-	-	13,324	15,410	-	-	-	15.7%
4. El Dorado Hills Boulevard to Silva Valley Parkway	Mid-Weekday Avg	14,522	14,682	14,195	12,334	14,527	0.0%	-1.1%	2.3%	17.8%
	Weekly Avg	12,925	14,341	13,665	12,033	14,565	12.7%	1.6%	6.6%	21.0%
	Weekend Avg	11,388	12,819	12,372	11,029	13,618	19.6%	6.2%	10.1%	23.5%
7. Deer Valley Road (West) to Bass Lake Road	Mid-Weekday Avg	9,963	10,970	10,997	10,759	10,871	9.1%	-0.9%	-1.1%	1.0%
	Weekly Avg	10,078	9,893	10,193	11,035	10,210	1.3%	3.2%	0.2%	-7.5%
	Weekend Avg	9,238	8,493	8,153	8,475	8,688	-6.0%	2.3%	6.6%	2.5%
8. Bass Lake Road to Cameron Park Drive	Mid-Weekday Avg	11,165	10,776	11,065	11,358	12,662	13.4%	17.5%	14.4%	11.5%
	Weekly Avg	10,194	10,732	10,439	-	11,970	17.4%	11.5%	14.7%	-
	Weekend Avg	8,559	9,394	8,913	-	10,199	19.2%	8.6%	14.4%	-
9. Cameron Park Drive to Ponderosa Road	Mid-Weekday Avg	6,337	6,832	6,692	-	6,290	-0.7%	-7.9%	-6.0%	-
	Weekly Avg	5,737	6,857	5,971	-	6,341	10.5%	-7.5%	6.2%	-
	Weekend Avg	4,901	4,965	4,448	-	4,884	-0.3%	-1.6%	9.8%	-
10. Ponderosa Rd to N Shingle Road	Mid-Weekday Avg	-	-	-	4,071	4,651	-	-	-	14.2%
	Weekly Avg	-	-	-	4,267	4,418	-	-	-	3.5%
	Weekend Avg	-	-	-	3,299	3,902	-	-	-	18.3%
11. N Shingle Rd to Lotus Road	Mid-Weekday Avg	7,282	7,605	7,091	-	8,349	14.7%	9.8%	17.7%	-
	Weekly Avg	6,586	-	7,019	-	7,979	21.2%	-	13.7%	-
	Weekend Avg	5,511	5,908	6,431	-	6,987	26.8%	18.3%	8.6%	-

Source: Kittelson & Associates, 2014

Mid-Week Average Daily Traffic

With exception to Segment #2 (Sophia Parkway to Francisco Drive) and Segment #9 (Cameron Park Drive to Ponderosa Road), the mid-week ADT along the corridor grew ranging from 2.5 percent to 17 percent relative to the prior year. Throughout the study period, Segment #2 (Sophia Parkway to Francisco Drive) had the highest ADT among all of the study segments, with 2013 registering the highest traffic volumes during mid-week days. The majority of commercial development along the study corridor is located on the north and south sides of Segment #2 and #3. In addition, Segment #2 serves many residential subdivisions that access Green Valley Road and provide accessibility to El Dorado Hills Boulevard, which provides a route to U.S. 50 to the south which runs parallel to Green Valley Road. As such, this segment provides one of the main routes into and out of the County and is subject to commute traffic leaving the residential subdivisions. The lowest ADT (approximately 4,650) occurred along Segment #10 (Ponderosa Road to North Shingle Road), which provides very little development and access to three local streets along the segment. Exhibit 51 shows the ADT per year of mid-weekdays throughout the study period. Overall trend for the mid-week ADT indicates that the current year (2014) volumes may not be highest at all study segments, but match very closely with the historical data.

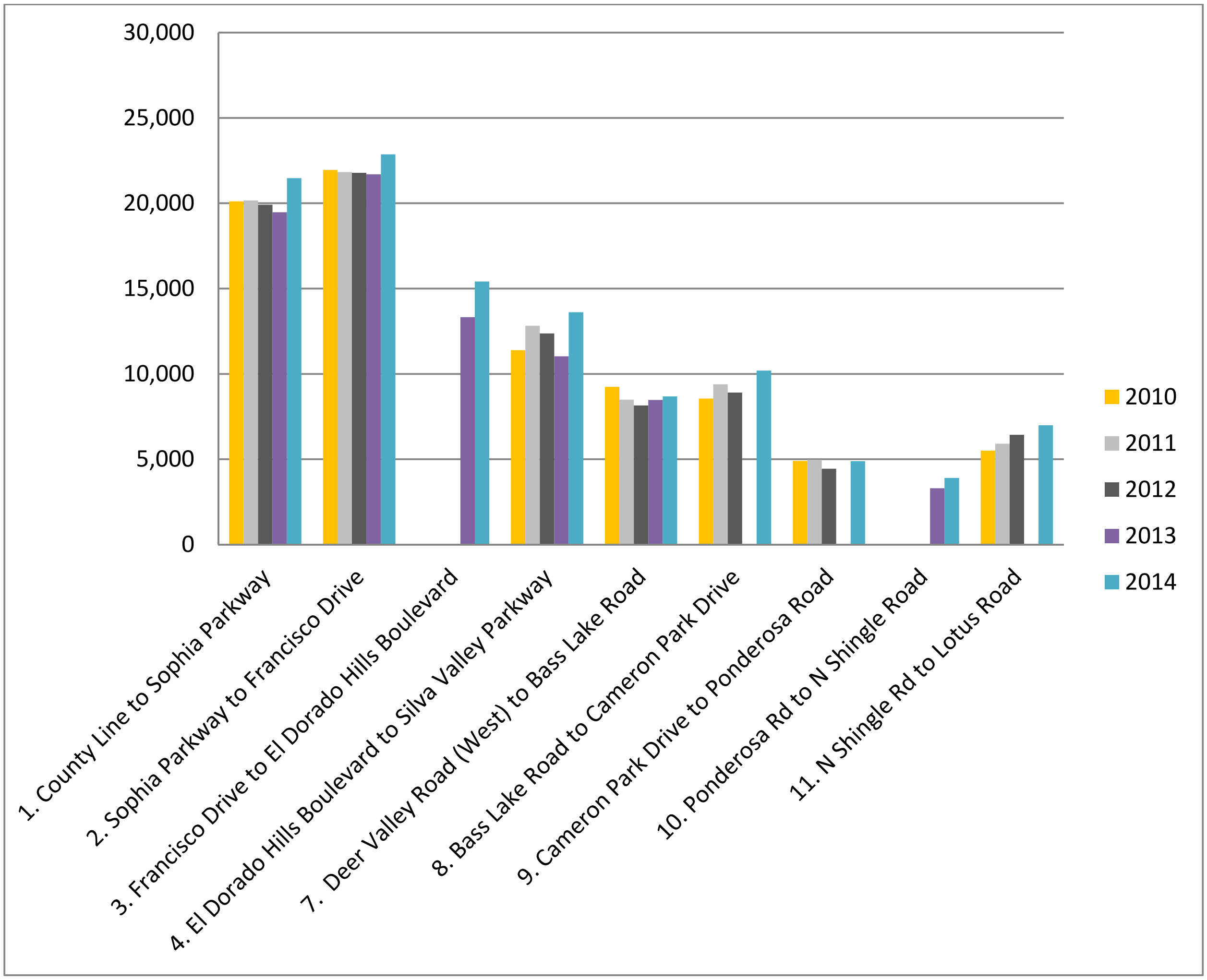
Exhibit 51. Average Mid-Week ADT (2010 - 2014)



Weekend Average Daily Traffic

The weekend ADT volumes were calculated using the average daily volumes from Saturday and Sunday. As expected the weekend ADT volumes were lower on each of the study segments compared to the mid-week ADT volumes. This is attributed to the decrease of commuting traffic during non-weekdays. From 2010 to 2014, the ADT on weekend days grew significantly on each study segment. Contrary to overall trends along the corridor during mid-week, 2014 had the highest ADT along the corridor. Exhibit 52 shows each of the segments weekend ADT from 2010 to 2014. Overall trend for the weekend ADT indicates that the current year (2014) volumes match closely with the historical data.

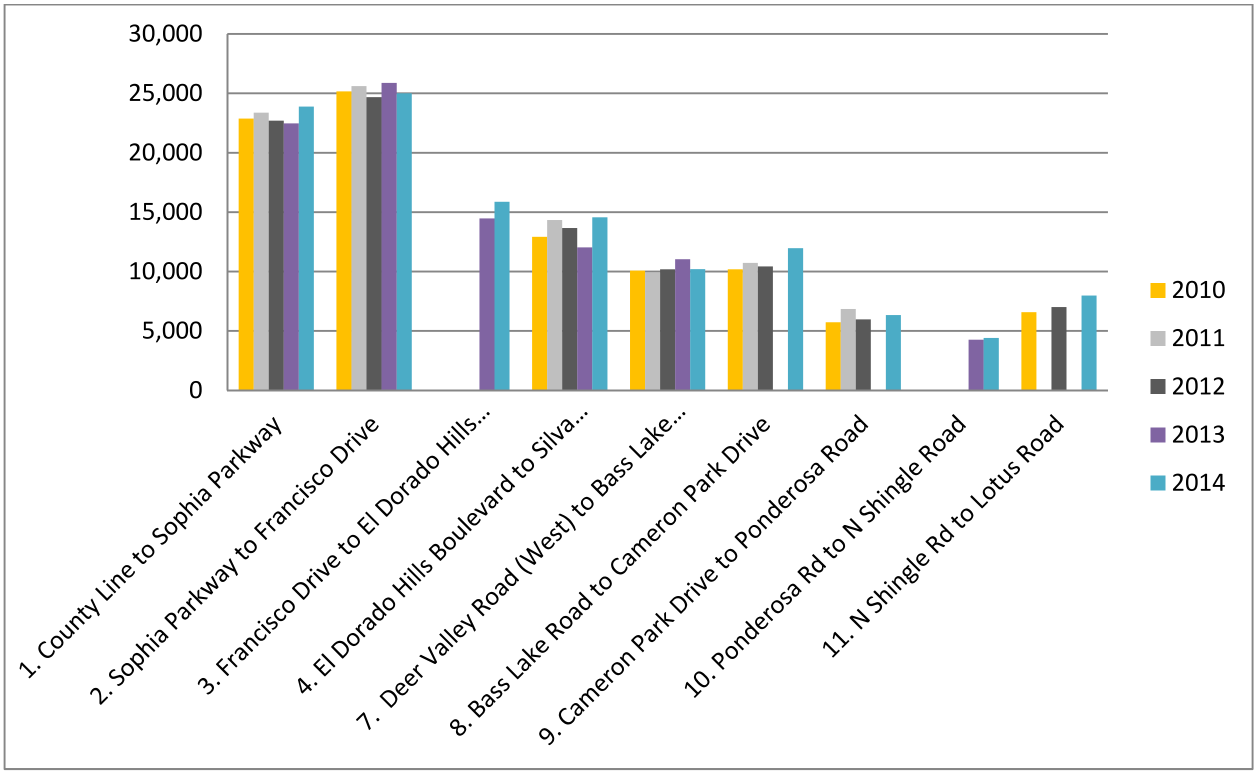
Exhibit 52. Average Weekend ADT (2010 - 2014)



Weekly Average Daily Traffic

The weekly ADT volumes were calculated by taking the average of the Sunday through Saturday counts along each segment throughout the five year study period. Because the weekly average includes all days of the week, weekly ADT volumes are between the mid-weekday and weekend ADT volumes. Exhibit 53 illustrates the weekly ADT throughout the five year study period. When comparing total weekly volumes on each study segment, 2014 ADTs were the highest at some segments, but decreased from peak volumes in previous years.

Exhibit 53. Average Weekly ADT (2010 - 2014)



Historical Intersection Data Summary

Similar to roadways, intersection turning movement data for the most recent five years available was obtained from the County staff. Table 10 compares KAI collected 2014 counts with the historical data. Traffic volumes depict the total entering intersection volumes. Overall, intersection turning movements during the peak hours increased by 4.5 percent relative the most recent prior year's available data (January 2013 for all intersections except for Sophia Parkway, where the most recent available count was from November 2012). A few individual intersections show a marginal decline in turning movements relative to previous year's data. Growth was more substantial in the PM peak hour than the AM peak hour.

Given the lack of any serious deviation from historical counts and the fact that growth rates were relatively consistent it was determined that the 2014 turning movement counts at the intersection could be considered without the need to recount locations.

Table 10. Historical Intersection Turning Movements (2011-2014)

ID	Green Valley Road & Cross Street	Traffic Volumes				Growth in 2014 from Prior Years		
		May-14	Jan-13	Nov-12	Oct-11	Jan-13	Nov-12	Oct-11
1	Sophia Parkway							
	AM Peak	2,257	-	2,270	-	-	-0.6%	-
	PM Peak	2,800	-	2,760	-	-	1.4%	-
2	Francisco Drive							
	AM Peak	2,831	2,633	-	2,733	7.5%	-	3.6%
	PM Peak	3,344	3,145	-	3,308	6.3%	-	1.1%
3	El Dorado Hills Boulevard							
	AM Peak	1,809	1,740	-	1,792	4.0%	-	0.9%
	PM Peak	2,091	1,941	-	2,023	7.7%	-	3.4%
4	Silva Valley Parkway							
	AM Peak	1,512	1,423	-	1,503	6.3%	-	0.6%
	PM Peak	1,720	1,538	-	1,677	11.8%	-	2.6%
5	Loch Way							
	AM Peak	908	894	-	-	1.6%	-	-
	PM Peak	1,132	1,054	-	-	7.4%	-	-
7	Malcolm Dixon Road							
	AM Peak	870	829	-	-	4.9%	-	-
	PM Peak	1,106	1,032	-	-	7.2%	-	-
8	Deer Valley Road (West)							
	AM Peak	864	826	-	-	4.6%	-	-
	PM Peak	1,112	1,058	-	-	5.1%	-	-
10	Bass Lake Road							
	AM Peak	1,531	1,502	-	1,543	1.9%	-	-0.8%
	PM Peak	1,477	1,357	-	1,326	8.8%	-	11.4%
11	Cambridge Road							
	AM Peak	1,276	1,240	-	1,287	2.9%	-	-0.9%
	PM Peak	1,348	1,288	-	1,260	4.7%	-	7.0%
12	Cameron Park Drive							
	AM Peak	1,183	1,196	-	1,163	-1.1%	-	1.7%
	PM Peak	1,402	1,428	-	1,315	-1.8%	-	6.6%

Notes:
Jan 2013 and Oct 2011 counts were obtained from the Dixon Ranch Traffic Study
Nov 2012 counts were obtained from the Arco AM/PM Traffic Study
Source: Kittelson & Associates, 2014

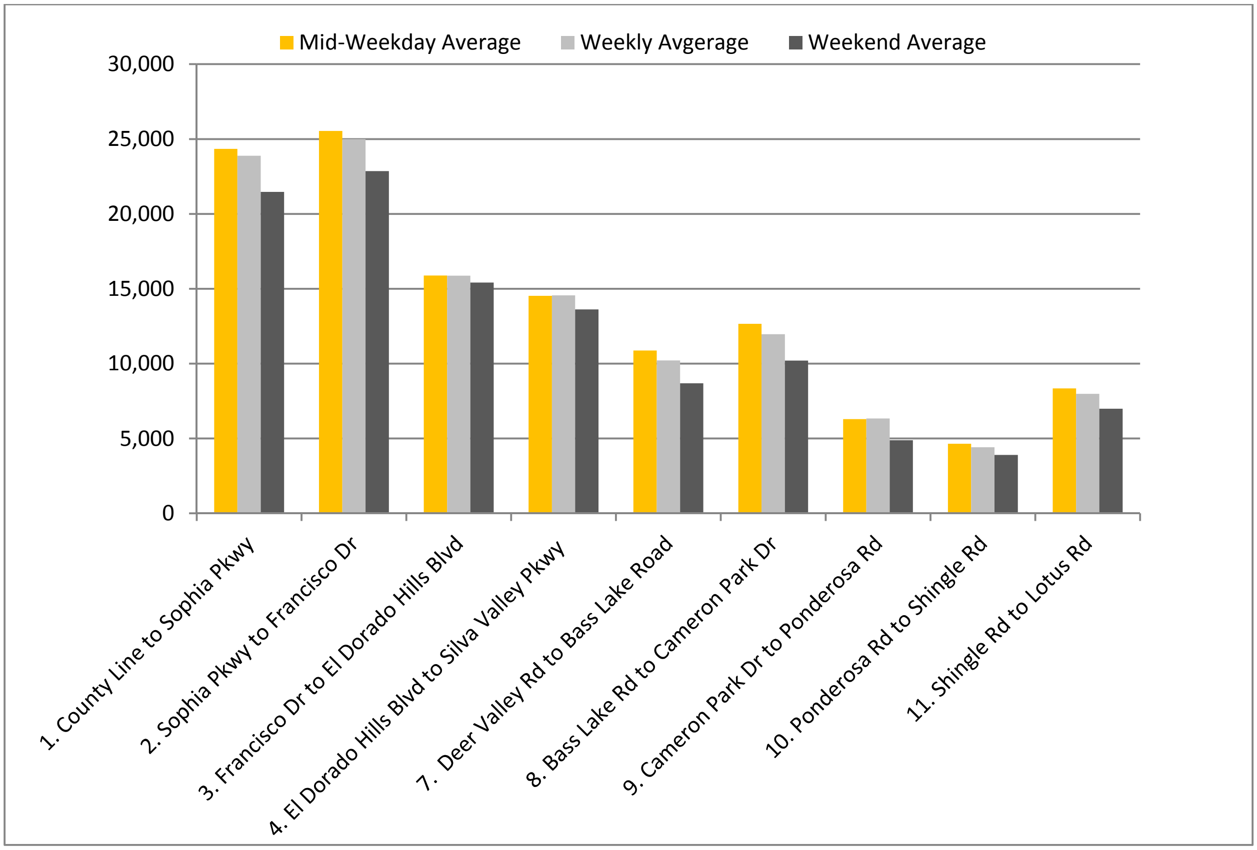
Existing 2014 Data Assessment

As noted above, 2014 traffic volumes collected by KAI show consistency relative to previous year's data, and therefore, were considered for further evaluation.

Traffic Volumes

Exhibit 54 illustrates 2014 ADTs for each study segment. It clearly shows the ADT gradually declines along each of the study segments from west to east. Moving east from the El Dorado County line, residential development gradually becomes less dense which contributes to the lower ADT along the study roadway segments on the east side of the study corridor. Exhibit 54 also shows that each study location carries highest traffic volumes during mid-week.

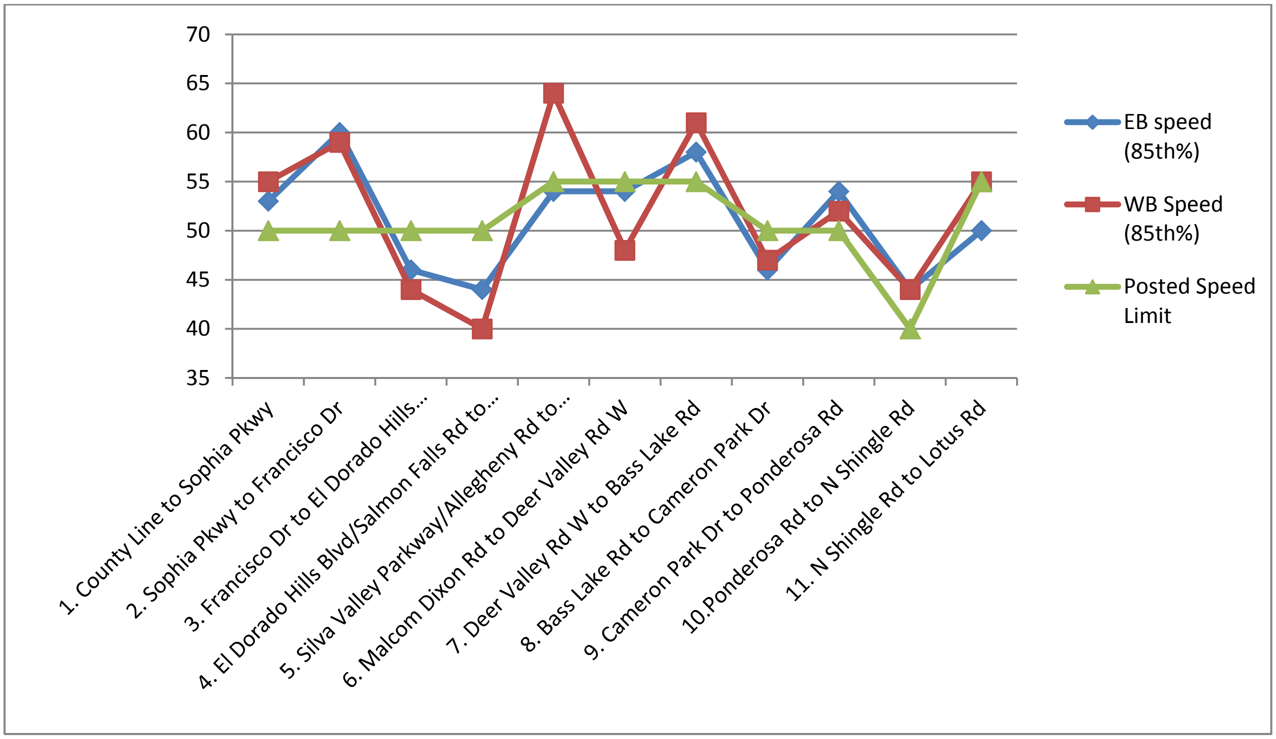
Exhibit 54. Green Valley Road 2014 ADT Summary



Speeds

The 2014 tube counts collected along Green Valley Road corridor included speed. These speeds were summarized to the 85th percentile speed along each segment. The 85th percentile speed represents the speed at which 85 percent of the vehicles drive at or below. Exhibit 55 illustrates the 85th percentile speeds along each segment in both the eastbound and westbound directions. The figure also compares these speeds to the posted speed on each of the study segments.

Exhibit 55. Green Valley Road Speed Data



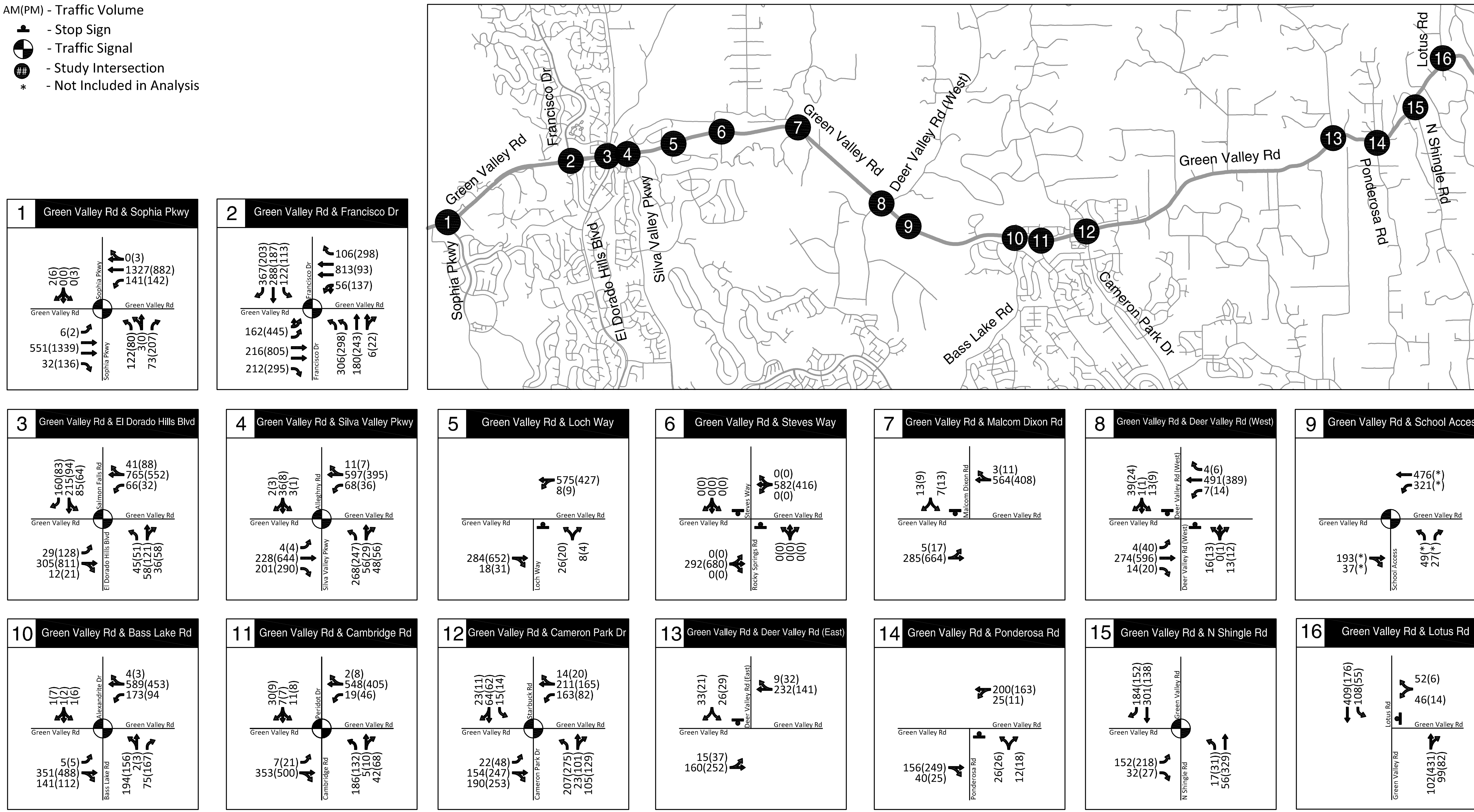
Posted speeds along the study corridor vary from 40 mph to 55 mph. In general the majority of 85th percentile speeds were within 5 mph of the posted or maximum allowed speed limit, exceptthe following:

Segment #2, which had the highest ADT and most collisions along the study corridor, also reported one of the highest speeds (60 mph) on the corridor for both directions. The maximum allowed speed along Segment #5 is 55 mph in each direction, whereas the 85th percentile speed was 64 mph in the westbound direction, 9 mph higher than the prima facie speed. The 85th percentile speed in the westbound direction on Segment #7 was recorded approximately 6 mph higher than the prima facie speed limit of 55 mph. This could potentially be caused by a westbound downgrade between Silver Springs Parkway and Bass Lake Road.

Although Segment #3 and 4 has two of the higher ADT volumes along the corridor, 85th percentile speeds in both directions were below the posted speed limits on the segments. Overall, when looking at the whole study corridor, the average posted speed along the Green Valley Road corridor is 50 mph. This speed is in line with the 85th percentile speed of 51 mph in both eastbound and westbound directions.

Existing Traffic Volumes

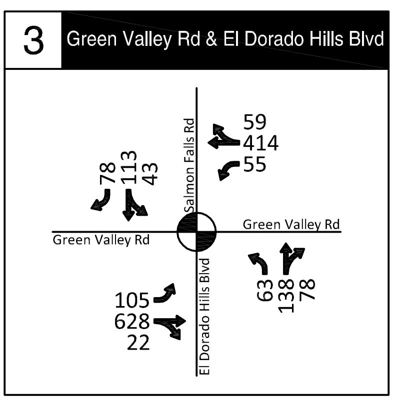
Exhibit 56 and Exhibit 57 show peak hour intersection turning movement counts along with the existing lane configuration and traffic control for each intersection.

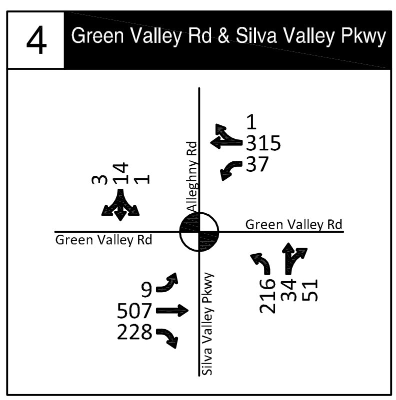


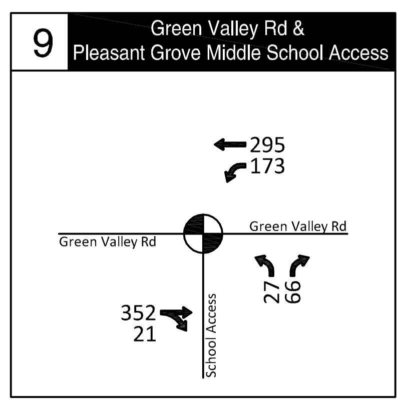
Existing AM and PM Traffic Volumes
El Dorado County, California

Exhibit
56

Kittelson & Associates, Inc.
Transportation Engineering/Planning







- Traffic Signal

School Peak Hour Traffic Volumes
El Dorado County, California

Exhibit
57

Existing Traffic Operations

The results of the Existing Conditions intersection LOS analysis are shown in Table 11. All study intersections currently meet El Dorado County's LOS standards during the weekday AM, PM and school peak hours with exception of the El Dorado Hills Boulevard intersection which currently operates at LOS F during the afternoon school peak hour. The El Dorado Hills Boulevard intersection operates at LOS E during the weekday AM and PM peak hours. The Loch Way, Deer Valley Road (West), Pleasant Grove Middle School Access, and Lotus Road intersections operate at LOS D.

Based on the HCM operational methodology, LOS at the Pleasant Grove Middle School access intersection meets the County's threshold during the weekday AM and afternoon school peak hours. While the westbound Green Valley Road left-turn movement is projected to operate at LOS F in the AM peak, consistent with the field observations, the average delays and queues on the westbound Green Valley Road approach did not match field observations. Therefore, SimTraffic[22] analysis was performed to verify HCM operational results at the Pleasant Grove Middle School primary access intersection during the AM peak hour. The simulation was conducted for the entire peak hour using four 15-minute intervals within the peak hour. The results were averaged for ten model runs. The SimTraffic model was reasonably calibrated to match field observations. The average delay indicated that the intersection currently operates at LOS E, exceeding the County's LOS threshold. The critical movements, i.e. westbound Green Valley Road left-turn and through movements operate at LOS F and LOS D respectively.

Operational analysis indicates extensive queuing at several left-turn lanes at the intersections during one or more peak hours. Intersections and movements where queues exceed the storage capacity are listed below:

- #3 El Dorado Hills Boulevard eastbound left-turn lane
- #4 Silva Valley Parkway northbound left-turn lane
- #9 Pleasant Grove School Access westbound left-turn lane
- #11 Cambridge Road northbound left-turn lane
- #12 Cameron Park Drive westbound and northbound left-turn lanes

[22] Micro-simulation analysis tool included in the Synchro Suite package.

Table 11. Existing Level of Service for AM, PM, and School Peak Hours

#	Green Valley Road & Cross Street	Control	LOS Threshold	AM Peak		PM Peak		School Peak	
				Delay	LOS	Delay	LOS	Delay	LOS
1	Sophia Parkway / Access Road	Signalized	E	16.5	B	22.8	C	--	--
2	Francisco Drive	Signalized	E	40.7	D	33.5	C	--	--
3	El Dorado Hills Boulevard / Salmon Falls Road	Signalized	E	66.2	E	57.4	E	**80.8**	**F**
4	Silva Valley Parkway / Allegheny Road	Signalized	E	23.2	C	18.2	B	20.8	C
5	Loch Way	TWSC	D	0.8 (18.7)	A (C)	0.7 (26.6)	A (D)	--	--
6	Rocky Springs Road	TWSC	D	0.0 (0.0)	A (A)	0.0 (0.0)	A (A)	--	--
7	Malcolm Dixon Road	TWSC	D	0.5 (14.8)	A (B)	0.7 (22.3)	A (C)	--	--
8	Deer Valley Road (West)	TWSC	D	1.8 (17.8)	A (C)	1.8 (26.9)	A (D)	--	--
9	Pleasant Grove Middle School Access	Signalized	D	59.8	**E**	--	--	15.7	B
10	Bass Lake Road / Alexandrite Drive	Signalized	E	42.3	D	20.1	C	--	--
11	Cambridge Road / Peridot	Signalized	E	23.6	C	16.6	B	--	--
12	Cameron Park Drive / Starbuck Road	Signalized	E	30.7	C	23.4	C	--	--
13	Deer Valley Road (East)	TWSC	D	1.7 (11.8)	A (B)	2.0 (12.4)	A (B)	--	--
14	Ponderosa Road (East)	TWSC	D	1.7 (12.5)	A (B)	1.4 (12.3)	A (B)	--	--
15	North Shingle Road	Signalized	D	10.5	B	9.7	B	--	--
16	Lotus Road	TWSC	D	3.1 (17)	A (C)	8.5 (33.5)	A (D)	--	--

TWSC = Two Way Stop Control, intersection average delay and LOS is reported first followed by the delay and LOS for the worst movement in parentheses.

Source: Kittelson & Associates, 2014

For the roadway segment analysis, the highest volume mid-week day was chosen for operational assessment at each study segment. The AM and PM peak hour volumes were extracted for this analysis.

The results of the existing conditions roadway segment LOS analysis are shown in Table 12. The table reports the relatively worse peak hour operations. All study segments currently operate acceptably per El Dorado County LOS standards during the weekday AM and PM peak hours.

Table 12. Existing Roadway Segment LOS Results by Direction of Travel

ID	Location	Facility Type	LOS Threshold	Eastbound			Westbound		
				PTSF / PFFS (%)	V/C (Density, pc/mi/h)	LOS	PTSF / PFFS (%)	V/C (Density, pc/mi/h)	LOS
1	County Line to Sophia Parkway	Two-Lane, Class II	E	94.2	0.82	E	97.1	0.93	E
2	Sophia Parkway to Francisco Drive	Multilane	E	--	(12.3)	B	--	(15.2)	B
3	Francisco Drive to El Dorado Hills Boulevard	Two-Lane, Class II	E	83.4	0.44	D	93.7	0.68	E
4	El Dorado Hills Boulevard to Silva Valley Parkway	Two-Lane, Class II	E	83	0.44	D	83.4	0.47	D
5	Silva Valley Parkway to Malcolm Dixon Road	Two-Lane, Class II	D	83.9	0.46	D	80.6	0.41	D
6	Malcolm Dixon Road to Deer Valley Road (West)	Two-Lane. Class II	D	84.7	0.51	D	77.9	0.43	D
7	Deer Valley Road (West) to Bass Lake Road	Two-Lane, Class II	D	81.4	0.44	D	78.6	0.42	D
8	Bass Lake Road to Cameron Park Drive	Two-Lane, Class III	E	75.6	0.42	C	75.3	0.49	C
9	Cameron Park Drive to Ponderosa Road (East)	Two-Lane, Class II	D	70.9	0.25	D	69.4	0.25	C
10	Ponderosa Road to North Shingle Road	Two-Lane, Class II	D	68.2	0.26	C	60.1	0.19	C
11	North Shingle Road to Lotus Road	Two-Lane, Class II	D	77.7	0.42	D	72.5	0.37	D
Source: Kittelson & Associates, 2014									

Synchro and HCS analysis worksheets are provided in Appendix 4 and Appendix 5 respectively.

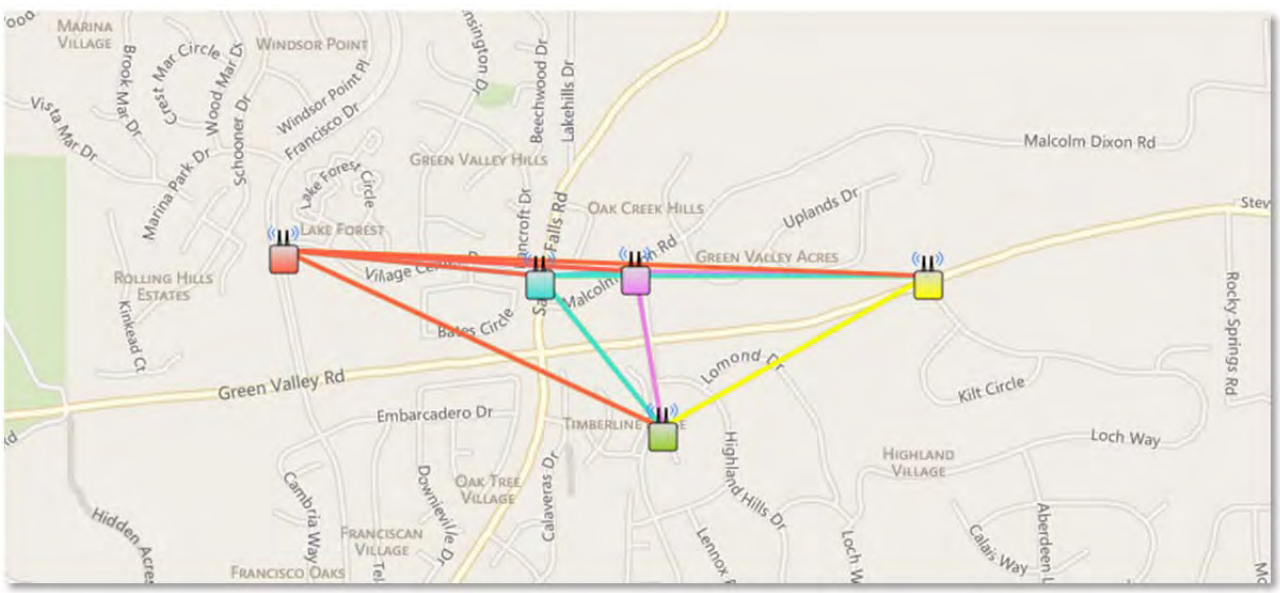
CUT-THROUGH TRAFFIC

This section summarizes the data and methodology used to analyze cut-through traffic on Allegheny Road and El Dorado Hills Boulevard. In order to determine traffic volumes to and from specific roadways, origin-destination (OD) data was collected using Bluetooth™ technology. BlueMAC readers were used. They detect anonymous MAC addresses and wireless identifications used to connect Bluetooth™ technologies on mobile devices in vehicles such as phones, headsets and music players. The system calculates travel time, estimated origin-destinations and route patterns through analysis of subsequent detections.

BlueMAC readers were deployed at five locations to capture origin-destinations and route patterns on Allegheny Road and El Dorado Hills Boulevard. The BlueMAC readers were stationed at the following five locations and as shown in Exhibit 58.

- Red: Francisco Drive & Village Center Drive;
- Cyan: Salmon Falls Road & Village Center Drive;
- Purple: Allegheny Road & Malcom Dixon Road;
- Green: Silva Valley Parkway & Shortlidge Court; and
- Yellow: Loch Way & Green Valley Road.

Exhibit 58. BlueMAC Reader Locations



Origin-destination data is presented for each cut-through route, capturing the total origin-destination demand and providing the percentage of cut-through traffic along that particular route. The analysis captured the origin destination data collected between Friday, May 2, 2014 and Tuesday, May 13, 2014. Origin-destination data was analyzed for the mid-weekdays (Tuesday, Wednesday, and Thursday) to find the percentage of cut-through traffic for the AM and PM peak periods (7-9 AM and 4-6 PM respectively) and daily totals.

Cut-Through Route: Allegheny Road

Cut-through traffic using Allegheny Road to access destinations north of Salmon Falls Road and Francisco Drive averaged 10 percent of the total traffic between the OD pair during mid-week days within a twenty-four hour time period. Table 13 shows the results of possible cut-through traffic using Allegheny Road between various origin and destinations during the each time period.

Table 13. Allegheny Road Cut-Through Traffic Results

Origin	Destination	Time Period	Total OD Demand	Cut-Through Traffic	Percentage of Cut-Through Traffic
Silva Valley Pkwy/ South of Green Valley Road	North on Salmon Falls Road	Study Period	278	49	18%
		Mid-Week AM Peak	15	2	13%
		Mid-Week PM Peak	40	7	18%
Silva Valley Pkwy/ South of Green Valley Road	Francisco Drive	Study Period	183	22	12%
		Mid-Week AM Peak	22	5	23%
		Mid-Week PM Peak	18	2	11%
East of Silva Valley Pkwy/Green Valley Road	North on Salmon Falls Road	Study Period	279	16	6%
		Mid-Week AM Peak	27	5	19%
		Mid-Week PM Peak	29	3	10%
East of Silva Valley Pkwy/Green Valley Road	Francisco Drive	Study Period	182	5	3%
		Mid-Week AM Peak	21	2	10%
		Mid-Week PM Peak	21	2	10%

Source: Kittelson & Associates, 2014

Cut-through traffic using Allegheny Road during the AM peak period averaged 16 percent of the total traffic between the OD pairs. The AM peak period had the highest percentage of cut-through traffic during peak time periods. The highest percentage of cut-through traffic occurred between vehicles accessing Francisco Drive from Silva Valley Parkway. Vehicles cutting through on Allegheny Road would bypass traffic signals at the Green Valley Road/El Dorado Hills Boulevard and Green Valley Road/Francisco Drive intersections. The signal operations analysis based on traffic counts collected by KAI in May 2014 at the Green Valley Road/El Dorado Hills Boulevard intersection, indicate the LOS for the westbound approach during the AM peak is LOS F. Motorists from Silva Valley Parkway electing to use Green Valley Road to access the developments to the north, off of Francisco Drive, could potentially incur up to two minutes of delay if stopped at both intersections.

Cut-through traffic using Allegheny Road during the PM peak period averaged 12 percent of the total traffic between OD pairs. During the PM peak period, 18 percent of traffic originated on Silva Valley

Parkway used Allegheny Road to cut-through to developments north off of Salmon Falls Road. Although, there were no apparent traffic operational issues on the westbound Green Valley Road approach at El Dorado Hills Boulevard.

Cut-Through Route: Salmon Falls Road

Cut-through traffic using Salmon Falls Road to access destinations to the north, off of Francisco Drive averaged 19 percent of the total traffic between OD pairs during mid-week days within a twenty-four hour time period. The highest percentage (22) of cut-through traffic occurred between vehicles on Silva Valley Parkway south of Green Valley Road, using Salmon Falls Road to access Francisco Drive during the PM peak period. Although, there were no apparent traffic operational issues on the westbound Green Valley Road approaches at El Dorado Hills Boulevard and Francisco Drive. Table 14 displays the results for vehicles using Salmon Falls Road to cut-through to Francisco Drive.

Table 14. Salmon Falls Road Cut-Through Traffic Results

Origin	Destination	Time Period	Total OD Demand	Cut-Through Traffic	Percentage of Cut-Through Traffic
South of Silva Valley Pkwy/Green Valley Road	Francisco Drive	Study Period	183	41	22%
		Mid-Week AM Peak	22	0	0%
		Mid-Week PM Peak	18	4	22%
East of Silva Valley Pkwy/Green Valley Road	Francisco Drive	Study Period	182	29	16%
		Mid-Week AM Peak	21	2	10%
		Mid-Week PM Peak	21	1	5%
Source: Kittelson & Associates, 2014					

The raw OD data collected by BlueMAC readers are attached in Appendix 6.

Part E: Community Outreach and Next Steps

PART E: COMMUNITY OUTREACH AND NEXT STEPS

COMMUNITY OUTREACH

A community outreach meeting was conducted on September 17, 2014 at the Pleasant Grove Middle School from 6:00 to 8:00 PM. The purpose of the meeting was to present and discuss the findings of the draft study and to solicit public feedback through comments. A survey was also provided at the meeting and provided on the LRP web page. El Dorado County Community Development Agency, Long Range Planning (LRP) Division sent emails to several individuals and organizations who advocated for the Green Valley Road Corridor study. The organizations notified included: Rescue Community Center; Shingle Springs Community Alliance; Cameron Park and El Dorado Hills Community Services District(s) (CSD); El Dorado County, El Dorado Hills and Shingle Springs-Cameron Park Chamber of Commerce(s); El Dorado Hills Area Planning Advisory Committee (APAC); County Office of Education; El Dorado County Farm Bureau; Cameron Park, El Dorado Hills and Shingle Springs Fire Department(s); Rescue Fire Board; Green Valley Alliance; El Dorado Union High School District; Rescue Historical Society; Francisco Oaks, Green Springs Ranch, Highland Hills and Sterlingshire Home Owners Association(s) (HOA); County Libraries in Cameron Park and El Dorado Hills; and Rescue Union School District. A notice of the meeting was also posted on the County website. The draft study and technical documents were uploaded on the County website to provide easy access to the residents prior to the meeting. Approximately 21 residents attended the meeting.

Informational boards were prepared to present key findings of the elements listed below:

1. Introduction of the study
2. Study Corridor
3. Traffic Conditions
4. Safety and Physical Conditions
5. Bicycle Lanes, Speed Limits and Speed Surveys
6. Access and Cut-Through Traffic Evaluation
7. Pleasant Grove Middle School

Throughout the meeting, residents were encouraged to fill out the comment cards to provide their feedback for consideration. Participants were also asked to fill out brief survey forms to express their concerns in the corridor and to rank treatment types and locations. The comments and surveys were processed and are contained in Appendix 7.

NEXT STEPS

KAI and county staff will present the study to the Board of Supervisors for their consideration. The findings of the study, public comments and surveys will be considered during the on-going update to the Traffic Impact Mitigation (TIM) Fees and the West Slope Capital Improvement Program (CIP).

County staff will use the information as the basis of additional engineering assessments and for potential grant applications.

Attachment #5

El Dorado Irrigation District

SB 610 Water Supply Assessment for the Dixon Ranch Residential Project

SB 610 Water Supply Assessment

Prepared for the
Dixon Ranch Residential Project

Final

August 2013

Prepared by:

Tully & Young
Comprehensive Water Planning

Prepared for:

El Dorado Irrigation District

Approved by Eldorado Irrigation District Board of Directors
on August 26, 2013 as action item #8

Contact: Cindy Megerdigian – Water/Hydro Engineering Manager
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Table of Contents

Section 1 – Project Introduction

1.1 Introduction

In December 2012, the El Dorado Irrigation District (EID) received a letter from the El Dorado County Planning Department (County) requesting the completion of a Water Supply Assessment (WSA) for the Dixon Ranch Residential Project (hereafter referred to as the "Proposed Project"). As the proposed water supply purveyor for the Proposed Project, EID has prepared this WSA to assess the availability and sufficiency of EID's water supplies to meet the Proposed Project's estimated water demands. This document provides the necessary information to comply with the assessment of sufficiency as required by statute.

Statutory Background

Enacted in 2001, Senate Bill 610 added section 21151.9 to the Public Resources Code requiring that any proposed "project," as defined in section 10912 of the Water Code, comply with Water Code section 10910, et seq. Commonly referred to as a "SB 610 Water Supply Assessment," Water Code section 10910 outlines the necessary information and analysis that must be included in an environmental analysis of the project (e.g. CEQA compliance) to ensure that proposed land developments have a sufficient water supply to meet existing and planned water demands over a 20-year projection.

Proposed "projects" requiring the preparation of a SB 610 water supply assessment include, among others, residential developments of more than 500 dwelling units, shopping centers or business establishments employing more than 1,000 persons or having more than 500,000 square feet of floor space, commercial office buildings employing more than 1,000 persons or having more than 250,000 square feet of floor space and projects that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.[1]

The Proposed Project requires a WSA because it contemplates more than 500 new dwelling units as detailed in Section 1.2.

Document Organization

This WSA supports the Proposed Project's environmental review process and analyzes the sufficiency of water supplies to meet projected water demands of the Proposed Project through the required planning horizon. The WSA is organized according to the following sections:

- **Section 1: Project Introduction**. This section provides an overview of WSA requirements, and a detailed description of the Proposed Project, especially the land-use elements that will require water service.

[1] Water Code § 10912, subdivision (a).

- **Section 2: Proposed Project Estimated Water Demands**. This section describes the methodology used to estimate water demands of the Proposed Project and details the estimated water demands at build-out of the Proposed Project.

- **Section 3: Other Estimated Water Demands**. This section details the other water demands currently served by EID and anticipated to be served based on information in the El Dorado County's (County) General Plan as well as known and potential planned modifications since the County's adoption of the General Plan.

- **Section 4: Water Supply Characterization**. This section characterizes the EID water supply portfolio that will serve the Proposed Project along with other current and future water demands. Water rights, along with water service contracts and agreements are characterized for normal, single dry, and multiple dry year conditions.

- **Section 5: Sufficiency Analysis**. This section assesses whether sufficient water will be available to meet the Proposed Project water demands, while recognizing existing and other potential planned water demands within the EID service area. To provide the necessary conclusions required by statute, the analysis integrates the demand detailed in Section 2 and Section 3 with the characterization of EID's water supply portfolio detailed in Section 4.

1.2 PROPOSED PROJECT DESCRIPTION

The Proposed Project is a planned development, south of the Green Valley Road, north of Serrano Country Club, encompassing 280 acres in the unincorporated community of El Dorado Hills (see **Figure 1-1**).

The Proposed Project includes 605 residences of varying size, active and passive parks, a club house, and open space. Proposed residential dwelling units include 1 existing parcel of 5 acres, 5 custom large lot estates of approximately 3 acres, 5 custom estates on approximately 1 acre, 112 custom and production hillside lots with a density of about 4 dwelling units per acre, 173 production village lots with a density of about 6 dwelling units pre acre, 229 production village and age-restricted lots with a density of about 7.5 dwelling units per acre, and 80 production age-restricted lots with a density of about 9 dwelling units pre acre. A large 9-acre village park will serve the community and a smaller 2-acre neighborhood will serve residents. To accompany the age-restricted lots, a club house will be built.

Table 1-1 summarizes the proposed land use acreages.

Figure 1-1 – Proposed Project Location and Land Uses

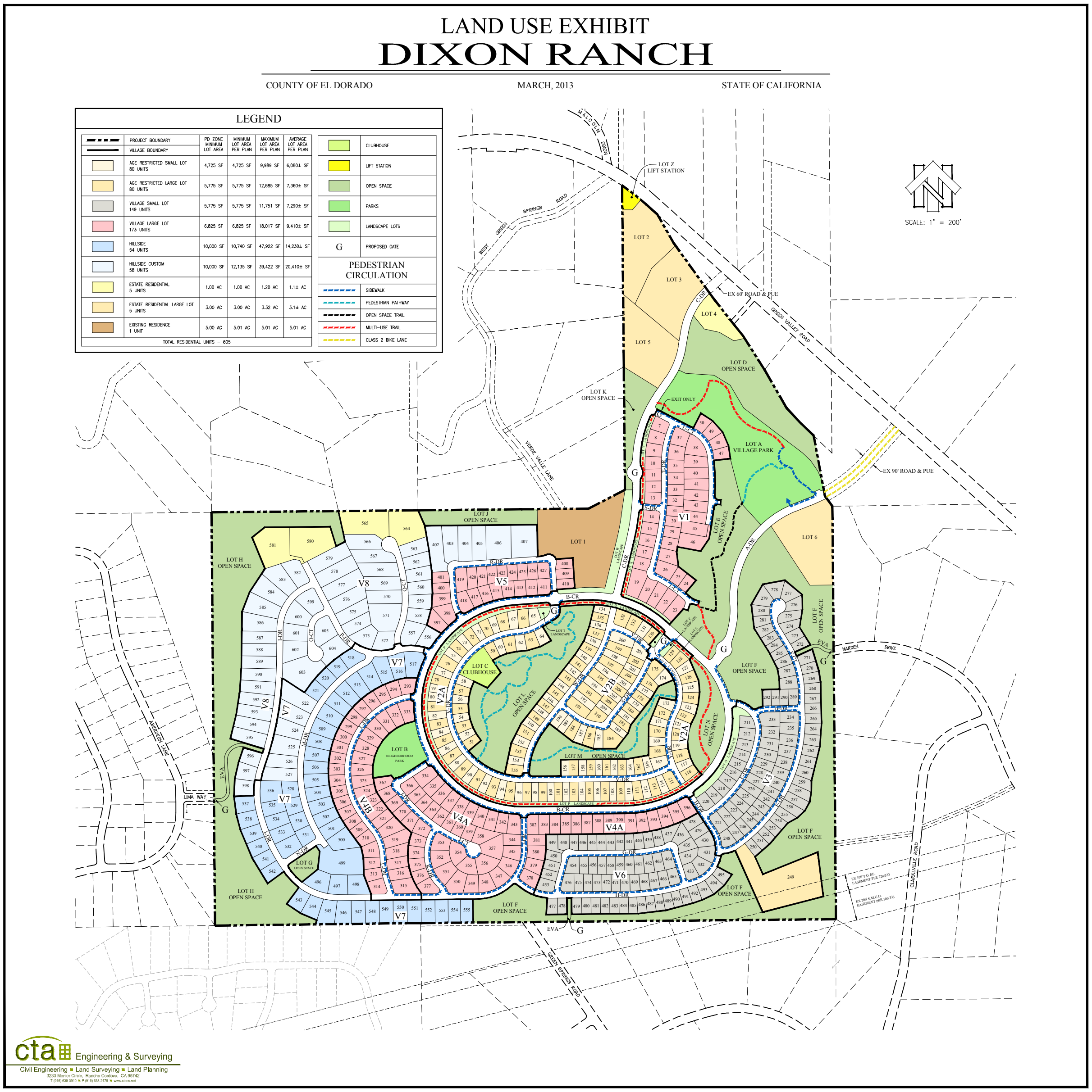

Table 1-1 – Summary of Proposed Build-Out Land Uses and Acreages[2]

Land Use	Description	Acres	Units
Large Lot Estate Residential	3 Acre Lots	--	5
Estate Residential	1 Acre Lots	--	5
Hillside Custom	1/2 to 1 Acre Lots	--	58
Hillside Production	1/4 to 1/2 Acre Lots	--	54
Village Large Lot	8,000 to 10,000 Sqft Lots	--	173
Village Small Lot	5,000 to 8,000 Sqft Lots	--	149
Age Restricted Large Lot	5,000 to 8,000 Sqft Lots	--	80
Age Restricted Small Lot	5,000 to 8,000 Sqft Lots	--	80
Community Center	--	1	--
Village Park	--	11	--
Open Space	--	68	--
ROW and Landscaping	--	6	--

1.3 Proposed Project Phasing

Table 1-2 describes the Proposed Project's three construction phases. Each phase represents a portion of the development, focusing on particular land-use classifications. Before constructing homes, community center, or other parts of the development, the proponents will begin site grading and project-wide infrastructure development. Some infrastructure and site grading will continue throughout all phases of the Proposed Project, as necessary. These activities include installing facilities for potable water, sewer, electric, telecommunications, gas, stormwater, and roads. During these activities, a small water demand will exist – referred to in this WSA as "construction water." This demand is included in the yearly water demands presented in Section 2.

The initial phase, ending prior to the construction phases, will bring about the infrastructure and will not use and significant water. The initial construction phase, scheduled to conclude in 2015 will see the first 125 housing units and the community center constructed. This First phase will see around one third of the total project water demand come online. The subsequent constructions phases, consisting each of years 2016 and 2017 will see 300 and 180 housing unite respectively. This approach will ramp up water demands quickly with construction being completed in 2017, well within the 20-year planning horizon of this WSA.

[2] Specific Plan Land Use Summary was provided by El Dorado County of Development Services Department.

Table 1-2 – Proposed Project Schedule

Land Use	Phase 1 By 2015	Phase 2 2016	Phase 3 2017	Total
Residential Units	125	300	180	605
Community Center	1	--	--	--
Parks	--	2	1	--

SECTION 2 – PROPOSED PROJECT ESTIMATED WATER DEMANDS

2.1 INTRODUCTION

This section describes the methodology, provides the supporting evidence, and presents the estimated water demands for the Proposed Project. For the purpose of estimating water demand, the Proposed Project is planned to develop according to the phasing in **Table 1-2**.

2.2 DETERMINING UNIT WATER DEMAND FACTORS

As detailed in Section 1, the Proposed Project has specific residential and non-residential land-uses with defined residential lot-sizes, and other characteristics. As these attributes vary among the types of proposed land-uses, so too will the water needs. To understand the water needs of the entire Proposed Project, unique demand factors that correspond with each unique land use are necessary. This subsection presents the methodology for determining the baseline unit water use demand factors that become the basis of the Proposed Project water demand estimates. Two distinct groups of demand factors are presented: (1) residential, and (2) non-residential.

2.3 PRIMARY SOURCE OF BASELINE WATER USE DATA

Because the Proposed Project is very similar in nature to particular elements built as part of the Serrano and El Dorado Hills developments over the past few decades, recent water use data for comparable products in these neighborhoods provides a reliable foundation for EID to establish new project-specific water demands. Through comparison of Proposed Project land-use elements to existing land uses, EID determined appropriate existing, established neighborhoods and non-residential facilities that best aligned with each unique residential and non-residential project element. For each comparable neighborhood, EID gathered and assessed total annual water use for the years 2008 through 2012. This selected period of water use best represents 1) the greatest number of homes occupied within each selected area (including established back-yard landscapes), and 2) varied water use over a range of climatic conditions reflecting various rainfall amounts and timing. Average annual uses were derived from the data and are discussed under the respective land-use categories.

2.4 BASELINE RESIDENTIAL WATER USE DEMAND FACTORS

The Proposed Project anticipates specific residential products that fall within general lot-size designations. The size of the lot will have the largest impact on the annual per-lot demand for water. Indoor demands remain relatively consistent regardless of lot size.

For purposes of this WSA, the per-lot demand for residential lots will be described as "the acre-feet of water use annually per dwelling unit" – or simply put, acre-feet/dwelling unit (af/du).

This value will reflect indoor and outdoor uses expected for a typical dwelling unit for each of the following classifications:[3]

- 3-acre custom estate lots
- 1-acre custom home lots
- ¼ and ½ acre hillside lots (14,000 to 20,000 square foot lots)
- 8,000 to 10,000 square foot production lots
- 5,000 to 8,000 square foot production lots

The method and basis for determining the baseline unit water demand factor for each of these classifications is detailed in the following subsections.

3-Acre Custom Estate Lots

Water demand factors for the proposed 3-acre lots are based on the demand factors developed for the 1-acre customer home lots. Because limited data is available to define "typical" demand based on existing use records, the 1-acre demand factor is simply multiplied by three. Therefore, the baseline unit water demand factor for this land-use category is approximately 3.48 af/du. This is a conservative assumption used for this WSA.

1-Acre Custom Home Lots

Water demand factors for the proposed large lots are based on recent water use data records for residential lots in the Serrano development – specifically existing residential lots located on Greenview Drive, Errante Drive, and others. The proposed lots in this category average about 2 acres and have a 1-acre minimum. However, not all land on these lots will be landscaped. For instance, a lot may include hillside and/or areas of oak woodland that must be protected, resulting in a diminished area for the home's footprint, outdoor hardscapes and landscaping. Generally, the house itself is large, with extensive outdoor features including pools, hardscapes, water features, and significant landscaping with well-maintained turf areas.

Based on available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is approximately 1.16 af/du.

¼ and ½-Acre Hillside Lots

Water demand factors for the proposed large lots are based on recent water use data records for residential lots in the Serrano development – specifically existing residential lots located on Renaissance Way and Renaissance Place. The proposed lots in this category average 10,000 to 20,000 square feet, though some of the lot will likely be restricted to low or no-water use landscape due to grading within the hillside areas. Generally, the house itself is large, with extensive outdoor features including pools, hardscapes, water features, and significant

[3] These classifications reflect EID's defined water demand factor categories as EID believes they best relate to the Proposed Project's land-use classifications as shown in the Table 1-1.

landscaping with well-maintained turf areas. But has slightly less landscaped area than the 1-acre custom home lots.

Based on available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is approximately 0.87 af/du.

8,000 to 10,000 Square-foot Production Lots

The proposed project will include a large number of lots reserved for production homes on lots typically described as "large" for a residential community. For these lots, ranging up to ¼-acre or more, water demands will be based on recent water use data records for similar lots in the Serrano development – specifically Village D2 and portions of Village E, which includes numerous similar-sized lots. In contrast to the smaller lot production homes described in the next classification, these lots will retain adequate area on the lot for well-maintained turf and other landscaping. As much as one-half, but not less than about one-quarter, of the lot may still remain for landscaping, after accounting for the home's footprint and hardscape areas – equating to a few thousand to several thousand square-feet. Though less landscaped area than the custom home lots, the landscaped area will drive water use on these lots.

Based on the available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is 0.55 af/du.

5,000 to 7,000 Square-foot Production Lots

The Proposed Project includes numerous proposed lots ranging from 5,000 to 7,000 square feet. This includes the "age-restricted" large and small lots listed in **Table 1-1**. As a result of the limited outdoor area, many of these lots are limited to front-yard landscaping with well-maintained turf, and back yards often only including hardscapes, pools or other amenities, and lower water using landscapes. Unit water demands are based on recent water use data records for similar lots in the Serrano development – specifically Village D1A, portions of Village E and Euer Ranch, which include numerous similar-sized lots.

Based on the available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is 0.50 af/du.

Residential Indoor Water Use

Based on EID meter data for the past several years, indoor water use for typical single-family homes averages about 0.18 af/du.[4] This value can be used to derive separation of residential demands that could be served with non-potable supplies, such as recycled water from the Deer Creek and/or El Dorado Hills wastewater treatment facilities (see Section 2.7.2).

[4] This value is a subset of the total usage estimated for a dwelling unit under each land-use category. Data from 2012 Water Resources and Service Reliability Report, EID, August 13, 2012, Appendix Table A, p.42

2.5 MODIFYING BASELINE VALUES

All of the above-developed water demand factors for the residential classifications are based on similar existing developments in the El Dorado Hills area. However, since construction of the existing houses, a few changes have occurred that will reduce the Proposed Project's water demands from the baseline unit water demands derived from existing meter data. These include:

- CAL Green Code
- California Model Water Efficient Landscape Ordinance

CAL Green Code

In January 2010, the California Building Standards Commission adopted the statewide mandatory Green Building Standards Code (CAL Green Code) that requires the installation of water-efficient indoor infrastructure for all new projects beginning January 1, 2011. CAL Green Code was incorporated as Part 11 into Title 24 of the California Code of Regulations.[5] The CAL Green Code applies to the planning, design, operation, construction, use and occupancy of every newly constructed building or structure. All proposed land uses must satisfy the indoor water use infrastructure standards necessary to meet the CAL Green Code. The CAL Green Code requires residential and nonresidential water efficiency and conservation measures for new buildings and structures that will reduce the overall potable water use inside the building by 20 percent. The 20 percent water savings can be achieved in one of the following ways: (1) installation of plumbing fixtures and fittings that meet the 20 percent reduced flow rate specified in the CAL Green Code, or (2) by demonstrating a 20 percent reduction in water use from the building "water use baseline."[6] The Proposed Project will satisfy one of these two requirements through the use of appliances and fixtures such as high-efficiency toilets, faucet aerators, on-demand water heaters, as well as Energy Star and California Energy Commission-approved appliances.

California Model Water Efficient Landscape Ordinance

In 2006, the Water Conservation in Landscaping Act was enacted, which required the Department of Water Resources to update the Model Water Efficient Landscape Ordinance (MWELO).[7] In fall of 2009, the Office of Administrative Law (OAL) approved the updated MWELO, which required that a retail water supplier adopt the provisions of the MWELO by January 1, 2010 or enact its own provisions equal to or more restrictive than the MWELO provisions.

The provisions of the MWELO are applicable to new construction with a landscape area greater than 2,500 square feet.[8] The MWELO provides a methodology to calculate total water use based

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5 The CAL Green Code is Part 11 in Title 24.
6 See CAL Green Code.
7 Gov. Code §§ 65591-65599
8 CCR Tit. 23, Div. 2, Ch. 27, Sec. 490.1.

upon a given plant factor and irrigation efficiency. Finally, MWELO requires the landscape design plan to delineate hydrozones (based upon plant factors) and then assign a unique valve for each hydrozone (low, medium, high water use).[9] The design of landscape irrigation systems is anticipated to better match the needs of grouped plant-types and thus result in more efficient outdoor irrigation.

Applying Conservation to Baseline Demand Factors

Collectively, these and other factors will put downward pressure on the baseline residential unit water demand factors – potentially dropping each unit demand by up to 10 percent for the larger lots. Table 2-1 provides a summary of the baseline demand factor for each residential land-use category, the anticipated savings from the conservation mandates, and the resulting unit demand factor used to estimate the Proposed Project's water use.

Table 2-1 – Summary of Residential Baseline and Proposed Project Demand Factors

EID Water Demand Category (Relates to Table 1-1 Land Use)	Lot Size	Current Factor (af/du)	Conservation Applied	Factor Used (af/du)
3-Acre Custom Estate Lots	3 Ac	3.48	10%	3.13
1-Acre Custom Home Lots	1 Ac	1.16	10%	1.04
1/4 and 1/2-Acre Hillside Lots	1/2 to 1 Ac	0.87	8%	0.80
8,000-10,000 sf Lots	8,000 to 10,000 Sqft	0.55	5%	0.53
5,000-7,000 sf Lots	5,000 to 8,000 Sqft	0.50	5%	0.48
Age Restricted Large Lot	5,000 to 8,000 Sqft	0.50	5%	0.48
Age Restricted Small Lot	5,000 to 8,000 Sqft	0.50	5%	0.48

2.6 Baseline Non-Residential Water Use Demand Factors

Similar to the residential water demand factors, non-residential factors are based upon recent water use trends for similar types of land classifications.

For purposes of this WSA, the per-lot demand for non-residential lots is described as "the acre-feet of water use annually per acre of land" – or simply put, acre-feet/acre (af/ac). This value reflects indoor and outdoor water needs expected for a typical non-residential use for each of the following classifications:

- Village and neighborhood parks
- Community Center
- Other miscellaneous uses, including street medians, environmental mitigation, sewer lift stations, and natural ponds.

[9] CCR Tit. 23, Div. 2, Ch. 27, Secs. 492.3(a)(2)(A) and 492.7(a)(2).

The method and basis for determining the baseline unit water demand factor for each of these classifications is detailed in the following subsections.

Village and Neighborhood Parks

The Proposed Project includes a large village park of approximately 9 acres that will include expansive turf areas, playfields and other park amenities and smaller neighborhood parks totaling about 2 acres. Based upon recent water meter data for similar park facilities in the El Dorado Hills area – namely Bella Terra Park, Allan Lindsey Park, and the Village A, C, L3, and L4 parks – a representative water demand factor was identified. A “smart meter” controls the irrigation system at each existing park. These devices adjust water use to actual climate data, including precipitation events. Thus, the recent meter data is very indicative of expected demands for the new parks, which will also be outfitted with similar technology.

Based on the available historic meter data for similar facilities served by EID, the unit water demand factor is 2.77 af/ac.

Community Center

The Proposed Project includes a Community Center located among the age-restricted housing. Through discussions with the Proposed Project’s representative, the proposed community center would be similar to other small community centers located in the area. Meter data obtained from community centers in El Dorado Hills, Cameron Park, Shingle Springs, and Rescue was analyzed, with the resulting demand ranging greatly with the size and amenities of each facility. To match the more moderately sized proposed facility, historic water use data from the Cameron Park Community Center was chosen. For purposes of this WSA, the average value of water use for years 2009 to 2012 was used.

Based on the available historic meter data for similar facilities served by EID, the unit water demand factor will use a baseline value of approximately 4.48 af/ac.

Other Miscellaneous Uses

The Proposed Project has additional miscellaneous uses including landscaped street medians, environmental mitigation requirements, natural ponds, sewer lift stations, and construction water. These uses have minimal impacts to the overall per-project total water use due to their limited size and water needs, and some are temporary in nature.

Landscape Street Medians and Community Entrances

The Proposed Project includes proposed landscaping along street corridors and at entrances to particular residential areas, as is common in El Dorado Hills. Since comparable data is not available due to the variety of landscapes used in existing street medians around El Dorado Hills, unit water demands for this category is derived from the MWELO (see prior discussion under “residential land-uses”). To provide flexibility to the Proposed Project to landscape as needed, the entire width of the landscaped area was assumed to demand the maximum use allowed by MWELO.[10] This maximum is determined as 70 percent of the reference evapotranspiration for the area. Using available maps from the California Department of Water Resources, the reference evapotranspiration for the Proposed Project area is approximately 57 inches per year.[11] The resulting demand factor is 3.3 af/ac.

Oak Woodlands Management

As of the preparation of this WSA, the mitigation requirements for impacts to oak woodlands resulting from the Proposed Project are as detailed in the County's Policy 7.4.4.4.[12] For purposes of estimating the water demands of this Proposed Project element, the WSA assumes mitigation will include establishing new trees, likely with associated irrigation water to assure seedlings are established. As defined in the County's Oak Woodland Management Plan Monitoring Program:

> *"Replacement of removed tree canopy . . . is subject to intensive to moderate management and 10 to 15 years of monitoring, respectively. The survival rate shall be 90 percent as specified in the approved monitoring plan for the project, prepared by a qualified professional. Acorns may be used instead of saplings or one gallon trees."*

> *"Management intensity assumes that 10 years after planting 1 year old saplings that trees that have been nurtured with high management intensity will be on average 2 inches DBH with 90 percent survival; moderate management intensity will result in trees that are on average 1.5 inches DBH with 85 percent survival."*

More precisely, an intensive management program is required to obtain 90 percent survival. The management includes10 years of monitoring for one-gallon/one year old saplings and 15 years of monitoring if acorns are planted. Any trees/acorns that do not survive within the monitoring periods are to be replaced within that time, so that 90 percent survival is achieved at the end of the monitoring period.

Because establishment of new trees is highly dependent on site conditions (soil depth and composition, depth to water table, slope, aspect, existing vegetation), planting conditions (water

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[10] Although this may be higher than seen by EID for current street medians and community entrances, this conservative assumption allows the Proposed Project with flexibility to landscape these areas up to the full demands of MWELO.

[11] Reference Evapotranspiration is obtained from the map available at http://wwwcimis.water.ca.gov/cimis/cimiSatEtoZones.jsp

[12] The County Board of Supervisors has an Oak Woodland Management Plan (OWMP) codified as Chapter 17.73 of the County Code (Ord. 4771. May 6, 2008.). The primary purpose of this plan is to implement the Option B provisions of Policy 7.4.4.4. On September 24, 2012, the Board of Supervisors directed the Development Services Department to prepare a General Plan amendment to amend Policies 7.4.2.8, 7.4.2.9, 7.4.4.4, 7.4.4.5, 7.4.5.1, and 7.4.5.2 and their related implementation measures to clarify and refine the County's policies regarding oak tree protection and habitat preservation. (This excerpt was copied from the following El Dorado County web site: http://www.edcgov.us/Government/Planning/General_Plan_Oak_Woodlands.aspx on May 4, 2013.)

year, starting from acorns or saplings, weed mats, mulch, density of plantings and other adjacent veg, etc.), establishment and maintenance practices (manual or installed irrigation systems, and irrigation intervals), and the required success criteria (target % survival), the estimated water demands are difficult to predict.[13] However, in order to be reasonably conservative, this WSA assumes that each acre of habitat mitigation will require 1 acre-foot per acre of annual irrigation for a period of 15 years.[14] For instance, if the Proposed Project must mitigate with 10 acres of woodland, the demand would be 10 acre-feet annually. All oak woodland will be established prior to build-out and require no on-going irrigation.

Sewer Lift Stations

Lift station demand comes in form of maintenance of the stations. Operational flushing at these lift stations is the primary water use. Based on EID records for such operations, each lift station is assumed to demand 2.5 acre-feet of water annually.

Construction Water

As stated in Section 1, early phases of the Proposed Project will include site grading and infrastructure installation. These and other construction elements will require dust suppression and other incidental water uses. These are estimated to be nominal, and do not continue beyond the construction phases of the Proposed Project. For purposes of identifying incremental water demands, construction water is assumed within this WSA to be 1 acre-foot per year (this is over 300,000 gallons – or over 75 fill-ups of a 4,000 gallon water truck).

Pond Supplementation

As part of maintaining the aesthetics of the parks on the Proposed Project site, maintaining the level in the two ponds will be required. With know surface areas of about 3 acres for the upper pond, and about 1.4 acres for the lower pond, the combined surface area is about 4.4 acres. Because these ponds are naturally fed and water rights associated with continued storage within the ponds exists, the supplemental water needs are difficult to determine. However, for purposes of this WSA, the same unit water demand used for the landscape right-of-ways, which is based upon the evaporation rates in the area, will be used. The resulting demand factor is 3.3 af/ac.

Modifications to Reflect Additional Water Use Reductions

Similar to the residential demand factors, the above-developed water demand factors for the non-residential classifications are based on similar existing developments in the El Dorado Hills area. Considerations to reduce these baseline values for conservation factors, however, are not required, since demand factors for many of the landscaped features, such as parks, will not

[13] A qualified professional will likely develop the project specific oak management plan. More detailed water use will be available in this plan. Review of information from oak mitigation projects in the area revealed a range of planting types, irrigation methods, and management time frames. Overall, irrigation demands were all low as would be expected for a native species.

[14] A conservative water demand number and a long management window were assumed to provide the Proposed Project applicants flexibility in meeting the oak woodland mitigation requirements.

change from the existing values. The landscape-dominant demand factors are affected primarily by climatic conditions that drive plant evapotranspiration. In other words, an acre of turf at a park will still use the same amount of water in the new parks as the existing parks. **Table 2-2** summarizes the non-residential demand factors used in this WSA.

Table 2-2 – Summary of Non-Residential Demand Factors

Land Use	Use Factor	Units
Community Center	4.48	AF/Unit
Parks	2.77	AF/Ac
ROW Landscaping	3.30	AF/Ac
Lift Station	2.50	AF/Unit
Open Space	0.00	AF/Ac

2.7 Proposed Project Water Demand Projection

Combining the Proposed Project's land-use details and phasing as summarized in **Table 1-1** and **Table 1-2** with the demand factors presented in **Table 2-1** and **Table 2-2**, the water demands for the project from initiation to build-out are estimated. In addition to the Proposed Project elements, the Proposed Project also includes the potential to serve the existing residence, located on a 5-acre lot on the northern border of the project. This parcel currently uses a personal well to serve its needs. However, with the construction of the Proposed Project, EID water will be available, should the existing owner's desire. To accommodate this possibility, the existing residence is assumed to have the same demand as the 3-acre custom estate lots – or 3.13 acre-feet per year at build-out.

At completion, the Proposed Project is estimated to need 427 acre-feet of water annually (prior to considerations of non-revenue water, described in the next subsection) as shown in **Table 2-3**.

2.7.1 Non-Revenue Water Demands

The demand factors presented earlier in this section represent the demand for water at the customer's meter for each category. To fully represent the demand on EID's water resources, non-revenue water also needs to be included. Non-revenue water represents all of the water necessary to deliver to the customer accounts and reflects distribution system leaks, water demands from potentially un-metered uses such as fire protection, hydrant flushing, and unauthorized connections, and inescapable inaccuracies in meter readings.[15] In most instances, the predominant source of non-revenue water is from system leaks – the loss from fittings and

[15] The American Water Works Association and the California Urban Water Conservation Council recognize the inherent non-revenue water that is either lost or mis-accounted in urban treated water distribution systems and suggest purveyors strive for a value of 10% of all delivered water. Obtaining this value is dependent on numerous factors including the age and extent of distribution system infrastructure, meter rehabilitation programs, and how a purveyor accounts for actions such as fire flows and hydrant flushing.

connections from EID's water sources through treatment plants, tanks, pumping plants, major delivery system back-bone pipelines, and community distribution systems. Because a significant portion of the delivery system used to bring water to the Proposed Project already exists, the benefits of new piping within the Proposed Project has limited effect on the overall percentage of non-revenue water necessary to operate the system.

Although EID has an established program for identifying and accounting for most unbilled and other system losses, there are still pipeline leaks, unmetered uses, unauthorized connections, meter inaccuracies, and other losses that are difficult to specifically quantify. Consistent with the District's methodology for calculating future water meter availability, as defined in the *2012 Water Resources and Service Reliability Report*, non-revenue water is projected at a fixed rate of 13 percent. Non-revenue demand is estimated to add 55 acre-feet per year at build-out to the Proposed Project's land-use demands, bringing the estimated build-out water demand attributed to the Proposed Project to 482 acre-feet annually (see **Table 2-3**).

2.7.2 Recycled Water Demand

The Proposed Project will not be utilizing EID's recycled water facilities to serve any part of the project.

Table 2-3 – Estimated Proposed Project Water Demands from Start-up to Build-out

	Unit Count or Acreage						Demand Factor (af/du or af/ac)						Demand (af/yr)					
Category	Current	2015	2020	2025	2030	2035	Current	2015	2020	2025	2030	2035	Current	2015	2020	2025	2030	2035
Residential [A]																		
Existing Large-Lot Estate	1	1	1	1	1	1	0.00	3.13	3.13	3.13	3.13	3.13	0	3	3	3	3	3
3-Acre Custom Estate Lots	0	1	5	5	5	5	3.48	3.13	3.13	3.13	3.13	3.13	0	3	16	16	16	16
1-Acre Custom Home Lots	0	1	5	5	5	5	1.16	1.04	1.04	1.04	1.04	1.04	0	1	5	5	5	5
1/4 and 1/2 Ac Hillside Lots	0	20	112	112	112	112	0.87	0.80	0.80	0.80	0.80	0.80	0	16	90	90	90	90
8,000-10,000 sf Lots	0	23	173	173	173	173	0.55	0.53	0.53	0.53	0.53	0.53	0	12	91	91	91	91
5,000-7,000 sf Lots	0	20	149	149	149	149	0.50	0.48	0.48	0.48	0.48	0.48	0	10	71	71	71	71
Age Restricted Large Lot	0	30	80	80	80	80	0.50	0.48	0.48	0.48	0.48	0.48	0	14	38	38	38	38
Age Restricted Small Lot	0	30	80	80	80	80	0.50	0.48	0.48	0.48	0.48	0.48	0	14	38	38	38	38
												Subtotal		73	351	351	351	351
Public																		
Community Center	0	1	1	1	1	1	4.48	4.48	4.48	4.48	4.48	4.48	0	4	4	4	4	4
Village Park	0	0	9	9	9	9	2.77	2.77	2.77	2.77	2.77	2.77	0	0	25	25	25	25
Neighborhood Park	0	0	2	2	2	2	2.77	2.77	2.77	2.77	2.77	2.77	0	0	5	5	5	5
Lift Station	0	2	2	2	2	2	2.50	2.50	2.50	2.50	2.50	2.50	0	5	5	5	5	5
Open Space	0	66	66	66	66	66	0	0	0	0	0	0	0	0	0	0	0	0
												Subtotal		9	40	40	40	40
Other																		
Mitigation	0	15	31	31	15	0	1.00	1.00	1.00	1.00	1.00	1.00	0	15	31	31	15	0
ROW & Landscape	0	6.3	6.3	6.3	6.3	6.3	3.30	3.30	3.30	3.30	3.30	3.30	0	21	21	21	21	21
Pond Supplementation	0	4.4	4.4	4.4	4.4	4.4	3.30	3.30	3.30	3.30	3.30	3.30	0	15	15	15	15	15
Construction Water	0	1	1	0	0	0	1.00	1.00	1.00	1.00	1.00	1.00	0	1	1	0	0	0
												Subtotal		52	67	66	51	35
												Total Water Demand	**0**	**135**	**459**	**458**	**442**	**427**
												Non-Revenue Demand at 13%	0	17	59	59	57	55
												Total Proposed Project Demand	**0**	**152**	**518**	**517**	**499**	**482**

[A] The distribution of housing units over time is EID's representation of the anticipated total number of units planned under each phase as described in Table 1-2.

SECTION 3 – OTHER ESTIMATED WATER DEMANDS

3.1 INTRODUCTION

As stated in this excerpt from Water Code Section 10910(b)(3): *"[T]he water supply assessment for the project shall include a discussion with regard to whether the public water system's total projected water supplies available…will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses…"* This section details EID's other "existing and planned future uses." For purposes of this WSA, existing and planned future uses are subdivided into the following:

- **Other Currently Proposed Projects –** in addition to the Proposed Project, El Dorado County (County) is the Lead Agency (pursuant to CEQA) for four additional proposed development projects. As Lead Agency, the County has requested separate WSAs from EID for each of these other projects. Because detailed land-use information is available for three of the four projects and separate WSAs are being developed for these three in parallel to this WSA, each of these three projects have unique water demand estimates that are included in this WSA.[16]

- **All Other Existing and Planned Future Uses –** in addition to the Proposed Project and the Other Currently Proposed Projects, existing customers and anticipated growth in the County must be quantified. The subdivisions of this category are:

    - **Current Customers and Uses –** using 2012 as a baseline condition, this category reflects the current range of EID's potable and recycled water customers. Because these customers and uses already exist, keeping them separate from planned future uses allows an analysis to reflect anticipated reductions in use over time as EID continues to implement its urban water conservation programs targeted at many of the existing customers.[17]

    - **Adjusted General Plan Update Land Use Growth –** in addition to the identified development projects currently undergoing County CEQA review, the County's 2004 General Plan Update (GPU) anticipates continued urban growth throughout the EID service area. This growth is accounted for in the EID 2013 *Integrated*

[16] EID understands the fourth project, San Stino, to be undergoing changes to its land-use plans at the time of drafting this WSA. Lacking the details needed to determine water demands similar to the other WSAs currently being completed, the San Stino project is reflected in the next subgroup of demands (see Section 3.3).

[17] New customers added to EID's system will have lower demand factors, as discussed in Section 2, and will be less likely to implement additional conservation or see much reduction when changes are made. For instance, many existing customers may still have 3 gallon per flush toilets or even 1.6 gallon per flush toilets, which when replaced, will likely only use 1.28 gallons. New houses will be constructed, per the CAL Green Code, with 1.28 gallon per flush toilets. EID has had conservation and incentives programs for more than 20 years.

Water Resources Master Plan (2013 IWRMP) and serves as the primary water demand driver into the future. Adjustments to anticipated GPU growth to reflect the "Other Currently Proposed Projects" and other proposed land-use changes, however, must be made. The adjustments discussed under this category include: (1) potential changes in the 2004 General Plan land use designations as identified in Facility Improvement Letters received and analyzed by EID; and (2) the removal of the Proposed Project and other proposed project uses being developed under concurrent WSAs.

- **Other Authorized Uses –** EID does not anticipate increases above 2012 levels in other authorized potable water uses such as fire flows, meter testing, water quality flushing, and ditch system operations. Demands for this category of water use is removed from the general plan growth and included separately.

- **Non-Revenue Water –** As discussed in Section 2.7.1, an additional demand is seen by EID to treat and deliver water to all customers. Referred to as non-revenue water, this water demand represents a 13 percent increase added to estimated customer demands. This value represents a long-term average experienced by EID.

3.2 Other Currently Proposed Projects

As mentioned in the previous section, El Dorado County is the Lead CEQA Agency for four additional proposed development projects and has requested EID to prepare WSA's for each development concurrent with this Proposed Project WSA. EID is currently drafting three of these four WSAs.[18] The estimate of water demand for each WSA follows the same methods used in Section 2 of this WSA, with specific unit demand factors applied to each unique land use element. The other projects are:

- Central El Dorado Hills – located along El Dorado Hills Blvd north of Hwy 50, this projects is a planned infill mixed development with primarily residential units and some commercial space.
- Lime Rock Valley Specific Plan – located adjacent to the Village of Marble Valley, this development is a planned residential community with a variety of lot sizes and housing types.
- The Village of Marble Valley Specific Plan – located southeast of the Propose Project, this development features many additional complex water use elements such as vineyards, schools, parks, a large lake, and a diverse range of housing types and lot sizes.

Based on the detailed analysis completed in the other WSAs, these "Other Currently Proposed Projects" represent approximately 2,800 acre-feet per year of new demand by 2035. **Table 3-1**,

[18] EID understands that the San Stino development project is undergoing changes to the land-use plans previously submitted to the County. Therefore, EID has not begun the WSA for that project.

presented later in this section, summarizes the estimated water demands as determined and detailed in the concurrent WSAs for each unique project. The values shown are the estimated customer and use demands and do not include the additional water associated with non-revenue percentages attributable to the treatment and distribution for each project (see Section 3.5).

3.3 ALL OTHER EXISTING AND PLANNED FUTURE USES

In simple terms, this category of use would typically reflect all the other water demands anticipated by EID that are in addition to the Proposed Project. However, because of the unique circumstance that other WSAs are concurrently being drafted by EID, this category must be adjusted to remove those other well-defined water demands. Furthermore, because other potential changes to the 2004 GPU have been brought to EID's attention, and EID anticipates changes to current customer uses, a more detailed assessment of future demands is warranted. This subsection describes:

- Current Customers and Uses
- Adjusted GPU Land Use Growth
- Other Authorized Uses

3.3.1 Current Customers and Uses

Current customers and uses in the contiguous EID service area provide a baseline from which to assess additional demand from the Proposed Project and other potential planned uses. For purposes of the WSA, the deliveries to current customers in 2012 were used to define this baseline. Based on the 2012 EID *Water Diversion Report*, EID diverted 36,580 acre-feet into its potable water system. In addition to the potable water, EID served 2,404 acre-feet of recycled water to meet customer demands.[19] Combined, the current water demand is represented as 38,984 acre-feet. This value includes the non-revenue water (see Section 2.7.1), including system losses, necessary to deliver these supplies from their respective treatment plants to the customer meter. This value also includes 1,269 acre-feet sold to the City of Placerville.[20]

Since the WSA uses 2012 as a baseline, the "current" demand varies from that used in the recently adopted 2013 IWRMP, which used the year 2008 for its baseline.[21] Given on-going conservation efforts, adoption of new rate structures, and other drivers, EID has seen an overall decrease in the annual customer use since the IWRMP selected its baseline. Therefore the 2012 baseline used for this WSA is more representative of the baseline use expected into the future from these existing customers and uses.

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[19] See EID 2013 Water Resources and Reliability Report (Table 14)
[20] See EID Consumption Report: Reporting Year 2012 (Table on p. 7)
[21] The IWRMP, adopted by the EID Board in March 2013, began several years ago and at the time used 2008 as a baseline. Since that time, EID's annual diversions have dropped from a high in 2008 of about 45,000 acre-feet to 35,678, 33,453, and 36,580 in 2010, 2011, and 2012, respectively. Combined with recycled water deliveries, the 2012 demand is lower than that used for the 2013 IWRMP, but greater than 2010 and 2011.

A slight adjustment to this baseline is necessary, however, to project it into the future. Although this demand will remain relatively constant since it does not add any new uses (additional uses are discussed in the next subsections), a slight decrease is assumed that reflects on-going implementation of conservation and installation of new water-using fixtures by existing customers. EID's continued leadership in conservation will enable existing customers to retrofit toilets, receive appliance rebates for new household items such as dishwashers, water heaters and clothes washers, and implement irrigation efficiency improvements through various incentives. Additional reductions in existing customer demands will also occur simply as a result of the natural replacement of old fixtures and appliances with lower water-use devices. For purposes of the WSA, EID estimates the reduction in current customer demand will be approximately 2% by 2020 and an additional 1% by 2035. This is consistent with EID's expectations necessary to meet its per-capita water use targets as detailed in the 2010 Urban Water Management Plan.[22]

3.3.2 Adjusted GPU Land Use Growth

In the 2004 GPU, the County made growth projections using land-use zoning throughout the County. Within the contiguous EID water service area, the GPU land-use zoning correlates to EID defined unit water demand factors. During preparation of the recently adopted 2013 IWRMP, EID used GIS-based land-use designations, combined with the water demand factors, to develop estimated growth in water demand. Absent any changes to the 2004 GPU land-use designations, the 2013 IWRMP demand projections would provide a valid representation of future water needs. However, because several proposed changes to the GPU land-use designations have been submitted – both through the County's formal process, such as is the situation with the Proposed Project and Other Planned Projects, and through an EID process explained below – the 2013 IWRMP demand projections require refinement. The steps to adjust these demands included:

- Removal of Proposed Project and Other Planned Projects water demands
- Modifying land-use zoning based on Facility Improvement Letters
- Determining Growth to Year 2035

Once these steps were completed, the analysis reassessed the water demand using the water demand factors applied in the 2013 IWRMP.

Step 1: Removal of Proposed Project and Other Planned Project Water Demands

The first step in adjusting the water demands was to remove the detailed water demands estimated in this WSA for the Proposed Project and for the Other Planned Projects (see Section 2 and Section 3.2). This step involved removing the specific acreage and water demand factors from the 2013 IWRMP analysis. The 2004 GPU included land-use zoning for the lands underlying the Proposed Project as well as the Other Planned Projects. In the 2013

[22] See Section 3 of the 2010 UWMP available here: http://www.eid.org/modules/showdocument.aspx?documentid=338

IWRMP, water demands were estimated using the existing zoning. Removing these land uses eliminates the potential to double-count the associated acreage when assessing the remaining GPU expected growth.

Step 2: Modifying Land-use Zoning based on FILs

When investigating water service from EID for development projects (e.g. lot splits, land use changes, and new service to existing parcels), existing landowners submit a Facilities Improvement Letter (FIL). This document allows EID to assess whether infrastructure or supplies are available to serve the proposed project. In some instances, the FILs include proposed land-use zoning changes not previously incorporated into EID water demand projections. By using GIS to map the locations of the FILs requesting a change in land-use zoning, EID was able to identify where changes to the 2013 IWRMP demand estimates would occur. About 25 specific FILs were identified as having land-use designation changes. These identified parcels were removed from the prior analysis to eliminate potential double counting of demands.

In a separate analysis, the water demand for this subset of parcels was recalculated using the appropriate water demand factor for the new proposed land-use classification (e.g. water needs for these parcels may have previously been calculated based on very-low density housing, but is requesting a change to higher density housing). Through the analysis, an increased demand of approximately 3,000 acre-feet over the 2013 IWRMP projections was identified.

Step 3: Determining Growth to 2035

The GPU identifies anticipated build-out conditions for the County and, as a subset, for the EID contiguous water service area. Since this WSA assesses water demands in 5-year increments only to 2035 – well short of the anticipated timing of the County's build-out – the amount of build-out growth occurring by 2035 must be determined. This was done for both the parcels identified with new land-use zoning through the FIL analysis, and for the remaining parcels with original GPU land-use designations.

Because there is little detail about planned development rates for the FIL-related parcels, this WSA assumed that these parcels would have full water demand usage by 2035.[23] This is a conservative estimate, since some of these lands may not develop by 2035 or may never develop. Thus, the estimated increase in demand of approximately 3,000 acre-feet was assumed to occur by 2035 with the 2013 IWRMP growth rate applied.

For the remaining parcels, growth rates used to determine the degree of development were based on EID's 2013 IWRMP. In the 2013 IWRMP, growth rates for the El Dorado Hills,

[23] This assumption also considers that a landowner would likely only submit a FIL to EID if they are seriously contemplating the development activity. Thus, there is a higher likelihood that these parcels will develop at a faster rate than other generally anticipated growth for the remaining parcels in the GPU.

and Western/Eastern water service areas were identified for specific year-ranges.[24] This WSA uses those growth rates for the remaining parcels. Using the 2013 IWRMP growth rates, the analysis determined build-out for the El Dorado and Western/Eastern service areas occurs after 2035.

During this adjustment, special attention was provided to the City of Placerville. The City purchases potable water from EID for distribution to its residents. The 2013 IWRMP projected future water demands for the City based on the City's existing General Plan. This WSA assumes the same rate of growth and build-out demand as the 2013 IWRMP for the City.

Upon completion of these steps, the adjusted demand for the GPU land uses was determined. **Table 3-1** summarizes the anticipated increase in water demand during each 5-year increment as a result of these adjustments to the GPU land-uses.

3.3.3 Other Authorized Uses

In addition to the sale of water to metered customers, EID has a set of water demands it refers to as "Other Authorized Uses." This designation is for the following existing uses:

- Knolls Reservoir Assessment District
- Private Fire Services
- Temporary Water Use Permit
- Bulk Water Stations - Permanent
- Bulk Water Stations - Temporary
- Lift Stations
- Collection System Flushing
- Spills, Overflows, and Flushing
- Clear Creek Aesthetics Flow Maintenance District

Of these, the Clear Creek aesthetic flows comprise over 80 percent of the annual authorized uses. Lift stations and temporary use permits comprise another 10 percent. The current demand of approximately 2,200 acre-feet is already reflected in the "Current Customers and Uses." EID anticipates no growth in these authorized water uses, with the total demand to remain constant at 2,200 acre-feet through 2035.

3.4 Non-Revenue Water Demands

The subtotal values in **Table 3-1** represent the demand for water at the customer's meter for each category. To fully represent the demand placed on EID's water resources, non-revenue water also needs to be included. Non-revenue water represents all of the water necessary to deliver to

[24] EID Integrated Water Resources Master Plan, adopted March 2013 (Table 9-2).

the meter and reflects distribution system leaks, water demands from potentially un-metered uses of fire protection, fire hydrant flushing, and unauthorized connections, and inescapable inaccuracies in meter readings.[25] In most instances, the predominant source of non-revenue water is from system losses – the loss from fittings and connections from the District's water sources through treatment plants, tanks, pumping plants, major delivery system back-bone pipelines, and community distribution systems.

Although the District has an established program for identifying and accounting for most unbilled and other system losses, there are still pipeline leaks, unmetered uses, unauthorized connections, meter inaccuracies, and other losses that are difficult to specifically quantify. Consistent with the District's methodology for calculating future water meter availability, as defined in the *2012 Water Resources and Service Reliability Report*, non-revenue water is projected at a fixed rate of 13 percent.

As shown in **Table 3-1**, non-revenue demand for Existing and Planned Future Uses is estimated to be about 7,700 acre-feet per year by 2035.

3.5 ESTIMATED EXISTING AND PLANNED FUTURE USES

Combining the estimated water demand for Other Currently Planned Projects (see Section 3.2 with the All Other Existing and Planned Future Uses demand (Current Customers and Uses plus the Adjusted GPU Land Use values), the total estimated demand during each 5-year increment to 2035 is derived (see subtotal water demand in **Table 3-1)**.

Table 3-1 – All Other Existing and Planned Future Uses

Category	Estimated Demand (af/yr)					
	Current	2015	2020	2025	2030	2035
Other Currently Proposed Projects	0	153	876	1,732	2,476	2,832
Current Customers and Uses [1]	38,984	34,154	33,809	33,694	33,579	33,464
Adjusted GPU Land Use [2]	0	514	2,853	7,975	14,718	22,830
Subtotal Water Demand	**38,984**	**34,821**	**37,539**	**43,401**	**50,774**	**59,127**
	Current	**2015**	**2020**	**2025**	**2030**	**2035**
Non-Revenue Water at 13%	--	4,527	4,880	5,642	6,601	7,686
Total Water Demand	**38,984**	**39,348**	**42,419**	**49,043**	**57,375**	**66,813**

1. The "Current Customers and Uses" demand value includes the "Other Authorized Uses." The Value is greater under the "Current" condition because "Non-Revenue Water" is included in the current year. All other years will have "non-revenue water" added on a separate line. A 3% conservation decrease occurs by 2035.
2. "Adjusted GPU Land Use" reflects changes to the 2004 GPU as determined by FILs submitted to EID. This value also does NOT include the other proposed projects currently undergoing County CEQA review.

[25] See footnote 14

3.6 TOTAL ESTIMATED DEMAND

The other existing and planned future water demands described in this section represent the total demands anticipated *in addition to* the water demands of the Proposed Project. Combining the estimated Proposed Project water demands of 482 acre-feet annually (see **Table 2-3**) with the estimated Existing and Planned Future water demands of nearly 67,000 acre-feet annually (see **Table 3-1**), a total estimated demand for EID water supplies by 2035 is determined. Estimated existing and planned future water demands, inclusive of non-revenue water needs, for each 5-year increment to 2035 are presented in **Table 3-2**. The estimated demand for EID Water supplies is 67,295 acre-feet annually.

Table 3-2 – Total Estimated Water Demands

Category	Estimated Demand (af/yr)					
	Current	2015	2020	2025	2030	2035
Proposed Project	0	152	518	517	500	482
Existing and Planned Future Uses	38,984	39,348	42,419	49,043	57,375	66,813
Total Water Demand	**38,984**	**39,500**	**42,937**	**49,560**	**57,875**	**67,295**

Of note is that the estimated water demand for 2035 presented in **Table 3-2** fits within the range of total demands presented in Table 9-1 of the 2013 IWRMP (estimated to be between 61,262 acre-feet and 77,315 acre-feet). The primary differences is that the 2013 IWRMP used 2008 as a baseline demand, which is substantially higher than EID has seen in the last several years. This WSA uses 2012 as a baseline. The 2008 value was approximately 45,000 acre-feet, while the 2012 value is 38,984 – or about 39,000 acre-feet. This represents a difference of about 6,000 acre-feet. Starting from a different baseline quantity and year, and then applying the 2013 IWRMP growth rates, results in a different estimated total demand when reaching 2035.

SECTION 4 – WATER SUPPLY CHARACTERIZATION

4.1 INTRODUCTION

This section explains the intended water supply that EID will use to serve the Proposed Project.[26] EID will meet the Proposed Project's water demands by utilizing water assets derived from its existing sources as well as through future asset acquisition efforts with El Dorado County Water Agency. This section details the Proposed Project's available water supplies and entitlements as well as its planned water supplies and entitlements in both normal water years and dry water years. The Proposed Project exists completely in El Dorado Irrigation District's contiguous water service area (see **Figure 4-1**) but may only be served with treated water, as recycled water infrastructure does not reach the project site.[27]

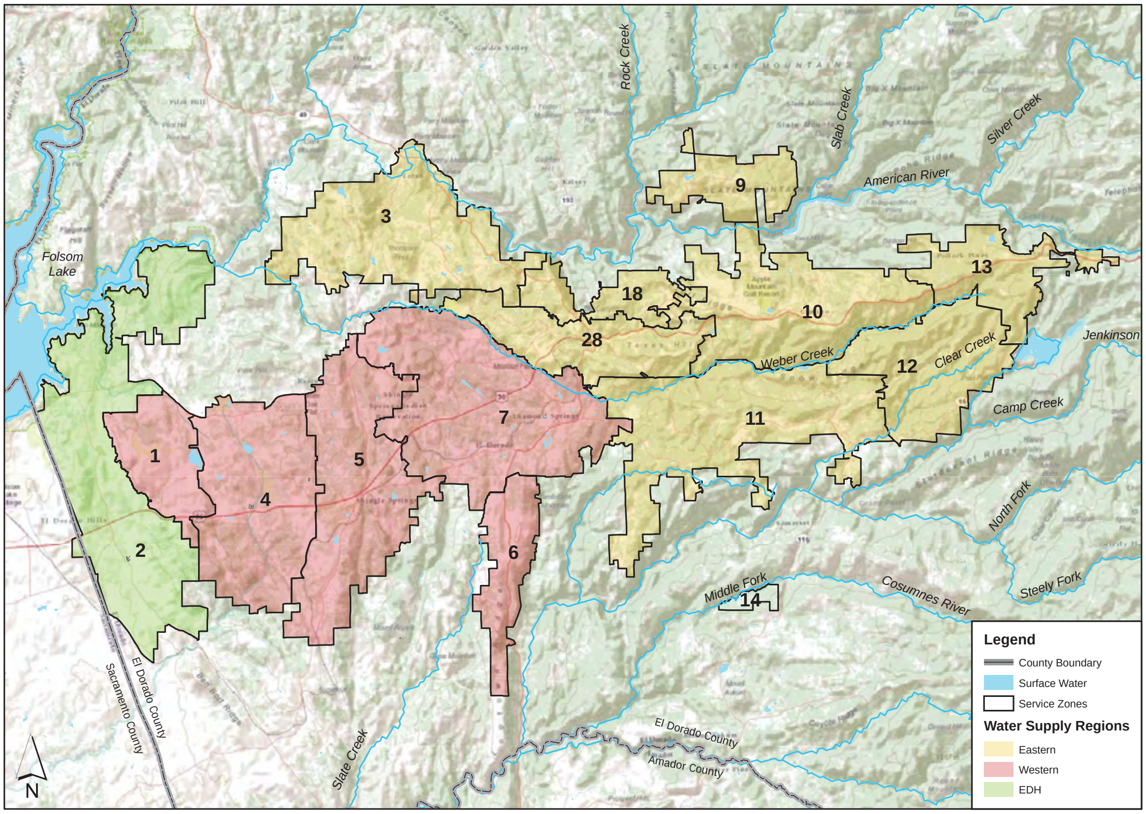
El Dorado Irrigation District maintains two primary interconnected water systems in its contiguous service area: the El Dorado Hills system and the Western/Eastern system, along with a separate recycled water system. The El Dorado Hills water system obtains its primary supplies under rights and entitlements from Folsom Reservoir. The Western/Eastern system derives its supplies from sources under rights and entitlements emanating from further up the American River watershed and the Cosumnes River watershed. The recycled water system serves treated wastewater from the El Dorado Hills wastewater treatment plant and the Deer Creek wastewater treatment plant.

The water assets can be further categorized by the service area they primarily serve and the treatment plant they flow through. Water derived from Folsom Reservoir is delivered to the El Dorado Hills water treatment plant and serves the El Dorado Hills area. Water derived from upstream American River watershed diversions and storage reservoirs generally use the Reservoir 1 Water Treatment Plant while the Cosumnes River diversions use Reservoir A Water Treatment Plant to serve the Western/Eastern area. Water assets from these upstream diversions can be delivered by gravity feed to the El Dorado Hills area, but assets from Folsom Reservoir are not delivered outside the El Dorado Hills area due to infrastructure limitations. The following subsections describe these water supplies and delivery mechanics in more detail.

[26] CWC § 10910(d)(1) requires that "The assessment… include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system…under existing water supply entitlements, water rights, or water service contracts. (2) An identification of existing water supply entitlements, water rights, or water service contracts held by the public water system…shall be demonstrated by providing information related to all of the following: (A) Written contracts or other proof of entitlement to an identified water supply. (B) Copies of a capital outlay program for financing the delivery of a water supply that has been adopted by the public water system. (C) Federal, state, and local permits for construction of necessary infrastructure associated with delivering the water supply. (D) Any necessary regulatory approvals that are required in order to be able to convey or deliver the water supply."

[27] EID also has surface water assets that it serves to two non-contiguous areas as well as raw water assets that are used for agricultural purposes. These water assets are irrelevant to the Proposed Project contemplated in this Water Supply Assessment and are, therefore, not analyzed.

Figure 4-1 – El Dorado Irrigation District Service Area
(from Figure 8-7, Integrated Water Resources Master Plan, EID, March 2013)



4.2 TREATED WATER SUPPLIES

EID's treated water supplies identified for the Proposed Project are derived from a number of water rights and entitlements as detailed in **Table 4-1**. The maximum available water assets column in **Table 4-1** does not account for other hydrological, technical, regulatory, and contractual limitations that apply to the water assets for normal year and dry year deliveries. These issues are addressed in the other two columns in the table. EID's water assets available for the Proposed Project include water rights and entitlements that EID currently has in its possession and planned water rights and entitlements that it will control in the future.

4.2.1 Water Rights and Entitlements Description

Generally, EID's water assets are derived from pre-1914 appropriative water rights, licensed and permitted appropriative water rights, Central Valley Project (CVP) contracts, Warren Act contracts (that allow non-federal water assets to be wheeled through the federal storage and conveyance facilities), and recycled water generated from the effluent treated at the District's two wastewater treatment plants. The District's counsel has recently confirmed all of these water rights and entitlements. Pertinent information regarding these water assets is included in **Appendix A** of this document as required by Water Code section 10910(d).

Water for the Proposed Project will be derived from both Folsom Reservoir and upstream American River and Cosumnes River diversions. As shown in **Table 4-1**, the primary water assets for diversion at Folsom Reservoir are: CVP Contract 14-06-200-1375A-LTR1, and License 2184 and several pre-1914 water rights incorporated into Warren Act contract 06-WC-20-3315. EID is seeking to finalize its Warren Act contract for diversions of Permit 21112 at Folsom Reservoir. EID also has additional water assets under the El Dorado – SMUD Cooperation Agreement and a Central Valley Project water entitlement derived from El Dorado County Water Agency's Fazio water supply. These water assets will be described in **Section 4.2.2**.

Table 4-1 – Water Rights, Entitlements, and Supply Availability

Water Right or Entitlement	Maximum Water Assets Available (Ac-ft)	Normal Year Planned Supply Availability (Ac-ft)	Dry-Year Planned Supply Availability (Ac-ft)
License 2184 and pre-1914 ditch rights including Warren Act Contract 06-WC-20-3315	4,560	4,560	3,000
Licenses 11835 and 11836	33,400	23,000	20920[A]
CVP Contract 14-06-200-1375A-LTR1	7,550	7,550	5,660
Pre-1914 American River diversion and storage rights	15,080	15,080	15,080
Permit 21112	17,000	17,000	17,000
Subtotal Existing	**77,590**	**67,190**	**61,660**
Central Valley Project Fazio water entitlement (PL 101-514 (1990) Fazio) [D]	7,500	7,500	5,625
Applications 5645X12, 5644X02 and partial assignment of Applications 5645, 5644 with El Dorado-SMUD Cooperation Agreement [E]	40,000[B]	30,000	5,000[C]
Subtotal Planned	**47,500**	**37,500**	**10,625**
Recycled Water	5,600	5,600	5,600
Total	**130,690**	**110,290**	**77,885**

[A] This is the modeled safe-yield of this water right during a single dry-year. For planning purposes, the second and third dry years of a three-year dry period are assumed to be 17,000 acre-feet, and 15,500 acre-feet, respectfully
[B] Section 5.1.1 of the El-Dorado SMUD Cooperation Agreement indicates that 40,000 acre-feet of SMUD water will be available after 2025. For conservative Normal Year planning purposes, the District uses 30,000 acre-feet of available supply.
[C] Available supply is 15,000 acre-feet in a single dry year but in preparing for multiple dry years EID anticipates using only 5,000 acre-feet per year for a three year period.
[D] Available starting in 2015
[E] Available starting in 2025

License 2184 and Pre-1914 Water Rights

Water rights associated with Weber Dam, Weber Creek (Farmer's Free Ditch), Slab Creek (Summerfield Ditch), and Hangtown Creek (Gold Hill Ditch) are available to be diverted at Folsom Reservoir under a long-term Warren Act Contract, with approximately 4,560 acre-feet available each year from these sources. A Warren Act Contract allows the use of federal facilities to take non-CVP water such as these supplies. The 40-year contract commenced on March 1, 2011 and has a maximum net contract amount of 4,560 acre-feet per year. The contract total also assumes a 15% conveyance loss between the former points of diversion and Folsom Reservoir, which can be adjusted at a later date by mutual agreement without amending the contract. The annual water diversion season is limited to April through November 15 and the water must be used for municipal and industrial purposes in the El Dorado Hills and Cameron Park areas.

Licenses 11835 and 11836

Licenses 11835 and 11836 allow for 33,400 acre-feet of diversion in EID's upstream system in the Cosumnes River watershed. These diversions are stored in Jenkinson Lake, the largest storage reservoir in EID, formed by two earth and rock dams across Sly Park Creek near Pollock Pines with a maximum capacity of 41,033 acre-feet. The dam was constructed as a portion of the United States Bureau of Reclamation (USBR) CVP in 1955. With the transfer of ownership from the USBR of the Sly Park dam and associated lands and facilities in 2003, EID not only operates and maintains the Jenkinson Lake and Sly Park Dam facilities, including recreational aspects, but also holds the water rights. The average annual use from this facility is approximately 23,000 acre-feet, though EID's annual water right is for 33,400 acre-feet of total beneficial use. This water supply is used entirely within EID's contiguous service area. Under average flow conditions, Jenkinson Lake is operated to maintain 14,000 to 18,000 acre-feet of carryover storage each year. The outlet works at Sly Park Dam have a maximum capacity of 125 cfs. Water is released to the Reservoir A Water Treatment Plant for subsequent treatment, transmission, and distribution.

Jenkinson Lake contributes approximately 20,920 acre-feet per year to EID's system firm yield. Over the past five years, EID's annual diversions from Jenkinson Lake have averaged approximately 22,600 acre-feet per year. EID's maximum and minimum diversions from this particular water source during this five-year period were 25,745 and 20,800 acre-feet per year, respectively.

USBR CVP Contract 14-06-200-1375A-LTR1

Surface water from Folsom Reservoir is provided to the El Dorado Hills area. By contract with the USBR for Folsom Reservoir water, EID is entitled to 7,550 acre-feet per year. The contract includes provisions for use in a particular area that generally encompasses the El Dorado Hills and Cameron Park areas. Folsom Reservoir is operated by the USBR as part of the CVP, a multipurpose project that provides flood control, hydroelectricity, drinking water, and water for irrigation.

The El Dorado Hills County Water District entered into a USBR Contract in 1964 for water supply from Folsom Reservoir. The contract had a not-to-exceed limit of 37,600 acre-feet per year. When EID annexed the El Dorado Hills County Water District in 1973, the contract was assigned to EID, and subsequently, in 1979, an amendatory contract replaced the original 1964 contract and reduced the maximum annual supply quantity of Folsom Reservoir water to 6,500 acre-feet per year. In 1983, the USBR increased the maximum annual supply quantity from 6,500 to 7,500 acre-feet per year. EID also annexed and succeeded to a USBR Contract for 50 acre-feet per year to supply the Lakehills area in El Dorado Hills. In 2006, these two contracts were consolidated into a single 40-year USBR Contract with a maximum quantity of 7,550 acre-feet per year.

Pre-1914 South Fork American River and Project 184

EID acquired Project 184 from Pacific Gas and Electric (PG&E) in 1999. Project 184 includes reservoirs and associated dams, 22 miles of canals, a 21 Mw powerhouse, and other ancillary facilities. Prior to the transfer of ownership and water rights, EID held a contract to purchase water from PG&E and its predecessor, Western States Gas and Electric Co. The original water rights claims date back to 1856, with additional claims being filed in the 1860s and 1870s. The water rights for diversions from Echo Lake were established in 1880 in a California Supreme Court decision. Then, in 1918, the California Railroad Commission (predecessor to the California Public Utilities Commission) recognized the use of water from the El Dorado Canal for irrigation and domestic purposes.

The sources of this water supply include natural flows in the South Fork American River and its tributaries, and stored water in Silver, Aloha, Echo, and Caples Lakes. The supply is diverted from the South Fork American River at Kyburz and is conveyed via the El Dorado Canal to the El Dorado Forebay. Some additional water is obtained by diversions into the El Dorado Canal from streams tributary to the South Fork American River. EID takes consumptive use of the water supply at the Main Ditch Intake, located at the El Dorado Forebay. This particular supply contributes 15,080 acre-feet per year to EID's system firm yield.

Water diversions of up to 156 cfs can be made from the South Fork American River at the diversion dam. In addition to these direct diversion rights, EID also has pre-1914 diversion and storage rights associated with portions of the waters stored in Silver Lake, Caples Lake, and Lake Aloha and all of the waters stored in Echo Lake.

El Dorado Forebay is filled by the surface water supply from the Project 184 facilities upstream in the South Fork American River basin and at Echo Lake. EID has a consumptive water entitlement of 15,080 acre-feet per year delivery at the Forebay. The entitlement is a pre-1914 water right, and diversions are made in compliance with the 40-year Federal Energy Regulatory Commission Project 184 operating license issued to EID in October 2006. Because the full entitlement can be provided in all years including the most severe historic single dry year of 1977, this source of water is considered assured, and not subject to shortage from hydrologic droughts.

Permit 21112 and Warren Act Contract

The State Water Resources Control Board (SWRCB) issued EID a water right permit in 2001 for an additional 17,000 acre-feet per year of water supply associated with Project 184 facilities and power operations to be taken at Folsom Reservoir. This water supply was authorized under Permit 21112 for diversion and consumptive use anywhere within EID's contiguous service area. There are no cutback provisions on this supply.

The El Dorado County Water Agency (EDCWA) and EID applied to the SWRCB to obtain water rights for consumptive use of waters previously stored and released for power generation from Caples, Silver, and Aloha Lakes, as well as certain direct diversions from the South Fork American River, all of which have been used by Project 184 for hydroelectric power generation or instream flows. The EDCWA later assigned all of its rights under this application to EID. The SWRCB granted the right to appropriate 17,000 acre-feet per year of water. Permit 21112 allows EID to make direct diversions from the South Fork American River at Folsom Reservoir; to store in Caples, Silver, and Aloha Lakes; and to redivert the water released from storage. The sole approved point of take for consumptive purposes is Folsom Reservoir.

A diversion from Folsom Reservoir requires acquiescence from the USBR and issuance of a Warren Act Contract. EID has diverted water under this right under a temporary urgency basis and the Warren Act Contract is pending.

Recycled Water Supplies

EID produces recycled water at both the El Dorado Hills and Deer Creek wastewater treatment plants which is then used by EID's customers for irrigation of residential landscape and commercial landscape. The availability of recycled water is currently limited to the El Dorado Hills and Cameron Park areas. EID anticipates a 2035 recycled water supply totaling 5,600 acre-feet per year (see Section 4.3 for further details).

4.2.2 Planned Water Supplies

EID has plans to acquire and use two additional water supplies from EDCWA for use within its service area to make available for the Proposed Project – water under the El Dorado-SMUD Cooperation Agreement and water under EDCWA's Fazio CVP supply. This section describes these supplies.

El Dorado-SMUD Cooperation Agreement

As shown in **Table 4-1**, the additional supplies include a grouping of water right applications and assignment of existing water right applications totaling approximately 40,000 acre-feet of water. This supply is being developed by the El Dorado Water and Power Authority (EDWPA). EDWPA is a Joint Powers Authority consisting of El Dorado County, El Dorado County Water Agency and El Dorado Irrigation District (collectively, El Dorado Parties). EDWPA was formed to pursue additional water supplies for the western slope of El Dorado County as determined by the El Dorado County General Plan. This need is identified in the El Dorado County Water Agency Water Resources Development and Management Plan (Water Plan).[28] The Water Plan is

[28] http://www.edcgov.us/water/final_water_resources_plan.html

designed to coordinate water resource planning activities within El Dorado County and identifies water supply needs for the western slope of El Dorado County of approximately 34,000 acre-feet per year (AFA) at the 2025 demand level.

In 2005, the El Dorado Parties signed the "El Dorado – SMUD Cooperation Agreement" (included with **Appendix A**), which would help meet the Water Plan's identified water supply needs. This Agreement requires SMUD to make annual deliveries of up to 30,000 acre-feet of water through 2025 and 40,000 acre-feet thereafter from SMUD's Upper American River Project (UARP) to the El Dorado Parties. In 2008, EDWPA petitioned the SWRCB for partial assignment of two applications for diversion and storage to obtain water supplies necessary to trigger SMUD's obligations. A Draft Environmental Impact Report has been prepared in support of the water rights application and was circulated in July 2010. EDWPA is currently in the protest settlement phase and the CEQA process is anticipated to be completed in 2014 with award of water rights shortly thereafter.

The El Dorado-SMUD Cooperation Agreement also obliges SMUD to provide carryover storage and delivery to EID of up to 15,000 acre-feet of drought protection water supplies to be obtained by EDWPA. Based on demand projections, EID anticipates that only 30,000 acre-feet of the 40,000 acre-feet identified in the water right applications and the El Dorado – SMUD Cooperative Agreement will be available to EID in normal years. Moreover, EID has planned that a mere 5,000 acre-feet of the water supply will be available for EID's uses in each dry year. This number is derived from Appendix H of the El Dorado – SMUD Cooperation Agreement describing deliveries available from carryover storage. Both of these conservative assumptions are shown in **Table 4-1**. EID has planned this supply to be available starting in 2025.

Fazio CVP Supply

EID is also in the final stages of securing 7,500 acre-feet of CVP water supplies in conjunction with EDCWA. In 1990, Congress directed the Secretary of the Interior, through the USBR, to enter into a new CVP Municipal and Industrial (M&I) water service contract with EDCWA for up to 15,000 acre-feet of water annually (Section 206 of P.L. 101-514). The CVP water service contract requires requisite compliance by EDCWA and the USBR with CEQA, NEPA, and ESA statutes.

In 2009, a draft EIS/EIR was released for public review and comment for the CVP M&I water rights contract. In 2010, USBR advised EDCWA that it would take another 5 years before the CVP-Operations Criteria and Plan (OCAP) related litigation would allow the EIS to move forward. As a result, EDCWA made the decision to detach the EIR from the EIS – essentially separating the CEQA and NEPA processes. EDCWA certified the Final EIR and approved the project in January 2011. EDCWA then prepared and submitted to USBR a draft Biological Assessment (BA) in September 2011 and a draft Final EIS in October 2011. USBR submitted the draft Final EIS to NOAA Fisheries in December 2011. Final EIS completion and contract execution is pending completion of ESA consultation with NOAA Fisheries.

The CVP contract seeks to acquire 15,000 acre-feet of CVP project water, of which at least 7,500 acre-feet would be made available to EID by subcontracts with EDCWA.[29] Diversions by EID would occur at its existing intake in Folsom Reservoir, conveyed to the El Dorado Hills Water Treatment Plant, and delivered to a specific place of use location in El Dorado Hills and Cameron Park areas as shown in Figure ES-2 of EDCWA's EIR.

The contract negotiations and environmental compliance efforts are ongoing. These actions allow EID to use this water supply in this WSA as a planned supply that will be available to EID in the future to serve the Proposed Project. The approval of the contract terms as well as finalization of the environmental documents will allow EID to apply the water supplies under this contract entitlement to municipal and industrial beneficial uses. EID has planned this water supply to be available starting in 2015.

4.2.3 Normal Year Water Supply Availability

As shown in **Table 4-1**, EID's total water entitlements under its existing and planned supplies does not equate to the amount of water available in normal years in the future. The normal year water supplies will be described in this section.

Excluding recycled supplies, EID's secured water rights and entitlements available for the Proposed Project total 67,190 acre-feet. As shown in the sufficiency analysis in Section 5, this amount is insufficient to serve EID's future demand incorporating the Proposed Project and all planned future projects. Accordingly, this section assesses both EID's secured supplies and additional planned supplies. EID's water supplies associated with the entire secured and planned water assets totals 110,290 acre-feet per year.

The 67,190 acre-feet of secured supplies include appropriative water right license 2184 and pre-1914 appropriative water rights associated with Slab Creek, Hangtown Creek and Weber Creek. As described above, these rights are collectively combined for conveyance purposes in a Warren Act Contract, No. 06-WC-20-3315, that allows for storage in and diversion from Folsom Reservoir. The total volume is 4,560, net of a negotiated 15% conveyance loss under the terms of the Warren Act contract. For purposes of serving the Proposed Project, EID assumes full diversion at 4,560 in normal years under these water assets.

Appropriative water right licenses 11835 and 11836 are also secured supplies. These supplies can be diverted from several creeks in the Cosumnes River watershed (Camp, Hazel, and Sly

[29] Central Valley Project Water Supply Contracts Under Public Law 101-514 (Section 206): Proposed Contract Between the U.S. Bureau of Reclamation and the El Dorado County Water Agency, and Proposed Subcontracts Between the El Dorado County Water Agency and the El Dorado Irrigation District, and Between the El Dorado County Water Agency and the Georgetown Divide Public Utility District Final Environmental Impact Report at ES-1, January 2011.

Park) and are typically stored in Jenkinson Lake. The maximum rate of diversion is 500 cfs for a total possible diversion volume of 33,400. However, due to limitations in storage availability in Jenkinson Lake assessed through OASIS hydrologic modeling, the maximum available normal year supply for the Proposed Project is 23,000 acre-feet.[30] Although EID has diverted as much as 25,745 acre-feet from this reservoir, EID does not anticipate using more than 23,000 acre-feet under this right for its normal year diversions in the future.

Central Valley Project Contract 14-06-200-1375A-LTR1 is a secured supply available for immediate use for the Proposed Project. This CVP contract entitlement requires the USBR to deliver up to 7,550 acre-feet of water from its SWRCB water right permits on the American River to EID.

As described in Section 4.2.1, EID also has a number of pre-1914 appropriative water rights on the American River with storage components in Silver Lake, Lake Aloha, Caples Lake, and Echo Lake. For purposes of this document, these are collectively called the pre-1914 American River water rights.[31] The total volume of water available under the pre-1914 American River water rights is 15,080 acre-feet in normal years.

Appropriative water right permit 21112 is a secured supply for purposes of this WSA. Permit 21112 allows EID to divert up to 17,000 acre-feet of water per year from Folsom Reservoir to be used in EID's service area. EID has diverted water under this permit as part of a temporary urgency in 2008. EID must finalize its Warren Act Contract to divert this water at Folsom Reservoir. However, based upon the availability of the supply in Permit 21112, the ability to store the water in Caples, Silver, and Aloha lakes, and the pending conveyance agreement with USBR, the normal-year availability of this supply is 17,000 acre-feet.[32]

As described in Section 4.2.2, EID's planned water supplies include the CVP Fazio supply of 7,500 acre-feet as authorized under federal law. Once secured, EID should receive normal-year deliveries of the full entitlement just as USBR promises to other CVP M&I contract holders on the American River system. There is no reason to believe that this contract entitlement will be different than other CVP contract entitlements on the American River system.

Last, as described in Section 4.2.2, EID's planned water supplies derived from the EDWPA appropriative water right applications filings and assignments, as well as the El Dorado – SMUD Cooperation Agreement, indicate that EID should receive normal-year water deliveries of 30,000 acre-feet per year starting in 2025 and then as much as 40,000 acre-feet of deliveries thereafter.

[30] 2013 Water Resources Report
[31] California Water Code section 10910(d)(2)(A) requires "proof of entitlement" of each individual water right that is combined into this pre-1914 American River water rights grouping. These documents are contained in **Appendix A** of this Water Supply Assessment.
[32] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-7 of 22. Follow-up discussion with EID Counsel on water availability on April 23, 2013.

Based on demand projections, the District uses 30,000 acre-feet of normal-year deliveries under these collective applications and the El Dorado-SMUD Cooperation Agreement.

4.2.4 Dry-Year Water Supply Availability

As shown in **Table 4-1**, EID anticipates less water being available in dry years than is otherwise available in normal years as described in Section 4.2.3. Dry-year supplies include supply reductions attributable to hydrologic droughts and regulatory curtailments. The dry-year water supplies are described in this section.

EID's entire normal-year secured and planned water assets total 110,290 acre-feet per year. In dry years, EID's total water assets equal 77,885 acre-feet. Of this total supply, 61,660 acre-feet are secured water assets and 16,225 acre-feet are planned water assets.

As described in Section 4.2.3, the secured water assets include License 2184 and the additional pre-1914 appropriative rights that are included in Warren Act contract 06-WC-20-3315, Licenses 11835 and 11836, CVP Contract 14-06-200-1375A-LTR1, the pre-1914 American River water rights grouping, and Permit 21112. All of these water rights are subject to different regulatory and hydrological restrictions that could result, in some instances, in reduction of the water supplies available under the right or entitlement in dry years.

The water rights contained in the Warren Act Contract 06-WC-20-3315 have some level of regulatory restrictions and hydrological uncertainty. EID's 2010 UWMP indicates that the estimated dry-year yield associated with this water asset is 3,000 acre-feet per year based upon regional hydrologic conditions.[33] Accordingly, based upon the presumed hydrologic conditions, the dry-year reliability for this supply in three consecutive dry years is 3,000 acre-feet per year.

Licenses 11835 and 11836 have a full diversion entitlement of 33,400 acre-feet per year. Of that amount, carryover storage in Jenkinson Lake and diminished inflow reduce that entitlement to a normal-year supply of 23,000 acre-feet per year. In dry years, this amount is further reduced based upon hydrologic conditions as well as carryover storage needs for future years from Jenkinson Lake. Accordingly, based upon the OASIS hydrologic modeling report, EID reduces this supply's availability to 20,920 acre-feet in a single dry year. Thus, 20,920 acre-feet per year is used in this WSA as the dry-year safe yield number for a single dry year. To be conservative, EID plans for this supply to be further reduced during year two and again in year three of and three consecutive dry years. This WSA uses 17,000 acre-feet and 15,500 acre-feet as the available supply in year two and year three of a multi-year drought, respectfully.

CVP Contract 14-06-200-1375A-LTR1 has a normal-year entitlement of 7,500 acre-feet per year. The USBR, however, assesses the dry-year supply availability of its CVP M&I contracts

[33] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-6 of 22. Follow-up discussion with EID Counsel on water availability on April 23, 2013.

through the CVP M&I Shortage Policy. Based on inflow and storage criteria developed at the joint operations center, USBR can reduce contract water supplies under the CVP M&I Shortage Policy by up to 25% of historic use with various adjustments made for population, use of non-CVP water and extraordinary conservation actions.[34] With these adjustments in mind, USBR calculates the reduced CVP M&I delivery essentially based upon the average of the three previous normal years of use under the CVP contract. Under the strictest interpretation of this policy, if the water under the CVP contract was not used, then the dry year water is not available. But, USBR has considered that use of non-CVP supplies in lieu of CVP water use may be used to calculate use under this shortage policy. For purposes of this analysis, however, we have determined that based upon normal growth in demand in EID's service area, EID's customers would utilize the entire contract entitlement in normal years in the future. As such, EID calculates its dry-year reduction for this Proposed Project based upon three years of full use of its contract allocation. Accordingly, the dry year supply under this water contract entitlement is 5,660 acre-feet per year.

EID's pre-1914 American River water rights-grouping has a normal-year reliability of 15,080 acre-feet per year. Based upon the early priority date of these water assets and the storage capability within EID's system associated with these water assets, they are not reduced at all in a single dry year or three consecutive dry years.

Permit 21112 is another secure dry-year water asset. EID's 2010 UWMP states "there are no cutback provisions on this supply."[35] As such, the dry year reliability of Permit 21112 is 17,000 acre-feet per year.

As described in Section 4.2.2, EID's planned supplies include the CVP Fazio supply, and the several rights and contract that make up the UARP SMUD water. All of these assets combined have a three consecutive dry year supply reliability of 10,625 acre-feet per year.

The CVP Fazio supply is another CVP M&I contract supply that is subject to the same Municipal and Industrial shortage provisions described above for EID's other CVP contract entitlement. EID's expected portion of the Fazio supply has a normal-year contract allocation of 7,500 acre-feet per year. Assuming under the rules described above that EID is able to use its entire contract entitlement in the future, a 25% reduction from the contract entitlement reduces the delivery by 1,875 acre-feet per year. As such, the single dry year reliability and three consecutive dry year reliability under this contract is 5,625 acre-feet per year.

[34] Reclamation has the authority to reduce the supply volumes even further under extreme conditions – Health and Safety criteria – but this sort of supply reduction would only occur in extreme drought and would be offset by reductions in demand in EID's service area, as needed, to maintain basic Health and Safety conditions. The District's drought contingency plans address these situations.

[35] This assertion was confirmed in a telephone conversation with the District's Counsel on April 23, 2013.

Last, the UARP SMUD water that is derived from the numerous water right applications and assignments as well as the El Dorado-SMUD Cooperative Agreement indicates that the water available under these components in dry years could be severely curtailed. Appendix H of the Agreement states that annual deliveries can be superseded and deliveries from carryover drought storage can be reduced to as little as 5,000 acre-feet in a declared Critically Dry year if SMUD reservoir storage drops below 100,000 acre-feet (approximately 25%). Out of an abundance of caution, EID anticipates only 5,000 acre-feet of carryover drought-supply water would be available each year over the course of a three-year drought.

4.3 RECYCLED WATER SUPPLIES

EID uses recycled water to meet some current non-potable demands within its service area. EID may expand its development and use of recycled water in the future to meet a portion of the non-potable demands associated with the Proposed Project and other anticipated new demands. EID's current recycled water use is about 2,200 acre-feet per year. This use will expand incrementally over time. By 2035, EID anticipates a supply of 5,600 acre-feet of recycled water per year within its service area.[36]

EID's recycled water system consists of supply from the El Dorado Hills wastewater treatment plant and the Deer Creek wastewater treatment plant. These treatment plants have an interconnected network of transmission and distribution pipelines, pump stations, storage tanks, pressure reducing stations, and appurtenant facilities located within the communities of El Dorado Hills and Cameron Park.[37] EID mandates the use of recycled water through Board Policy 7010, wherever economically and physically feasible as determined by the Board, for non-domestic purposes.[38] At this time, non-domestic use includes commercial landscape irrigation, residential or multi-family dual-plumbed landscape irrigation, construction water, and recreational impoundments.

Recycled water availability is an outcome of increased municipal and domestic demand and wastewater production as a byproduct of this demand. In other words, annual recycled water production capabilities are based on the total wastewater flows to the treatment plants. With the population and industrial demands growing in this region, as described in Section 3, the availability of recycled water will increase. EID is taking a conservative view of the growth in recycled water based upon its current production levels, estimated regional population growth, facility expansion identified in its 2013 IWRMP and WWFMP, treated water discharge requirements, and its ability to capture and store recycled water supplies in the future. The total recycled water available for use in 2035 is estimated to be 5,600 acre-feet per year.[39]

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[36] EID Integrated Water Resources Master Plan, March 31, 2013
[37] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-10 of 22.
[38] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-6 of 22.
[39] EID Integrated Water Resources Master Plan, March 31, 2013 at page 221.

Accordingly, Table 4-2 shows the incremental recycled water assets that would be available over time for the District's non-potable water uses.

Table 4-2 – Timing of Recycled Water and Quantities

Year	Recycled Water Supply (acre-feet)
Current	2,200
2015	2,400
2020	2,600
2025	3,100
2030	4,200
2035	5,600

4.4 FACILITY COSTS AND FINANCING

EID's recently completed 2013 IWRMP and WWFMP identify and allocate the future costs of capital expansion and replacement needs, and addresses financing mechanisms for EID's water assets. These costs and financing mechanisms are hereby incorporated by reference.

The District establishes and periodically updates its Facility Capacity Charges (FCCs) to recover the cost of those portions of existing District facilities that will be used by future customers and to fund needed expansion, or additional capacity, of District facilities to serve new users. The District periodically reviews its FCCs to ensure they accurately reflect the costs of providing service to new customers. Currently the District is updating the FCCs to incorporate projects identified in the adopted 2013 IWRMP. The FCC update is currently under review by the Board and a developer committee, and the District anticipates adoption of the updated FCCs in August 2013.

4.5 REGULATORY APPROVALS AND PERMITS

As described in Section 4.2.2, EID has water assets that require further regulatory approvals, permit compliance, and contract approvals. Each water asset has its own set of regulatory requirements that are assessed in this section.

Appropriative water right Permit 21112 issued by the SWRCB has not been perfected. In order to perfect an appropriative water right, EID must put all of the water assets under that permit to beneficial use. Upon putting the water to beneficial uses and meeting all of the other conditions in the water right permit, EID will be eligible to obtain a water right license for this appropriative water right. Attaining a water right license further fortifies the legitimacy of the water right for EID's continual use in the future. There is no indication that EID will have difficulty in obtaining a water right license for Permit 21112.

Permit 21112 also requires a Warren Act Contract to be negotiated and approved by the USBR. The Warren Act Contract will allow EID to divert water from Folsom Reservoir for delivery to the El Dorado Hills Water Treatment Plant. Although the District may choose to divert some of the water upstream of Folsom Reservoir through other SWRCB regulatory processes, a Warren Act Contract is essential for any diversions emanating from Folsom Reservoir. EID is currently in negotiations with USBR to obtain a long-term contract. While those negotiations continue, short-term Warren Act Contracts are also obtainable, if needed. There are no foreseeable reasons that these negotiations will not succeed. Both EID's Board of Directors and USBR officials will need to execute the contract once the terms have been drafted, and EID will need to obtain judgment in a judicial action to validate the contract.

The Fazio water supply also has additional regulatory approvals and permits pending. This CVP contract entitlement is authorized by Public Law 101-514. The 15,000 acre-feet of water supply is contemplated to be split equally between Georgetown Divide Public Utilities District and EID. As described in Section 4.2.2, EDCWA is negotiating with USBR on behalf of EID to secure the CVP contract entitlement authorized by this federal statute and finalize the EIS. Accordingly, EID will continue to work with EDCWA and USBR to finalize acquisition of this water supply. Upon completion of the EIS, the EDCWA's designee and USBR officials will need to execute the CVP water supply contract, and EDCWA may need to obtain judgment in a judicial action validating the contract.

The pending water right applications and application assignments before the SWRCB as well as the El Dorado – SMUD Cooperation Agreement constitute the last water supply that is pending further regulatory approvals. As described in Section 4.2.2, EDWPA is awaiting approvals from SWRCB for these water assets. Upon SWRCB approval, EID will obtain 30,000 acre-feet of water under the El Dorado – SMUD Cooperation Agreement.

The SWRCB water right process requires the SWRCB to conduct an internal project review of the applicable technical and hydrological information as well as consider the broader effects on other legal users of water throughout the watershed before issuing a permit. This regulatory process may eventually necessitate a SWRCB hearing where testimony from proponents and opponents of the water right permit is heard and weighed by the SWRCB Board Members before issuing the conditioned permits. Once permits have been issued, then the District must comply with the permit terms and perfect application of the water supplies to beneficial use in order to acquire water right licenses associated with the appropriative water rights.

The El Dorado – SMUD Cooperation Agreement is an agreement among the various parties to cooperate in facilitating the storage and delivery of these water assets to the identified purveyors. As such, through the processing of the water right applications and the furtherance of compliance with the terms of those agreements, the water assets considered there are likely to be available to

EID. The regulatory approvals and permits needed to finalize EID's control over these water assets are moving forward.

4.6 SUPPLY SUMMARY

EID has two broad categories of water assets that are available for the Proposed Project – the secured water assets and planned water assets. Collectively, these supplies total 110,290 acre-feet in normal water years and 77,885 acre-feet in a single dry water year. In year two and year three of a multi-year drought, supplies are further reduced to 73,965 acre-feet and 72,465 acre-feet, respectfully.

As described above, the secured water assets include appropriative water right License 2184 and the accompanying pre-1914 appropriative water rights held under Warren Act Contract 06-WC-20-3315, appropriative water right Licenses 11835 and 11836, CVP Contract 14-060200-1375A-LTR1, the pre-1914 American River storage and diversion appropriative water rights, and Permit 21112. The normal year water supplies available to EID under the secured assets total 67,190 acre-feet per year. In dry years, the water supplies available to EID under the secured assets totals 61,660 acre-feet per year.

The planned water assets, although partially secured, are not yet fully available for EID's use to serve the Proposed Project contemplated in this WSA. As described above, these assets are sufficiently secure to be considered planned supplies for the Proposed Project in 2035. In normal years, the water supplies under these assets total 37,500 acre-feet. In dry years, the water supplies under these assets total 10,625 acre-feet.

Finally, the recycled water assets in both normal and dry years, derived from planned growth and continual indoor water usage regardless of year type, total 5,600 acre-feet in 2035.

Section 5 – Sufficiency Analysis

5.1 Introduction

The analysis detailed in this section provides a basis for determining whether sufficient water supplies exist to meet the estimated water demand of the Proposed Project.[40]

This section includes:

- Analysis of sufficiency, considering variations in supply and demand characteristics under normal, single-dry and multi-dry hydrologic conditions,
- Analysis conclusions

5.2 Sufficiency Analysis

The sufficiency analysis integrates the water demands detailed in Section 2 and Section 3 with the water supplies characterized in Section 4. The results are presented in **Table 5-1** beginning with "current" conditions (recognized as 2012) and continuing with 5-year increments from 2015 through 2035. While the analysis at various intervals before build-out is important, the most critical projection for the sufficiency analysis occurs in 2035. This analysis assumes that the Proposed Project, along with the other projects simultaneously undergoing a WSA analysis (see Section 3.3), are fully constructed by 2035, and other anticipated growth continues as described in Section 3.4.

Table 5-1 incorporates the Proposed Project water demand projection in **Table 2-3**, assuming the Proposed Project develops as detailed in Section 1, and the estimated water demands for all other existing and planned future uses through 2035 as detailed in **Table 3-2**. **Table 5-1** also presents the available water supplies for the contiguous EID service area during normal, single-dry and multiple-dry years, as detailed in Section 4. The water demands and available supplies in a single dry-year and multiple dry-year condition are discussed in the following subsections.

[40] CWC § 10910 (c)(4) provides that "If the city or county is required to comply with this part pursuant to subdivision (b), the water supply assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses."

Table 5-1 – Comparable Analysis of Supply and Demand

Year	Project Water Demand (af/yr)	All Other EID Water Demands (af/yr)	Total Water Demands (af/yr)	Non-Revenue Water @ 13%	Demands with Loss	EID Water Supplies: Surface Water: Hydrologic Year Type		EDH Service Area (af/yr)	West/East Service Area (af/yr)	Total (af/yr)	Recycled Water (af/yr)	Total Available Water Supply (af/yr)	Projected Surplus/ (Shortfall) (af/yr)
	0	38,984	38,984	N/A	38,984	Normal		29,110	38,080	67,190		69,390	30,406
	0	40,933	40,933	N/A	40,933	Single Dry		25,660	36,000	61,660		63,860	22,927
Current	0	40,933	40,933	N/A	40,933	Multiple Dry	Year 1	25,660	36,000	61,660	2,200	63,860	22,927
	0	38,068	38,068	N/A	38,068		Year 2	25,660	32,080	57,740		59,940	21,872
	0	34,793	34,793	N/A	34,793		Year 3	25,660	30,580	56,240		58,440	23,647
	135	34,821	34,956	4,544	39,500	Normal		36,610	38,080	74,690		77,090	37,590
	141	36,562	36,704	4,771	41,475	Single Dry		31,285	36,000	67,285		69,685	28,210
2015	141	36,562	36,704	4,771	41,475	Multiple Dry	Year 1	31,285	36,000	67,285	2,400	69,685	28,210
	131	34,003	34,134	4,437	38,572		Year 2	31,285	32,080	63,365		65,765	27,193
	120	31,078	31,198	4,056	35,254		Year 3	31,285	30,580	61,865		64,265	29,011
	459	37,539	37,997	4,940	42,937	Normal		36,610	38,080	74,690		77,290	34,353
	481	39,415	39,897	5,187	45,084	Single Dry		31,285	36,000	67,285		69,885	24,801
2020	481	39,415	39,897	5,187	45,084	Multiple Dry	Year 1	31,285	36,000	67,285	2,600	69,885	24,801
	448	36,656	37,104	4,824	41,928		Year 2	31,285	32,080	63,365		65,965	24,037
	409	33,503	33,912	4,409	38,321		Year 3	31,285	30,580	61,865		64,465	26,144
	458	43,401	43,859	5,702	49,561	Normal		19,610	85,080	104,690		107,890	58,329
	480	45,572	46,052	5,987	52,039	Single Dry		14,285	58,000	72,285		75,485	23,446
2025	480	45,572	46,052	5,987	52,039	Multiple Dry	Year 1	14,285	58,000	72,285	3,200	75,485	23,446
	447	42,382	42,828	5,568	48,396		Year 2	14,285	54,080	68,365		71,565	23,169
	408	38,736	39,144	5,089	44,233		Year 3	14,285	52,580	66,865		70,065	25,832
	442	50,774	51,216	6,658	57,874	Normal		19,610	85,080	104,690		108,790	50,916
	464	53,312	53,777	6,991	60,768	Single Dry		14,285	58,000	72,285		76,385	15,617
2030	464	53,312	53,777	6,991	60,768	Multiple Dry	Year 1	14,285	58,000	72,285	4,100	76,385	15,617
	432	49,580	50,012	6,502	56,514		Year 2	14,285	54,080	68,365		72,465	15,951
	395	45,315	45,710	5,942	51,652		Year 3	14,285	52,580	66,865		70,965	19,313
	427	59,127	59,554	7,742	67,295	Normal		19,610	85,080	104,690		110,290	42,995
	448	62,083	62,531	8,129	70,660	Single Dry		14,285	58,000	72,285		77,885	7,225
2035	448	62,083	62,531	8,129	70,660	Multiple Dry	Year 1	14,285	58,000	72,285	5,600	77,885	7,225
	417	57,737	58,154	7,560	65,714		Year 2	14,285	54,080	68,365		73,965	8,251
	381	52,771	53,152	6,910	60,061		Year 3	14,285	52,580	66,865		72,465	12,404

5.2.1 Single Dry Year Supply and Demand Conditions

Under this condition, EID would anticipate a variance from the normal-year analysis, including: (1) shortage in full availability of supplies as detailed in **Section 4**, and (2) an increase in water demand. The increase in demand is based on the following:

- Landscape irrigation demands will increase to reflect the generalized earlier start of the landscape irrigation season due to limited rainfall in the single driest year. Since this increase only applies to the outdoor portion of a customer's demand, an adjustment factor of 5 percent is applied to the total normal-year water demand values.
- Historically, during single dry year circumstances, EID does not implement its shortage contingency plan,[41] since the extent of the dry conditions into future years is unknown. EID follows adopted policies and its 2008 *Drought Preparedness Plan* when implementing any voluntary or mandatory demand reduction measures.

As a result of these factors, the Proposed Project water demand and those of the other existing and planned uses is expected to increase in a single dry year above the demand expected under normal hydrologic circumstances. Additionally, as detailed in Section 4, EID anticipates a decrease in available water supplies. These changes are shown in **Table 5-1**.

5.2.2 Multi-Dry Year Supply and Demand Conditions

When a single dry year expands into a series of dry years, water supply and demand conditions will continue to evolve. Under such a multi-dry year, EID would anticipate many similar conditions that were assumed for the single-dry year, including: (1) shortage in full availability of supplies as detailed in Section 4, and (2) increases in projected demands. However, when entering the second and third year of a sequence of dry-years, EID would implement necessary policies to manage limited water supplies.[42] Demands over a series of three dry years are adjusted as follows:

- Year 1 – the first year mimics a "single-dry year" condition, where demands increase approximately 5 percent and EID shortage policies are not yet invoked (see Section 5.2.1).
- Year 2 – The demands again mimic a "single-dry year" and would be expected to increase by 5 percent above normal year conditions. However, when recognizing a second dry-year, EID would invoke the first stage of the 2008 *Drought Preparedness Plan*. This stage states: "*The objective of Stage 1 is to initiate public awareness of predicted water shortage conditions, and encourage voluntary water conservation to*

[41] See EID Board Policy AR 5011-Water Supply Management Conditions (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).
[42] See EID Board Policy AR 5011-Water Supply Management Conditions (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).

decrease normal demand up to 15%."[43] As part of this stage, EID implements drought water rates among other specified activities to encourage conservation. For purposes of this WSA, the demand reduction achieved under Stage 1 is estimated to be 7 percent of the already higher single dry-year demand.

- Year 3 – Upon entering the third dry year, EID would invoke the second stage of the Drought Preparedness Plan. This stage states: "*The objective of Stage 2 is to increase public understanding of worsening water supply conditions, encourage voluntary water conservation measures, and then if necessary, enforce mandatory conservation measures in order to decrease normal demand up to 30%*."[44] Under this Stage, EID increases efforts to reduce demand. For purposes of this WSA, the savings achieved under Stage 2 is estimated to be 15 percent of the already higher single dry-year demand.

As a result of these factors, the Proposed Project water demand and those of the Other Existing and Planned Uses is expected to increase in the first year of a multi dry-year condition above that estimated during normal hydrologic circumstances. In subsequent years, the demand will drop as elements of EID's Drought Preparedness Plan are implemented. These changes are shown in **Table 5-1**.

5.2.3 Analysis

As shown in **Table 5-1**, the demand and supply are compared under each hydrologic condition for each 5-year increment out to 2035. The resulting "supply surplus" or "supply shortfall" is shown in the final column. Based on the analyses, EID anticipates it will have sufficient water under all hydrologic conditions in each of the 5-year increments through 2035. Notably, the "surplus" supply is lowest during the second year of a multi-dry year condition, since this is the circumstance where demand is only slightly constrained, while supplies are the most constrained. Yet, even under such circumstances, sufficient water should be available.

5.3 Sufficiency Analysis Conclusions

As detailed in **Section 2**, this WSA estimates water demands for the Proposed Project of 482 acre-feet per year at build-out (including non-revenue water demands). The annual water demand estimate for all existing and planned projects in the contiguous EID service area, as detailed in **Section 3**, is approximately 67,300 acre-feet per year by 2035. After accounting for these demand projections for the next twenty years, EID should have sufficient water to meet the demands of the Proposed Project and its other service area demands for at least the next 20 years.

[43] See EID Board Policy AR 5011.2-Water supply slightly restricted Drought Stage 1 – Voluntary reductions in use (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).
[44] See EID Board Policy AR 5011.3-Water supply slightly restricted Drought Stage 2 – Voluntary and mandatory reductions (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).

The conclusion that EID should have sufficient water available to meet the needs of the Proposed Project, in addition to the other demands in its service area through 2035, rests on the following set of assumptions:

- EID, EDCWA, and EDWPA successfully execute the contracts and obtain the water right permit approvals for currently unsecured water supplies discussed in Section 4. Absent these steps, the water supplies currently held by EID and recognized to be diverted under existing contracts and agreements would be insufficient in 2035 to meet the Proposed Project demands along with all other existing and planned future uses.
- EID will commit to implement Facility Capacity Charges in an amount sufficient to assure the financing is available as appropriate to construct the necessary infrastructure as detailed in the March 2013 EID *Integrated Water Resources Master Plan*.
- Demand in single-dry years includes an additional 5 percent of demand over the normal year demand during the same time period. This conservative assumption accounts for the likelihood that EID customers will irrigate earlier in the season to account for dry spring conditions. This hypothetical demand augmentation may or may not manifest in dry years, but this conservative assumption further tests the sufficiency of water supplies during dry conditions.
- The estimated demands include 13 percent to account for non-revenue water losses (e.g. distribution system losses).

The finding of this WSA is that EID should have sufficient water to meet the demands of Proposed Project and its other service area demands for the next 20 years.

Attachment #6

RESOLUTION NO. 179-2014

OF THE BOARD OF SUPERVISORS OF THE COUNTY OF EL DORADO

WHEREAS, Government Code section 8630(a) provides that a local emergency may be proclaimed only by the governing body of a county or by an official designated by ordinance adopted by that governing body; and

WHEREAS, Government Code section 8558(c) defines a "local emergency" as the duly proclaimed existence of conditions of disaster or extreme peril to the safety of persons or property within the territorial limits of the County caused by drought; and

WHEREAS, on January 17, 2014, the Governor of the State of California proclaimed a state of emergency in the State of California due to current drought conditions in the state; and

WHEREAS, the Governor's proclamation acknowledged that the State of California is experiencing record dry conditions that have persisted since 2012; and

WHEREAS, due to severe water shortage, there is extreme peril to existing crops and livestock with significant danger of socioeconomic losses, including jobs and reduced business activity; and

WHEREAS, these persistent drought conditions have negatively impacted and continue to threaten the County's economy; and

WHEREAS, conditions of drought exacerbate already perilous fire conditions threatening towns and communities throughout El Dorado County; and

WHEREAS, on September 17, 2014, the U.S. Department of Agriculture designated 42 California counties, including El Dorado County, as disaster areas due to agricultural losses caused by Drought that occurred January 1, 2014, and continuing; and

WHEREAS, reduced water supplies have begun to impact the health and sanitation of the county residents living in the community of Outingdale requiring the importation of drinking water, and

WHEREAS, several small municipal water districts exist within the County and the threat for additional communities to be adversely impacted in the same manner as Outingdale is extremely high, and

WHEREAS, the Board of Supervisors of the County of El Dorado do hereby find;

That conditions of extreme peril to the safety of persons and property have arisen within said County, caused by extreme drought conditions that have been persistent since the 1st day of January, 2014, and continuing and;

That these conditions are or are likely to be beyond the control of the services, personnel, equipment, and facilities of said County;

NOW, THEREFORE, IT IS HEREBY PROCLAIMED that a local emergency now exists throughout said County;

BE IT FURTHER RESOLVED that the County of El Dorado also requests the State of California to waive regulations that hinder response and recovery efforts, to make available recovery assistance under the California

Disaster Assistance Act, and to expedite access to federal resources and any other appropriate federal disaster relief programs.

IT IS FURTHER PROCLAIMED AND ORDERED that said local State of Emergency shall be deemed to continue to exist until its termination is proclaimed by the Board of Supervisors, County of El Dorado, State of California.

IT IS FURTHER PROCLAIMED AND ORDERED that during the existence of said local emergency the powers, functions, and duties of the emergency organization of this County shall be those prescribed by state law, by ordinance, and resolutions of this County;

PASSED AND ADOPTED by the Board of Supervisors of the County of El Dorado at a regular meeting of said Board, held the 21 day of October, 2014 by the following vote of said Board:

Ayes: Briggs, Veerkamp, Mikulaco, Frentzen, Santiago
Noes: none
Absent: none
Abstained : none

Attest
James S. Mitrisin
Clerk of the Board of Supervisors

By: Kathryn Tyler
Deputy Clerk

B.K. Veerkamp
Chair, Board of Supervisors
Brian K. Veerkamp
First Vice-Chair

Attachment #7

El Dorado Union High School District

4675 Missouri Flat Road
Placerville, CA 95667
530.622.5081

2014 Master Plan

for

El Dorado Union High School District

MARCH 2014

Christopher Hoffman
Superintendent

Baldev Johal
Associate Superintendent - Business Services

Prepared by:

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Facility Problem Solvers

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APPENDICES

INTRODUCTION

A Facilities Master Plan is a compilation of information, policies, and statistical data about a school district's facility resources. It is used for long- and short-range school facility planning in order to help meet the changing needs of district students and to help ensure that resources are allocated in an efficient manner. It is organized to provide a continuous basis for planning educational facilities that will meet the changing needs of a community, and provide alternatives in allocating facility resources to achieve the district's goals and objectives.

The plan is not only designed to assess and meet the District's current and future facility needs, it also provides a financing plan that delivers resources in an efficient manner to ensure its successful implementation. A master plan forms a foundation by establishing fundamental parameters which provide a framework for future facilities improvements.

The District's educational programs, vision and goals, and Board policies drive a facilities master plan to include relevant information such as: history of the district, demographics, education programming on employment trends and future post-secondary pathways, student housing needs, and possible funding sources/limitations provide a context for crafting the plan. Paramount is the need to understand that education is ever changing and that facility planning is a dynamic process that requires adaptability and forward thinking.

The El Dorado Union High School District Board of Trustees has adopted policies recognizing that "one of its major responsibilities is to provide healthful, safe and adequate facilities that enhance the instructional program." Recognizing that schools serve as a focal point for the community, the Board endeavors to ensure that our schools "fit harmoniously and attractively into their neighborhoods and that they have flexibility of design to meet future educational and community needs" (Board Policy 7000).

The Facilities Master Plan is intended to guide the upgrading, modernization, and management of its school facilities for the next 10 years. The development of the Facilities Master Plan is a public process designed to ensure that planning efforts are community-based, built upon consensus, and meet the current and future educational needs of students, faculty, staff, and the community.

Periodic revisions to the Facility Master Plan are necessary due to the dynamic nature of educational needs and the community. For example, regulations and educational programs change, new students arrive sooner or later than projected, and new needs are discovered. The Board endeavors to make the provision of adequate school facilities a priority in the District. A comprehensive school planning process under the leadership of the Board of Trustees serves as a guide for the future needs of the El Dorado Union High School District as it continues to grow and provide excellence in education which meets the needs of all our students.

This report is organized into the following sections:

- Section A provides an introduction, goals, and objectives;
- Section B offers historical information on the District's geography, demographics, schools, educational programs, changes, and the greater community served;
- Section C provides demographic information, projected new development, student yield factors, enrollment trends, and projected enrollment;
- Section D details the District's current facilities inventory, site capacities, and projections, and provides an analysis of current and future facilities needs;
- Section E identifies facilities needs and funding options available to finance facilities;
- Section F explains the District's responsibility under Proposition 39 to Charter School facilities needs;
- Section G concludes the Plan with a summary, recommendations, and procedures for revisions and evaluations.
- Appendices provide backup materials to support the Plan's research and data.

GOALS AND OBJECTIVES

The Facilities Master Plan is developed with the El Dorado Union High School District's Mission Statement as a guiding principle. The Mission Statement states:

The El Dorado Union High School District is committed to educating all students in a safe, supportive environment that will challenge students to pursue appropriate, rigorous paths for academic and career development and achievement that lead to lifelong learning and productive adulthood.

In addition, the District has adopted Strategic Planning Goals, which can be found on the District's web site and are attached as Appendix 1. Adherence to the Strategic Planning Goals is considered as part of the process of developing a Master Plan.

As a first step in developing the Master Plan, the Master Plan Committee established a set of goals and planning principles. These goals and principles are based on the understanding that the educational program needs of the District should be the driving force of the Facilities Master Plan.

Goals:

- Ensure that every student has access to comprehensive programs, now and in the future;
- Maintain equity in facilities assets, offering access to programs District- wide, so that each site offers:
  - equity in facilities for similar programs;
  - opportunity to pursue career-technical education;
  - educational programs necessary for California State University/University of California college admission.
- Using environmentally friendly products and practices when possible, establish basic classroom needs providing standards for technology, lighting, acoustics, air quality, configuration, energy efficiency and equipment;
- Establish community partnerships with businesses; and
- Develop a finished feasible plan that will withstand the test of time.

Planning Principles:

- Use data-based decision making;
- Explore and be open to all options;
- Allow flexibility for instruction;
- Provide for an aesthetically pleasing environment that is clean, safe, and modern, fostering the desire to be at school;
- Consider smart classrooms and resource centers providing distance learning capabilities;
- Connect academic core to life experiences;
- Consider future employment projections for students;
- Consider community needs; and
- Prioritize needs.

HISTORY

El Dorado County is located in North Central California, between the Sacramento Metropolitan area and the Nevada State Line at South Lake Tahoe. Two major highways, U.S. 50 and State Route 49, intersect the county, while State Route 88 establishes the county's southern border with Amador and Alpine Counties. Placer County forms the County's northern border. El Dorado County stretches across 90 miles of foothills, valleys, and mountain peaks of the Sierra Nevada Mountains.

There are two incorporated cities. Placerville, which became the county seat in 1857, is located 44 miles east of the state capitol of Sacramento. South Lake Tahoe, 60 miles east of Placerville, is the hub of the world-renowned Lake Tahoe recreation area.

The Placerville area developed as the county's first population center with the discovery of gold in 1848. During this time, the population of the county grew to 21,000 residents. When the Gold Rush declined, so did the population.

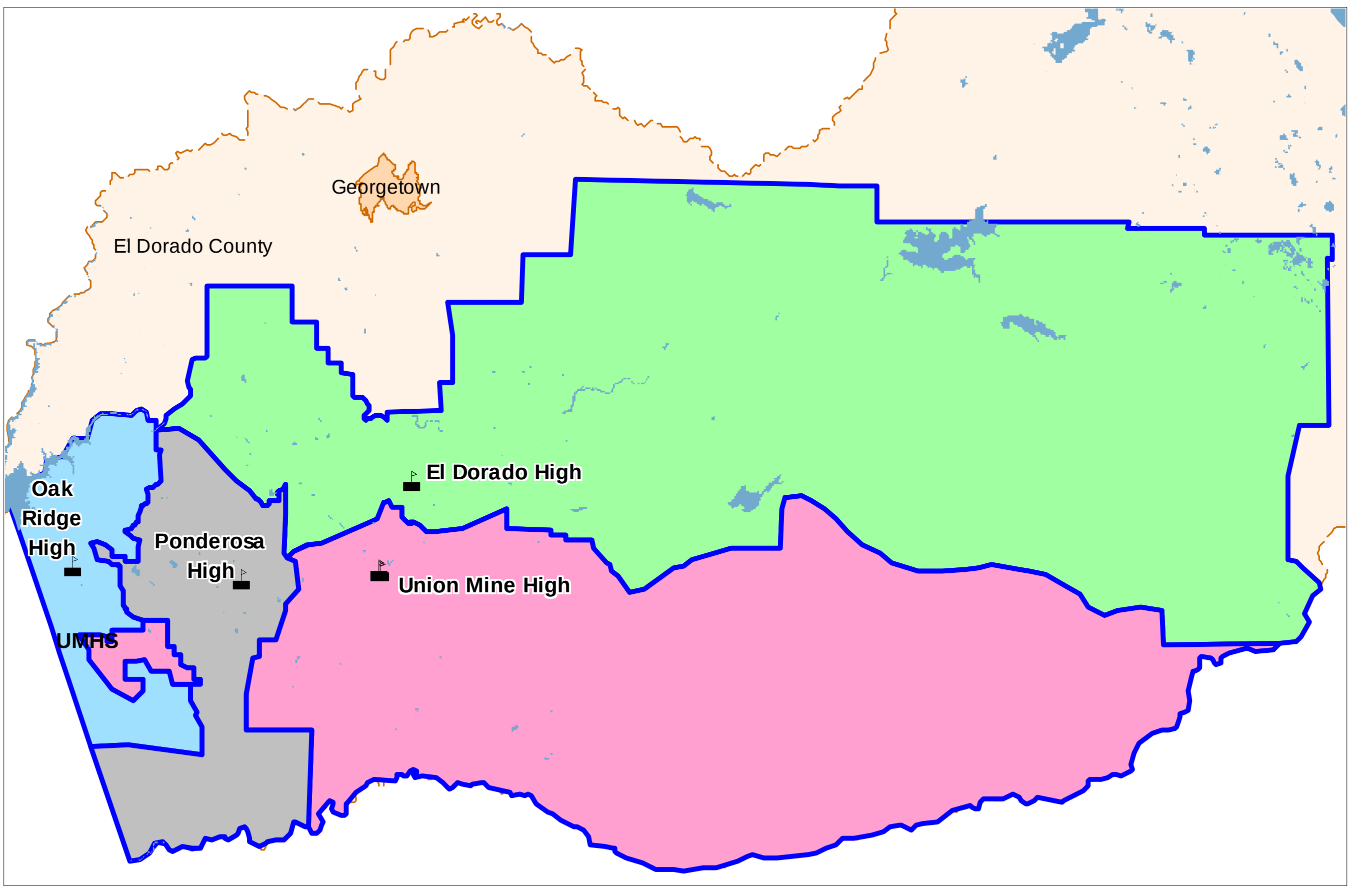
The allure of El Dorado County's quality of life and community, coupled with its proximity to the Sacramento metropolitan area, has resulted in consistent population growth in recent decades. A majority of the growth of the overall Sacramento area has occurred in the El Dorado Hills/Cameron Park area, with their close proximity to the Highway 50 freeway corridor and employment centers. The median age of the population is 39.7, and the average household income is reported at $70,022, 34% higher than the national average. Education levels of residents are also higher than the national average (Census Bureau).

From the period of 1996 to 2006, El Dorado County stated a population increase of 17% (EDC.GOV), surpassing the national average. The July 1, 2008 California Department of finance population estimate for El Dorado County was 179,969, a 13.52% increase from 2000 to 2008. The 2010 Census counted a total population of 181,058. Growth projections posted to the El Dorado County Government web site project El Dorado County's population will be over 218,000 by the year 2015 (EDC.GOV). However, while growth is still occurring, El Dorado County's rate of growth has been declining on average 0.21% annually since 2000. If the current rates of decline in growth continue, the 2015 population estimates could be as low as 200,000.

THE DISTRICT

The El Dorado Union High School District (the District) is located on the western slope of El Dorado County and encompasses approximately 1,200 square miles. The District serves the communities of Cameron Park, Camino, Diamond Springs, El Dorado, El Dorado Hills, Latrobe, Placerville, Pollock Pines, Rescue, Shingle Springs, Somerset, and many smaller rural communities. The District is bordered on the north by Black Oak Mine Unified School District and on the south by Highway 88 at the Amador County line. The District borders South Lake Tahoe Unified School District on the east at Echo Summit and the Sacramento County line to the west.

Map #1 - El Dorado Union High School District Map



The District was established in 1905 with one high school located on Clay Street in the City of Placerville. In 1922 a board was elected, and it became the El Dorado High School District. In 1963, with the addition of Ponderosa High School, the District name was changed to its current name of El Dorado Union High School District.

The District now consists of four comprehensive high schools, a charter school, and five alternative education high schools. In addition, the Central Sierra Regional Occupation Program operates a variety of career/technical education courses on the District's school sites, and the County Office of Education houses special education programs on some of our campuses. The District serves grades 9 through 12.

The District's four comprehensive high schools are:

El Dorado High School (EDHS)

EDHS was originally constructed to house 300 students in 1928 at 561 Canal Street in the City of Placerville. The school size was doubled in 1939, and in the late 1950s the school had a major expansion of eight buildings, totaling 75,000 square feet, that housed industrial arts, science, the large gym, small gym, shower and locker rooms, business, and performing arts. The main brick building that was in use since 1928 for classrooms and administration was torn down and replaced in 1974 with a 35,000 square foot building housing administration, counseling, the library, and classrooms. Additions to the campus include a 19,000 square foot science wing in 1993, a 2,000 square foot wrestling building in 1999, and a 7,800 square foot special education and modern language building in 2005. Also constructed in 2005 was a community funded project adding an amphitheater to the south side of the campus.

In addition to the expansion projects, the cafeteria wing was modernized in 1987, and in 2001 the campus underwent a major $5 million modernization project consisting of classroom renovations, infrastructure improvements, and site improvements, including improving access for people with disabilities. In 2005, a 24-year-old portable building was replaced with a 1,920 square foot portable to house the ROP medical program.

The grass football field and decomposed granite track were replaced during the summer of 2009 with a synthetic football field and all-weather track. These improvements will enhance health and fitness activities by allowing year-round use by students and the community.

Portable classrooms were added and removed as necessary. The school currently has three classrooms housed in portables. EDHS' enrollment peaked in 1998/99, a year before Union Mine High School (UMHS) opened. EDHS' 2013/14 student population is 1,352 which includes 53 students in the Vista High program. The enrollment is projected to decline to about 1,263 students over the next 10 years.

A state-of-the-art Culinary Arts Educational Facility was constructed in 2009 which will allow students in the very successful Culinary Arts program to experience work-based learning in a culinary facility that mirrors the workplace.

In the summer of 2010 upgrades were made to the EDHS campus including expanding and renovating the library, renovating the science building, and building new athletic field restrooms.

EDHS also has an east campus located at 3240 Pondorado Road in Camino. This campus was originally built in 1972 and was operated as an alternative school. It became the El Dorado East campus in 2003, and consists of five portable classrooms, restrooms and maintenance buildings. This site houses the ROP fire science class, and is currently being used for the Natural Resources/Land Management program outdoor laboratory. To facilitate the Natural Resources program, a 2,856 square foot permanent building housing two research labs, a greenhouse, and two outdoor lab shelters were constructed during the spring/summer 2010.

Oak Ridge High School (ORHS)

ORHS opened in 1980 in portable buildings at 1120 Harvard Way in El Dorado Hills. The first phase of the permanent campus (97,000 square feet) was constructed in 1982 and consisted of the administration/ classroom building, library, trades and industry building, consumer science building, science labs, the gymnasium/locker room/cafeteria building, and four standard classroom buildings. All of these buildings were modernized in 2008 and 2009.

A 9,000 square foot performing arts building consisting of a 300 seat theater and a band/choir room was constructed in 1992, along with an expansion of the library and five additional teaching stations. In 1994, a new cafeteria building was constructed and the former cafeteria was converted to gymnasium space. In addition, a counseling building and three additional classrooms were added. This project added 22,000 square feet to the campus. A campus addition of eight standard classrooms (8,000 square feet) was completed in 2005. In 2008, a 1,820 square foot choir room was added to the performing arts building, and a 3,982 square foot multi-purpose room was added to the gymnasium complex. The old maintenance building located in the core campus area was demolished, and a new maintenance building was constructed near the football stadium in 2008 to make room for the new two-story classroom building that was completed in August 2009. The 20,800 square foot classroom building houses four science labs, four computer labs, and seven standard classrooms. Over the years, portable classrooms were added as the student population grew. With the completion of the two-story permanent building, seven portable classrooms were removed from the campus, leaving 21 classrooms housed in portables; nine of these portables are leased.

In the summer of 2009, the grass football field was replaced with a synthetic turf field and the all-weather track was resurfaced. These improvements will enhance health and fitness activities by allowing year-round use by students and the community.

In 2013, the main gymnasium was expanded by 1400 sq. ft. and a new 1,200 sq. ft. wrestling room was added. The small gym was remodeled with the installation of a new floor.

The ORHS student population increased slightly over the last 10 years. The enrollment was just under 2,000 students in 1998/99 before UMHS opened and the student population declined to 1,713 students. The 2013/14 student population is 2,316 and is projected to remain stable for the next 6 years and then decline to 2,112 in ten years.

Ponderosa High School (PHS)

PHS was built in 1962 at 3661 Ponderosa Road in Shingle Springs. The school opened to students in 1963 with 19 classrooms, an administration building, and a cafeteria, totaling 43,000 square feet of space. Specialized classroom space included four science labs and four trades and industry labs. In 1965, an additional 30,000 square feet of space was added, including the main gym and locker rooms, library, music building, a business wing, three additional science labs, and six standard classrooms. In 1987 a 6,000 square foot second gymnasium was added, and in 1993 a 5,000 square foot science wing was constructed. The most recent construction included the addition of 14 permanent classrooms (14,000 sq. ft.), demolition and replacement of the maintenance building, staff parking lot, and site and landscaping improvements, and was completed in December of 2005.

In addition to campus expansion projects, the buildings constructed in 1962 and 1965 were modernized under two separate projects. Phase 1 modernization of the gym, locker rooms, and library was completed in 1996. The Phase 2 modernization was completed over the course of three summers, from 2001 to 2003. The Phase 2 project included replacing the old redwood siding with stucco and brick veneer, gutting and replacing the interiors of several buildings and restrooms, and expanding the cafeteria. In addition, many upgrades were done to improve access for people with disabilities.

A major parking and traffic flow improvement was completed in 2008 creating a safe, more efficient drop-off and pick-up area for parents and students. The grass football field and decomposed granite track were replaced during the summer of 2009 with a synthetic football field and all-weather track. These improvements will enhance health and fitness activities by allowing year-round use by students and the community.

Many portable classrooms were added to accommodate the enrollment growth over the years. Currently the school has 31 classrooms house in portable, 13 of them leased. One of the portables is used exclusively by ROP, and the County Office of Education owns a portable used for a Special Education Class.

During the summer of 2010, campus improvements included enlarging the gymnasium, adding a foyer with restrooms and a snack bar to the gymnasium entrance, renovating the theater interior, creating a back stage area for the theater with dressing rooms, a green room and a set construction studio. The fire alarm system was replaced.

In 2013, the cafeteria was remodeled to facilitate a large serving area as well as an extension of an overhang to allow for more covered outdoor seating. The small gym was also resided and a new wood floor was installed.

PHS' enrollment peaked at 2,146 in 1998/99, the year before UMHS opened. With the new boundary changes implemented in 2006, the student population declined from 2,062 to its current 1,791. A continued decline to 1,637 students is projected over the next four years, then projections show a short increase before declining to approximately 1,562 students by 2023/24.

Union Mine High School (UMHS)

UMHS opened in 1999 at 6530 Koki Lane in the community of El Dorado. Phase 1 consisted of 141,000 square feet, which included 31 permanent classrooms, 15 portable classrooms, a gymnasium, locker rooms, a cafeteria, a 398 seat theater, an administration building, and a library/counseling building. Phase 2 included the construction of an art building, a music building, and a portable wood-shop building. These classrooms totaled 11,000 square feet. A 6,000 square foot, six-classroom building and a 7,802 square foot second gymnasium were added to the campus in 2007. The campus has 22 classrooms housed in portables.

The grass football field and decomposed granite track were replaced during the summer of 2009 with a synthetic football field and all-weather track. These improvements will enhance health and fitness activities by allowing year-round use by students and the community.

The student population peaked at 1,569 in 2002/03 and slowly declined to its current level of 1,097 due to the aging of the community. The population is projected to remain stable over the next 6 years and then begin increasing and reach 1,220 in ten years.

Charter School

Shenandoah Charter High School (SHS) site is located at 6540 Koki Lane in the town of El Dorado, adjacent to the UMHS campus. It was opened in 2002 as a shared charter school and ROP campus.

The original facilities consisted of a 6,000 square foot permanent building housing an ROP computer lab, two charter school classrooms, a multiuse area, and offices; two portables used as ROP classrooms, which were relocated from IHS; a portable restroom facility; and a 1,400 square foot portable administrative office that was moved from the Pondorado (El Dorado East Campus) site in Camino.

SHS began operation with a 9th grade class, adding a new group of 9th graders each year as the previous year's students advanced a grade. Portable classrooms were added to accommodate the additional students in 2003, 2004, and 2005. the enrollment at SHS has grown the last two years and is now at 63 students. The demographic projections currently show the enrollment increasing steadily to 141 over the next 10 years.

In 2005, a second portable restroom was added, and ROP purchased and installed a 1,440 square foot portable which is used for the ROP Dental Assistant program. A new Cosmetology building was constructed in 2009, and the program moved from PHS to SHS in January 2010.

In 2013, the science classroom was completely remodeled with the installation of a new floor and eight new workstations.

Alternative Education Programs

- **Independence Continuation High School** is located at 2227 Pleasant Valley Road in Diamond Springs. The 3.19 acre campus was originally an elementary school that was built in 1928. The original school building was abandoned for school use, converted into District warehouse space for a number of years, and demolished in 1996. IHS began using the site in

1968. Building A, constructed in 1948, houses an art classroom and a standard classroom, and was modernized in 1997. Two relocatable structures, which currently house administration and the cafeteria, were brought to the campus in 1975 and modernized in 1995.

A second permanent building was constructed in 1981 by the ROP construction tech students. This building houses the GED testing program and a weight room. In addition, portables were added to the campus as needed to house students and programs. Four 25-year-old portable classrooms were replaced in 2008. The project included significant site improvements, including improving access for people with disabilities.

- **Independent Study Program** is located on the Independence, Ponderosa High School, Oak Ridge High School and El Dorado High School campuses.
- **Community Day School** is located on the Independence campus.
- **Vista High School** opened in 2003 and is an on-site continuation high school housed on the El Dorado High School campus.
- **Mountain View High School** opened in 2004 and is an on-site continuation high school housed on the Union Mine campus.

The educational programs offered at the schools are described later in this section, and a complete description of the school facilities can be found in Section D and Appendix 6.

HISTORIC ENROLLMENT

Following are 10-year historic enrollments for each school. Enrollment projections for the next 10-year period can be found in Sections C and D.

Figure #1 - Enrollment for Years 2004/05 – 2013/14

School	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
EDHS	1,285	1,244	1,280	1,307	1,399	1,347	1,366	1,408	1,347	1,299
PHS	2,006	2,061	2,024	1,978	1,961	1,907	1,894	1,890	1,853	1,791
ORHS	1,921	2,094	2,120	2,182	2,229	2,221	2,241	2,261	2,274	2,316
UMHS	1,502	1,476	1,405	1,261	1,176	1,061	1,030	984	1,008	1,069
IHS	117	115	100	127	120	129	144	119	135	114
ILC/ISP	235	217	213	215	193	177	111	102	108	97
CDS	12	10	10	13	14	20	17	14	9	6
SHS	107	124	129	126	101	96	53	35	45	63
VHS	29	32	32	30	34	49	56	57	53	53
MVHS	34	34	31	37	31	47	43	32	30	28
Total	7,248	7,407	515	7,276	7,258	7,054	6,955	6,902	6,862	6,836

EDUCATIONAL SYSTEM

The El Dorado Union High School District is committed to educating all students in a safe, supportive environment that will challenge students to pursue appropriate, rigorous paths for academic and career development and achievement that lead to lifelong learning and a productive adulthood. In order to deliver on this mission, District facilities need to be available to provide students with the opportunity to meet high school graduation requirements and be college and career ready.

The District graduation requirements afford students with the opportunity to enroll in a variety of courses from multiple academic disciplines. The District facilities are designed to ensure students have access to facilities that allow them to meet these requirements and in doing so master the California Content Standards and Frameworks. The following table lists the District graduation requirements.

GRADUATION COURSE REQUIREMENTS

SUBJECT	YRS	UNITS
English	4	40
Social Studies		
World History	1	10
U.S. History / Geography	1	10
American Government	0.5	5
Economics	0.5	5
Math	3	30*
*Minimum of Algebra 1 (10 units)		
Physical Science	1	10
Life Science	1	10
Health Education	0.5	5
ICT Foundations		5
(UMHS)		(10)
Fine Arts / Foreign Language	1	10
Physical Education:	2	20
Life Fitness I & II		
Core Units		
Required Subjects		160
Elective Units		80
(UMHS)		(75)

The graduation requirements necessitate that students have access to specialized facilities beyond the traditional classroom setting. Physical and life science courses need access to science classrooms that have access to running water, sinks, lab stations and demonstration tables. ICT Foundation courses need to be designed as computer labs where a workstation is available for each student. Visual and performing arts (VAPA) classrooms need to be specially designed for band, choir, art and drama courses. Physical education facilities need to be available to allow for indoor and outdoor educational units. As a result of these needs, all four comprehensive high schools have specially designed science classrooms, ICT Foundation computer labs, expansive indoor and outdoor physical education facilities and specialized band, choir, art and drama classrooms.

College ready students need access to classrooms and programs that enable students to meet University of California (UC) and California State University (CSU) entrance requirements. To be eligible to attend a four-year college or university immediately after high school, students must complete additional courses. These courses require additional facilities.

To prepare students for college and university admission, additional specialized science classrooms for chemistry are needed. Library facilities also play a valuable role in providing students access to literature, information text, online databases, technology and media resources. Being able to access library resources for educational assignments is part of the college preparatory experience. All four comprehensive sites have specialized chemistry classrooms and libraries with extensive print and digital materials.

The combined efforts of effective teaching practices, counseling, facilities and technology have led to 50% of District graduates meeting the UC/CSU entrance requirements. That compares to only 38% of the high school graduates in California in 2010.

Career technical education (CTE) industry sector pathways need facilities that allow students the opportunity to progress through a sequence of courses that provide them with skills needed to qualify for and succeed in postsecondary job training and/or education necessary for their chosen career (i.e. technical/vocational program, community college, apprenticeship or significant on-the-job training). The District maintains and operates CTE facilities for District and Central Sierra Regional Occupation Programs (CSROP) that encompass a multitude of industry sector pathways. The following table describes the location of such programs throughout the District to include specialized designed facilities in El Dorado East Campus in Camino and Shenandoah High School.

Figure #2 – Career Education Program Matrix - 2013-14

Career Technical Education Program	EDHS	IHS	ORHS	PHS	SHS	UMHS	ECOE
Agriculture & Natural Resources	X			X			
Arts, Media & Entertainment	X	X	X			X	
Building & Construction Trades	X			X		X	
Education, Child Development & Family Services			X	X		X	
Engineering & Architecture	X	X	X			X	
Fashion & Interior Design				X	X	X	
Business & Finance	X					X	
Health Science & Medical Technology	X				X		
Hospitality, Tourism & Recreation	X		X	X		X	
Information & Communication Technologies			X	X	X		
Manufacturing & Product Development	X						
Marketing, Sales & Service			X				
Public Services	X		X	X			
Transportation	X		X	X			

To effectively prepare students for the listed pathways, up-to-date and industry specific facilities are needed. Using Measure Q Funds, State grants and other District resources most CTE facilities have experienced significant upgrades. The most notable facility upgrades have occured in Culinary Arts, Natural Resources, Cosmetology, Agriculture, Engineering and Design, and Automotive. CTE programs have also benefited from the upgrades in technology. All CTE programs have updated computers and industry specific software.

Quality educational facilities are essential for academic achievement. Well maintained clean campuses equipped with specialized facilities for different academic departments and reliable information technology networks contribute to the District's success. California's educational system is implementing the new Common Core State Standards and investing in CTE programs that lead to higher wage, high demand careers linked to regional community college opportunities. These initiatives require facilities equipped with technology and industry specific equipment and classroom layouts. Therefore, in order for the District to meet its stated strategic goal of preparing college-ready and career-ready students to successfully meet entrance and performance requirements of postsecondary institutions the District's facilities must be designed accordingly. The District's emphasis on continuing the upward progress of student achievement based upon the implementation of sound, research-based practices is ongoing and supported by improved educational facilities.

School Organization Patterns

The El Dorado Union High School District currently operates four comprehensive high schools, two on-site necessary small continuation high schools (Mountain View High School on the UMHS campus and Vista High School, which is housed on the EDHS campus), a continuation high school (Independence High School), a charter school (Shenandoah High School), an independent study program which is housed at ORHS, EDHS and PHS campuses, and a community day school which is located adjacent to the Independence High School campus.

Students in grades 9 through 12 are served at each of the comprehensive high schools and at the charter school. Continuation high schools serve students who are at least 16 years old. The community day school serves students who have been expelled for disciplinary reasons or have had their expulsion suspended. It is recommended that students in this program remain at the school for one semester or for the term of their expulsion.

PROJECTIONS FOR GROWTH:

LAND USE

At this time there is still a significant amount of vacant land available for development in the future. There are 12,968 acres (over 20 square miles) of planned new residential housing development projects in the District. Some of the projects are currently under construction.

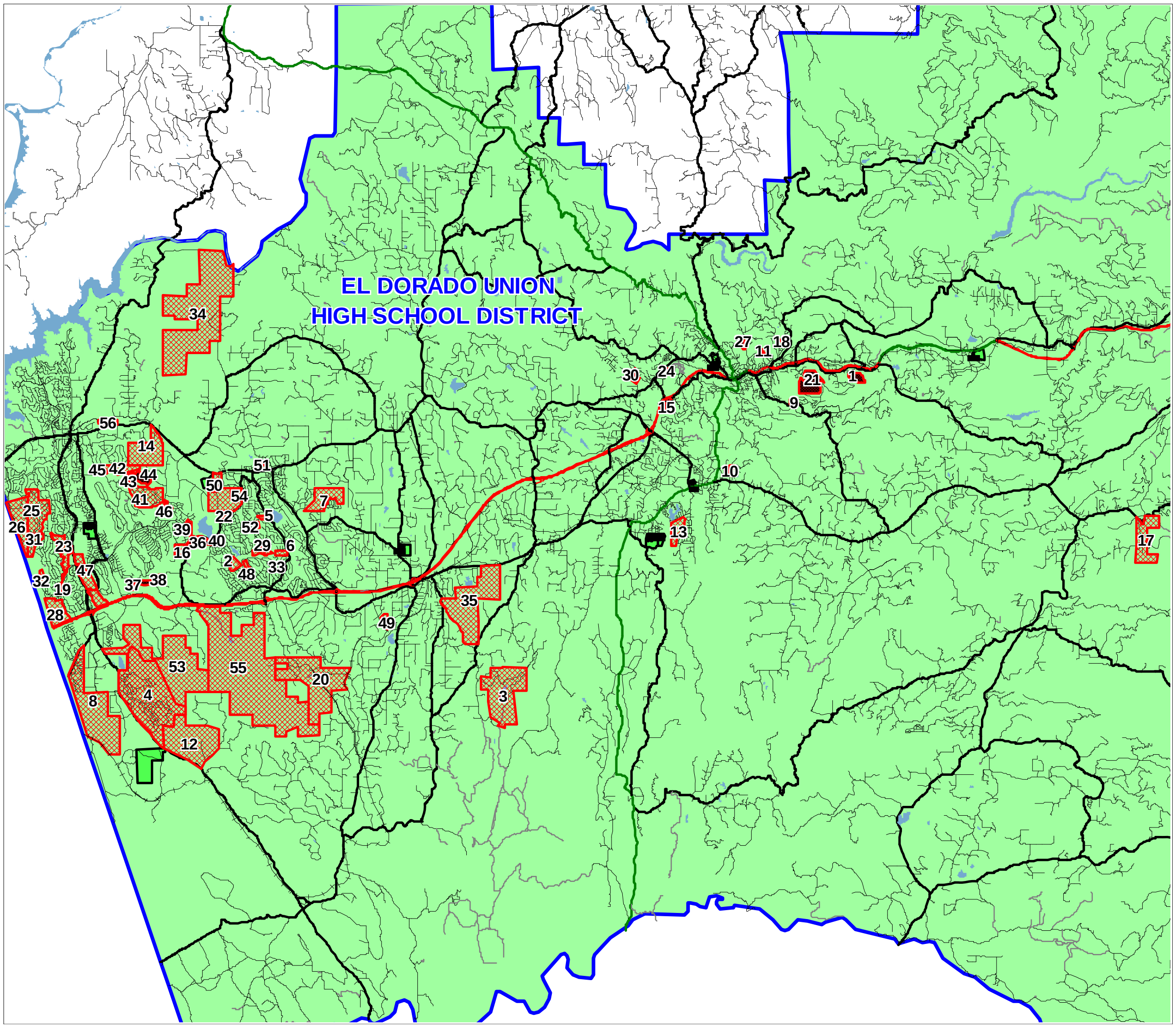
GROWTH POTENTIAL

This Master Plan includes current student enrollment figures and projections for the next ten years. It is important, however, to have some historic perspective upon which to analyze the current situation and project into the future.

NEW HOUSING DEVELOPMENTS

There are currently several new housing developments planned within the El Dorado Union High School District boundaries. The following map shows the major developments planned within the next ten years. Continued development can be expected. It is important to remember many external factors, such as environmental issues, economic changes, market trends, and changes in governmental regulations, affect the location and timing of new housing developments.

Map #2 – New Developments



ID	Name	Remaining Units	6 Year Projection
1	Astonia (Placerville Estates)	39	0
2	Bell Woods	54	45
3	Big Canyon Ranch	40	30
4	BlackStone	660	660
5	Cameron Heights	25	25
6	Cameron Hills	41	30
7	Cameron Meadows	374	72
8	CARSON CREEK & EUER RANCH	1,700	20
9	Cedar Bluffs Phase 2 & 3	58	0
10	Cottage Gardens	50	15
11	Cottonwood Park Phase 4&6	39	0
12	Deer Creek Estates	121	20
13	Diamond Dorado	744	15
14	Dixon Ranch	605	605
15	Forni Rd	34	0
16	Hawk View Ridge	116	35
17	Hutton Hills Estates Preliminary	35	20
18	Jewell Ridge Estates	17	0
19	La Cresta Woods	25	25
20	Limerock Valley Specific Plan	800	0
21	Lumsden Ranch	366	0
22	Oak View Estates	24	24
23	Pedregal Planning Area	265	150
24	Placerville Heritage Homes	20	0
25	Promontory Villages	28	28
26	Promontory Villages 1-5	81	44
27	Quartz Mountain	22	12
28	Rancho Dorado	207	127
29	Rancho Tierra	54	34
30	Ridge at Orchard Hill	94	50
31	Ridgeview Village #9	49	23
32	Ridgeview West	12	12
33	Rihan Estates	15	15
34	Salmon Falls Preserve	375	0
35	San Stino	1,041	0
36	Serrano J5 & J6	119	80
37	Serrano Village A	54	0
38	Serrano Village C2	50	0
39	Serrano Village J LotH	83	0
40	Serrano Village J7	71	0
41	Serrano Village K1/K2	113	105
42	Serrano Village M2	73	33
43	Serrano Village M3	30	0
44	Serrano Village M4	38	0
45	Serrano Village M5	10	0
46	Serrano Villages K5 P2	115	115
47	Serrano Westside	763	150
48	Shady Glen Estates	22	22
49	Sierra Gold Condos	91	40
50	Silver Springs	244	55
51	Starbuck Ranch	49	42
52	Sunrise Heights 1/2	36	36
53	VALLEY VIEW	1,440	0
54	Verde Vista	69	35
55	Village of Marble Valley SP	3,236	250
56	Wilson Estates	58	0
	Totals	**14,994**	**3,099**

Based on information from the planned developments and the county planning department, the projections in this report assume there will be a total of 6,283 new housing units built over the next ten years. This represents 41.9% of the 14,994 proposed housing units planned in the proposed tract maps. It is assumed the remaining units would be built beyond the ten year period of this report. The majority of these units are single family residences. Assuming this construction rate, there will be an average of 628 new homes per year. Following is the building schedule that has been used:

EL DORADO UNION HIGH SCHOOL DISTRICT
New Development Construction
Housing Units per Year

School	14/15 Year 1	15/16 Year 2	16/17 Year 3	17/18 Year 4	18/19 Year 5	19/20 Year 6	20/21 Year 7	21/22 Year 8	22/23 Year 9	23/24 Year 10	Totals
El Dorado High	7	7	12	12	22	22	41	41	41	41	**246**
Oak Ridge High	11	66	122	284	351	383	304	304	304	304	**2,433**
Ponderosa High	35	35	83	156	236	265	236	236	236	236	**1,754**
Union Mine High	150	160	170	180	115	215	215	215	215	215	**1,850**
HIGH TOTALS	**203**	**268**	**387**	**632**	**724**	**885**	**796**	**796**	**796**	**796**	**6,283**

STUDENT YIELD RATES

To determine the potential impact of the new housing developments, student yield factors are used to project the number of students who will be expected to live in a particular development. Currently the State uses a factor of 0.2 students per home to determine the average number of high school students in a new housing project. This would generate 200 students in every 1,000 homes. The current District yield rate used for this report is 0.177 students per home. This rate is lower than the State rate and is typical among rural Districts and those areas with higher home prices.

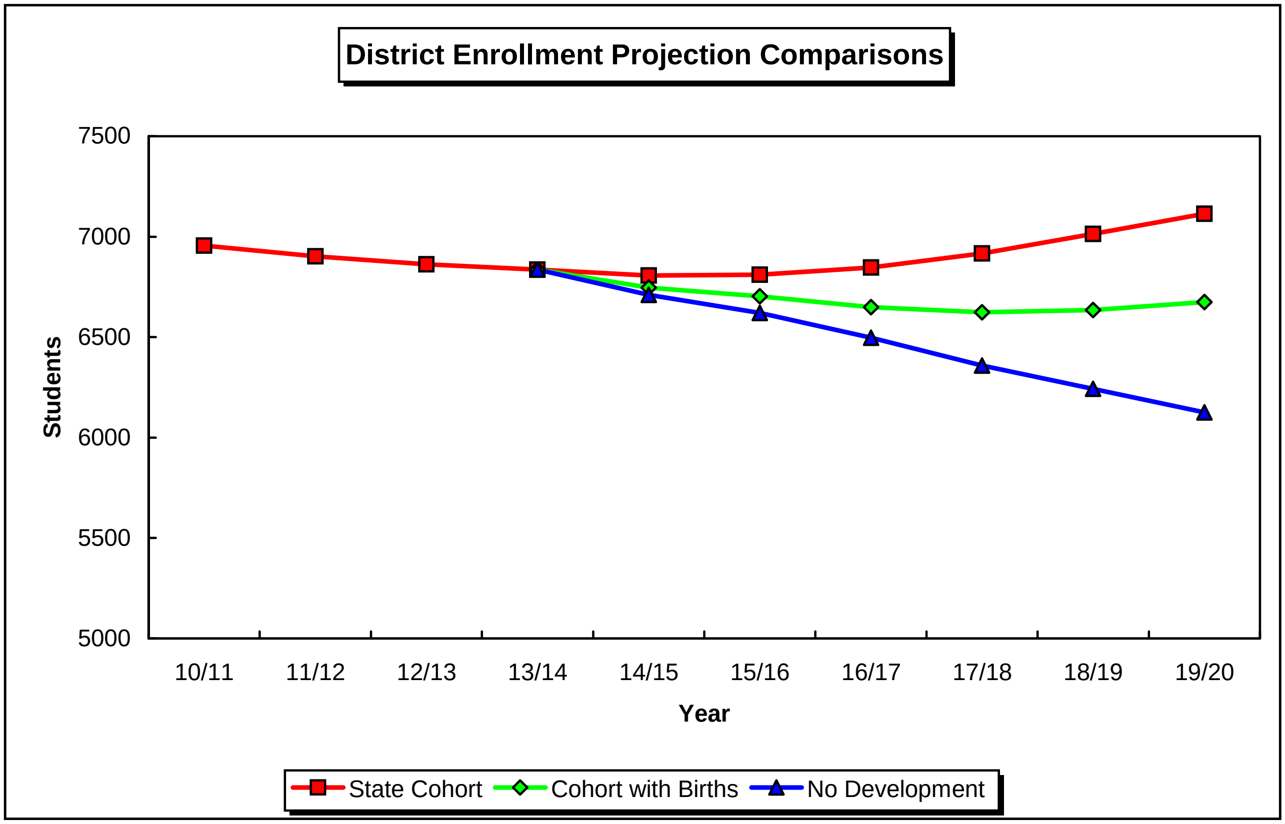
The 6,283 housing units projected will yield an estimated 1,112 new high school students in the District. Not all of these will attend the comprehensive schools. It is also important to note that this does not suggest the enrollment will increase by 1,112 students in the next ten years. The actual projections must also take into account additional demographic trends taking place in the community. The net impact of the developments are included in the projections in the following sections.

STUDENT ENROLLMENT PROJECTIONS

Three methods of projection are displayed in the following figure:

1. State Cohort	**Modified Cohort Projection used by S.A.B. to determine eligibility for State Building funds**
2. Cohort w/ Births	**Cohort Projection utilizing the student database along with birth rate statistics and housing impact.**
3. No Development	**A cohort projection method that does not account for the impact of new housing developments.**

Figure #3



Year:	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
State Cohort	6,955	6,902	6,862	6,836	6,806	6,811	6,847	6,917	7,014	7,114
Cohort with Births				6,836	6,746	6,704	6,649	6,623	6,635	6,675
No Development				6,836	6,710	6,621	6,497	6,359	6,243	6,126

As can be seen on the chart, the District should expect as many as 6,675 students enrolled in six years from now. This is a loss of 161 students, and represents a decline of 2.35% over the six-year period.

The largest total projected enrollment is 7,114 and is from the State Cohort method. The lowest total projected is 6,126 and is from the No Development method.

The projections in the remainder of this report will be based on the Cohort with Births method, which accounts for changes in birth rates and planned residential developments in addition to the standard Cohort trends.

Figure #4

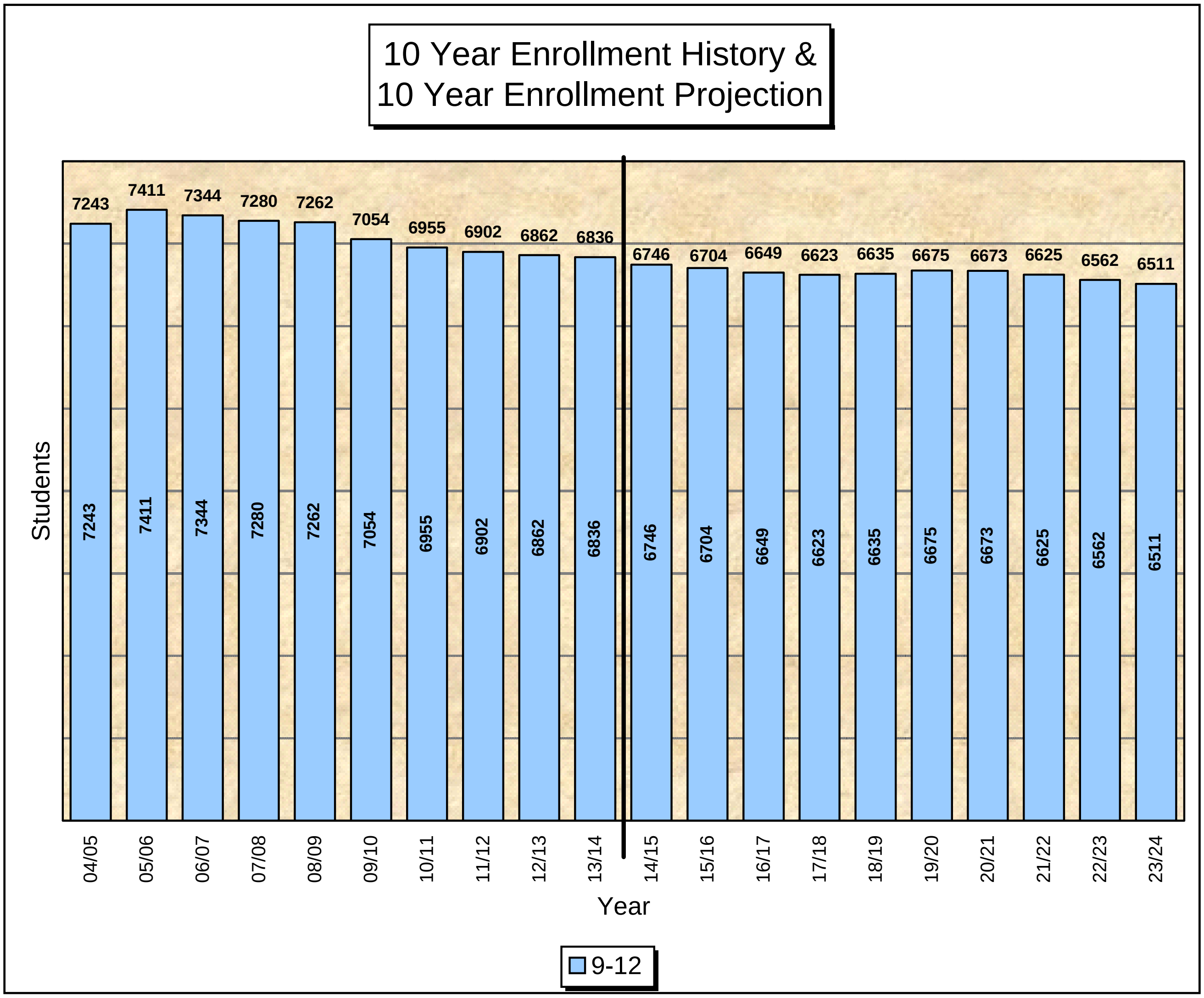


Figure #4 illustrates the change in the enrollment for a ten-year history. The District experienced consistent growth until 2005. That trend has now changed and the enrollment is in decline through 2017. After that the projections will be relatively stable though 2021 unless there are some major increases in new development activity.

The main reasons for the decline in the enrollment trends include a slow housing market along with the fact there were a large number of students in the high schools that are being replaced by smaller classes incoming from 8th grade.

The projections are shown by school for the following ten years in the next figure along with the annual change in enrollment.

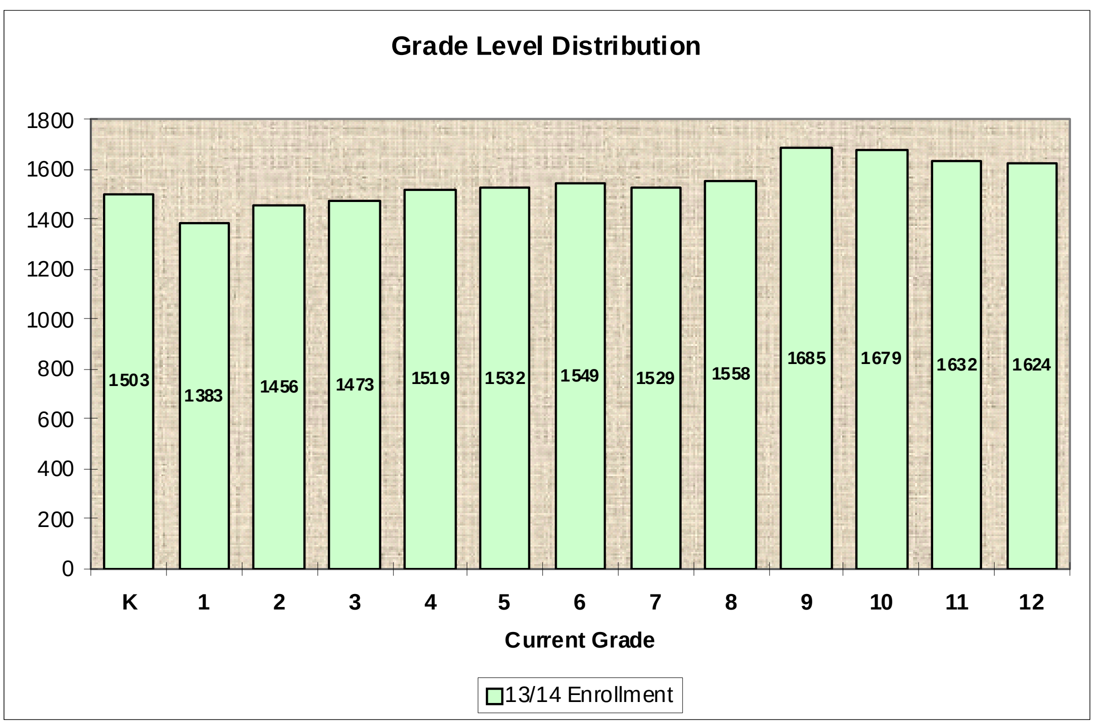
Figure #5

Enrollment Projections
Annual Growth

	EDHS		UMHS		ORHS		PHS		Alternative		Total	
	Enrollment	Annual Growth	Enrollment	Annual Growth	Enrollment	Annual Growth	Enrollment	Annual Growth	Enrollment	Annual Growth	Enrollment	Annual Growth
2013/14	1,352		1,097		2,316		1,791		280		6,836	
2014/15	1,328	-24	1,047	-50	2,310	-6	1,749	-42	312	32	6,746	-90
2015/16	1,308	-20	1,082	35	2,316	6	1,683	-66	315	3	6,704	-42
2016/17	1,274	-34	1,041	-41	2,366	50	1,651	-32	317	2	6,649	-55
2017/18	1,267	-7	1,049	8	2,348	-18	1,637	-14	322	5	6,623	-26
2018/19	1,210	-57	1,061	12	2,342	-6	1,695	58	327	5	6,635	12
2019/20	1,218	8	1,079	18	2,339	-3	1,705	10	334	7	6,675	40
2020/21	1,237	19	1,136	57	2,261	-78	1,700	-5	339	5	6,673	-2
2021/22	1,271	34	1,170	34	2,181	-80	1,657	-43	346	7	6,625	-48
2022/23	1,272	1	1,205	35	2,158	-23	1,577	-80	350	4	6,562	-63
2023/24	1,263	-9	1,220	15	2,112	-46	1,562	-15	354	4	6,511	-51

The Alternative schools column in this figure include ISP, Independence High, Shenandoah and Community Day.

The following chart shows the distribution by grade level of the District students and its feeders. As can be seen, elementary schools have seen smaller incoming classes that will impact the future enrollments at the high schools. The kindergarten enrollment data includes the new transitional kindergarten students.



Attendance Pattern Impacts

Attendance Matrix

Residence — School: Area	El Dorado High	Oak Ridge High	Ponderosa High	Union Mine High	Independence High	Mountain View High	Shenandoah Virtual Academy	ISP	Total Residing
	School of Attendance								
Inter-District	19	10	12	6	1	0	2	0	**50**
El Dorado High	**1,291**	3	52	109	43	2	13	0	**1,513**
Oak Ridge High	3	**2,269**	43	13	11	0	18	0	**2,357**
Ponderosa High	12	57	**1,696**	40	44	7	19	0	**1,875**
Union Mine High	45	7	38	**914**	16	19	11	0	**1,050**
Correction Factor*	-18	-30	-50	15	-1	0	0	97	**13**
Total Attending	**1,352**	**2,316**	**1,791**	**1,097**	**114**	**28**	**63**	**97**	**6,858**
Intra-Ins	60	37	83	177	113	28	61	97	**656**
Inter-Ins	19	10	12	6	1	0	2	0	**50**
Total In-Flow	**79**	**47**	**95**	**183**	**114**	**28**	**63**	**97**	**706**
Intra-Outs	222	88	179	136	0	0	0	0	**625**
% In Flow Students	**5.8%**	**2.0%**	**5.3%**	**16.7%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**10.3%**
% Out Flow Students	**14.7%**	**3.7%**	**9.5%**	**13.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**9.1%**

* The correction factor represents the difference between the student data dowload counts and the actual Calpads counts.

This chart shows the transfers between schools and the resulting net impact of the transfers. Oak Ridge High had the fewest transfer students both in and out of the school. Union Mine had the largest inflow for a comprehensive high school in the district. El Dorado High had the most transfers out.

Future High School Planning

Planning for a new high school should begin once the enrollment for the comprehensive high schools reach 7,000 students and additional growth is anticipated. A new high school should be planned to open once the district has 7,500 high school students at the four comprehensive school sites. The anticipated cost to build a new comprehensive high school will be between $100 to $150 million. Based on these guidelines, planning should begin once the district grows by an additional 500 students.

FACILITY INVENTORY

This report provides vital and current information on the status and square footage of the facilities at each site. By comparing the facilities to standards established by the District and the enrollment projections, the school capacities and facility needs will be determined.

Figure #6

COMPARISON OF STATE AND DISTRICT CLASSROOM LOADING STANDARDS

GRADE	STATE	GRADE	DISTRICT
9-12	27	9-12	27.5
Cont High	27	Cont High	25
Special Ed	13	Special Ed	12

The State standards shown here are those used under SB 50 for determining the District's eligibility for State funds for new construction and modernization projects. The District standards account for normal loading conditions and do not include interim overloading situations. For short-term periods, the loading standard can be increased to 30 students per classroom for grades 9-12.

DISTRICT CAPACITY AT EACH SCHOOL:

A classroom utilization report was prepared as part of this Master Plan. For the purposes of this and the following computations, the number of teaching stations includes portable classrooms. The classrooms are multiplied by the District Classroom Loading Standards to determine the capacity.

Figure #7

Calculation of Classroom Capacity with District Standards

School Facility Capacity

High Schools	**Classrooms**	**District Capacity**
El Dorado High	57	1,521
Oak Ridge High	88	2,405
Ponderosa High	83	2,221
Union Mine High	54	1,470
Sub-Totals	**282**	**7,616**
Other Schools		
Independence High	9	225
Shenandoah Virtual Academy	13	286
Community Day	1	25
ISP	0	0
Sub-Totals	**23**	**536**
District Totals	**305**	**8,152**

CAPACITY OF SCHOOLS AND PROJECTED ENROLLMENT:

Following are maps, graphs and charts for each school in the District.

The attendance pattern map shows the location of the students either attending the school or those living in the school boundary. The maps are color coded so it is easy to see how many and where the students live that are transferring in and out of each school.

The school site map indicates the room use for each space and is color coded by building type to help identify any portables buildings.

The capacity and projected enrollment graph shows the projected enrolments in comparison to the school capacities. If the enrollment exceeds the capacity, the district will need to decide how to handle the overcrowding situation. In some cases, there are temporary measures such as increasing class sizes that can help accommodate students. This graph also include a blue line that represents how many high school age students live in the school boundary. This illustrates the net impact of the transfer students when compared to the red enrollment line.

It is good to remember “projections” are nothing more than a systematic way to attempt to look into the future based on assumptions. Different techniques can produce different results. External forces, beyond the control of the school district, can change the factors contributing to student enrollment (e.g., housing starts, environmental issues, general plan revisions, changes in the economy, etc.). The enrollment needs to be monitored each year to determine where and to what extent the actual enrollment and population shifts (reality) are meeting the projections, the point being to make mid-course modifications, if necessary, to facility planning and decisions – past decisions and those yet to be made.

The classroom needs timeline is shown below each enrollment projection graph. This chart compares the projected enrollment with the facility capacity according to District standards and determines the number of classrooms needed (or the number of available seats). These figures also indicate the anticipated timeline for any needed additional classrooms based upon current conditions.

The facilities adequacy graph compares the adequacy of eight types of facilities to the current and projected enrollments.

The adequacy is determined by comparing the actual area of each facility category with the area guideline for that facility. For example, if a school has a 1,500 square foot kitchen and the area guideline for kitchen space is 1.0 square feet per student, then the capacity of the kitchen would be 1,500 students. The area guidelines used for this report are based on a study done by the State and by analyzing the facilities in the El Dorado Union High School District. The area guidelines which were used for this report are shown here:

Figure #8

BUILDING AREA GUIDELINES

	HIGH SCHOOL	
ADMIN	4	Sq Ft Per Student
LIBRARY/RESOURCE	6,000	Sq Ft
KITCHEN	1	Sq Ft Per Student
MULTI-USE	4	Sq Ft Per Student
GYMNASIUM/PE	22,000	Sq Ft

The classroom loading standards were previously identified. The site acreage guidelines were based on CDE recommended school site sizes. Restroom guidelines were based on the uniform plumbing code standards.

The facility need analysis chart calculates the area of any needed facilities as shown in the graphs for each school. Also shown are the existing facility scores based on a scale of 10 being perfect. The score is a weighted average of the support facility scores, with a score of 10 meaning the support facilities meet 100% of the guidelines and a score of 7.5 meaning the facilities only meet 75% of the guidelines.

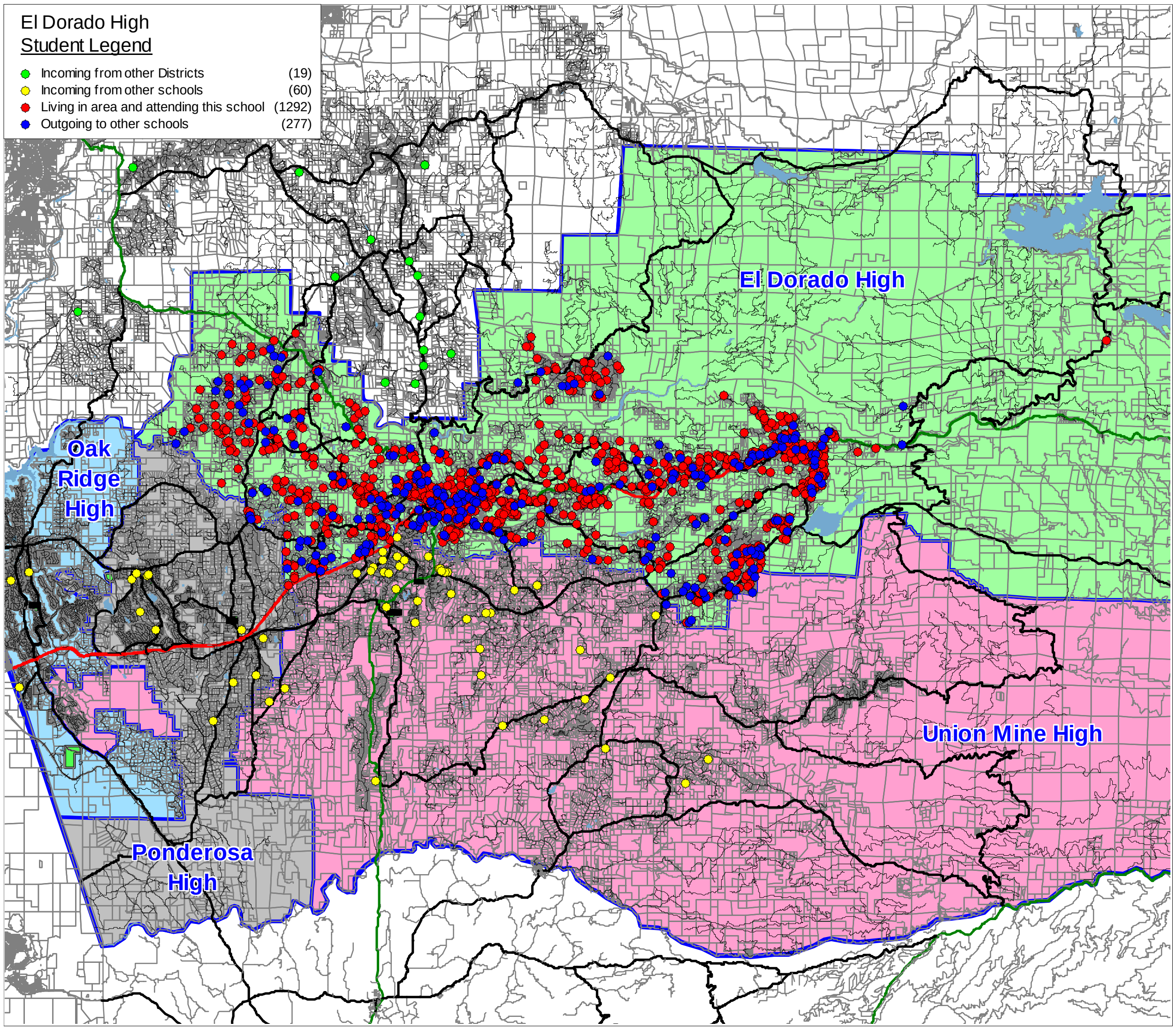
The chart also indicates the existing and needed building areas. The needed area is again based on the building area guidelines shown in figure #8. If the District changes its guidelines, then the needs will also change.

Those schools with lower scores are most likely either facilities that are overcrowded, have added classrooms without expanding the core facilities, or have not completed the campus master plan. The scores can be increased by building the needed facilities, reducing the enrollment, or reprioritizing the usage of existing space. Enrollments are usually reduced by changing school attendance boundaries to better utilize capacities at other school sites or building a new school, if such capacities are necessary to facilitate District-wide future student growth.

Support facility needs are shown as a blue bar on the graph only for areas in which the existing facility is less than 85% of the guideline and those that require at least an additional 1,000 square feet of space. Minor needs were not included in the estimates, as it was assumed the project would not be economically feasible.

The facility needs shown assume the students projected for the school will attend that school and may not reflect the actual plans for the District. This information is for planning purposes based upon need and not a recommendation of what should be done on the specific site.

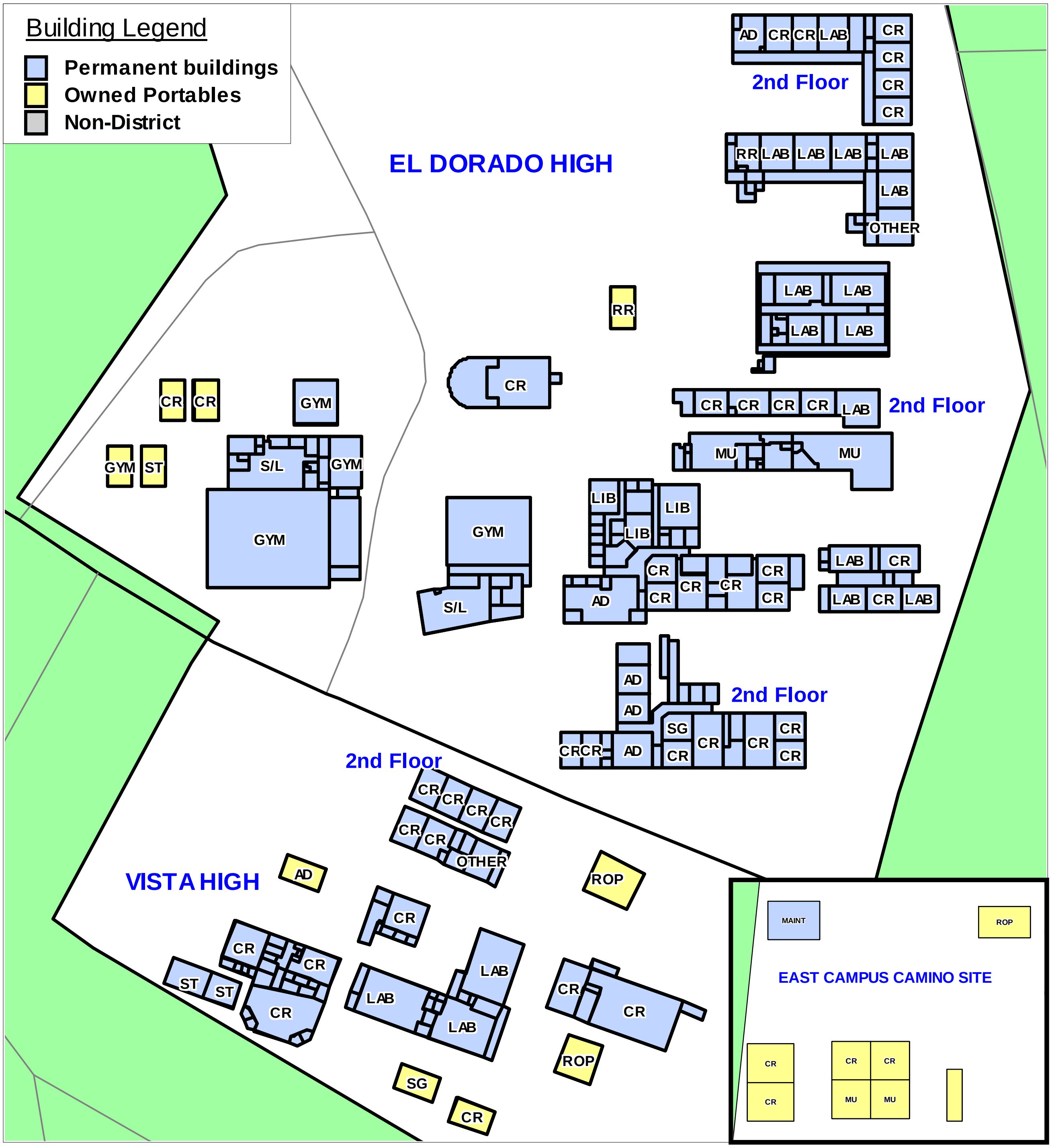
Map #3 - El Dorado High School Attendance Patterns



The 2013/14 attendance patterns for EDHS, based on student home addresses, are shown above. The transfers out include students attending the other comprehensive high schools, along with students attending alternative programs. Many of the blue dots (transfers out) are due to the fact there are students still attending Union Mine or Ponderosa that used to be in those attendance areas before the boundary changes.

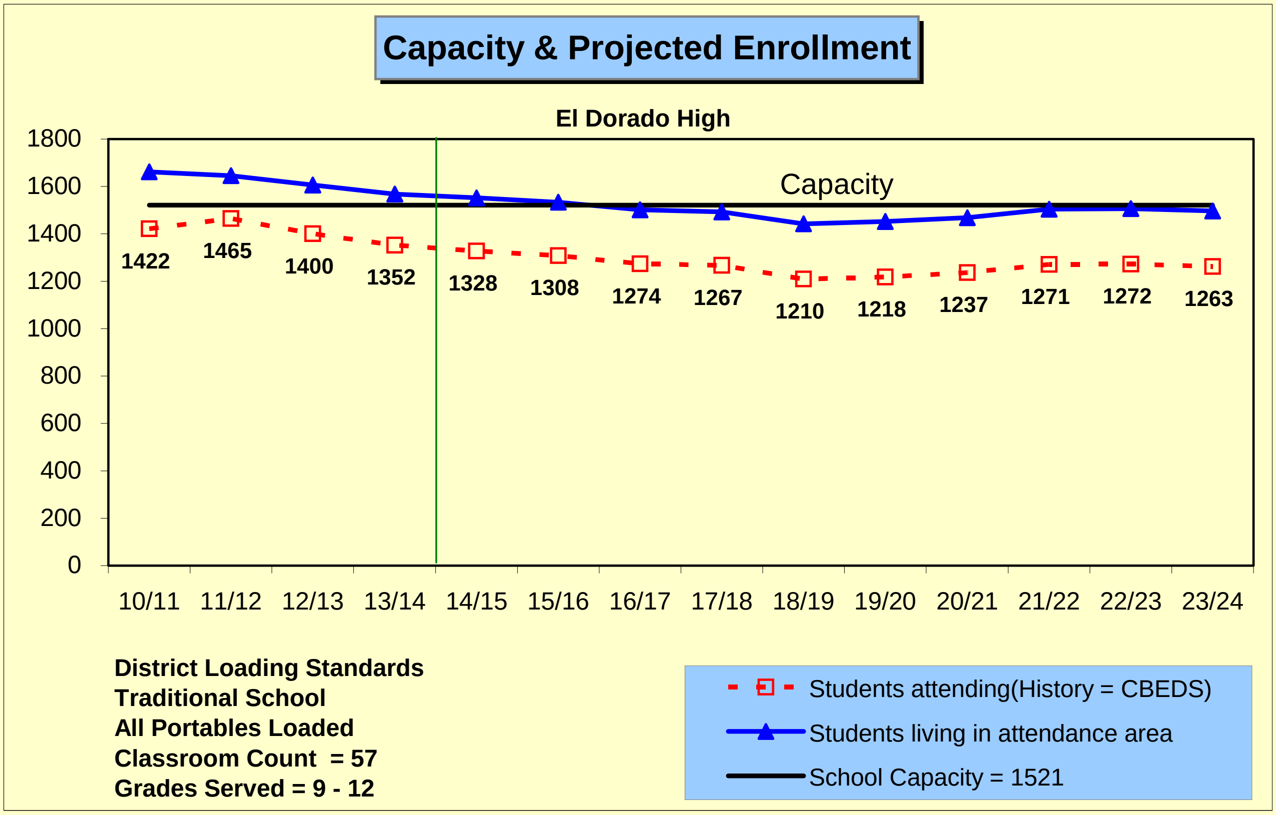
The enrollment for the El Dorado High School site includes the students enrolled in the Vista High program.

Map #4 – El Dorado High School Site Map



This site houses the VHS program, which uses one permanent classroom and core facilities as indicated in the diagram. El Dorado High also includes an East Campus which is used for CTE/ROP programs which includes the Natural Resources program.

Figure #9



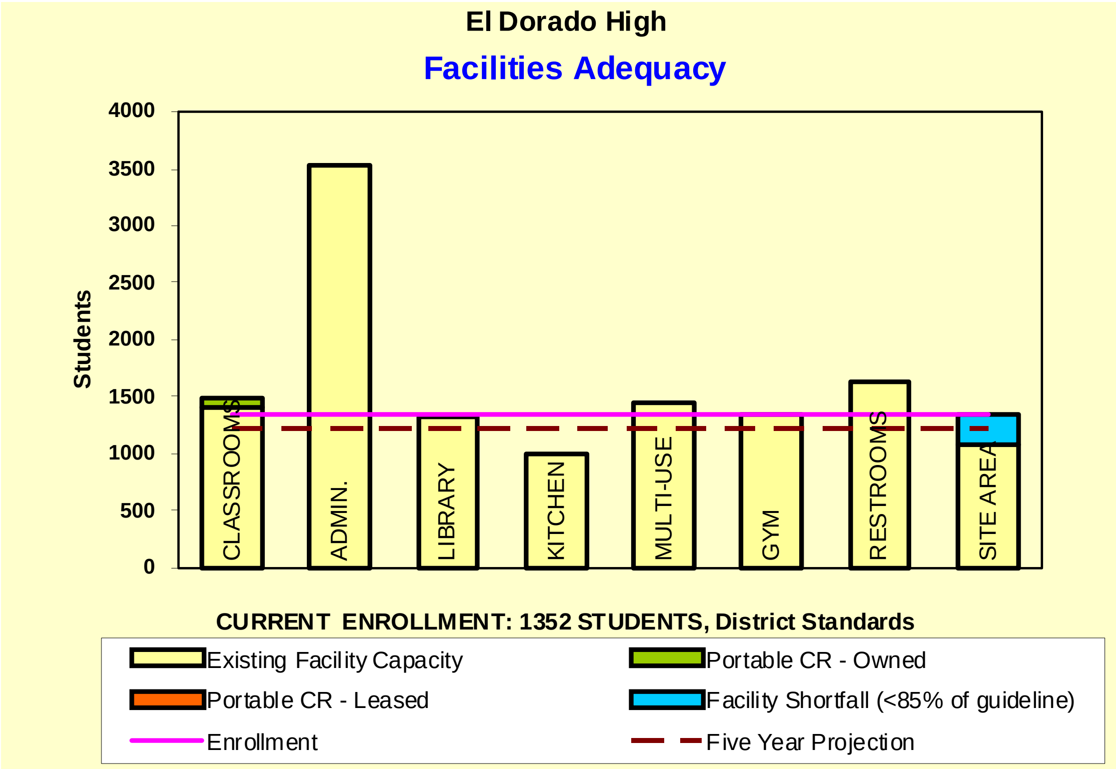
Classroom Needs Timeline

Year	Total Students*	Annual Change	Spec. Ed. Students	Facility Capacity	Unhoused Students	Annual CR Needed	Total CR's Needed	Available Seats	Projected Housing Units
13/14	1352	-48	36	1521	0	0	-6	169	
14/15	1328	-24	35	1521	0	0	-7	193	7
15/16	1308	-20	35	1521	0	0	-8	213	7
16/17	1274	-34	34	1521	0	0	-9	247	12
17/18	1267	-7	34	1521	0	0	-9	254	12
18/19	1210	-57	32	1521	0	0	-11	311	22
19/20	1218	8	32	1521	0	0	-11	303	22

* Based on Students Attending (Squares on Graph)
Classroom Count = 57

EDHS is projected to slowly drop in enrollment over the next 5 years and then begin to start increasing in enrollment.

Figure #10



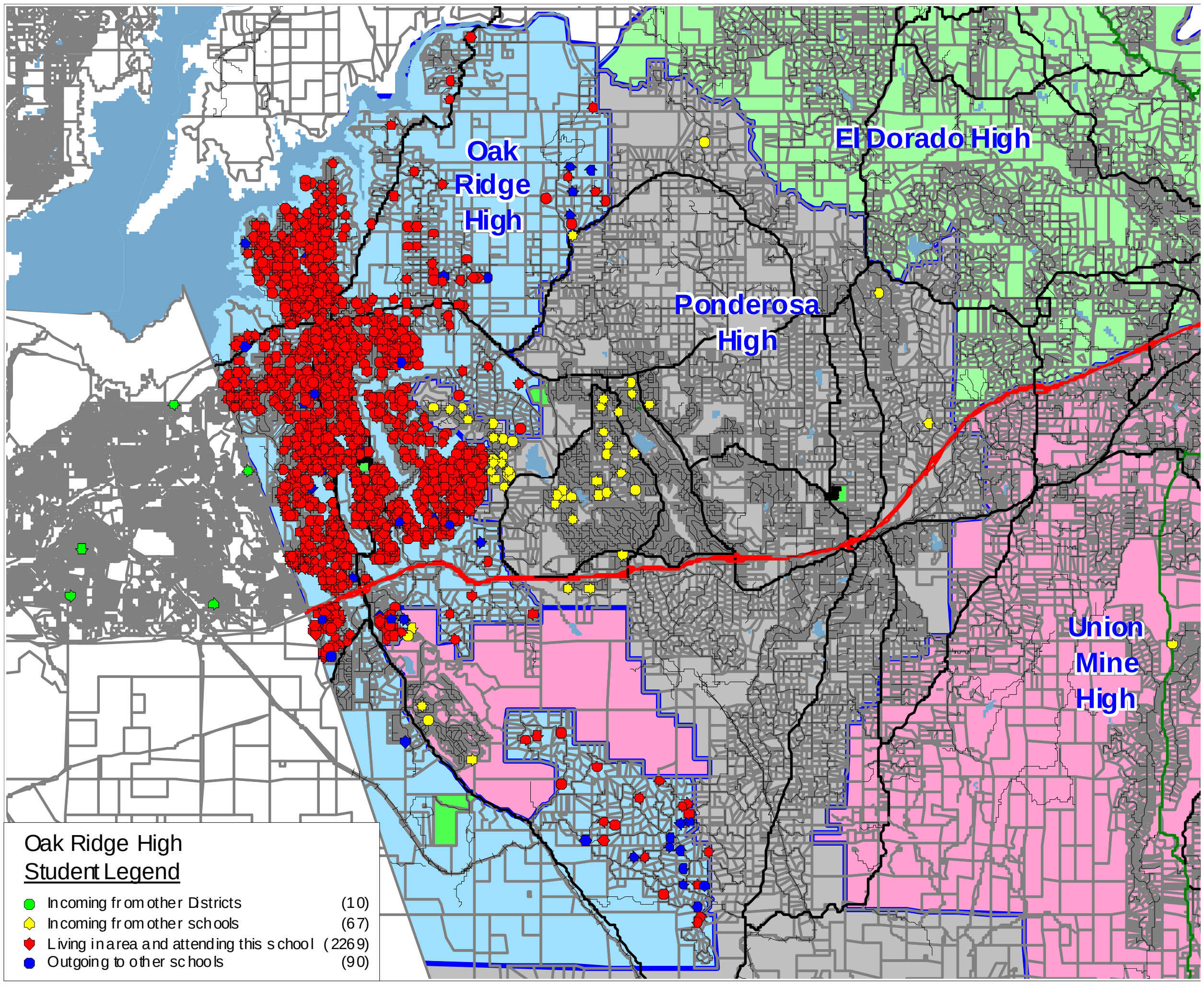
FACILITY NEEDS ANALYSIS

El Dorado High Current Year District Standards FACILITY TYPE	EXISTING FACILITIES UNITS (SQ FT)	INITIAL SCORE		NEW FACILITIES NEEDED UNITS (SQ FT)	PLANNED UNITS (SQ FT)	STD. UNIT COST*	FINAL SCORE#
CLASSROOMS:	75,578		# CR				
- PORTABLE	6,240		0	0		$60,000	
- PERMANENT	69,338		0	0		281.60	
ADMINISTRATION	14,113	10.0		0		327.62	10.0
LIBRARY	5,964	9.8		0		317.65	9.8
SMALL GROUP ROOMS	3,106			0		300.03	
KITCHEN	1,006	7.4		0		481.90	7.4
MULTI-USE	5,791	10.0		0		328.93	10.0
GYMNASIUM	22,169	10.0		0		395.70	10.0
SHOWER/LOCKER	6,292			0		361.35	
STORAGE	11,269			0		247.77	
RESTROOMS	6,380	10.0		0		653.48	10.0
SITE AREA (ACRES)	31	8.1		7.4		100,000	10.0
Totals	**151,668**	**9.5**					**9.8**

* Standard Unit Costs based on values established by the State's Office of Public School Construction.
\# On a 10 point scale(assumes improvements are made).
Note: Area totals include portables

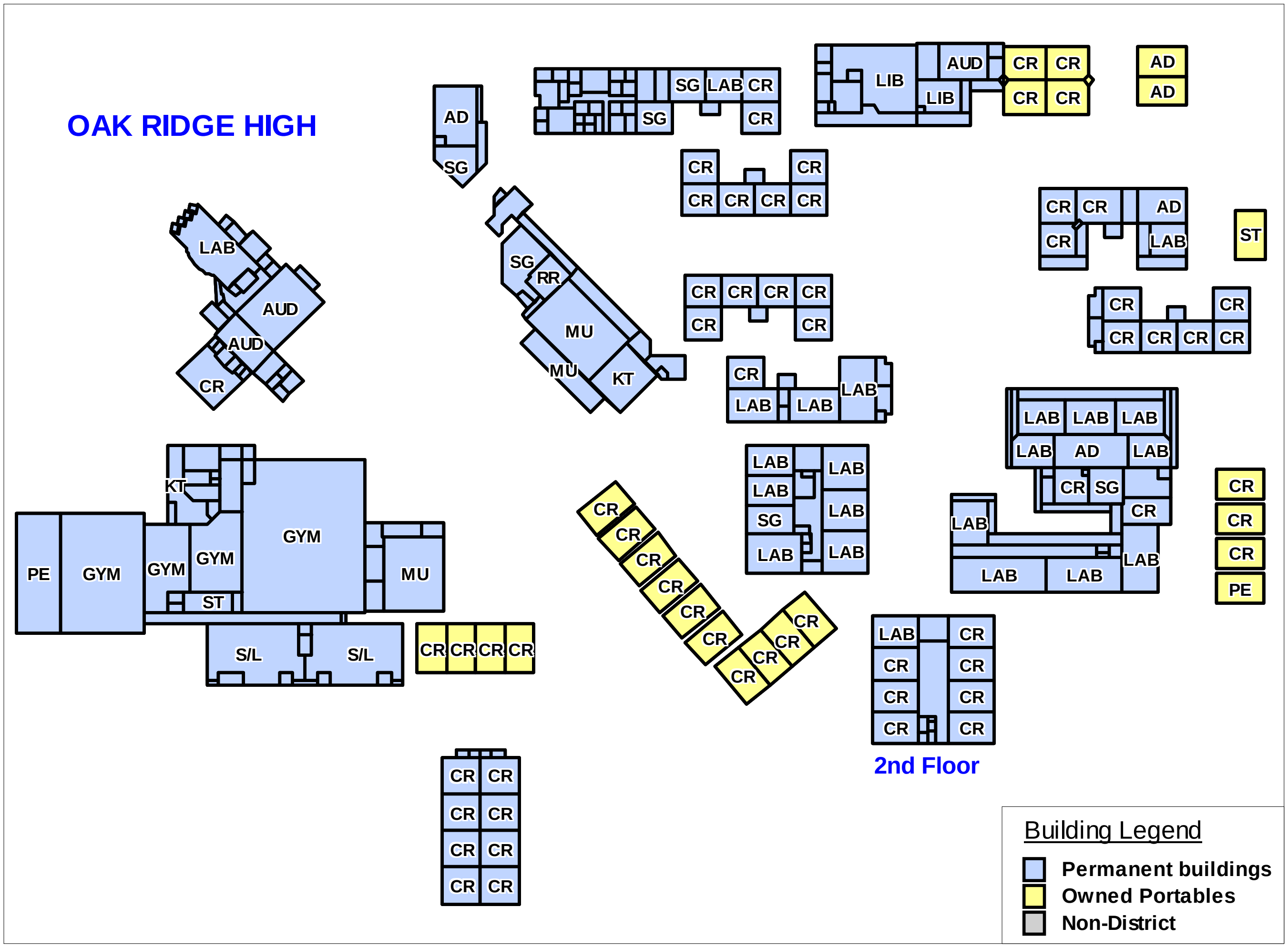
The Site area for El Dorado High includes the 12 acres of the County owned park.

Map #5 – Oak Ridge High School Attendance Patterns



The 2013/14 attendance patterns for ORHS, based on student home addresses, are shown above. There were more students transferring out than in. The transfers out include students attending the other comprehensive high schools, along with students attending any of the alternative programs.

Map #6 – Oak Ridge High School Site Plan



This diagram shows the room utilization for ORHS.

Room Labels:

MU - Multi use or cafeteria | **LIB - Library** | **CR – Classroom**

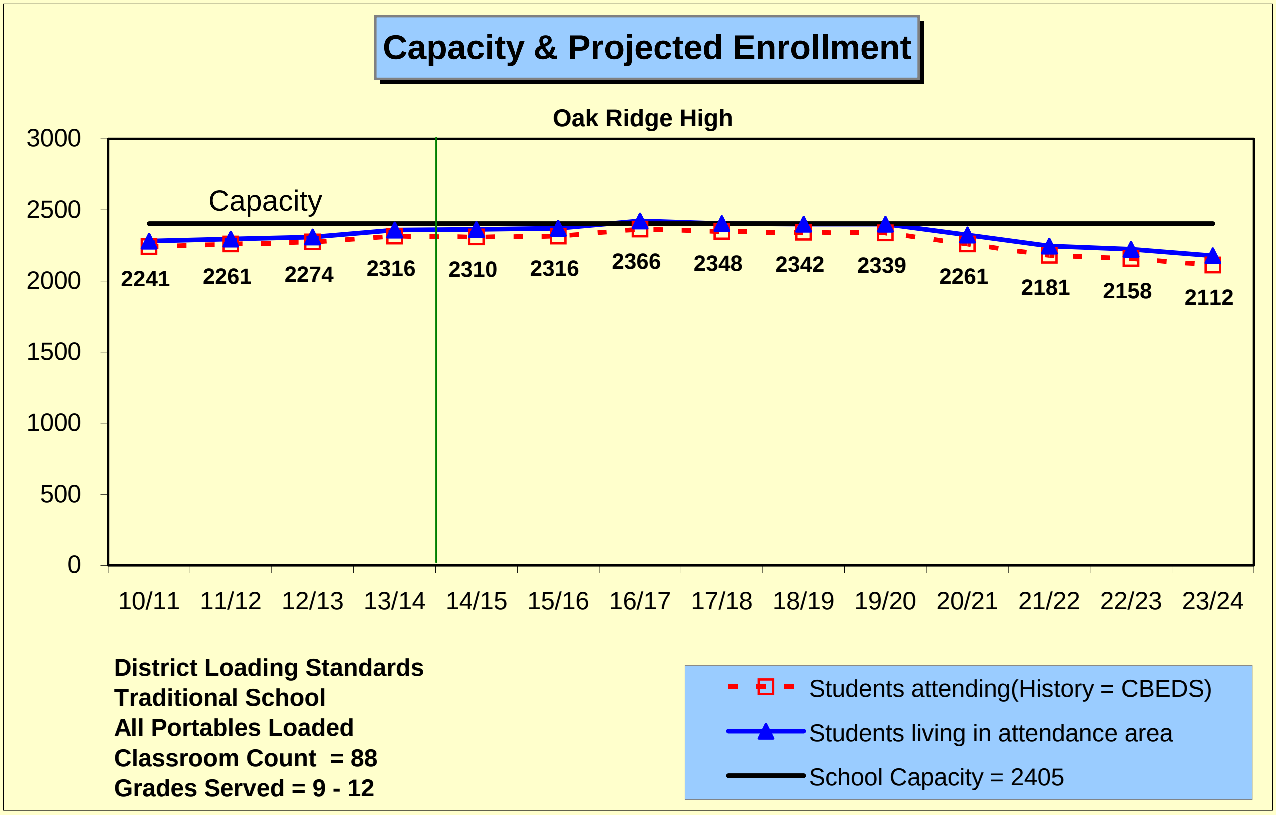
SG - Small group instruction | **ST - Storage** | **WW - Walkways**

AD - Administration/Offices | **AUD - Auditorium** | **KT - Kitchen**

S/L - Shower/Locker Room | **Other - Other uses (ROP, County)**

LAB – Specialized Classroom | **GYM – Gymnasium or other PE use**

Figure #11



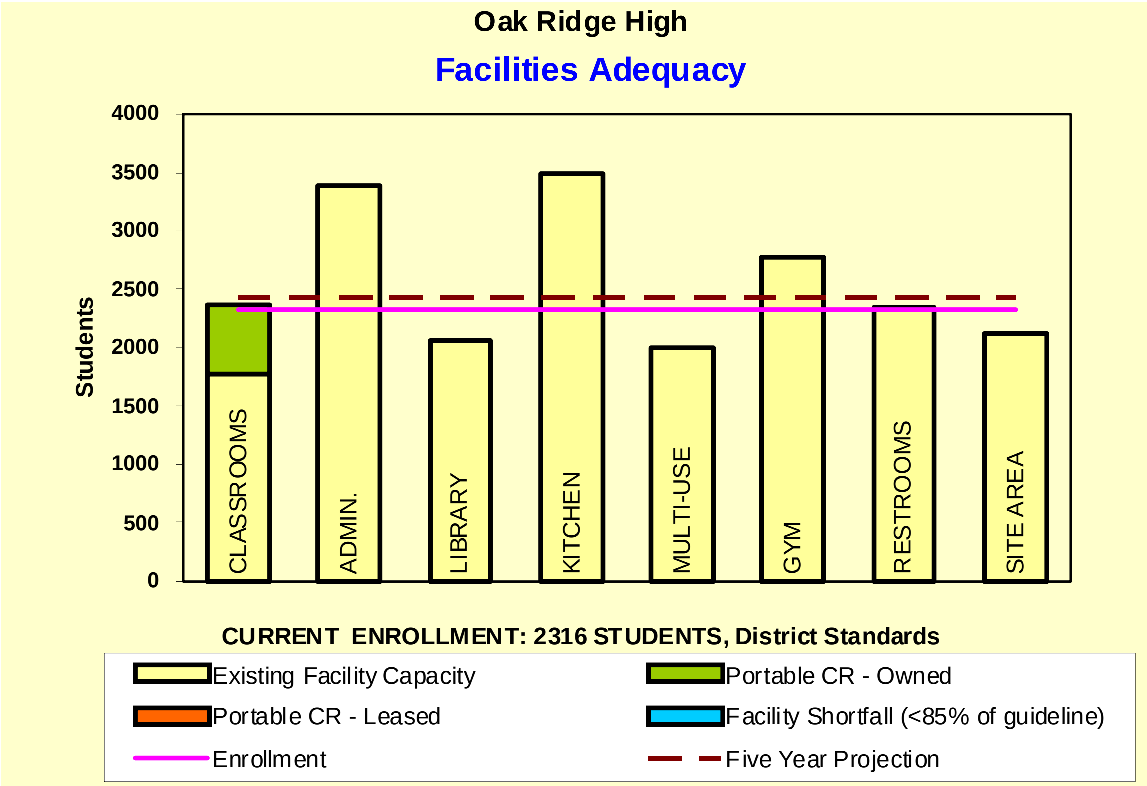
Classroom Needs Timeline

Year	Total Students*	Annual Change	Spec. Ed. Students	Facility Capacity	Unhoused Students	Annual CR Needed	Total CR's Needed	Available Seats	Projected Housing Units
13/14	2316	42	12	2405	0	0	-3	89	
14/15	2310	-6	12	2405	0	0	-3	95	11
15/16	2316	6	12	2405	0	0	-3	89	66
16/17	2366	50	12	2405	0	0	-1	39	122
17/18	2348	-18	12	2405	0	0	-2	57	284
18/19	2342	-6	12	2405	0	0	-2	63	351
19/20	2339	-3	12	2405	0	0	-2	66	383

* Based on Students Attending (Squares on Graph)
Classroom Count = 88

ORHS is projected to slightly increase in enrollment for the next 6 years and then will begin to decline.

Figure #12

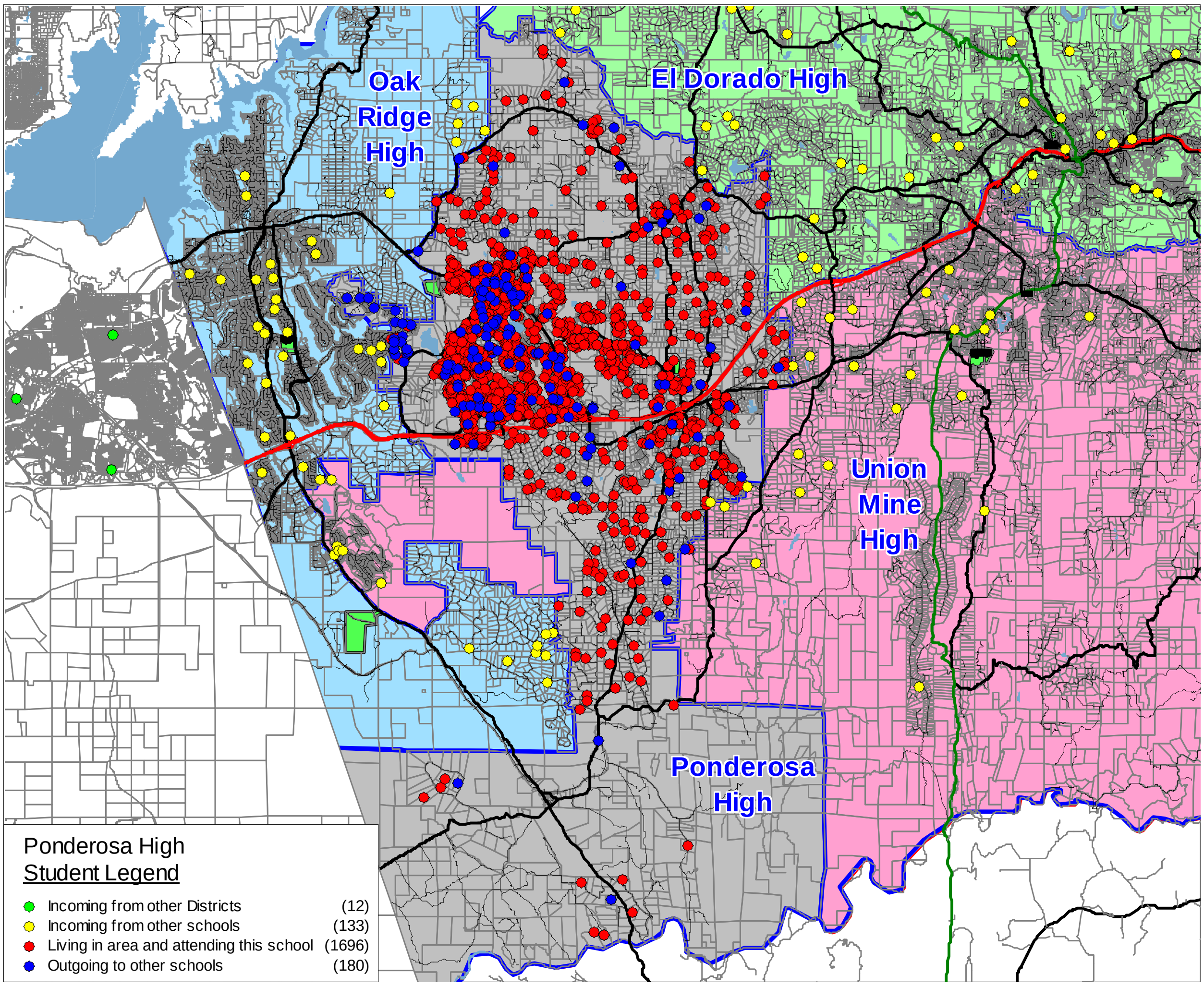


FACILITY NEEDS ANALYSIS

Oak Ridge High / Current Year / District Standards / FACILITY TYPE	EXISTING FACILITIES UNITS (SQ FT)	EXISTING FACILITIES INITIAL SCORE	# CR	NEW FACILITIES NEEDED UNITS (SQ FT)	NEW FACILITIES PLANNED UNITS (SQ FT)	STD. UNIT COST*	FINAL SCORE#
CLASSROOMS:	87,695						
- PORTABLE	21,064		0	0		$60,000	
- PERMANENT	66,631		0	0		281.60	
ADMINISTRATION	13,570	10.0		0		327.62	10.0
LIBRARY	5,257	8.9		0		317.65	8.9
SMALL GROUP ROOMS	5,968			0		300.03	
KITCHEN	3,481	10.0		0		481.90	10.0
MULTI-USE	7,980	8.6		0		328.93	8.6
GYMNASIUM	25,990	10.0		0		395.70	10.0
SHOWER/LOCKER	6,978			0		361.35	
STORAGE	6,118			0		247.77	
RESTROOMS	5,428	10.0		0		653.48	10.0
SITE AREA (ACRES)	49	9.1		0.0		100,000	9.1
Totals	**168,465**	**9.5**					**9.5**

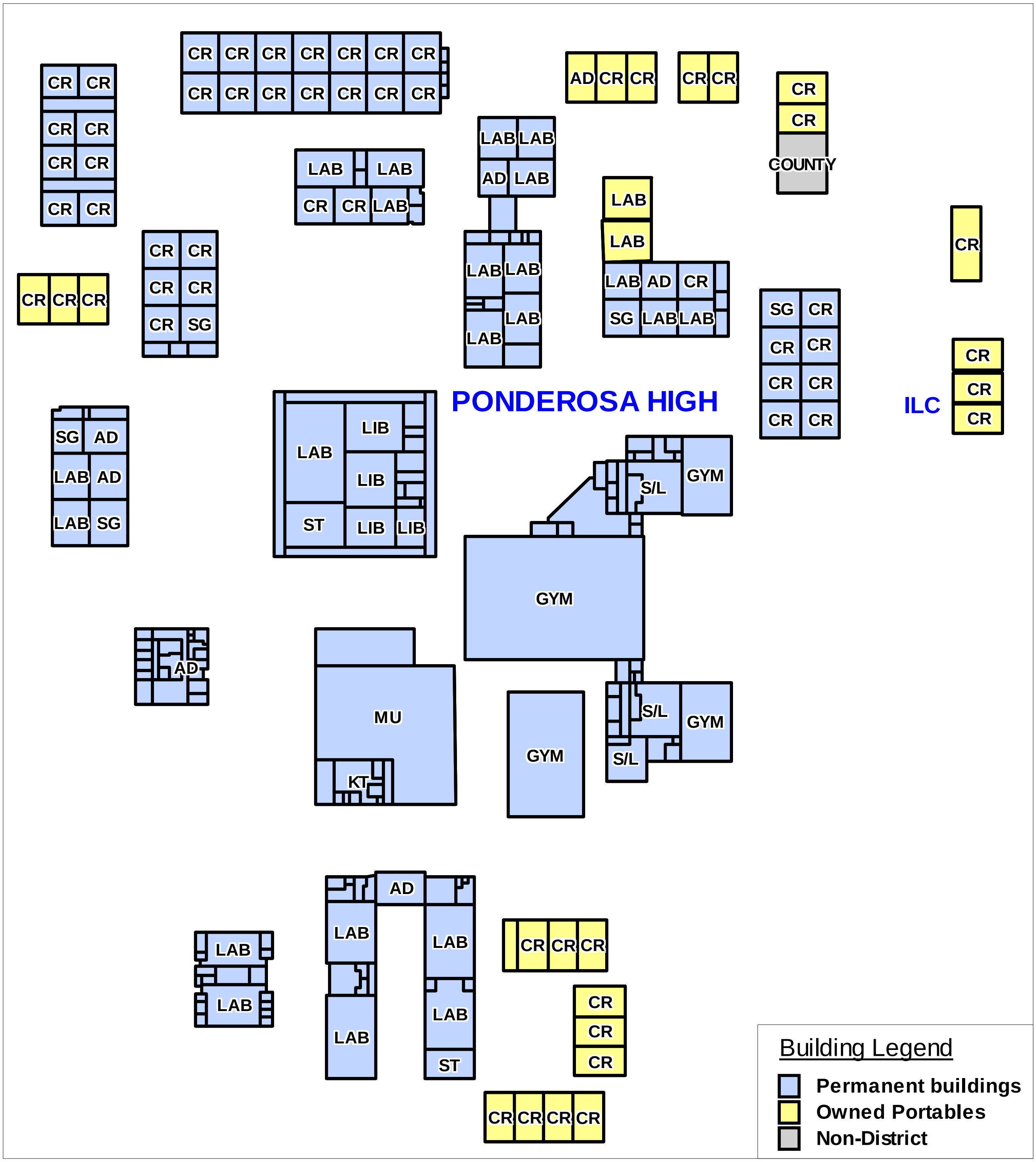
* Standard Unit Costs based on values established by the State's Office of Public School Construction.
\# On a 10 point scale(assumes improvements are made).
Note: Area totals include portables

Map #7 – Ponderosa High School Attendance Patterns



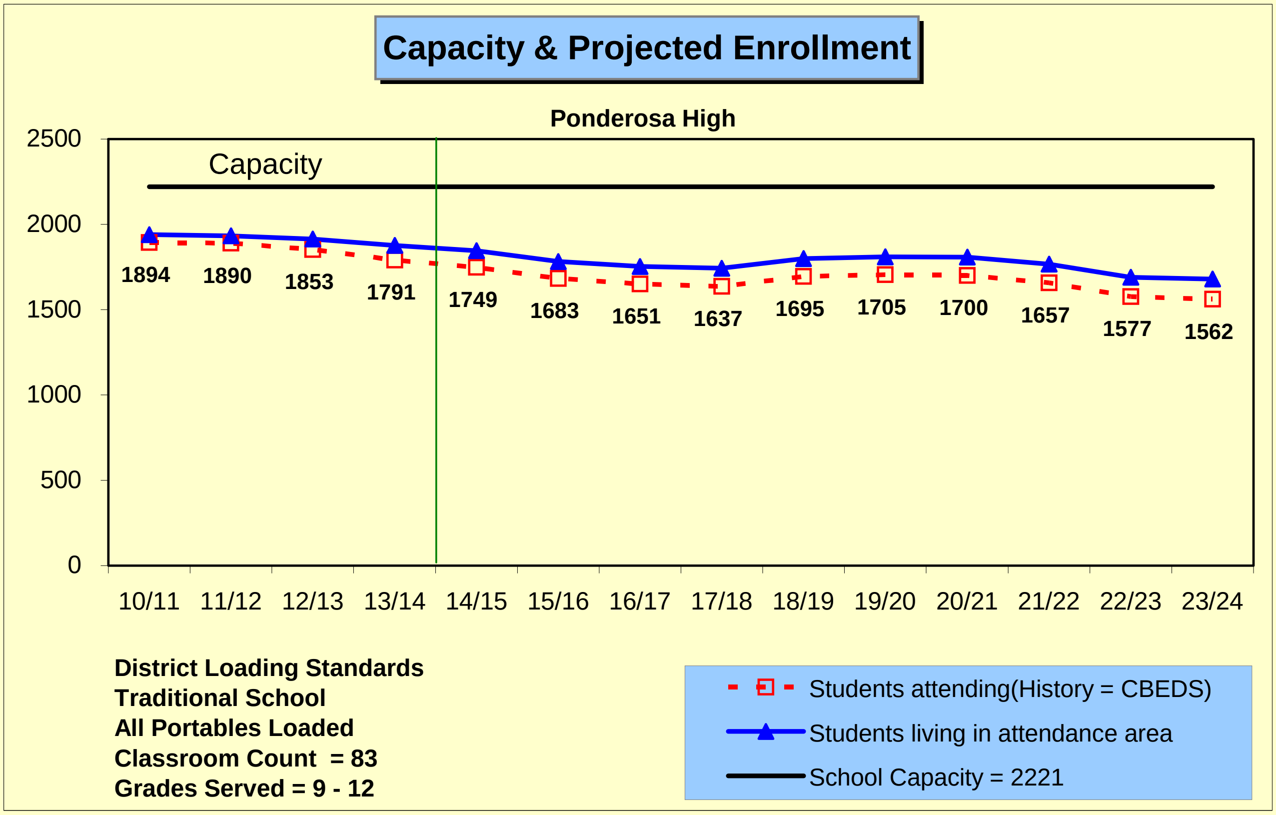
The 2013/14 attendance patterns for PHS, based on student home addresses, are shown above. There are fewer number of students transferring in compared to those transferring out of PHS.

Map #8 – Ponderosa High School Site Plan



This diagram shows the room utilization for PHS. Two classrooms on this campus are used for the ILC program.

Figure #13



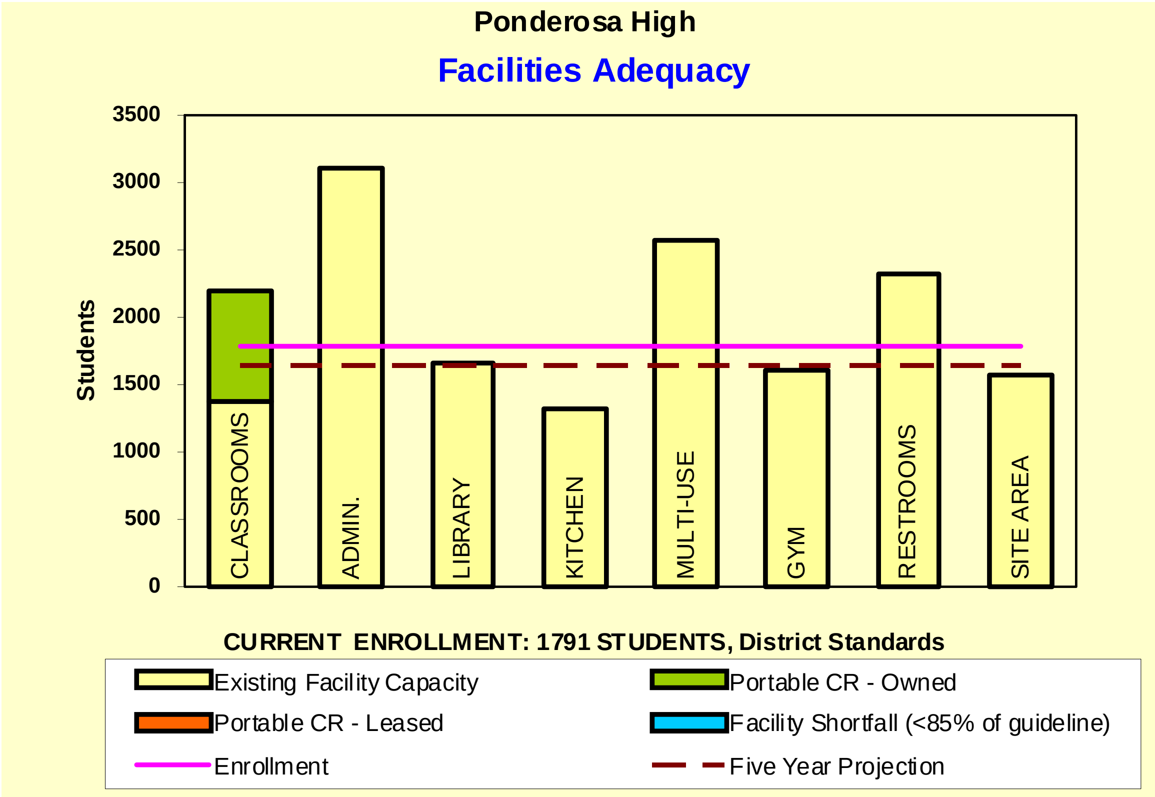
Classroom Needs Timeline

Year	Total Students*	Annual Change	Spec. Ed. Students	Facility Capacity	Unhoused Students	Annual CR Needed	Total CR's Needed	Available Seats	Projected Housing Units
13/14	1791	-62	55	2221	0	0	-15	430	
14/15	1749	-42	54	2221	0	0	-18	472	35
15/16	1683	-66	52	2221	0	0	-20	538	35
16/17	1651	-32	51	2221	0	0	-21	570	83
17/18	1637	-14	51	2221	0	0	-21	584	156
18/19	1695	58	53	2221	0	0	-19	526	236
19/20	1705	10	53	2221	0	0	-19	516	265

* Based on Students Attending (Squares on Graph)
Classroom Count = 83

Ponderosa High is projected to have a decrease in enrollment over the next ten years.

Figure #14

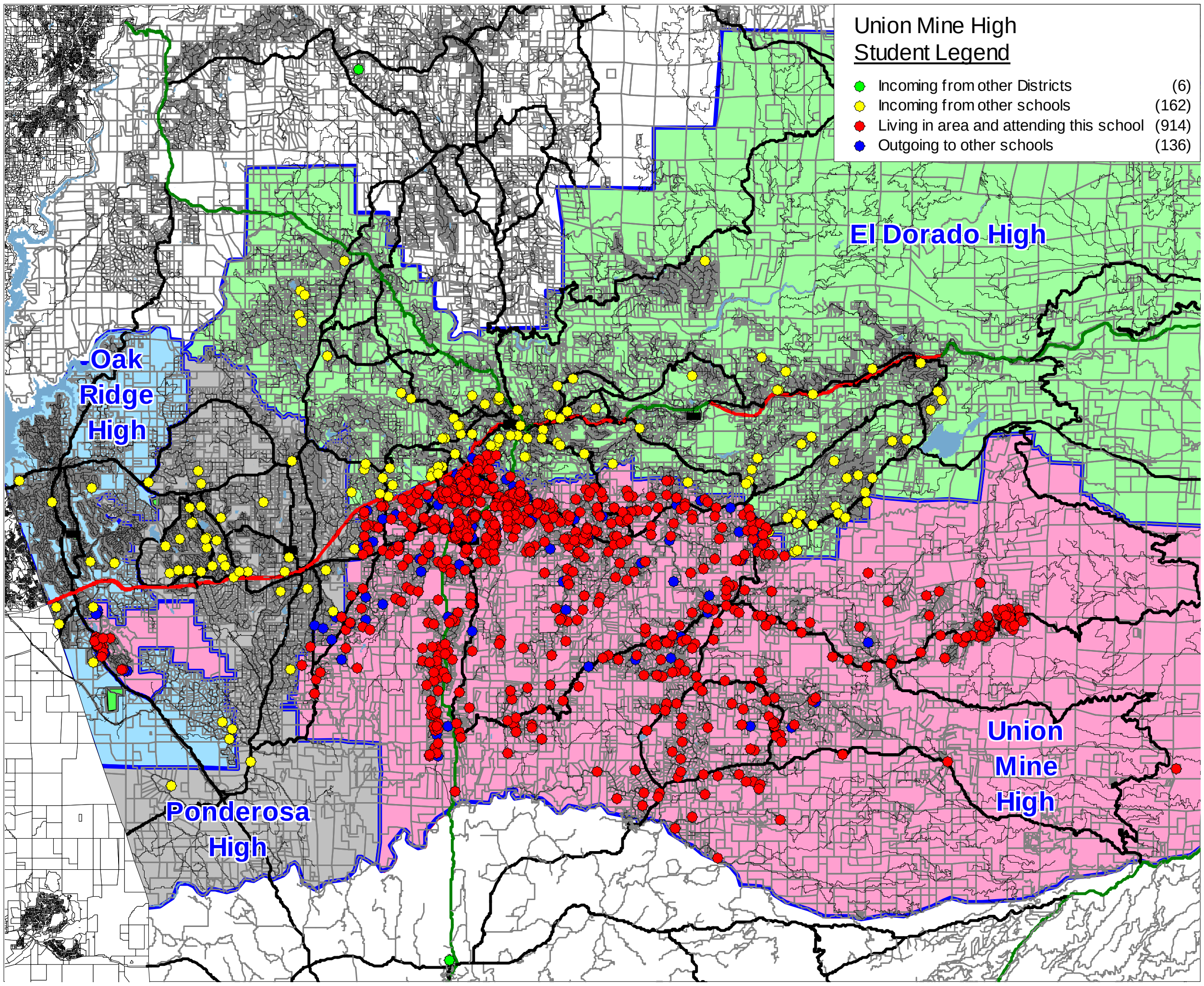


FACILITY NEEDS ANALYSIS

Ponderosa High Current Year District Standards FACILITY TYPE	EXISTING FACILITIES UNITS (SQ FT)	 INITIAL SCORE		NEW FACILITIES NEEDED UNITS (SQ FT)	 PLANNED UNITS (SQ FT)	 STD. UNIT COST*	 FINAL SCORE#
CLASSROOMS:	94,223		# CR				
- PORTABLE	31,440		0	0		$60,000	
- PERMANENT	62,783		0	0		281.60	
ADMINISTRATION	12,409	10.0		0		327.62	10.0
LIBRARY	5,762	9.3		0		317.65	9.3
SMALL GROUP ROOMS	5,984			0		300.03	
KITCHEN	1,329	7.4		0		481.90	7.4
MULTI-USE	10,260	10.0		0		328.93	10.0
GYMNASIUM	20,420	9.0		0		395.70	9.0
SHOWER/LOCKER	5,068			0		361.35	
STORAGE	8,884			0		247.77	
RESTROOMS	4,843	10.0		0		653.48	10.0
SITE AREA (ACRES)	41	8.8		0.0		100,000	8.8
Totals	**169,182**	**9.4**					**9.4**

* Standard Unit Costs based on values established by the State's Office of Public School Construction.
\# On a 10 point scale(assumes improvements are made).
Note: Area totals include portables

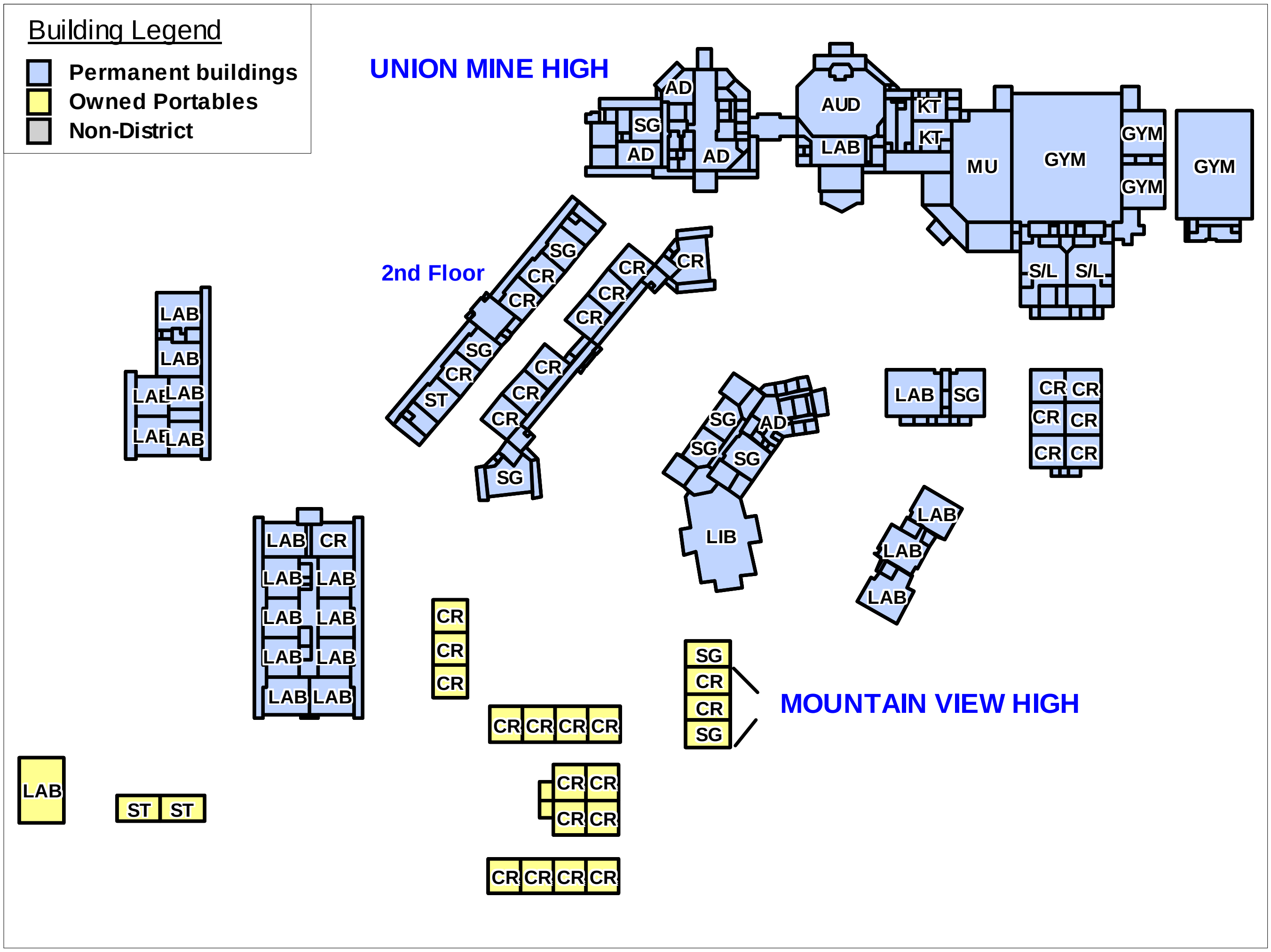
Map #9 – Union Mine High Attendance Patterns



The 2013/14 attendance patterns for UMHS, based on student home addresses, are shown above. UMHS serves the area shown in this map including the future development in the Valley View and Marble Valley areas.

The enrollment for the Union Mine High site includes the Mountain View High program.

Map #10 – Union Mine High School Site Plan

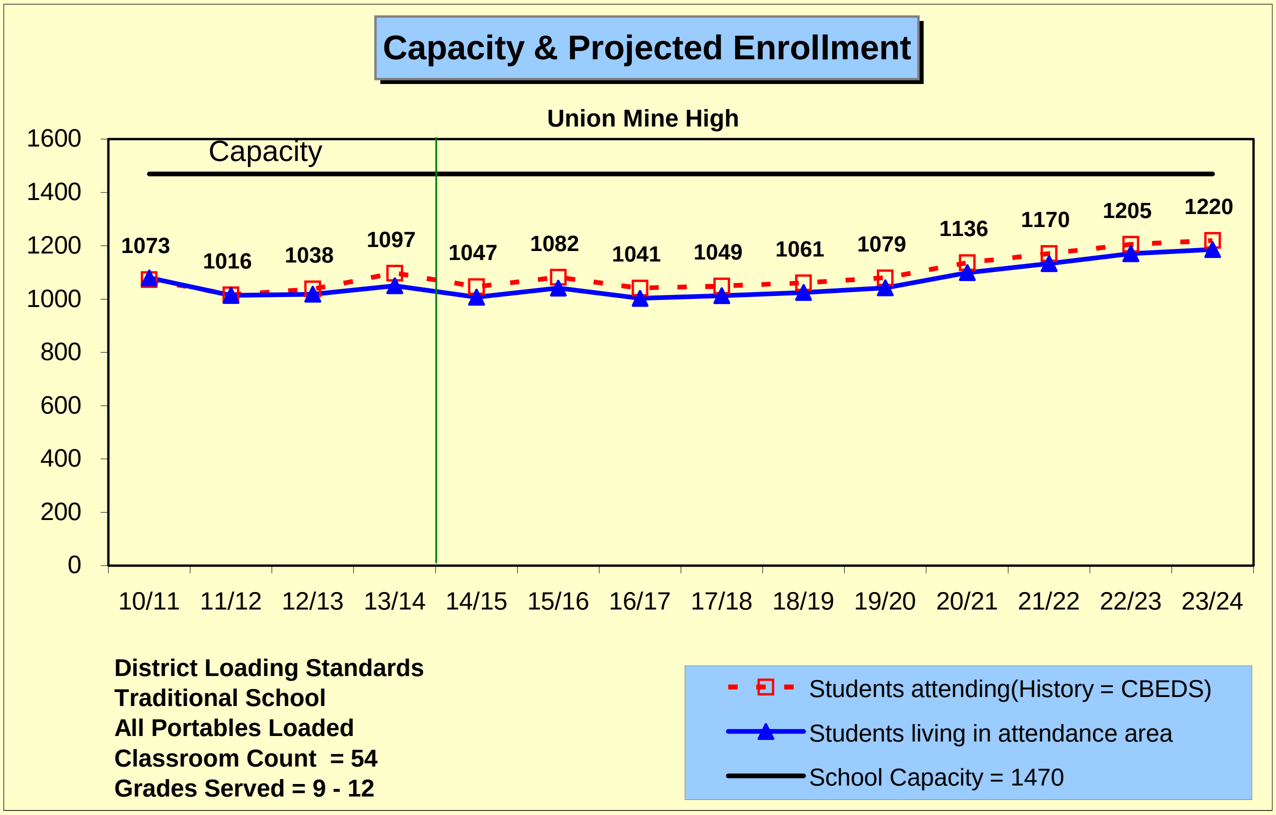


UMHS is the newest comprehensive high school in the District. A second gym and six permanent classrooms were recently added as shown in the figure above. This site houses the MVHS program, which uses three portables and core facilities.

Room Labels:

MU - Multi use or cafeteria	**LIB - Library**	**CR – Classroom**
SG - Small group instruction	**ST - Storage**	**WW - Walkways**
AD - Administration/Offices	**AUD - Auditorium**	**KT - Kitchen**
S/L - Shower/Locker Room	**Other - Other uses (ROP, County)**	
LAB – Specialized Classroom	**GYM – Gymnasium or other PE use**	

Figure #15



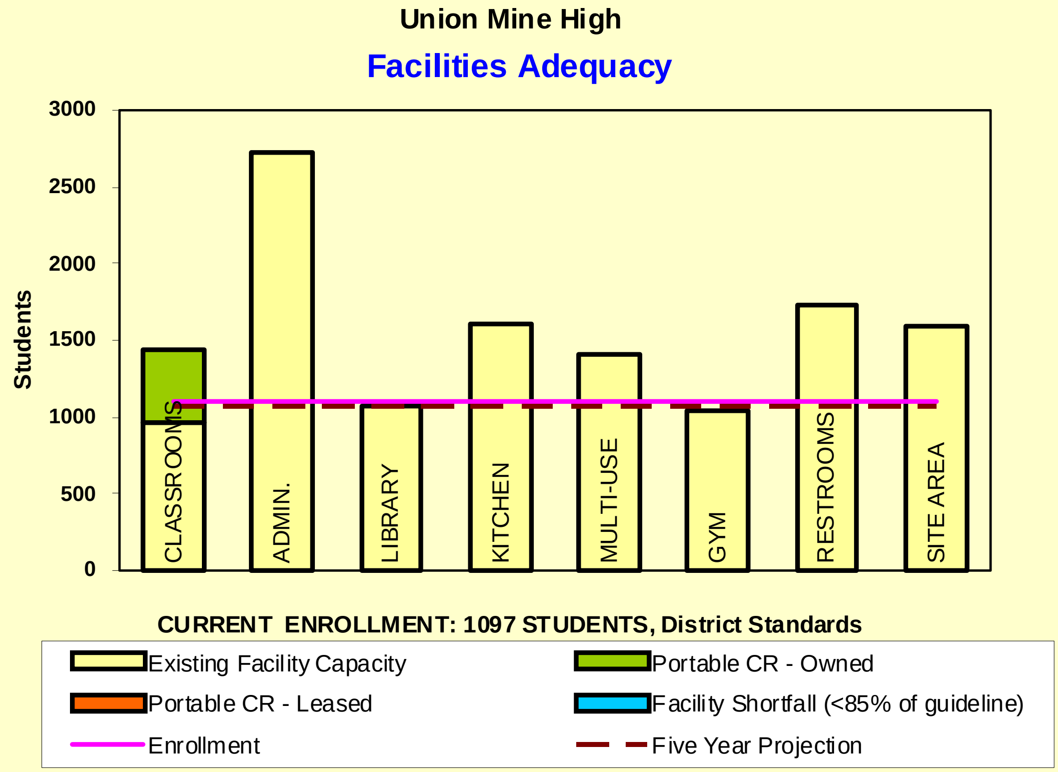
Classroom Needs Timeline

Year	Total Students*	Annual Change	Spec. Ed. Students	Facility Capacity	Unhoused Students	Annual CR Needed	Total CR's Needed	Available Seats	Projected Housing Units
13/14	1097	59	16	1470	0	0	-14	373	
14/15	1047	-50	15	1470	0	0	-15	423	150
15/16	1082	35	17	1470	0	0	-14	388	160
16/17	1041	-41	16	1470	0	0	-16	429	170
17/18	1049	8	16	1470	0	0	-15	421	180
18/19	1061	12	15	1470	0	0	-15	409	115
19/20	1079	18	17	1470	0	0	-14	391	215

* Based on Students Attending (Squares on Graph)
Classroom Count = 54

UMHS is not projected to exceed its classroom capacity during the next 10 years. The enrollment is projected to be stable the next six years and then begin to grow.

Figure #16

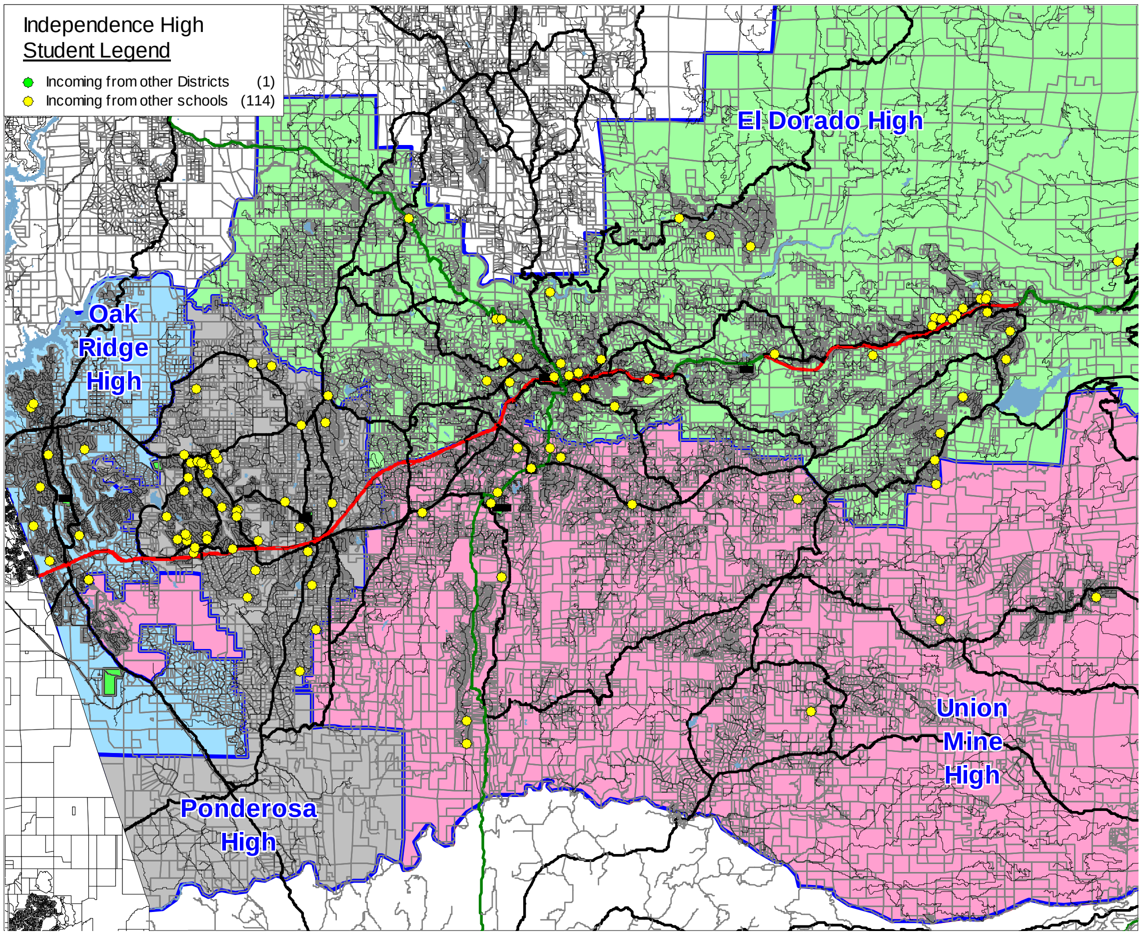


FACILITY NEEDS ANALYSIS

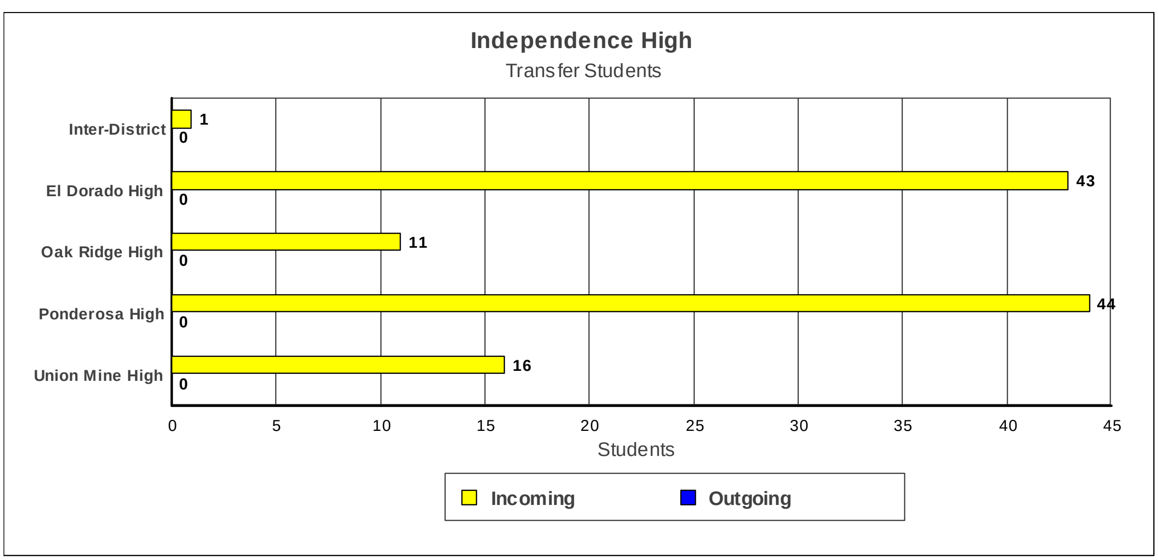
Union Mine High Current Year District Standards FACILITY TYPE	EXISTING FACILITIES UNITS (SQ FT)	INITIAL SCORE	# CR	NEW FACILITIES NEEDED UNITS (SQ FT)	PLANNED UNITS (SQ FT)	STD. UNIT COST*	FINAL SCORE#
CLASSROOMS:	61,836						
- PORTABLE	19,680		0	0		$60,000	
- PERMANENT	42,156		0	0		281.60	
ADMINISTRATION	10,880	10.0		0		327.62	10.0
LIBRARY	6,122	9.8		0		317.65	9.8
SMALL GROUP ROOMS	9,801			0		300.03	
KITCHEN	1,605	10.0		0		481.90	10.0
MULTI-USE	5,610	10.0		0		328.93	10.0
GYMNASIUM	21,820	9.5		0		395.70	9.5
SHOWER/LOCKER	4,625			0		361.35	
STORAGE	8,619			0		247.77	
RESTROOMS	4,725	10.0		0		653.48	10.0
SITE AREA (ACRES)	50	10.0		0.0		100,000	10.0
Totals	**135,643**	**9.9**					**9.9**

* Standard Unit Costs based on values established by the State's Office of Public School Construction.
# On a 10 point scale(assumes improvements are made).
Note: Area totals include portables

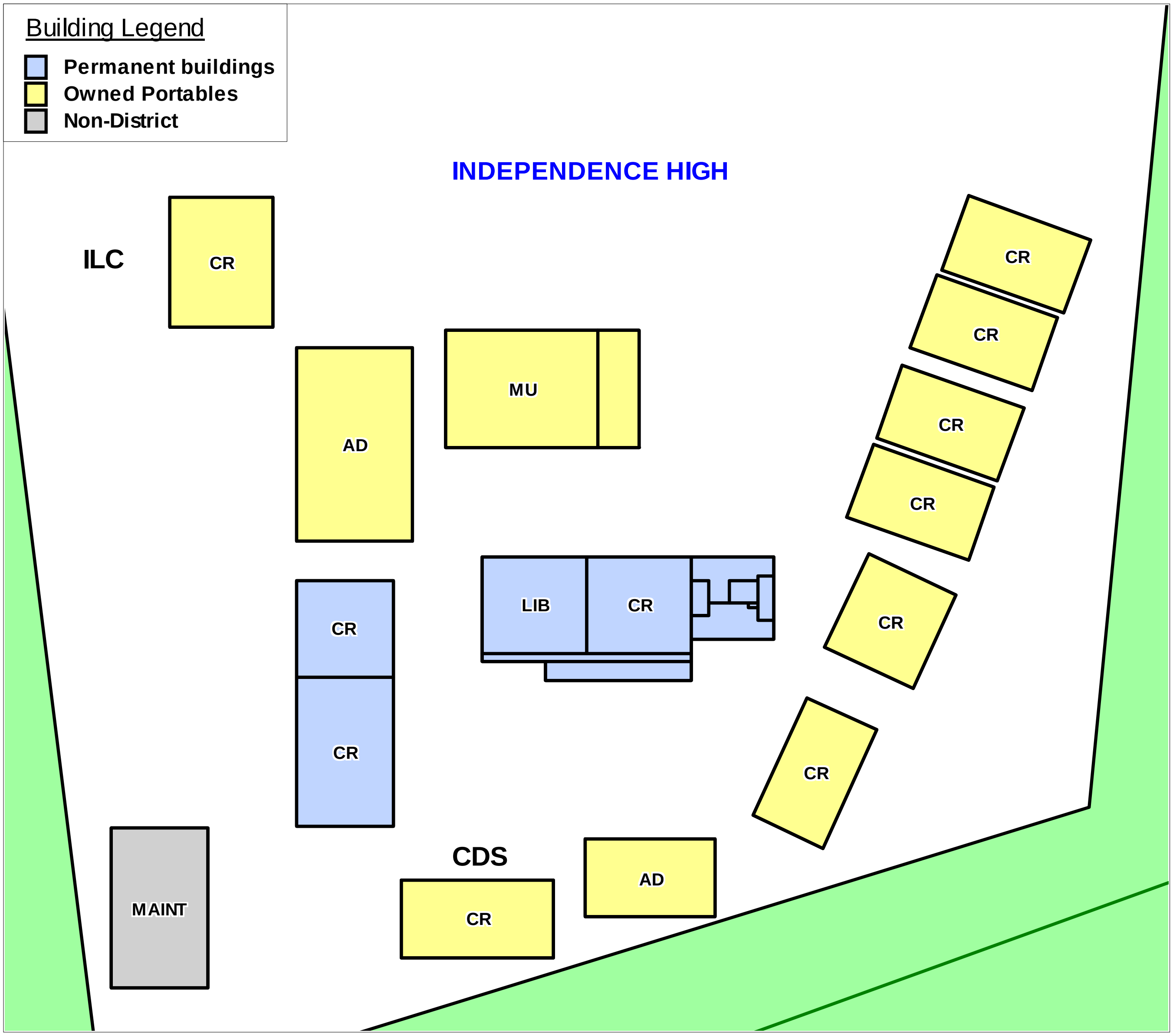
Map #11 – Independence High School Attendance Patterns



The home locations of students attending IHS in 2013/14 are shown on the map above. IHS serves students District-wide. The graph below summarizes the areas the students are residing in.

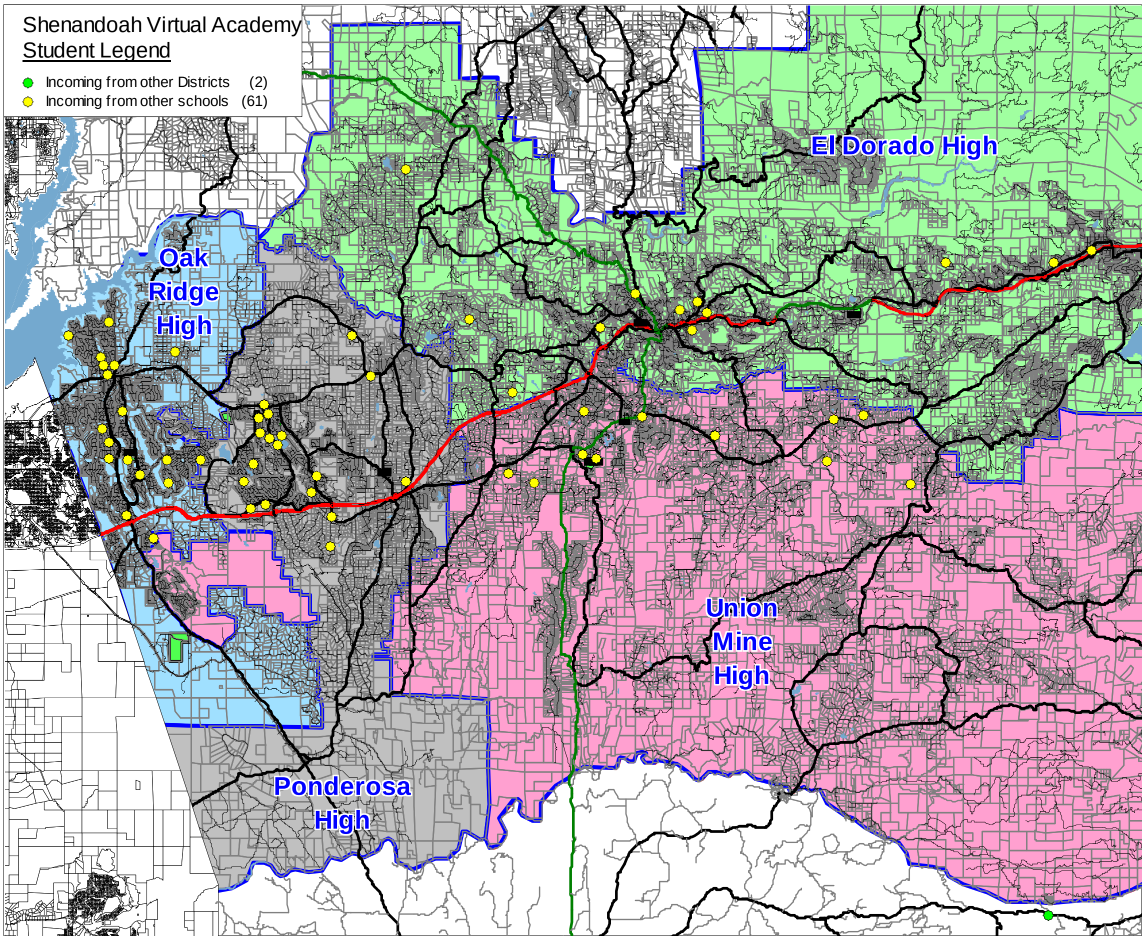


Map #12 – Independence High School Site Plan

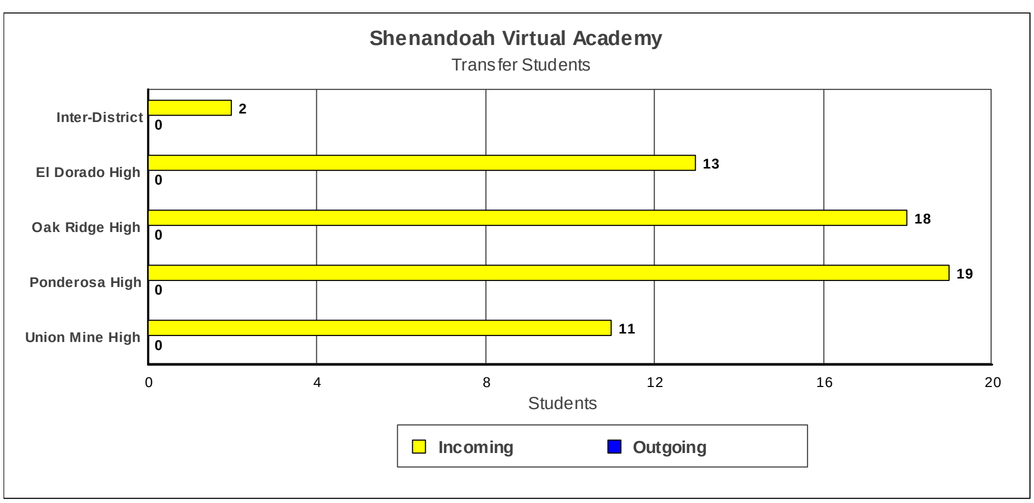


Independence Continuation High School is located on a 3.9 acre site near the District Office. This site also houses facilities used for Independent Learning Center (ILC) and Community Day School (CDS) as shown in the diagram.

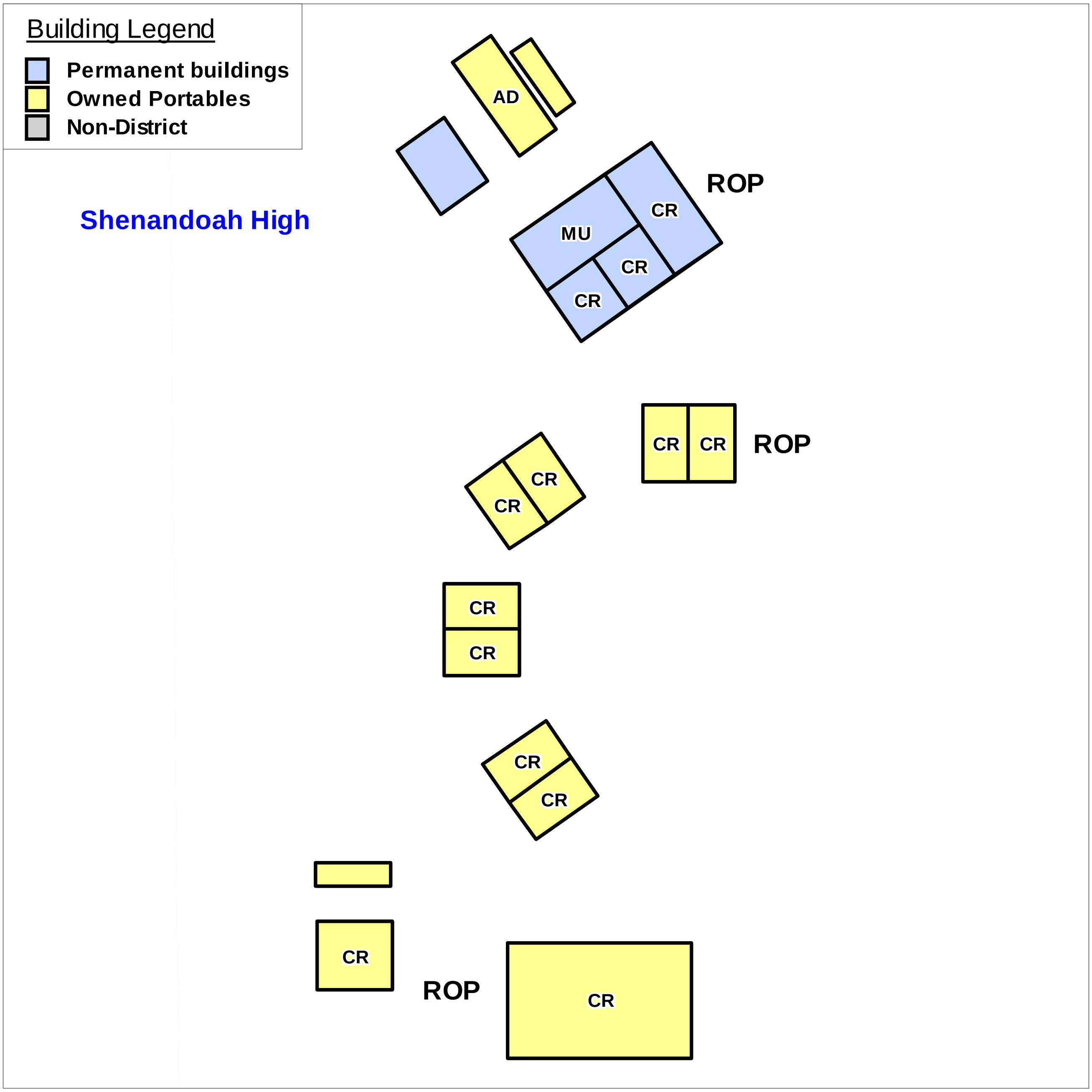
Map #13 – Shenandoah High School Attendance Patterns



The home locations of students attending SHS in 2013/14 are represented in this map. This program is open to students District-wide and to students living in adjoining counties. The following graph identifies the areas the students are living in.

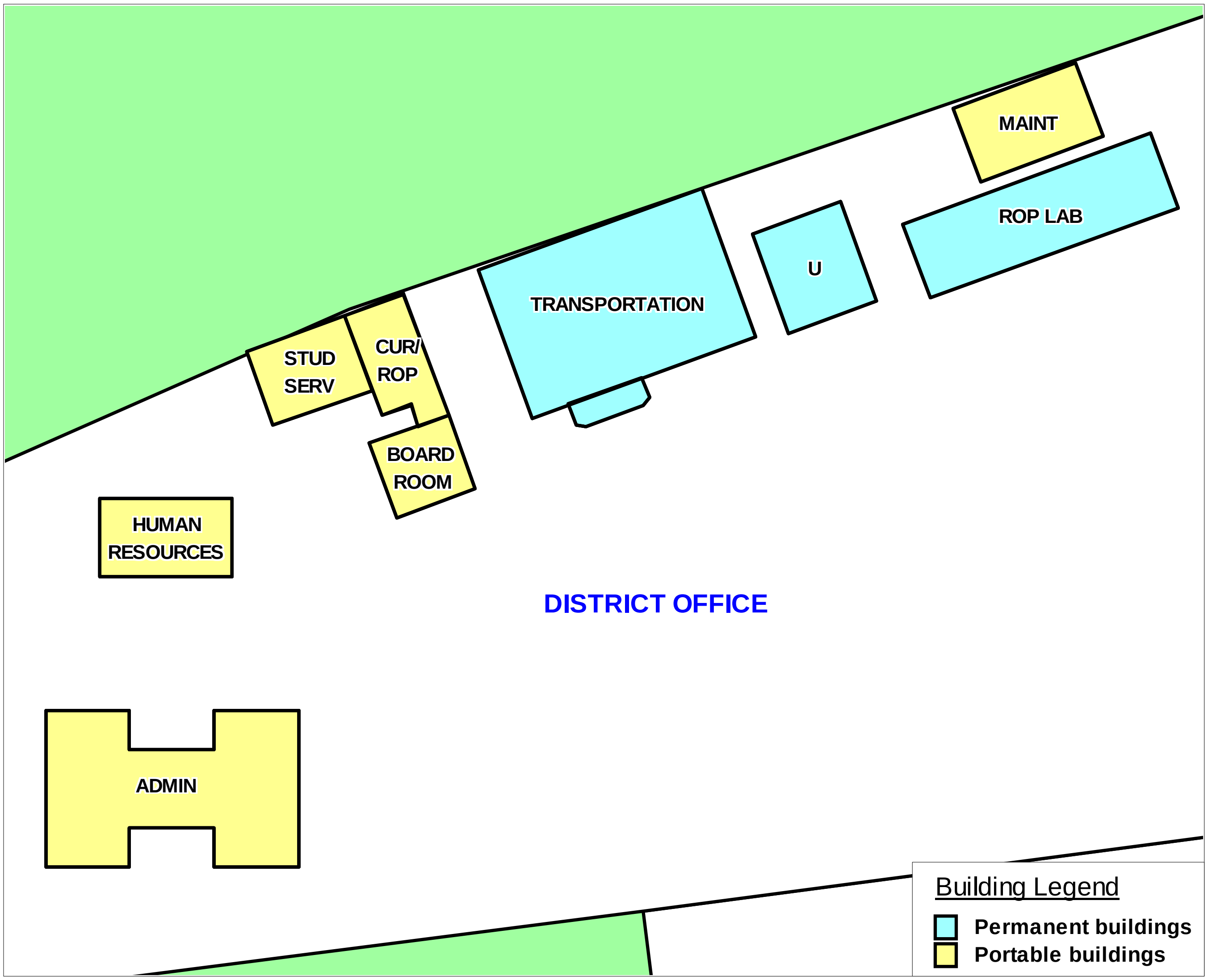


Map #14 – Shenandoah High School Site Plan



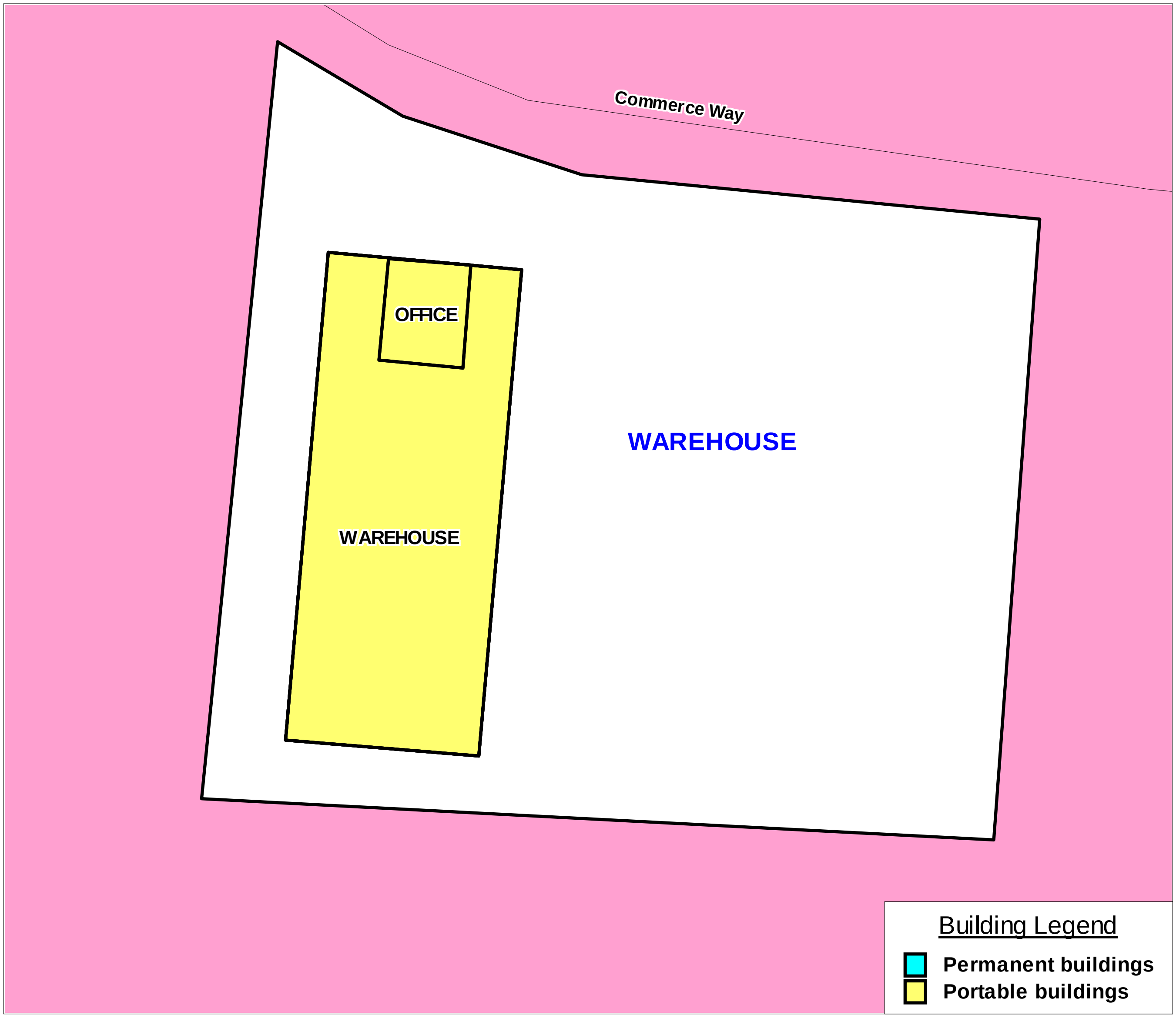
This site is located just east of Union Mine High. Several rooms on this campus are used for the ROP program as shown.

Map #15 – District Office Site Plan



The District Education Center contains various buildings that house the central administration, facilities, student services, human resources, ROP, and transportation departments. The District warehouse is located on a separate nearby site and is shown on the following page.

Map #16 – Warehouse Site Plan



The District warehouse houses the Maintenance Department.

DISTRICT NEEDS AND TIMELINES

The number of classrooms needed by the District at each school and the totals are summarized below:

Figure #17

District Classroom Needs by the Year 2019/20

SUMMARY OF NEEDED CLASSROOMS OVER THE NEXT SIX YEARS
Using District Loading Standards

School	13/14 Current CR Need	14/15 1 Year CR Need	15/16 2 Year CR Need	16/17 3 Year CR Need	17/18 4 Year CR Need	18/19 5 Year CR Need	19/20 6 Year CR Need
El Dorado High	-6	-7	-8	-9	-9	-11	-11
Oak Ridge High	-3	-3	-3	-1	-2	-2	-2
Ponderosa High	-15	-18	-20	-21	-21	-19	-19
Union Mine High	-14	-15	-14	-16	-15	-15	-14
High School Totals	**-38**	**-43**	**-45**	**-47**	**-47**	**-47**	**-46**

The classroom inventory includes all leased portables, owned portables, and permanent classrooms with the exception of those owned by other entities, such as the El Dorado County Office of Education (EDCOE).

The four comprehensive high schools have a total of 73 portable classrooms. Without the portables, the District would not have adequate seats to house all the students. Utilizing existing portable classrooms, there are no classrooms needed in the next 10 years, with the exception of replacing aging portables that will become eligible for modernization.

The next section will provide information on costs and revenues to meet the needs for facilities.

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FACILITY NEEDS

As shown in the previous section, there are various facility issues that need to be addressed. Typically, the facility needs fall into the following categories: growth, modernization, support facilities, program needs, and building and grounds upgrades.

Growth needs are those due to projected new developments which create more students in the future than those that can be housed in the existing facilities.

Modernization needs occur as the existing facilities age. State standards suggest buildings should be modernized when they become 25 years old. It is recommended that portables be modernized or perhaps even replaced at the age of 20 years or older.

Support facility needs are determined by analyzing the various sizes of the non-classroom areas on a campus compared to the number of students housed at the school. This typically includes library space, multi-use, kitchen, gymnasiums, restrooms, and site acreage. This category helps to address equity among the sites.

Program needs are normally generated by changes in the educational program, and are usually driven by comparing the school facilities to current educational specifications.

Building and grounds upgrades consist of items such as upgrading buildings for fire and safety, replacing roofs, upgrading electrical, plumbing, heating and air conditioning, and improving access for people with disabilities.

Some of the needs at the sites may also fall into more than one of the above categories. The following table identifies the needs by site and by category based on input by the Site Facilities Advisory Committees and the analysis from Section D.

FIGURE #18

PROJECTED SCHOOL FACILITY NEEDS
March 2014

Projected Needs By Category	Estimate
FIRE & SAFETY - Modernize facilities to meet current codes	$ 300,000
ROOFS - Replace or Repair	$ 1,140,000
SECURITY CAMERAS	$ 475,000
ELECTRICAL, PLUMBING, HVAC	$ 1,460,000
CLASSROOM TECHNOLOGY	$ 2,100,000
ADA - Improve Access for People with Disabilities	$ 500,000
HEALTH & FITNESS - Building and Equipment Improvements	$ 6,699,000
PORTABLE REPLACEMENT - 20+ Year Old Portables	$ 1,790,000
PORTABLE ROOF REPLACEMENT	$ 318,000
PORTABLE SIDING REPLACEMENT	$ 256,000
FACILITY MAINTENANCE	$ 2,256,000
FACILITY UPGRADES - Educational Needs	$ 11,275,000
FACILITY UPGRADES AND NEEDS	$ 10,200,000
PARKING AND TRAFFIC FLOW - Improvements	$ 4,205,000
SUB TOTAL	$ 42,974,000
CONTINGENCY - 10%	$ 4,297,000
TOTAL WITH CONTINGENCY	$ 47,271,000

The costs in the figure above are based on current estimates for the identified projects and are adjusted for projected inflation. The net need is a total of $47.3 million. The following pages will identify the potential and projected revenues to meet these facility needs.

POTENTIAL AND PROJECTED DISTRICT REVENUES

Revenue Sources

The District has several potential sources of revenues to pay for the facility needs within the District. Two of the ongoing revenue streams are developer fees and CFD (Community Facilities District) special taxes. Another common local funding source is general obligation bond money. Funds are also available from the State by utilizing the State building program, which provides funding based on eligibility determination calculations for projects including new construction, modernization, Career Technical Education and joint-use buildings.

Developer Fees

The District currently collects Level 1 developer fees as permits are issued for residential and commercial/industrial projects. The District and the elementary districts have a Level 1 developer fee sharing agreement and the high school district receives 39% of Level 1 fee collections. The District collects Level 1 fees on commercial/industrial projects, senior housing projects, and residential additions consisting of more than 500 square feet. The District's share of these fees is $0.18 and $1.16 per square foot, respectively. These funds are limited to growth-related capital facility projects and related expenses.

Community Facilities District (CFD)

The El Dorado Union High School District, the Buckeye Union School District, and the Rescue Union School District established a CFD (the El Dorado Schools Financing Authority CFD #1) in 1992 in the El Dorado Hills Specific Plan area. The special taxes collected in this CFD provide funds to the three participating school districts for capital facilities to serve the students generated from the new development. Since the establishment of the CFD, four smaller developments have been annexed into the special tax district. The EDUHSD receives 38.3% of the special taxes collected in the CFD. The EDUHSD's current annual revenue from the CFD is $1.9 million. Future growth will be minimal as the developments within the CFD are near build-out.

General Obligation Bonds

In order to raise the local funds required to match the State's share of new construction and modernization projects, many districts rely on the long-term financing of a general obligation bond. A general obligation bond is repaid by ad valorem property taxes. A $17.2

million general obligation bond was passed by El Dorado County voters in 1997 for the construction of Union Mine High School.

In June 2008, El Dorado County voters approved another general obligation bond of $66.3 million for the District's facility needs. During the 2008-2009, 2010-2011 and 2012-2013 fiscal years, the District approved the sale of $34,000,000, $17,300,000 and $14,999,904 respectively of general obligation bonds.

State School Facilities Program

The state offers assistance to school districts with needs for growth, modernization, Career Technical Education, and Joint Venture projects. A local funding source is required for each of these programs unless a school district is a financial hardship district. The District does not qualify as a hardship district.

State growth funding is a 50/50 match program. Growth projects are dependent on eligibility based on the school capacity and enrollment projections. These can be based on district-wide capacities and projections or high school attendance areas. The District is divided into three high school attendance areas – ORHS/PHS, UMHS, and EDHS. Eligibility is updated and verified by the State on an annual basis.

State modernization is a 60/40 funding program, where the state funds 60% and the district funds 40% of the project. Permanent buildings over 25 years of age and portable buildings over 20 years of age are eligible for modernization funding.

Career Technical Education funding is a competitive grant of up to $3 million for new construction and $1.5 million for modernization projects. Funds from this program were originally limited to two funding cycles, one in 2007 and one in 2008. A third funding cycle was offered in 2009 using funds remaining after the first two cycles. This is a 50% state, 50% local funding program that requires some financial participation from industry partners.

Joint use funding is available for buildings such as libraries, gyms, and multi-use facilities. The joint use partner must be a governmental agency, higher education, or a nonprofit. The State funds 50% of joint use project and the school district and the joint use partner share the remaining funding. The joint use partner must contribute at least 25% of the funding.

Special Taxes/Parcel Taxes

These taxes must be passed by a two-thirds vote and are District-wide. Their advantage over a general obligation bond is that they can be used for programmatic purposes as well as capital improvements.

School Facilities Improvement District (SFID)

This is a property tax that can be assessed in a defined area within the District, such as a specific development or a school attendance area. It also requires a two-thirds vote from within the defined area to pass, and can only be used for school facility improvements.

Certificate of Participation (COP)

The District has the ability to borrow money for capital facility projects when there is a revenue stream available to make the payments. The District utilizes COP to leverage developer fees and CFD taxes in order to provide adequate facilities when they are needed. Should the repayment revenue sources of developer fees and CFD taxes fail to be sufficient to meet the COP payments, the District's General Fund would be responsible for the debt service payments.

Deferred Maintenance

This program has been discontinued by the state starting in the 2012-2013 fiscal year. These previously restricted funds are incorporated in the local control funding formula.

Projected Funding Sources

The District makes every effort to maximize available funding sources for meeting its Capital Improvement needs, which currently includes developer fees, Community Facilities District special taxes (Mello-Roos), general obligation bond**,** State School Facilities Program, and Certificates of Participation.

Utilizing all of the funding sources potentially available to the District, the projected revenue is insufficient to meet the school facility needs identified in this plan, as of January 2014.

New High School Project Timeline

Although the projections indicated a new high school is not needed in the next 10 years, there are enough planned development projects to eventually generate a large enough population to justify a new high school beyond the ten year projections. It is anticipated the next high school will be needed in the western portion of the District. The District currently owns two future school sites in that area. Student enrollment, existing facilities, and operational costs will need to be considered to determine a feasible projected timeline for construction of the next high school based on current projections and assumptions.

Enrollment projections show 6,511 students District-wide in 2023/24, a decrease of 325 students over the next ten years. The facilities inventory in Section C shows that the projected student population can be housed in the District's existing schools.

Long-term enrollment projections will be updated annually in order to anticipate when sufficient enrollment will be reached to necessitate a fifth comprehensive high school.

Options to Explore:

- **Maximize existing capacities at all sites**
  - ➢ Develop programs to attract students to other schools; and
  - ➢ Implement minor boundary changes**,** as necessary to avert over capacity in the western part of the District.
- **Maximize existing capacities within attendance area**
  - ➢ Maximize available classroom space each period;
  - ➢ Virtual classrooms – on-line course offerings; and
  - ➢ Compatible schedules at all four comprehensive sites.

In addition to these strategies, community partnerships, community college partnerships, and joint use facilities should be pursued as law permits.

By considering capacities and enrollment, the efficiency of operational costs will allow for the accrual of funds in reserve to open a new school and maintain operational efficiency when the fifth school is open, thereby maintaining the current superior quality of education experienced in the District.

CHARTER SCHOOL PROVISIONS

Proposition 39 was approved as an initiative measure during the general election in November of 2000, reducing the vote necessary to carry a general bond measure from 66-2/3% to 55%. It also amended Education Code Section 47614 requiring school districts to make available to a charter school, operating in the district boundaries, facilities within the district “sufficient for the charter school to accommodate all of the charter school’s in-district students in conditions reasonably equivalent to those in which the students would be accommodated if they were attending another public school in the district.” Additionally, the facilities shall be contiguous, furnished, and equipped as necessary to conduct classroom-based instruction.

As a condition of obtaining such facilities, the charter school is required to provide the school district with a reasonable projection of the charter school’s expected average daily attendance by enrollment of at least 80 in-district students for the following year.

The El Dorado Union High School District Administrative Regulation (AR) 7160 addresses Charter School Facilities and can be found in Appendix 2 of this document and on the District website. To date, the District has received no requests from a charter school within the district to provide facilities.

SUMMARY, RECOMMENDATIONS AND EVALUATION PROCEDURES

Summary

A long-range Facilities Master Plan is a dynamic document that gives coherence and direction to the decisions made for the District's current and future facilities needs. It also provides a financing plan that delivers resources in an efficient manner to ensure its successful implementation and establishes a framework and foundation for future facilities improvements.

Under direction from Board of Trustees' study sessions, the Facilities Master Plan was developed with participation from District administrators, school site representatives, and community members.

On the basis of the research data provided in the preceding sections, the Facilities Master Plan is designed to establish the most efficient method of meeting the District's needs in accordance with present standards and the best available information on what may reasonably be expected to occur.

Recommendations

The following items are recommendations to continue the process of providing healthful, safe and adequate facilities that enhance the District's educational programs.

1. Maximize the use of existing capacities at all sites;
2. Maximize all available funding sources;
3. Provide facilities appropriate for the subjects being taught and the manner in which they are taught;
4. Strive for equity in facilities assets so that each site offers:
   Equity in facilities for similar programs;
   Career/technical education; and
   Educational programs necessary for California State University/University of California admission.
5. Use design criteria that enhances the educational process by providing appropriate, environmentally sound, and efficient: technology, lighting, acoustics, air quality, and equipment;
6. Add classrooms as necessary with flexibility to meet the ever-changing fluctuation in student population;

7. Provide adequate core and auxiliary facilities;
8. Work with the El Dorado County School Facilities Task Force, County Board of Supervisors, and local developers on mitigating the impact of new development;
9. Pursue joint use facilities with other agencies;
10. Support community involvement in addressing facility needs; and
11. Enlist support for a statewide mechanism to provide consistent and adequate school facilities construction funding.

Evaluation Procedures

It is the practice of the District to continually review and evaluate the Facilities Master Plan. A progress report on facilities will be brought to the Board of Trustees twice annually. The continuing evaluation procedures shall include monitoring of enrollment data and projections, new and projected housing developments, and changing educational program needs. Input on the effectiveness of the Plan shall be sought at regular meetings with each school site's Facilities Advisory Committee and incorporated in the Facilities Master Plan revisions.

Updating the Plan

Updating the long-range facilities plan is necessary to ensure that changes in program, facilities, or demographic data is analyzed in a timely manner for their implication to the overall plan. Appropriate revisions should be recommended to the District's Board of Trustees in a timely manner.

Updating the plan shall be coordinated by the Superintendent and the Director of Facilities in consultation with the Board of Trustees, District administrators, school site personnel, students, and the community.

El Dorado Union High School District
Facility Master Plan

APPENDIX 1

EDUHSD 2013-2017
Strategic Planning Goals

March 2014

EL DORADO UNION HIGH SCHOOL DISTRICT

Strategic Planning Goals*
2013–2017

College & Career Readiness

Prepare college-ready and career-ready students to successfully meet entrance and performance requirements of postsecondary institutions

Actions toward progress

- Utilize data from local, state, and federal assessments to monitor progress and identify areas of focus
- Increase the number of students taking Advanced Placement courses and passing exams
- Increase the number of students passing the Early Assessment Program assessments and meeting UC/CSU a–g admission requirements
- Increase the number of students qualifying to enroll in transferable, college-level courses and career-specific programs of study
- Provide students with similar experiences, subject matter, and expectations across the District
- Support well-round curricular offerings, including strong core subjects and extensive elective options, that support student development of personal responsibility and life skills essential to successful participation in a democratic society
- Evaluate Credit Recovery and Academic Recovery models, expand as feasible, and continue to improve responses to students yet to meet standards
- Expand implementation of effective instructional strategies through technology, including blended learning

Developing School Connectedness

Develop schools where individual students are connected and supported to make healthy, responsible decisions

Actions toward progress

- Provide caring, encouraging school environments where students connect with three or more supportive adults
- Engage students and families in the planning and execution of individual six-year high school and transition plans with the aid of online college and career resources
- Increase number of students involved in cocurricular/extracurricular activities
- Evaluate, revise, and monitor outcomes of the Connections Program to incorporate best practices to retain and support students
- Provide students with safe and well-maintained learning environments that are conducive to college and career preparation
- Utilize the Healthy Kids Survey biannually to monitor student acquisition of developmental assets of successful adolescents
- Implement online learning models, including remote access, at alternative education sites and evaluate conceivability of implementation at comprehensive sites

Strategic Planning Goals 2013–2017 (continued)

Staff Development	*Encourage and support continuous improvement of staff across District who provide instruction and other services to our students and community*
Actions toward progress	▪ Utilize the Professional Learning Teams to become versed in the most current research on effective instruction and examination of student work and data which promotes achievement for all students ▪ Facilitate processes where teachers from content areas across the District work collaboratively to identify, share, and implement the best instructional practices ▪ Provide professional development to support the effective implementation of common core standards ▪ Facilitate processes where staff from related services across the District work collaboratively to identify, share, and implement best practices ▪ Develop structures that promote implementation of identified best practices across the District in order to ensure that students experience similar expectations and learning across the District ▪ Provide professional development specific to job classifications designed to promote individual and group improvement of the skills necessary to meet the needs of individual students

Communication	*Promote and support an environment throughout the District where staff members effectively communicate with each other and all stakeholders*
Actions toward progress	▪ Develop accountable Professional Learning Teams across the district focused on improving instructional practices and other services ▪ Develop processes that encourage productive discourse among staff members across the district ▪ Develop, maintain, and improve communication tools that promote two-way communication between the District and stakeholder groups ▪ Seek and act upon input from stakeholder groups, including staff, students, parents, and community members ▪ Maintain and improve relationships between District and employee organizations

Resource Allocation & Financial Stability	**Allocate resources to reflect priorities outlined in these goals while maintaining financial stability of the District**
Actions toward progress	▪ Develop annual budgets that reflect our commitment to student learning, comparable compensation and benefits for District employees and necessary reserves to weather uncertain economic realities ▪ Evaluate effectiveness of instructional programs, staff development options, and noninstructional programs to determine effectiveness of each with relation to established expectations ▪ Monitor budgets multiple times throughout the fiscal year to ensure projected funding is in line with actual expenditures and make appropriate adjustments as necessary ▪ Develop and implement Facilities Master Plan designed to maximize local and state funding sources to maintain, upgrade, and modernize facilities and technology across the District ▪ Develop a clear understanding of budget areas where significant differences occur between expected funding levels, expenditures, and actual costs ▪ Continue collaborative collective bargaining processes that meet Board priorities and budget requirements

*Baseline data will be determined at the District and school-site levels once these Strategic Goals are adopted by the Board of Trustees.

El Dorado Union High School District
Facility Master Plan

APPENDIX 2

EDUHSD Board Policy BP 7160 and Administrative Regulation AR 7160 (Charter School Facilities)

March 2014

Facilities **CHARTER SCHOOL FACILITIES**
AR 7160

DEFINITIONS *(5 CCR 11969.2)*

Average daily classroom attendance (ADA) or classroom ADA is ADA for classroom-based apportionment as used in Education Code 47612.5.

In-district classroom ADA is classroom ADA attributable to in-district students.

In-district students are those charter school students who are entitled to attend a district school. Students eligible to attend district schools based on an interdistrict attendance agreement or parent/guardian employment shall be considered students of the district where they reside.

(cf. 5111.1 - District Residency)
(cf. 5111.12 - Residency Based on Parent/Guardian Employment)
(cf. 5117.1 - Interdistrict Attendance Agreements)

Operating in the district means the charter school is either currently providing public education to in-district students or has identified at least 80 in-district students who are meaningfully interested in enrolling in the charter school for the following year, regardless of whether the district is or is proposed to be the chartering entity and whether or not the charter school has a facility inside the district's boundaries. *(Education Code 47614; 5 CCR 11969.2)*

Reasonably equivalent facilities are facilities that are sufficient to accommodate charter school students in conditions reasonably equivalent to those in which the students would be accommodated if they were attending other public schools of the district. Reasonable equivalency shall be determined based on a comparison group of district schools with similar grade levels, the capacity of facilities, and the condition of facilities, as described below in the section "Submission and Review of Facilities Requests." *(5 CCR 11969.2, 11969.3)*

Furnished and equipped means the facilities include reasonably equivalent furnishing necessary to conduct classroom instruction and to provide for student services that directly support classroom instruction as found in the comparison group schools established under 5 CCR 11969.3(a) and that the facilities have equipment that is reasonably equivalent to the comparison group schools. **Equipment** means property that does not lose its identity when removed from its location and is not changed materially or consumed immediately (e.g., within 1 year). Equipment has relatively permanent value and its purchase increases the total value of the district's physical properties. Examples include furniture, vehicles, machinery, motion picture film, videotape, furnishings that are not an integral part of the building or building system, and certain intangible assets such as major software programs. Furnishings and equipment acquired for a school site with nondistrict resources are excluded when determining reasonable equivalence. *(5 CCR 11969.2)*

Contiguous facilities are those facilities contained on the school site or immediately adjacent to a school site. If the in-district classroom ADA of the charter school cannot be accommodated on any single school site, contiguous facilities also include facilities located at more than one site, provided that the district minimizes the number of sites assigned and considers student safety. If none of the district-operated schools has grade levels similar to the charter school, then a contiguous facility shall be an existing facility that is most consistent with the needs of students in the grade levels served at the charter school. *(5 CCR 11969.2, 11969.3)*

Conversion charter school is a charter school established through the conversion of an existing public school. *(Education Code 47605)*

ELIGIBILITY FOR DISTRICT FACILITIES

A charter school shall be operating in the district, as defined above, before it submits a request for facilities. A new or proposed charter school operating in the district is eligible to request facilities for a particular fiscal year only if it submits its charter petition before November 1 of the fiscal year preceding the year for which facilities are requested. A new charter school is entitled to be allocated and/or provided access to facilities only if it receives approval of its charter petition before March 15 of the fiscal year preceding the year for which facilities are requested. *(5 CCR 11969.9)*

(cf. 0420.4 – Charter School Authorization)

SUBMISSION AND REVIEW OF FACILTIES REQUESTS

The following procedures shall apply to a charter school's request for facilities:

1. On or before **November 1**, a charter school shall submit a written facilities request to the Superintendent or designee for the next fiscal year. The request shall include: *(Education Code 47614; 5 CCR 11969.2, 11969.9)*

    a. Reasonable projections of in-district and total ADA and in-district and total classroom ADA, based on ADA claimed for apportionment, if any, in the fiscal year prior to the fiscal year in which the facilities request is made, adjusted for expected changes in enrollment in the forthcoming fiscal year.

    Projections of in-district ADA, in-district classroom ADA, and the number of in-district students shall be broken down by grade level and by the district schools that the students would otherwise attend.

Nonclassroom ADA may be included in the ADA calculation to the extent of the instructional time that the students generating the nonclassroom ADA are actually in the classroom under the direct supervision of and control of a charter school employee, and only if the district and charter school agree upon the time(s) that the facilities devoted to students generating the nonclassroom-based ADA will be used.

    b. A description of the methodology for the projections.

c. If relevant (i.e., when a charter school is not yet open or to the extent an operating charter school projects a substantial increase in ADA), documentation of the number of in-district students meaningfully interested in attending the charter school that is sufficient for the district to determine the reasonableness of the projection, but that need not be verifiable for precise arithmetical accuracy.

d. The charter school's operational calendar.

e. Information regarding the district's school site and/or general geographic area in which the charter school wishes to locate.

f. Information on the charter school's educational program, if any, that is relevant to assignment of facilities, if any.

In submitting a facilities request, the charter school shall use a form specified by the district. The charter school shall distribute a reasonable number copies of the written request to parents/guardians, school staff, and/or other interested parties, of shall otherwise make the request available for review.

2. On or before **December 1**, the district shall review the charter school's projections of in-district and total ADA and in-district and total classroom ADA, express any objections in writing, and state the projections the district considers reasonable. If the district does not express any objections in writing and state its own projections by the deadline, the charter school's projections are no longer subject to challenge and the district shall base its offer of facilities on those projections. *(5 CCR 11969.9)*

3. On or before **January 2**, the charter school shall respond to any objections expressed by the district and to the district's attendance projections provided pursuant to item #2 above. The charter school shall reaffirm or modify its previous projections as necessary to respond to the information received from the district pursuant to item #2. If the charter school does not respond by January 2, the district's projections provided pursuant to item #2 are no longer subject to challenge and the district shall base its offer of facilities on those projections. *(5 CCR 11969.9)*

4. The district shall determine what facilities it will offer to the charter school, ensuring that the facilities are reasonably equivalent to other district facilities. *(5 CCR 11969.3)*

If a charter school was established through the conversion from an existing public school pursuant to Education Code 47605(a)(2), , the condition of the facility previously used by the district shall be considered to be reasonably equivalent for the first year the charter school uses the facility. *(5 CCR 11969.3)*

For any other charter school, reasonable equivalency shall be based on the following criteria as detailed in 5 CCR 11969.3:

a. A comparison group of district schools with similar grade levels. If a charter school's grade-level configuration is different from the configuration of the district's schools, the district shall not pay for the modification of a school site to accommodate the charter school's configuration

b. Capacity, including equivalency of the ratio of teaching stations (classrooms), specialized classroom space, and nonteaching space to ADA

c. Condition of facilities, as determined by assessing such factors as age of facilities (from last modernization), quality of materials, and state of maintenance, including:

   (1) School site size

   (2) Condition of interior and exterior surfaces

   (3) Conformity of mechanical, plumbing, electrical, and fire alarm systems, including conformity to applicable codes

   (4) Availability and condition of technology infrastructure

   (5) Condition of the facility as a safe learning environment, including but not limited to the suitability of lighting, noise mitigation, and size for intended use

   (6) Condition of the facility's furnishings and equipment

   (7) Condition of athletic fields and/or play area space

(cf. 7111 - Evaluating Existing Buildings)

5. On or before **February 1**, the district shall prepare a written preliminary proposal regarding the space to be allocated to the charter school and/or to which the charter school is to be provided access. In evaluating and accommodating the charter school's request, the charter school's in-district students shall be given the same consideration as students in the district's schools, subject to the requirement that the facilities provided must be contiguous. At a minimum, the preliminary proposal shall include: *(5 CCR 11969.2, 11969.9)*

   a. The projections of in-district classroom ADA on which the proposal is based

   b. The specific location(s) of the space

   c. All conditions pertaining to the space, including a draft of any proposed agreement pertaining to the charter school's use of the space

d. The projected pro rata share amount and a description of the methodology used to determine that amount

e. A list and description of the comparison group schools used in developing the district's preliminary proposal and a description of the difference between the preliminary proposal and the charter school's request submitted pursuant to item #1 above.

6. On or before **March 1**, the charter school shall respond in writing to the district's preliminary proposal made pursuant to item #5 above and shall express any concerns, including addressing differences between the preliminary proposal and the charter school's request, and or make a counter proposal. *(5 CCR 11969.9)*

7. On or before **April 1**, having reviewed any concerns and/or counter proposals made by the charter school pursuant to item #6 above, the district shall submit, in writing, a final notification of the space offered to the charter school. The notification shall include a response to the charter school's concerns and/or counter proposal, if any. The final notification shall specifically identify: *(5 CCR 11969.9)*

   a. The teaching stations, specialized classroom spaces, and nonteaching station space offered for the exclusive use of the charter school and the teaching stations, specialized classroom spaces, and nonteaching spaces to which the charter school is to be provided access on a shared basis with district-operated programs

   b. Arrangements for sharing any shared space

   c. The assumptions of in-district classroom ADA for the charter school upon which the allocation is based, and if the assumptions are different than those submitted by the charter school pursuant to item #3 above, a written explanation of the reasons for the differences

   d. The specific location(s) of the space

   e. All conditions pertaining to space

   f. The pro rata share amount

   g. The payment schedule for the pro rata amount, which shall take into account the timing of revenues from the state and from local property taxes

8. By **May 1 or within 30 days** after the district notification pursuant to item #7 above, whichever is later, the charter school shall notify the district in writing whether or not it intends to occupy the offered space. *(5 CCR 11969.9)*

   The charter's school's notification may be withdrawn or modified before this deadline. After the deadline, if the charter school has notified the district that it intends to occupy the offered space, the charter school is committed to paying the pro rata share amount as identified. If the charter school does not notify the district by this deadline that it intends to occupy the offered space, then the space shall remain available for district programs and the charter school shall not be entitled to use facilities of the district in the following year. *(5 CCR 11969.9)*

AVAILABILITY OF FACILITIES

The space allocated to the charter school by the district, or the space to which the district provides the charter school access, shall be furnished, equipped, and available for occupancy at least **10 working days** prior to the first day of instruction of the charter school. For good cause, the district may reduce the period of availability to a period of not less than 7 working days. *(5 CCR 11969.9)*

Space allocated for use by the charter school, subject to sharing arrangements, shall be available for the charter school's entire school year regardless of the district's instructional year or class schedule. *(5 CCR 11969.5)*

For a conversion charter school, the school site identified in the school's charter, shall be made available to the charter school for its second year of operation and thereafter upon annual request for facilities from the district pursuant to this administrative regulation.

If, as a result of a material revision of the charter, either the location of the conversion charter school is changed or the district approves the operation of additional sites by the school, then the school may request, and the district shall provide, facilities in accordance with the revised charter, law, and this administrative regulation. *(5 CCR 11969.3)*

WRITTEN AGREEMENT REGARDING FACILITIES OPERATIONS

The district and charter school shall negotiate an agreement regarding the use of and payment for the space which contains, at a minimum, information included in the district's final notification pursuant to item #7 in the section "Submission and Review of Facilities Requests" above. *(5 CCR 11969.9)*

A reciprocal hold-harmless/indemnification provision shall be established between the district and the charter school. The charter school shall maintain general liability insurance naming the district as an additional insured in order to indemnify the district for any damage and losses. The district shall maintain first party property insurance for the facilities allocated to the charter school. *(5 CCR 11969.9)*

(cf. 3530 - Risk Management / Insurance)

Responsibilities for facilities maintenance and improvements shall be as follows: *(5 CCR 11969.4, 11969.9)*

1. The district shall be responsible for:

a. Modifications necessary to maintain the facility in accordance with application building codes pursuant to Education Code 47610(d) or 47610.5

b. Replacement of district-provided furnishings and equipment in accordance with district schedules and practices

c. Projects eligible to be included in the district's deferred maintenance plan

2. The charter school shall be responsible for ongoing operations and maintenance of facilities, furnishings, and equipment.

The charter school shall not sublet or use the facilities for purposes other than those that are consistent with Board policies and district practices without permission of the Superintendent or designee. *(5 CCR 11969.5)*

(cf. 1330 - Use of School Facilities)

Facilities, furnishings, and equipment provided to a charter school by the district shall remain the property of the district. *(5 CCR 11969.4)*

The district may charge the charter school, in accordance with 5 CCR 11969.7, for a pro rata share of the district's facilities costs for activities related to keeping the physical plant open, comfortable, and safe for use and keeping the grounds, buildings, and equipment in working condition. Such activities include maintaining safety in buildings, on grounds, and in the vicinity of schools; plant maintenance and operations; facilities acquisition and construction; and facilities rents and leases. *(Education Code 47614; 5 CCR 11969.2)*

The charter school shall report actual in-district and total ADA and classroom ADA to the district every time that the charter school reports ADA for apportionment purposes. If the charter school generates less ADA than projected, the following provisions shall apply to any overallocated space: *(Education Code 47614; 5 CCR 11969.3, 11969.8, 11969.9)*

1. The charter school shall reimburse the district for the over-allocated space as set forth in 5 CCR 11969.8, unless the district agrees, in response to the notification by the charter school of overallocation, to exercise its sole discretion to use the overallocated space for district programs.

2. In the case of a conversion charter school, the overallocated space shall not be subject to reimbursement under the following circumstances:

   a. The school notifies the district that it will have over-allocated space in the following fiscal year. In such cases, the district may occupy all or a portion of the space identified. A charter school that wants to recover space surrendered to the district shall apply to the district and the district shall evaluate the application in accordance with law and this administrative regulation.

b. Based on the State Board of Education's waiver of attendance area requirements in Education Code 47605(d)(1), the district makes a decision, between November 1 and June 30, to change the school's attendance area in the forthcoming fiscal year.

MEDIATION OF DISPUTES

If a dispute arises between the district and a charter school pursuant to Education Code 47614 or 5 CCR 11969.1–11969.10, both parties may agree to settle the dispute using mediation, in accordance with the following procedures: *(5 CCR 11969.10)*

1. If both parties agree to mediation, the initiating party shall select a mediator, subject to the agreement of the responding party. If the parties are unable to agree on a mediator, the initiating party shall request the CDE to appoint a mediator within 7 days to assist the parties in resolving the dispute. The mediator shall meet with the parties as quickly as possible.

2. Within 7 days of the selection or appointment of the mediator, the party initiating the dispute resolution process shall send a notice to the responding party and the mediator. The notice shall include the following information:

   a. Name, address, and phone numbers of designated representatives of the parties

   b. A statement of the facts of the dispute, including information regarding the parties' attempts to resolve the dispute

   c. The specific sections of the statute or regulations that are in dispute

   d. The specific resolution sought by the initiating party

3. Within 7 days of receiving the notice, the responding party shall file a written response.

4. The mediation shall be entirely informal in nature. Each party shall share copies of exhibits upon which its case is based with the other party. The relevant facts shall be elicited in a narrative fashion to the extent possible, rather than through examination and cross-examination of witnesses.

5. Any agreement reached by the parties shall be in writing and shall not set a precedent for any other case.

6. The mediation shall be terminated if the district and the charter school fail to meet within the specified timelines, have not reached an agreement within 15 days from the first meeting held by the mediator, or if the mediator declares an impasse.

7. The costs of the mediation shall be divided equally between the parties and paid promptly.

EL DORADO UNION HIGH SCHOOL DISTRICT
BOARD POLICY

Facilities | **CHARTER SCHOOL FACILITIES**
BP 7160

Note: Pursuant to Education Code 47614 (Proposition 39, 2000), the district must make facilities available, upon request, to a charter school "operating in the district." A charter school is "operating in the district" if it is either currently serving students who are entitled to attend a district school or has identified at least 80 students who are entitled to attend a district school and are meaningfully interested in enrolling in the charter school for the following year. The facilities provided by the district must be furnished, equipped, and reasonable equivalent to those in other district schools.

Pursuant to 5 CCR 11969.2, charter school facilities may be located at more than one site if the charter school's students cannot be accommodated on any single district site, provided that the district minimized the number of sites and considers student safety. In Ridgecrest charter School v. Sierra Sands Unified School District, an appellate court held that a district must begin wit the assumption that all charter school students will be assigned to a single school site and then adjust other factors to accommodate this goal. How those factors will be weighed and whether those factors would make a single school site feasible will be a case-by-case determine. Consult legal counsel.

The Governing Board believes that all students, including those attending charter schools, should have access to adequate facilities that are safe and support student learning.

Facilities to be used by a charter school shall be specified in the school's charter pursuant to Education Code 47605 and also may be addressed in a written memorandum of understanding between the district and charter school.

(cf. 0420.4 - Charter Schools)

Upon request, the Board shall make available to an eligible charter school operating in the district, as defined in law and administrative regulation. In accordance with law, such facilities shall be contiguous, furnished, equipped, and sufficient to accommodate all the charter schools in-district students in conditions reasonably equivalent to those in which the students would be accommodated if they were attending other district schools. The Board shall make reasonable effort to provide the charter school with facilities near where the charter school wishes to locate and shall not move the charter school unnecessarily. If the district's preliminary proposal or final notification of space does not accommodate the charter school at a single school site, the Board shall make a specific finding that the charter school could not be accommodated at a single site and shall adopt a written statement of reasons explaining the finding. *(Education Code 47614; 5 CCR 11969.1-11969.10)*

(cf. 7110 - Facilities Master Plan)

The district shall not be required to use unrestricted general fund revenues to rent, buy, or lease facilities for charter schools. *(Education Code 47614)*

(cf. 3100 - Budget)

The Superintendent or designee may assist eligible charter schools in applying for state facilities funding for new construction or rehabilitation of facilities pursuant to Education Code 17078.52-17078.66 and/or for rent and least expenditures pursuant to Education Code 47614.5.

Legal Reference:

EDUCATION CODE
17070.10-17080 Leroy F. Greene School Facilities Act of 1998, including:
17078.52-17078.66 Charter schools facility funding; state bond proceeds
17280-17317 Field Act
46600 Interdistrict attendance agreements
47600-47616.5 Charter Schools Act of 1992, as amended
48204 Residency requirements for school attendance
GOVERNMENT CODE
53094 Authority to render zoning ordinance inapplicable
53097.3 Charter school ordinances
CODE OF REGULATIONS, TITLE 2
1859.2 Definitions
1859.31 Classroom inventory
1859.160-1859.172 Charter school facilities program, new construction
CODE OF REGULATIONS, TITLE 5
11969.1-11969.10 Charter school facilities
COURT DECISIONS
Bullis Charter School v. Los Altos School District, (2011) 200 Cal.App. 4th 1022
Ridgecrest Charter School v. Sierra Sands Unified School District, (2005) 130 Cal.App.4th 986
Sequoia Union High School District v. Aurora Charter High School (2003) 112 Cal.App.4th 185
ATTORNEY GENERAL OPINIONS
80 Ops.Cal.Atty.Gen. 52 (1997)

Management Resources:
CSBA PUBLICATIONS
The Role of the Charter School Authorizer, Online Course
Charter Schools: A Manual for Governance Teams, rev. 2009
Charter School Facilities and Proposition 39: Legal Implications for School Districts, 2005
OFFICE OF PUBLIC SCHOOL CONSTRUCTION PUBLICATIONS
School Facility Program Handbook, May 2008
WEB SITES
CSBA: http://www.csba.org
California Charter Schools Association: http://www.charterassociation.org
California Department of Education, Charter Schools: http://www.cde.ca.gov/sp/cs
Coalition for Adequate School Housing: http://www.cashnet.org
Office of Public School Construction: http://www.opsc.dgs.ca.gov

Policy Adopted: 2/24/09
Last Revised: 6/11/13

El Dorado Union High School District
Facility Master Plan

Career Technical Education/ROP Occupational Guides

March 2014

APPENDIX 3

Top 100 Fastest Growing Occupations in *California*, 2008-2018

	Occupation Title	Employment 2008	Employment 2018	Percent Change
	Biomedical Engineers	3,100	5,600	80.6%
	Information Security Analysts, Web Developers, and Computer Network Architects*	35,000	52,600	50.3%
	Biochemists and Biophysicists	4,800	7,100	47.9%
	Medical Scientists, Except Epidemiologists	26,200	38,500	46.9%
	Personal and Home Care Aides	346,500	504,700	45.7%
*	Home Health Aides	54,300	78,000	43.6%
	Physician Assistants	8,100	11,500	42.0%
	Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	7,300	10,200	39.7%
*	Physical Therapist Aides	5,900	8,100	37.3%
	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	1,100	1,500	36.4%
	Veterinary Technologists and Technicians	9,400	12,700	35.1%
	Veterinarians	5,600	7,500	33.9%
*	Physical Therapist Assistants	4,200	5,600	33.3%
	Financial Examiners	3,100	4,100	32.3%
	Software Developers, Applications	80,900	106,100	31.1%
	Emergency Medical Technicians and Paramedics	14,300	18,700	30.8%
*	Medical Assistants	76,100	99,400	30.6%
	Radiation Therapists	2,000	2,600	30.0%
	Medical Equipment Repairers	4,000	5,200	30.0%
*	Skin Care Specialists	4,100	5,300	29.3%
	Surgical Technologists	8,900	11,500	29.2%
	Cardiovascular Technologists and Technicians	3,800	4,900	28.9%
	Physical Therapists	15,300	19,700	28.8%
	Survey Researchers	2,100	2,700	28.6%
	Pharmacy Technicians	27,800	35,700	28.4%
	Compliance Officers, Except Agriculture, Construction, Health and Safety, and Transportation	31,900	40,800	27.9%
	Fitness Trainers and Aerobics Instructors	31,700	40,400	27.4%
	Curators	1,100	1,400	27.3%
	Respiratory Therapists	12,400	15,700	26.6%
*	Occupational Therapist Assistants	1,900	2,400	26.3%
	Dental Hygienists	18,500	23,300	25.9%
	Occupational Therapists	8,100	10,200	25.9%
	Software Developers, Systems Software	73,300	92,200	25.8%
	Registered Nurses*	236,400	297,200	25.7%
*	Dental Assistants	46,300	58,200	25.7%
	Market Research Analysts and Marketing Specialists	36,900	46,200	25.2%
	Museum Technicians and Conservators	1,200	1,500	25.0%
	Funeral Attendants	2,000	2,500	25.0%
	Medical Secretaries	88,000	109,100	24.0%
	Biological Technicians	10,600	13,100	23.6%
	Sociologists	1,300	1,600	23.1%
	Social Science Research Assistants	2,600	3,200	23.1%
	Obstetricians and Gynecologists	2,600	3,200	23.1%
	Captains, Mates, and Pilots of Water Vessels	1,300	1,600	23.1%
	Medical and Public Health Social Workers	10,900	13,400	22.9%
	Mixing and Blending Machine Setters, Operators, and Tenders	14,500	17,800	22.8%

*Indicates courses offered by EDUHSD and/or CSROP

*	Veterinary Assistants and Laboratory Animal Caretakers	7,500	9,200	22.7%
	Loan Counselors	3,100	3,800	22.6%
	Instructional Coordinators	18,300	22,400	22.4%
	Pediatricians, General	5,400	6,600	22.2%
	Microbiologists	2,700	3,300	22.2%
	Medical Records and Health Information Technicians	15,100	18,400	21.9%
	Personal Financial Advisors	28,400	34,600	21.8%
	Hotel, Motel, and Resort Desk Clerks	24,000	29,200	21.7%
	Tree Trimmers and Pruners	7,400	9,000	21.6%
*	Environmental Science and Protection Technicians, Including Health	3,700	4,500	21.6%
	Diagnostic Medical Sonographers	5,100	6,200	21.6%
	Public Relations Specialists	31,000	37,700	21.6%
	Licensed Practical and Licensed Vocational Nurses	63,300	76,900	21.5%
	Gaming Dealers	12,100	14,700	21.5%
	Family and General Practitioners	10,300	12,500	21.4%
	Environmental Scientists and Specialists, Including Health	13,100	15,900	21.4%
	Physics Teachers, Postsecondary	1,400	1,700	21.4%
	Employment, Recruitment, and Placement Specialists	19,600	23,800	21.4%
	Environmental Engineers	5,600	6,800	21.4%
	Training and Development Specialists	18,400	22,300	21.2%
*	Radiologic Technologists and Technicians*	16,000	19,400	21.2%
*	Nursing Aides, Orderlies, and Attendants*	108,100	130,800	21.0%
	Graduate Teaching Assistants	16,200	19,600	21.0%
	Special Education Teachers, Preschool, Kindergarten, and Elementary School*	19,200	23,200	20.8%
	Computer and Information Research Scientists	4,800	5,800	20.8%
	Septic Tank Servicers and Sewer Pipe Cleaners	2,400	2,900	20.8%
	Database Administrators	13,500	16,300	20.7%
	Optometrists	3,400	4,100	20.6%
	Internists, General	7,800	9,400	20.5%
	Anesthesiologists	3,900	4,700	20.5%
	Natural Sciences Managers	7,800	9,400	20.5%
	Special Education Teachers, Middle School	5,400	6,500	20.4%
	Compensation, Benefits, and Job Analysis Specialists	12,300	14,800	20.3%
	Medical and Clinical Laboratory Technologists	12,900	15,500	20.2%
	Medical and Clinical Laboratory Technicians	15,500	18,600	20.0%
	Cartographers and Photogrammetrists	1,000	1,200	20.0%
	Engineering Teachers, Postsecondary	3,000	3,600	20.0%
	Conservation Scientists	1,500	1,800	20.0%
	Ambulance Drivers and Attendants, Except Emergency Medical Technicians	2,000	2,400	20.0%
	Sailors and Marine Oilers	1,500	1,800	20.0%
	Biological Science Teachers, Postsecondary	9,200	11,000	19.6%
	Interpreters and Translators	9,200	11,000	19.6%
	Water and Liquid Waste Treatment Plant and System Operators	8,700	10,400	19.5%
	Police, Fire, and Ambulance Dispatchers	6,200	7,400	19.4%
	Paralegals and Legal Assistants	28,300	33,800	19.4%
	Health Educators	10,400	12,400	19.2%
	Urban and Regional Planners	7,800	9,300	19.2%
	Accountants and Auditors	140,200	167,100	19.2%
	Refuse and Recyclable Material Collectors	18,200	21,700	19.2%
	Sales Engineers	18,300	21,800	19.1%
*	Dishwashers	67,400	80,200	19.0%
	Bicycle Repairers	1,600	1,900	18.8%
	Law Teachers, Postsecondary	1,600	1,900	18.8%
	Human Resources, Training, and Labor Relations Specialists, All Other	26,800	31,800	18.7%

Search by Topic
Search by Keyword

*Indicates courses offered by EDUHSD and/or CSROP

U.S. Bureau of Labor Statistics

Economic News Release

Table 6. The 30 occupations with the largest projected employment growth, 2010-20

Table 6. The 30 occupations with the largest projected employment growth, 2010-20
(In thousands)

Occupation	Occupational group	Employment 2010	Employment 2020	Change Number	Change Percent	Pre-employment: Typical education needed for entry(1)	Pre-employment: Work experience in a related occupation(2)	Du Typical o
Registered nurses	Healthcare Practitioners and Technical Occupations	2,737.4	3,449.3	711.9	26.0	Associate's degree	None	None
Retail salespersons	Sales and Related Occupations	4,261.6	4,968.4	706.8	16.6	Less than high school	None	Short-ter
Home health aides	Healthcare Support Occupations	1,017.7	1,723.9	706.3	69.4	Less than high school	None	Short-ter
Personal care aides	Personal Care and Service Occupations	861.0	1,468.0	607.0	70.5	Less than high school	None	Short-ter
Office clerks, general	Office and Administrative Support Occupations	2,950.7	3,440.2	489.5	16.6	High school diploma or equivalent	None	Short-ter
Combined food preparation and serving workers, including fast food	Food Preparation and Serving Related Occupations	2,682.1	3,080.1	398.0	14.8	Less than high school	None	Short-ter
Customer service representatives	Office and Administrative Support Occupations	2,187.3	2,525.6	338.4	15.5	High school diploma or equivalent	None	Short-ter
Heavy and tractor-trailer truck drivers	Transportation and Material Moving Occupations	1,604.8	1,934.9	330.1	20.6	High school diploma or equivalent	1 to 5 years	Short-ter
Laborers and freight, stock, and material movers, hand	Transportation and Material Moving Occupations	2,068.2	2,387.3	319.1	15.4	Less than high school	None	Short-ter
Postsecondary teachers	Education, Training, and Library Occupations	1,756.0	2,061.7	305.7	17.4	Doctoral or professional degree	None	None
Nursing aides, orderlies, and attendants	Healthcare Support Occupations	1,505.3	1,807.2	302.0	20.1	Postsecondary non-degree award	None	None
Childcare workers	Personal Care and Service Occupations	1,282.3	1,544.3	262.0	20.4	High school diploma or equivalent	None	Short-ter
Bookkeeping, accounting, and auditing clerks	Office and Administrative Support Occupations	1,898.3	2,157.4	259.0	13.6	High school diploma or equivalent	None	Moderate-
Cashiers	Sales and Related Occupations	3,362.6	3,612.8	250.2	7.4	Less than high school	None	Short-ter
Elementary school teachers, except special education	Education, Training, and Library Occupations	1,476.5	1,725.3	248.8	16.8	Bachelor's degree	None	Internshi
Receptionists and information clerks	Office and Administrative Support Occupations	1,048.5	1,297.0	248.5	23.7	High school diploma or equivalent	None	Short-ter
Janitors and cleaners, except maids and housekeeping cleaners	Building and Grounds Cleaning and Maintenance Occupations	2,310.4	2,556.8	246.4	10.7	Less than high school	None	Short-ter
Landscaping and groundskeeping workers	Building and Grounds Cleaning and Maintenance Occupations	1,151.5	1,392.3	240.8	20.9	Less than high school	None	Short-ter
Sales representatives, wholesale and manufacturing, except technical and scientific products	Sales and Related Occupations	1,430.0	1,653.4	223.4	15.6	High school diploma or equivalent	None	Moderate-
Construction laborers	Construction and Extraction Occupations	998.8	1,211.2	212.4	21.3	Less than high school	None	Short-ter
Medical secretaries	Office and Administrative Support Occupations	508.7	718.9	210.2	41.3	High school diploma or equivalent	None	Moderate-
First-line supervisors of office and administrative support workers	Office and Administrative Support Occupations	1,424.4	1,627.8	203.4	14.3	High school diploma or equivalent	1 to 5 years	None
Carpenters	Construction and Extraction Occupations	1,001.7	1,197.6	196.0	19.6	High school diploma or equivalent	None	Apprentic
Waiters and waitresses	Food Preparation and Serving Related Occupations	2,260.3	2,456.2	195.9	8.7	Less than high school	None	Short-ter
Security guards	Protective Service Occupations	1,035.7	1,230.7	195.0	18.8	High school diploma or equivalent	None	Short-ter
Teacher assistants	Education, Training, and Library Occupations	1,288.3	1,479.3	191.1	14.8	High school diploma or equivalent	None	Short-ter
Accountants and auditors	Business and Financial Operations Occupations	1,216.9	1,407.6	190.7	15.7	Bachelor's degree	None	None
Licensed practical and licensed vocational nurses	Healthcare Practitioners and Technical Occupations	752.3	920.8	168.5	22.4	Postsecondary non-degree award	None	None
Physicians and surgeons	Healthcare Practitioners and Technical Occupations	691.0	859.3	168.3	24.4	Doctoral or professional degree	None	Internshi
Medical assistants	Healthcare Support Occupations	527.6	690.4	162.9	30.9	High school diploma or equival	None	Moderate-

1 Represents the typical education level needed to enter the occupation.
2 Indicates if work experience in a related occupation is commonly considered necessary by employers for entry, or is a commonly accepted substitute for formal types of training.
3 Indicates the typical on-the-job training needed to attain competency in the occupation.
NOTE: For more information about the education, work experience, and on-the-job training categories assigned to occupations, see www.bls.gov/emp/ep_education_training_system.htm

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El Dorado Union High School District
Facility Master Plan

APPENDIX 4

2012-2013 Progress and Expenditure Reports

March 2014

El Dorado Union High School District
4675 Missouri Flat Road
Placerville, CA 95667
(530) 622-5081, ext. 7215
FAX: (530) 622-5087

To: Christopher R. Hoffman, Superintendent

From: Baldev Johal, Associate Superintendent, Business Services

Subject: FACILITIES REPORT - STATUS OF PROJECTS AS OF **DECEMBER 31, 2013**

Date: February 6, 2014

Presented in this report is the status of facilities planning and construction projects in our District.

New information, which was not included in the previous report, is indicated in bold.

SCHOOL SITES

Oak Ridge High School
2013 Gym Expansion ($5,328,000)

This project expand**ed** the gymnasium by 32 feet to the north, adding 1,400 square feet. Also, the wrestling room area **was** reallocated, allowing for a 1,840 square foot expansion of the gymnasium seating at the mezzanine level. The expansion provide**s** additional physical education space for two full high school requirement length basketball courts, as well as two half courts in the expanded area. The bleacher seating capacity **has grown** from approximately 800 people to approximately 1,560 people for assemblies and approximately 1,360 people for basketball competitions. A new secondary lobby **was** added, as well as a storage space.

With the relocation of the wrestling room, the existing weight room **was** expanded by approximately 1,200 square feet. A new wrestling room **was** added to the west of the small gymnasium. The new wrestling room **is** 5,000 square feet and include**s** storage space and a small office. The wrestling room will be connected to the locker room hallway with a new sidewalk and covered walk around the back of the small gymnasium. Construction began on May 16, 2013 **and was basically completed on December 9, 2013.**

One remaining item is the covered walkway between the hallway to the south of the large gym and the new wrestling room. The structural steel is still being manufactured, and should be arriving at the site in late January.

Shenandoah High School
Reconstruction of Cosmetology Program Facility

The Cosmetology Program facility was burned in a fire on October 29, 2013. Fortunately, no teachers or students were in the building at the time.

Investigation into the cause of the fire is continuing. However, one of the HVAC units was taken to a lab for further testing. The fire appears to have started near one of the HVAC units, and the investigation has determined that the fire started from the ceiling and burned downward.

A temporary cosmetology lab was constructed in two connected portable classrooms; 3 hair washing sinks and 16 hair dressing stations were installed to allow continued program education for students.

District staff has worked with the manufacturer of the cosmetology building, structural engineers, California Design West Architects and the Division of the State Architect (DSA) to determine the best rebuilding methods. The 64' x 96' cosmetology building was constructed with 16 individual steel-framed modules. It was determined that 5 of the 16 modules would need to be replaced because the integrity of the steel frames could not be determined due to excessive heat and buckling. Structural plans were submitted to DSA over the winter break and approved before January 1st. The manufacturer began production of the 5 modules needed, and the modules should be delivered approximately the first week of February.

Once the modules are in place the restoration company will seal the new units off and begin restoration of all interior surfaces of the existing 11 modules. This process will remove all soot- and smoke-related damage. Following that, a sealer will be applied to all interior surfaces. The estimated time for this phase is 5 business days.

Upon completion of the restoration process, reconstruction can begin. The project will be completed in two phases. The priority will be to complete the 60 lab stations first to allow students to resume instruction and training, with the office, reception, and storage areas to following in phase 2. Optimistically, we hope to be back in partial operation by March 21st.

Reconstruction costs and costs for replacement of furniture and equipment will be covered by insurance.

Independence High School
2014 Cafeteria Remodel ($250,000)

All existing cabinets, appliances, and finishes in the kitchen and cafeteria will be removed and replaced. A new room for food service will be built adjacent to, and separate from, the existing kitchen. This project includes replacement of windows in the art/computer building, replacement of deteriorated exterior wood trim with hardy board trim, and weather proofing the existing stucco.

On June 11, 2013 the Board authorized solicitation of bids for this project. Both bids received were over the $175,000 allowed for informal bidding by the California Uniform Public Construction Cost Accounting Act, and thus the project must be put out for public bid. At this time it is anticipated that the project will go out to public bid early in 2014, with construction during the summer of 2014.

El Dorado High School
2014 Cafeteria Remodel and New Addition ($3,000,000)

The existing cafeteria, kitchen, and student eating areas are inadequate for the number of students being served during the assigned lunch period. **Plans for the new addition were submitted to the Division of the State Architect (DSA) for approval on December 18, 2013. Construction is planned for the summer of 2014.**

Roof Replacements

Replacement of roofs is one of the Measure Q Bond projects. The District's consultant evaluated the roof conditions and developed a multi-year schedule for replacement of aging roofs beginning in 2008/09.

Technology Infrastructure at All Sites ($8,816,000)

Since 2008, $7 million has been spent on technology infrastructure and equipment. Much like the safety upgrades, the technology upgrades are ongoing projects. The technology department has made updating and upgrading the technology infrastructure its first priority.

Computers have been upgraded from outdated and less efficient models to new fast, versatile platforms. Since October 1, 2010, 947 computers, 149 printers, and 113 interactive technical/electronic white boards have been installed, together with 1,667 smart response systems (individual devices), which allow students to interact with the boards. Also installed were 200 District-wide wireless access points. Thirty Netbooks have been added at Independence and 30 laptops have been installed at Shenandoah. Other items include increased bandwidth for internet access District-wide (100 Mb to 1 GB), installation of a central data backup system, data server upgrades at all sites, and data wiring upgrade District-wide (to be completed in the **future**).

Video Surveillance Systems at All Sites

As the District comes nearer to the end of the funds from the third issuance of the bond, the remaining projects are being prioritized. While currently working on both a data wiring project to update the computer infrastructure across the District and a security camera project, District staff plans to complete the computer infrastructure prior to developing the security camera project. However, the cabling needed for the cameras has been included with the data wiring project to be completed in the **future**.

Career Technical Education: Modernization/Reconfiguration of the Automotive Facility at Ponderosa High School to a Clean Diesel/Alternative Fuels Technology Program ($300,000)

Due to the changing nature of the economy, a revamped clean diesel/alternate fuels program will be reviewed.

Other

An updated Draft Consolidated Expenditure Report for bond projects is included as Attachment 1. Other projects planned for the future include ADA improvements, HVAC repairs/replacements, roof replacements, safety improvements, portable repairs, and new public address systems.

Future High School

The 2012 Facilities Master Plan identified a need for a new high school when the District enrollment reaches approximately 8,000 students. Based on current enrollment and development projections and assumptions, this will not happen within the next 10 years. The District owns two future high school sites in the western portion of the County.

Enrollment projections **are** updated annually in order to anticipate when sufficient enrollment will be reached to necessitate a fifth comprehensive high school and which site would be best suited to meet student population needs.

Bass Lake Site

The District purchased approximately one-half of the 44-acre Bass Lake site in July 2000, and acquired the remainder of the site in July 2005. EID water meters were purchased in July 2000. The site is located next to Pleasant Grove Middle School at the intersection of the proposed realigned Bass Lake Road and Green Valley Road.

The Board of Trustees selected ANOVA Nexus Architects as architect for the Bass Lake site high school. The

Board approved the high school architectural plans in June 2003. DSA plan approval was received August 13, 2004, and is now expired. Plans will need to be updated for code changes and reapproved prior to construction. CDE site approval was renewed on June 3, 2005, and has also expired.

Latrobe Road Site

The District purchased a 215 acre parcel of property off of Latrobe Road in May 2002 for a future high school site in the region south of Highway 50 in the western portion of the District. The completed EIR was approved by the Board at a public hearing and adopted on May 20, 2002. The District received final site approval for placement of a high school on the property from the CDE on August 26, 2002. Architectural planning for this school site has not yet begun.

The District worked with El Dorado Local Agency Formation Commission (LAFCO) and El Dorado Irrigation District (EID) to annex the property into the EID service district. The effective date for the boundary change for the annexation of the Latrobe Road site into the EID service district was May 7, 2013.

FINANCIAL INFORMATION

Project Funding and Office of Public School Construction (OPSC) and State Allocation Board (SAB):
In the last 10 years, the District has received apportionments from the state totaling **$27,585,086**. Ten-year revenue received from the state as of **December 31, 2013** is **$26,763,586**, which is **97.02%** of our total apportionments.

SB 50/State Allocation Board Regulations:
On January **22, 2014**, the SAB approved the "Annual Adjustment to School Facility Program Grants" per eligible ADA. The recent inflationary increases/decreases are shown below:

Grant Category	2011 Grant Amount	2012 Grant Amount	2013 Grant Amount	**2014** Grant Amount
New Construction	$12,260	$12,721	$13,119	**$13,429**
Modernization	$ 4,804	$ 4,995	$ 5,141	**$ 5,230**
Inflationary Adjustment	4.1%	3.76%	3.13%	**1.74%**

Developer and Mitigation Fees:
Attachment 2 of this report compares our actual developer fees/mitigation to projected revenue. Historical and projected developer fee/mitigation revenue are presented in Attachment 3. Attachment 4 is the 2013/14 Summary of Quarterly Developer Fees Collected. Developer fee projections are based on forecasts from various sources, including the El Dorado County Development Services Department and the El Dorado County Economic Forecast by California State University – Sacramento. Attachment 5 shows multi-year projections for the District's Developer Fee Fund over the next seven years.

On January **22, 2014**, the SAB increased developer fees (Level 1 fees), resulting in the following adjustments:

Category	2008 Level 1 K-12 Maximum Fee	2010 Level 1 K-12 Maximum Fee	2012 Level 1 K-12 Maximum Fee	**2014** Level 1 K-12 Maximum Fee
Residential	$2.97	$2.97 *	$3.20	**$3.36**
Commercial/Industrial	$0.47	$0.47 *	$0.51	**$0.54**
Inflationary Adjustment (Residential)	13%	0% *	7.7%	**4.93%**

* EDUHSD portion of the total K-12 fee is 39%, or $1.16 and $0.18, respectively.

The Board of Trustees **did not act** on the 2012 increase, so the 2010 Level 1 fees are still in effect at this time.

On April 12, 2011, the Board approved Level 2 fees of $1.54, which were effective for a period of one year. In 2012, the Board of Trustees did not act on Level 2 fees; therefore, effective April 16, 2012, the District has been collecting the current (2010) Level 1 fee, the District's portion of which is $1.16, in place of Level 2 fees. (Level 1 fees will continue to apply to commercial/industrial developments, additions to existing residential units, and fees collected in elementary school districts that cannot justify collection of fees, thereby resulting in 100% of the Level 1 fee collected by EDUHSD.) Level 2 fees **were not** reviewed by the District in 2013.

Mello-Roos District:

A Mello-Roos District (El Dorado Schools Financing Authority, CFD #1), created for the El Dorado Hills Specific Plan Area, is managed by a Joint Powers Authority consisting of Buckeye Union School District, Rescue Union School District, and EDUHSD.

Our portion of the 2013/14 tax roll is $1,795,500, which is slightly less than the 2012/13 tax roll due to a higher level of back taxes paid in 2012/13. Proceeds are not projected to grow much in future years as residential development nears buildout.

In 2006, the Board approved a COP in the amount of $14,295,000 that will be paid from the CFD #1 tax revenue. This COP is being used to fund capital improvements at ORHS and PHS, which serve students living within the CFD. It is anticipated that future tax revenue will be used to fund construction of the District's next high school. Attachment 6 shows multi-year revenue and expenditure projections for the EDUHSD portion of the CFD #1 tax revenue.

Statewide Facilities Bond Issues:

The State has less than **$14** million in remaining bond authority for modernization and new construction.

Summary of Fiscal Activity in the Facilities Office:

See Attachment 1 for financial summary activity.

Attachments:

1. Measure Q Draft Consolidated Expenditure Report for Bond Projects as of **December 31, 2013**
2. 2013/14 Capital Facilities Revenue Projections as of **December 31, 2013**
3. Developer/Mitigation Fee Revenue dated **December 31, 2013**
4. 2013/14 Summary of Quarterly Developer Fees Collected as of **December 31, 2013**
5. Developer Fees Multi-Year Projection as of **December 31, 2013**
6. El Dorado Union High School District CFD #1 Multi-Year Budget as of **December 31, 2013**

District: **El Dorado Union High School District** As of: 12/31/2013

Consolidated Expenditure Report

Account-Ability

	G.O. Bond	Budget	Expenditures & Retentions	Contract Balance	Measure Q/State Funding Balance	Other Funding Balance
1	08 Bond - ADA Access Improvements	645,016	645,016	-	-	
2	08 Bond - CTE (Careers W/Children) (35)	151,998	151,998	-	-	
3	08 Bond - CTE (Cosmetology Facility)	1,356,869	1,356,869	-	-	
4	08 Bond - CTE (Culinary Arts Bldg) (35)	2,370,370	2,370,370	-	-	
5	08 Bond - CTE (Engineering Lab)	1,643,697	1,643,697	-	-	
6	08 Bond - CTE (Natural Resources) (35)	2,573,490	2,314,524	22,001	236,965	
7	08 Bond - CTE (Improvements)	400,892	100,910	-	299,982	
8	08 Bond - 2014 EDHS Cafeteria Expansion/MOD	3,000,000	149,238	131,263	2,719,500	
8	08 Bond - 2013 PHS Cafeteria Expansion/MOD	2,097,165	2,085,336	11,829	-	
8	08 Bond - 2013 IHS Cafeteria MOD	250,000	22,910	5,287	221,804	
8	08 Bond - 2013 ORHS Cafeteria Flooring	46,075	-	46,075	-	
8	08 Bond - 2012 UMHS Shade Structure	119,552	119,552	-	-	
9	08 Bond - Health & Fitness - Gym	5,550,815	4,679,703	845,210	25,902	
10	08 Bond - Health & Fitness - Tennis Courts	405,678	348,258	-	57,420	
11	08 Bond - Health & Fitness - Track & Field	10,018,000	10,018,000	-	-	
12	08 Bond - Performing Arts Renovations - EDHS	10,460	10,460	-	-	
13	08 Bond - 2010 EDHS Science/Library	4,864,365	4,864,365	-	-	
14	08 Bond - 2010 PHS Renovation (Gym,Theater,Roofs,HVAC) (35)	8,719,367	8,719,367	-	-	
15	08 Bond - 2011 EDHS Renovation (C,T,V, Pool, & Gym)	3,564,429	3,564,429	-	-	
16	08 Bond - Portable Modernization IHS & ILC (35)	1,179,779	1,179,779	-	-	
17	08 Bond - Portable Modernization	798,827	66,827	8,552	223,449	500,000
18	08 Bond - 2011 ORHS Portables MOD & Theater Renovation (35)	1,004,504	1,004,504	-	-	
19	08 Bond - 2011 PHS Portable Replace/MOD (35)	3,316,781	3,316,781	-	-	
20	08 Bond - 2012 ORHS Portable Replace/MOD (35)	2,388,264	2,388,264	-	-	
21	08 Bond - 2012 PHS 8-Plex Portable/MOD & ADA & S-Gym Roof (35)	6,039,372	6,039,372	-	-	
22	08 Bond - Electrical, Plumbing, HVAC upgrades	619,110	553,437	-	65,673	
23	08 Bond - Parking & Traffic Flow Improvements	359,837	359,837	-	-	
24	08 Bond - Pool Deck - PHS	420,677	420,677	-	-	
25	08 Bond - Restrooms Repair	1,316,188	1,316,188	-	-	
26	08 Bond - ROOF/HVAC	1,716,404	1,639,014	27,390	50,000	
27	08 Bond - Safety (Communication, Locks, Cameras, Fire Safety, Alarms)	2,541,427	1,709,103	-	632,324	200,000
28	08 Bond - Technology	9,750,000	7,251,042	309,303	671,957	1,517,698
29	08 Bond - Other (Consultants)	441,788	354,188	2,000	85,600	
30	08 Bond - State Funded Project Savings	176,316	-	-	176,316	
30	08 Bond - Contingency	800,000	-	-	500,000	300,000
		80,657,514	**70,764,016**	**1,408,908**	**5,966,892**	**2,517,698**
	Less other State & Other Funding:	**14,357,514**			-	
	Projected Bond Expenditures:	**66,300,000**	**0.00**			

Attachment 1

District: **El Dorado Union High School District** As of: 12/31/2013

Consolidated Expenditure Report

Account-Ability

	State & Other Funding	COP 2006	Interest	Interest Yr
CTE Culinary Arts	805,780		379,314	FD 21/2008-09
CTE Natural Resources	1,286,745		107,337	FD 21/2009-10
IHS MOD	825,099	379,215	97,069	FD 21/2010-11
CTE Engineering (MET Lab)		499,012	36,065	FD 21/2011-12
Health & Fitness - Track & Field		879,588		
2010 PHS Renovation (Gym, Theater, Roofs, HVAC)		1,637,033		
2011 PHS Portable Mod, Science, Entry Paving	1,999,381			
2011 ORHS Portable Mod	535,630		124,557	FD 35/2008-09
2012 PHS 8-Plex Portable MOD	905,392	249,561	6,239	FD 35/2009-10
2012 ORHS Portable MOD	620,376		6,146	FD 35/2010-11
2008 ORHS Expansion Phase IV		176,316	(1,770)	FD 35/2011-12
Special Reserve Fund - Capital Outlay	2,517,698		44,591	FD 21+35/2012-13
Fund 21 Beginning Fund Balance (Pre Measure Q)*	241,139			
TOTALS:	9,737,240	3,820,726	799,547	
	Grand Total	**14,357,514**		

*2007/08 FD21 Beg balance less Health Academy Cost

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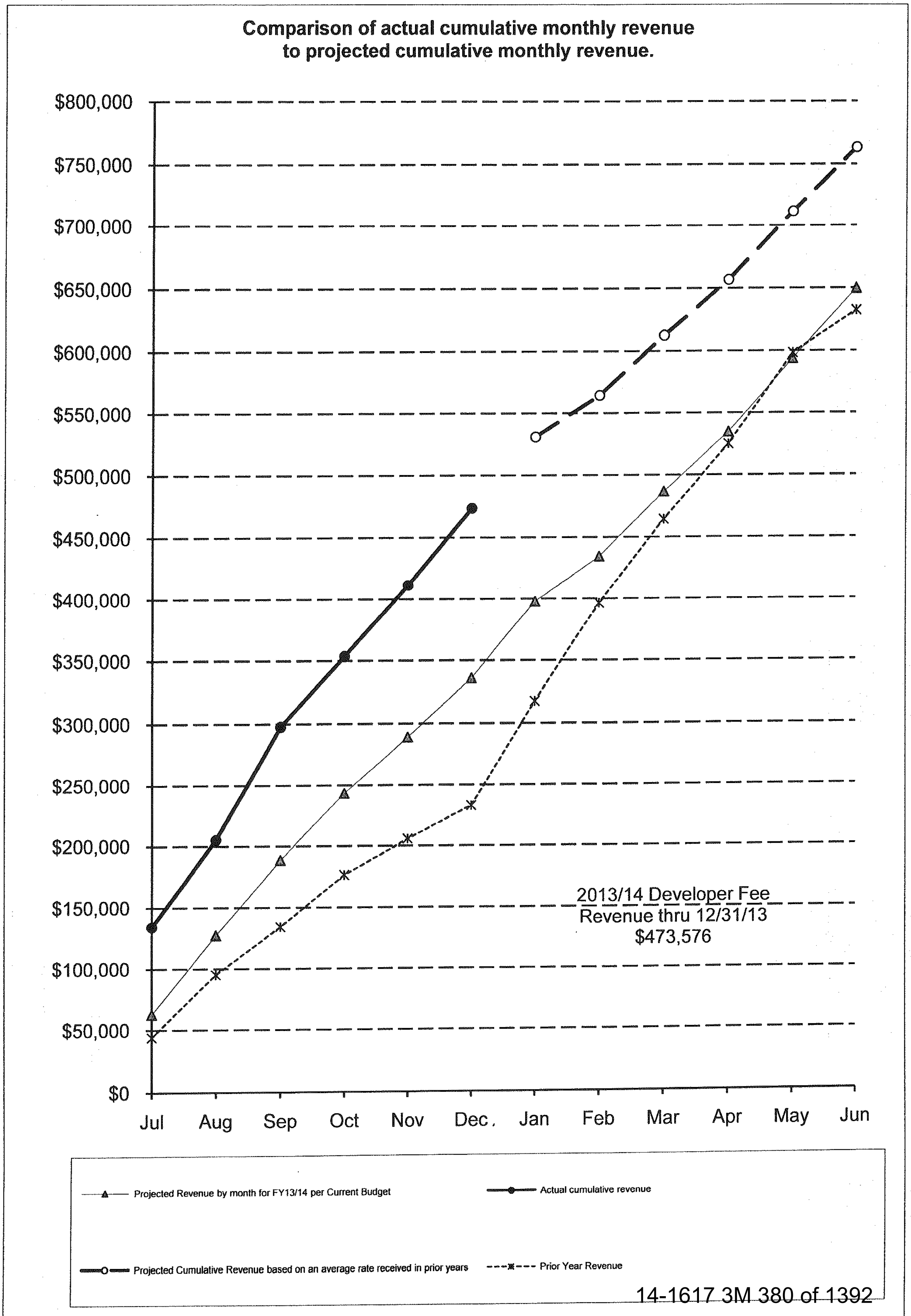
2013/14 Capital Facilities Revenue Projections

Developer Fees



DEVELOPER/MITIGATION FEE REVENUE

December 31, 2013

HISTORICAL

YEAR	TOTAL FEES COLLECTED	LEVEL I/STERLING (1)	LEVEL II (2) (4)	MIRA (3)	COMMERCIAL
1992/93	728,419	722,884			5,535
1993/94	1,152,757	1,095,001		39,301	18,455
1994/95	1,164,326	1,097,360		33,684	33,282
1995/96	1,343,530	1,240,962		82,869	19,699
1996/97	1,367,015	1,272,848		70,175	23,992
1997/98	1,328,008	1,102,612		168,420	56,976
1998/99	1,682,586	1,505,083		131,929	45,574
1999/00	2,409,688	1,731,249	2,491	618,274	57,674
2000/01	3,333,799	411,251	2,753,892	64,927	103,729
2001/02	3,786,452	143,984	3,377,635	200,093	64,740
2002/03	2,630,635	611,162	1,912,723	20,898	85,852
2003/04	3,361,313	834,884	2,215,188	214,317	96,924
2004/05	3,735,553	919,223	2,575,359	176,518	64,453
2005/06	3,491,711	829,113	2,353,893	103,414	205,291
2006/07	1,754,080	308,852	1,274,726	52,778	117,724
2007/08	1,733,948	150,499	1,466,810	9,935	106,704
2008/09	515,703	92,572	370,518	-	52,613
2009/10	365,443	59,478	292,056	-	13,909
2010/11	297,877	42,230	231,718	-	23,929
2011/12	553,653	148,576	396,412	-	8,665
2012/13	632,436	616,726	-	-	15,710

PROJECTIONS

YEAR	TOTAL FEES PROJECTED	LEVEL I/STERLING (1)	LEVEL II (2) (4)	MIRA (3)	COMMERCIAL
2013/14	650,000	630,000	-	-	20,000
2014/15	650,000	630,000	-	-	20,000
2015/16	650,000	630,000	-	-	20,000
2016/17	650,000	630,000	-	-	20,000

(1) Level 1 fees (1986's AB 2926) were first levied in 1987/88 against new residential housing, 500+ sq. ft. additions, and commercial/industrial developments

(2) Level 2 fees were first levied in May 2000. All existing lots and parcels, as well as new residential developments not in the Mello-Roos District, subject to a Mira fee, or in an elementary school district that cannot justify developer fee collections, will pay Level 2 fees. Commercial developments, additions to existing units, and parcels in elementary school districts where the EDUHSD collects 100% of the fees are subject to Level 1 fees.

(3) SB 50 curtailed new Mira agreements so revenues will decline over time, but those agreements in existence as of November 3, 1998 remain in full force and effect. In January 2000, The Promontory project paid a one-time $499,641 Mira fee, accounting for the major Mira revenues for 1999/00.

(4) As of April 15, 2012, the district is no longer collecting Level 2 fees as a result of the latest developer fee justification report.

EL DORADO UNION HIGH SCHOOL DISTRICT

Business Services

2013/14 Summary of Developer Fees Collected

COE Collections Report	Total 1st Quarter	October	November	December	Total 2nd Quarter	Total 3rd Quarter	Total 4th Quarter	Totals
Residential Level I Fees	287,688.00	60,014.00	57,911.00	62,158.00	180,083.00	0.00	0.00	467,771.00
Level II Fees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial	11,308.00	578.00	54.00	0.00	632.00	0.00	0.00	11,940.00
Total	**298,996.00**	**60,592.00**	**57,965.00**	**62,158.00**	**180,715.00**	**0.00**	**0.00**	**479,711.00**
Refunds/Adjustments								
Residential Level I Fee	(1,429.00)	0.00	0.00	0.00	0.00	0.00	0.00	(1,429.00)
Level II Fees	0.00	(4,706.00)	0.00	0.00	(4,706.00)	0.00	0.00	(4,706.00)
NSF Checks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Adjustments	**(1,429.00)**	**(4,706.00)**	**0.00**	**0.00**	**(4,706.00)**	**0.00**	**0.00**	**(6,135.00)**
Total Dev. Fees Collected	**297,567.00**	**55,886.00**	**57,965.00**	**62,158.00**	**176,009.00**	**0.00**	**0.00**	**473,576.00**
Level I Permits Issued	**103**	27	17	22	**66**	**0**	**0**	**169**
Level II Permits Issued	**0**	0	0	0	**0**	**0**	**0**	**0**
Commercial Permits Issued	**4**	3	1	0	**4**	**0**	**0**	**8**
MIRA Permits Issued	**0**	0	0	0	**0**	**0**	**0**	**0**
13/14 Net Total	**297,567.00**	**55,886.00**	**57,965.00**	**62,158.00**	**176,009.00**	**0.00**	**0.00**	**473,576.00**
13/14 Cumulative Total	**297,567.00**	**353,453.00**	**411,418.00**	**473,576.00**	**473,576.00**	**473,576.00**	**473,576.00**	
13/14 Qtrly%of Budget	**47%**	**9%**	**9%**	**10%**	**27%**	**0%**	**0%**	
13/14 Cum%of Budget	**46%**	**54%**	**63%**	**73%**	**73%**	**73%**	**73%**	
12/13 Net Total	**134,011.00**	**42,446.00**	**29,079.00**	**27,311.00**	**98,836.00**	**231,640.00**	**167,949.00**	**632,436.00**
12/13 Cumulative Total	**134,011.00**	**176,457.00**	**205,536.00**	**232,847.00**	**232,847.00**	**464,487.00**	**632,436.00**	
12/13 Qtrly%of Budget	21%	7%	5%	4%	16%	37%	27%	
12/13 Cum%of Budget	21%	28%	32%	37%	37%	73%	100%	
11/12 Net Total	**127,286.86**	**56,416.68**	**14,958.00**	**81,587.00**	**152,961.68**	**151,259.00**	**122,145.00**	**553,652.54**
11/12 Cumulative Total	**127,286.86**	**183,703.54**	**198,661.54**	**280,248.54**	**280,248.54**	**431,507.57**	**553,652.54**	
11/12 Qtrly%of Budget	23%	10%	3%	15%	28%	27%	22%	
11/12 Cum%of Budget	23%	33%	36%	51%	51%	78%	100%	
10/11 Net Total	**100,586.84**	**35,052.00**	**22,930.00**	**10,061.00**	**68,043.00**	**42,549.00**	**86,698.27**	**297,877.11**
10/11 Cumulative Total	**100,586.84**	**135,638.84**	**158,568.84**	**168,629.84**	**168,629.84**	**211,178.84**	**297,877.11**	
10/11 Qtrly%of Budget	25%	9%	6%	3%	17%	11%	22%	
10/11 Cum%of Budget	25%	34%	40%	42%	42%	53%	74%	
09/10 Net Total	**89,944.00**	**36,609.00**	**15,261.00**	**35,999.00**	**87,869.00**	**92,382.00**	**95,247.68**	**365,442.68**
09/10 Cumulative Total	**89,944.00**	**126,553.00**	**141,814.00**	**177,813.00**	**177,813.00**	**270,195.00**	**365,442.68**	
09/10 Qtrly%of Budget	22%	9%	4%	9%	22%	23%	24%	
09/10 Cum%of Budget	22%	32%	35%	44%	44%	68%	91%	
08/09 Net Total	**156,054.00**	**38,721.00**	**30,317.00**	**14,489.00**	**90,847.00**	**118,589.53**	**107,300.47**	**472,791.00**
08/09 Cumulative Total	**156,054.00**	**187,455.00**	**217,772.00**	**232,261.00**	**246,901.00**	**365,490.53**	**472,791.00**	
08/09 Qtrly%of Budget	31%	8%	6%	3%	18%	24%	21%	
08/09 Cum%of Budget	31%	37%	44%	46%	49%	73%	95%	
07/08 Net Total	**818,623.17**	**131,666.00**	**145,459.12**	**142,269.88**	**419,395.00**	**242,955.00**	**252,974.55**	**1,733,947.72**
07/08 Cumulative Total	**818,623.17**	**950,289.17**	**1,095,748.29**	**1,238,018.17**	**1,238,018.17**	**1,480,973.17**	**1,733,947.72**	
07/08 Qtrly%of Budget	45%	7%	8%	8%	23%	13%	14%	
07/08 Cum%of Budget	45%	53%	61%	69%	69%	82%	96%	
06/07 Net Total	**711,564.00**	**163,778.00**	**134,978.00**	**96,685.00**	**395,441.00**	**345,256.00**	**301,819.00**	**1,754,080.00**
06/07 Cumulative Total	**711,564.00**	**875,342.00**	**1,010,320.00**	**1,107,005.00**	**1,107,005.00**	**1,452,261.00**	**1,754,080.00**	
06/07 Qtrly%of Budget	40%	9%	7%	5%	22%	19%	17%	
06/07 Cum%of Budget	40%	49%	56%	62%	62%	81%	97%	
05/06 Net Total	**1,064,933.16**	**367,618.00**	**309,985.00**	**183,629.00**	**861,232.00**	**700,658.00**	**865,488.00**	**3,492,311.16**
05/06 Cumulative Total	1,064,933.16	1,432,551.16	1,742,536.16	1,926,165.16	1,926,165.16	2,626,823.16	3,492,311.16	
05/06 Qrtly % of Budget	30%	10%	9%	5%	24%	19%	24%	
05/06 Cum % of Budget	30%	40%	48%	54%	54%	73%	97%	
04/05 Net Total	**1,242,954.00**	**331,185.00**	**332,165.00**	**153,629.00**	**816,979.00**	**651,637.00**	**1,023,007.00**	**3,734,577.00**
04/05 Cumulative Total	1,242,954.00	1,574,139.00	1,906,304.00	2,059,933.00	2,059,933.00	2,711,570.00	3,734,577.00	
04/05 Qtrly % of Budget	35%	9%	9%	4%	23%	18%	28%	
04/05 Cum % of Budget	35%	44%	53%	57%	57%	75%	104%	

El Dorado Union High School District - Developer Fees (Multi-Year Projection)
2013/14 - 2018/19

	2013-14 Budgeted	2014-15 Projected	2015-16 Projected	2016-17 Projected	2017-18 Projected	2018-19 Projected	Total Multi-Year Projections
Projected Beginning Fund Balance	$784,005	$595,809	$416,520	$251,980	$87,440	$0	$784,005
Projected Revenue							
Developer Fee Collections	$650,000	$650,000	$650,000	$650,000	$650,000	$650,000	$3,900,000
Interest/Other Local Income	$1,250	$1,000	$750	$750	$500	$500	$4,750
General Fund Contributions	$0	$0	$0	$0	$77,350	$164,790	$242,140
Total Projected Revenue	$651,250	$651,000	$650,750	$650,750	$727,850	$815,290	$4,146,890
Projected Expenditures							
2009 Refunding COP	$655,290	$655,290	$655,290	$655,290	$655,290	$655,290	$3,931,739
Portable Leases	$0	$0	$0	$0	$0	$0	$0
Consultants (Legal, Financial, etc.)	$36,500	$35,000	$35,000	$35,000	$35,000	$35,000	$211,500
Capital Expenditures	$0	$0	$0	$0	$0	$0	$0
Facilities Office (Staffing & Operations)	$147,656	$140,000	$125,000	$125,000	$125,000	$125,000	$787,656
Total Projected Expenditures	$839,446	$830,290	$815,290	$815,290	$815,290	$815,290	$4,930,895
Net Increase(Decrease) to Fund Balance	($188,196)	($179,290)	($164,540)	($164,540)	($87,440)	$0	($784,005)
Projected Capital Facilities Fund Balance	$595,809	$416,520	$251,980	$87,440	$0	$0	$0

Attachment 5

El Dorado Schools Financing Authority, CFD #1
El Dorado Union High School District
Multi-Year Combined Budget

Prepared By: mcz
Revised: 12/31/2013

	2013/14 Budgeted	2014/15 Projected	2015/16 Projected	2016/17 Projected	2017/18 Projected	2018/19 Projected	Total Multi Year Projections
Projected Beginning Balance	$ 2,125,040	$ 1,886,192	$ 1,672,662	$ 49,623	$ 1,761,452	$ 3,496,018	
Projected Revenue							
Tax Revenue Current Year	$ 1,768,000	$ 1,794,520	$ 1,821,438	$ 1,839,652	$ 1,859,888	$ 1,878,487	$ 10,961,986
Tax Revenue Prior Year	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 90,000
Other Revenue (penalties, permits)	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 12,500	$ 75,000
Interest	$ 70,500	$ 68,385	$ 66,333	$ 5,000	$ 7,500	$ 10,000	$ 227,718
Contribution fr Measure Q for Ponderosa Projects	$ 3,088,593	$ -	$ -	$ -	$ -	$ -	
Contribution fr Measure Q for Independence Project	$ 377,544	$ -	$ -	$ -	$ -	$ -	
Total Projected Revenue	$ 5,332,137	$ 1,890,405	$ 1,915,271	$ 1,872,152	$ 1,894,888	$ 1,915,987	$ 11,354,704
Projected Expenditures							
Admin Expenses	$ 6,000	$ 6,150	$ 6,150	$ 6,300	$ 6,300	$ 6,300	$ 37,199
COP Trustee Administrative Expenses	$ 2,200	$ 2,200	$ 2,200	$ -	$ -	$ -	$ 6,600
COP Payments	$ 2,089,848	$ 2,088,585	$ 3,522,960	$ 147,023	$ 147,023	$ 147,023	$ 8,142,462
Contribution to Oak Ridge Gym Expansion	$ 3,466,137	$ -	$ -	$ -	$ -	$ -	$ 3,466,137
Consultants (Legal, Financial, etc.)	$ 6,800	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 41,800
Total Projected Expenditures	$ 5,570,985	$ 2,103,935	$ 3,538,310	$ 160,323	$ 160,323	$ 160,323	$ 11,694,198
Projected Capital Facilities Reserve	$ 1,886,192	$ 1,672,662	$ 49,623	$ 1,761,452	$ 3,496,018	$ 5,251,683	

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Attachment 6

EL DORADO UNION HIGH SCHOOL DISTRICT

ANNUAL REPORT OF THE MEASURE Q CITIZENS' OVERSIGHT COMMITTEE

OCTOBER 1, 2012 – SEPTEMBER 30, 2013

A REPORT ON THE EXPENDITURES OF THE 2008 MEASURE Q BOND FUNDING

Introduction to the 2008 Measure Q Bond

On June 3, 2008, voters approved a $66.3 million bond to improve student safety and the quality of education at every school by repairing, updating, constructing, furnishing, and equipping school facilities, including technology, job training, science and health facilities, roofs, electrical, plumbing, heating, and air conditioning systems. With the bond providing the local match, qualifying projects became eligible for millions of dollars in State matching funds.

In September 2008, $34 million in bonds were issued for these projects. Because of the history of strong fiscal management of the District, the bonds were sold at a favorable rate of 4.68%. The original $34 million was used to finance tremendous improvements at our schools, and on July 21, 2010, the second successful bond sale was held in the amount of $17.3 million at an even more favorable rate of 4.59%. The remaining $15 million in bonds were issued on August 16, 2012 at an average rate of 5.08%.

Over the duration of the bond, the majority of the bond funds have been expended in the area's local economy, aiding businesses and workers as well as the students and school staff. The voter approval of these funds not only allowed the school district to improve its sites and learning environment, but improved the overall economic health of El Dorado County by infusing millions of dollars into the construction and other associated industries. The decision by the voters to pass this bond was an investment in the future of our community.

About the Committee

In accordance with Education Code Section 15278, the El Dorado Union High School District (EDUHSD) Board of Trustees certified the election results at its regularly scheduled meeting, appointed members of the Citizens' Oversight Committee (COC) and charged it with the responsibility to inform the public on expenditures of the bond proceeds for the construction and rehabilitation of school facilities. The Committee includes a broad spectrum of community groups.

The Citizens' Oversight Committee

1. Business Organization Representative	Jeni Bitnoff
2. Senior Organization Representative	Vacant
3. Parent Representative	Scott Jonsson
4. Parent Representative	R. Scott Spriggs
5. Parent-Teacher Organization Representative	Bradley Silverbush
6. Community Member At Large	Suzanna George
7. Taxpayers' Organization Representative	Karl Weiland

The EDUHSD Board of Trustees adopted the Bylaws for the COC at its regularly scheduled meeting on July 29, 2008. The COC began its tasks on November 6, 2008; the most recent meeting was October 21, 2013.

Introduction to the Projects

The District has identified several projects that address the major bond categories. All of the projects have been deemed to provide a positive benefit to the students and community. All project costs are estimates pending construction completion. Information on projects completed between October 2011 and September 2012 was provided in the previous annual report, which can be found on the District website at eduhsd.net.

New 8-Plex Classroom Building at PHS
($6,040,000)

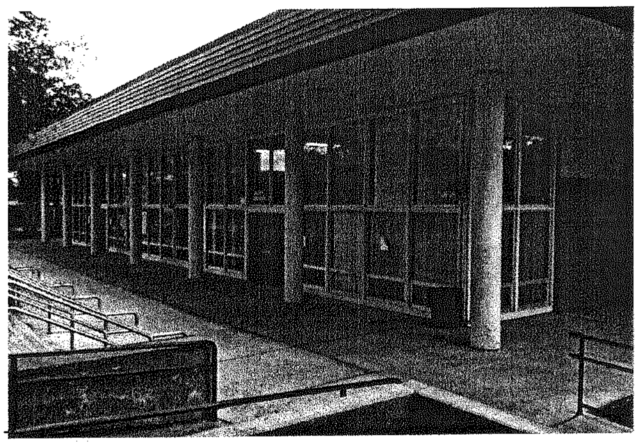
The portable classrooms removed in 2011 and 2012 were replaced by a permanent building consisting of seven standard classrooms, a computer lab, staff restrooms, and an electrical and data room. The new classroom building was completed December 13, 2012.

2013 Cafeteria Remodel at PHS
($2,000,000)

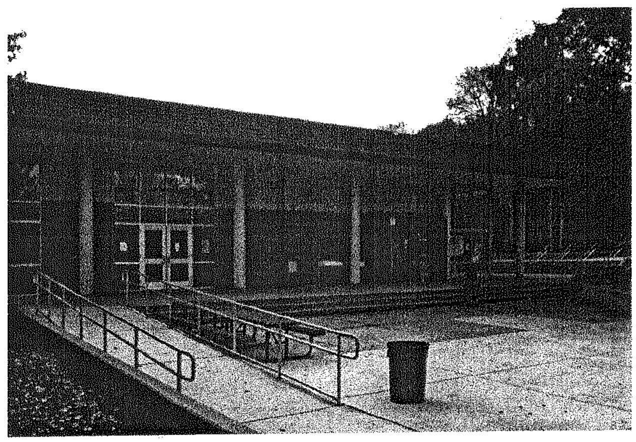
This project consisted of the renovation and expansion of the existing kitchen and doubling the size of the food serving areas. New kitchen finishes and equipment were provided and a larger pantry was added. The kitchen was reconfigured to make deliveries and food preparation more efficient.

A new 2,700 square foot outdoor dining canopy was added for extra student dining. An outdoor serving snack bar was added, as well as chair storage, new restrooms, and a new janitor's room. Construction began on May 21, 2013, and the project was completed prior to the start of school.

Outside PHS Cafeteria – Before



Outside PHS Cafeteria – Before



Outside PHS Cafeteria – After

Outside PHS Cafeteria – After

New Walk-In Cooler at PHS

One of Two New Lunch Lines at PHS

2013 Small Gym Siding and Floor Replacement Projects at PHS ($340,700)

The existing deteriorated plywood siding, trim, and fascia were removed and replaced with cement board siding and trim. This project also included the addition of 392.5 square feet of storage space, separated into four storage rooms, attached to and accessible directly from the small gym and accessible from the exterior of the gym building. These storage spaces are for chair and athletic equipment storage, freeing up storage space in the locker rooms and removing sheds located around campus that stored these items. A new hardwood floor was also installed in the small gym.

2013 Tennis Court and Parking Lot Resurfacing at PHS ($551,000)

This project involved the repair and replacement of tennis court paving, including fencing and posts, and repair and replacement of student parking lot paving, and paving in other areas.

2013 Gym Expansion and New Wrestling Room at ORHS ($5,328,000)

This project will expand the large gymnasium by a total of 6,100 square feet, 2,900 square feet to the north side to provide well-needed physical education space, as well as additional seating during sporting events. A 1,500 square foot entrance lobby with storage areas will be added to the east side. The west side of the large gym will expand into the existing wrestling room area to add 1,700 square feet of seating space and lobby area.

The expansion will provide additional physical education space for two full high school requirement length basketball courts, as well as two half courts in the expanded area. The bleacher seating capacity will grow from approximately 800 people to approximately 1,560 people for assemblies and approximately 1,360 people for basketball competitions. A new secondary lobby will be added, along with additional physical education storage space.

With the relocation of the wrestling room, the existing weight room will be expanded by approximately 1,200 square feet, providing additional physical education space. The existing wrestling room will be replaced by a new 5,000 square foot wrestling room added to the west of the small gymnasium. The new area will also be used for additional physical education stations and will include storage space and a small office. The wrestling room will be connected to the locker room *hallway with a new sidewalk and covered walk around the back of the small gymnasium.*

Construction began on May 16, 2013, with a scheduled completion date of December 11, 2013.

2013 Cafeteria Remodel at IHS ($162,400)

All existing cabinets, appliances, and finishes in the kitchen and cafeteria will be removed and replaced. A new room for food service will be built adjacent to, and separate from, the existing kitchen. This project includes replacement of windows in the art/computer building, replace-ment of deteriorated exterior wood trim with hardy board trim, and weather proofing the existing stucco.

On June 11, 2013 the Board of Trustees authorized solicitation of bids for this project. Both bids received were over the $175,000 allowed for informal bidding by the California Uniform Public Construction Cost Accounting Act, and thus the project must be put out for public bid. At this time it is anticipated that the project will go out to public bid early in 2014, with construction during the summer of 2014.

Roof Replacements

Replacement of roofs is one of the Measure Q Bond projects. The District's consultant evaluated the roof conditions and developed a multi-year schedule for replacement of aging roofs beginning in 2008/09. Roofs replaced in the summer of 2013 were the large gym and locker room at EDHS and the cafeteria at ORHS.

Technology Infrastructure and Equipment at All Sites ($7,882,000)

Since 2008, $7 million has been spent on technology infrastructure and equipment. Much like the safety upgrades, the technology upgrades are ongoing projects. The technology department has made updating and upgrading the technology infrastructure its first priority.

Computers have been upgraded from outdated and less efficient models to new fast, versatile platforms. Since October 1, 2010, 947 computers, 149 printers, and 113 interactive technical/electronic white boards have been installed, together with 1,667 smart response systems (individual devices), which allow students to interact with the boards. Also installed were 200 District-wide wireless access points. Thirty Netbooks have been added at IHS and 30 laptops have been installed at SHS. Other items include increased bandwidth for internet access District-wide (100 Mb to 1 GB), installation of a central data backup system, data server upgrades at all sites, and data wiring upgrade District-wide (to be completed in the fall).

Other

Other projects planned for the future include ADA improvements, HVAC repairs/ replacements, roof replacements, safety improvements, portable repairs, and new public address systems.

The District continues to evaluate opportunities to introduce more technology into the classroom.

PLANNING AND DEVELOPMENT PHASE PROJECTS

2014 Cafeteria Remodel at EDHS ($3,000,000)

The existing cafeteria, kitchen, and student eating areas are inadequate for the number of students being served during the assigned lunch period. District and site staff are working on plans to improve conditions to these areas for construction during the summer of 2014.

Video Surveillance Systems at All Sites

As the District comes nearer to the end of the funds from the third issuance of the bond, the remaining projects are being prioritized. While currently working on both a data wiring project to update the computer infrastructure across the District and a security camera project, District staff plans to complete the computer infrastructure prior to developing the security camera project. However, the cabling needed for the cameras has been included with the data wiring project to be completed in the fall.

Career Technical Education: Modernization/Reconfiguration of the Automotive Facility at PHS to a Clean Diesel/Alternative Fuels Technology Program ($300,000)

Due to the changing nature of the economy, a revamped clean diesel/alternate fuels program will be reviewed.

Performance Audit

Pursuant to statute, a Performance Audit is being prepared by an independent auditing firm and the report is expected to be issued toward the end of 2013. A copy of that audit report will be made available on the District's website when it is completed.

Conclusion

Based on the information provided thus far to the COC, the Committee has not noted any irregularities with the expenditures of any of the bond proceeds and is satisfied that:

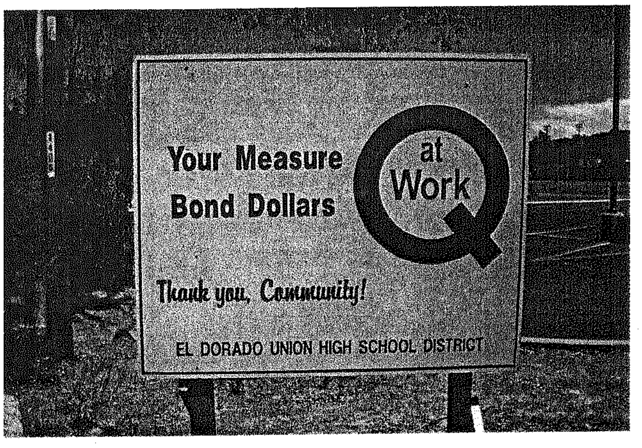
- ***None of the expenditures were used to pay for teacher or administrative salaries or any other school operating expenses.***
- ***The projects completed in the fiscal year ending June 30, 2013 matched the requirements for the Measure Q Bond projects.***
- ***Bonds were issued in accordance with the fiscal plan to keep the tax rates as low as possible.***
- ***The District has aggressively pursued additional State funds.***

The COC is also pleased that the great majority of the contracts for the school projects have been let to local contractors and businesses.

Some of the El Dorado County companies which worked on the projects to date are:

A.Albright Steel Service, Inc.
Ace Hardware, Placerville
Airgas
All Green Landscape Solutions
All Steel Fence, Inc.
Allied Environmental, Inc.
AmeriGas
ANOVA Nexus Architects
AWA Concrete Construction
Blain Stumpf Trucking
Blue Moon Electric
California Overhead Doors
Carnahan Electric Ltd
Carter-Kelly, Inc.
Cemex Concrete
Chase Electric
Charles L. Croft, Inc.
Commercial Caulking
Conforti Plumbing, Inc.
D & D Plumbing Supply
Dawson's Floor Fashions
Diamond Crane
Diamond International Lumber
Doug Veerkamp General Engineering, Inc.
El Dorado Disposal
Ferguson Plumbing Supply
Gold Country Tile Co.
Got Fence?
Hall Mark Services, Inc.
Hangtown Fire Control
Heath Construction
HEMCOR Construction, Inc.
Hemington Landscape Services
Hill Brothers Contracting, Inc.
Home Depot
Horizon Roofing, Inc.
Imperial Printing
J & J Glass
Joe Vicini, Inc.
John Deere Landscapes
Kennedy Electric, Inc.
Kevin Hansen Painting
Linda's Cleaning Service
McIntosh Construction
Maverick Insulation
Mountain Dry Wall
Myers & Sons Drywall
Navaho Building Specialties
Network Technologies
Phillips Steel
Piazza Heating & Air Conditioning
Piland Electric, Inc.
Placerville Glass
Prime Mechanical
Red Built
Removable Media Solutions, Inc.
Rexel (Nor Cal) Electrical Supply
Roebbelen Construction, Inc.
Sherwin Williams Paint
Ski Air Conditioning Co.
Starr Plastering, Inc.
Steve Swars Construction
Summerwood Construction
Syars Concrete
TC Residential Landscape & Maintenance
Tim Land General Engineering
True Value Hardware
Warren Consulting Engineers, Inc.
Wayne's Locksmith Service
Western Sign Company
Wilkinson Portable Toilets
Williams Pro Painting
Wunschel & Sons, Inc.
Youngdahl Consulting Group, Inc.

The members of the COC wish to thank the El Dorado Union High School District Board of Trustees: Kevin W. Brown, Timothy M. Cary, David Del Rio, Lori M. Veerkamp, and Todd R. White; Superintendent Christopher R. Hoffman; Associate Superintendent Baldev Johal; Director of Maintenance and Operations/Facilities Daniel J. Augino; and District staff for their assistance.



Attachment #8

Limited Intersection Sight Distance

The following access points had identified intersection sight distance issues:

- **The Purple Place Retail Center:** the eastern access has limited sight distance looking west, and the western access has limited sight distance looking east. The retaining walls and a vertical curve are primarily contributing factors limiting the sight distance for right and left out movements.
- **1072 Green Valley Road:** ISD is limited in both directions due to vegetation.
- **1530/1532/1540 Green Valley Road:** Line of sight for the right-turning vehicles looking west is limited due to the horizontal and vertical curvature of the road.
- **1680 Green Valley Road:** Line of sight to the east and west is limited due to vegetation and a horizontal curve. Trimming of the vegetation could improve ISD to the west, and all sight distances were acceptable when the vehicle position was moved to 10 feet from the edge of the roadway.
- **1840 Green Valley Road Home and Eastern Strawberry Entrance:** Line of sight to the west from both the 1840 Green Valley Road home access and the second entrance to the strawberry stand (coming from the west) is limited due to vegetation but could be improved with tree removal by the private property owner. ISD to the east is limited from the home driveway due to the vertical crest of the road.
- **1855 Green Valley Road:** ISD is limited in both directions due to vegetation to the west and vertical curvature to the east. ISD to the west for the unmarked access across the street is also limited due to vertical curvature.
- **Lexi Way:** ISD to the east is restrictive due to the vertical crest in the roadway.
- **1870/1880 Green Valley Road:** ISD to the east was extremely limited due to the vertical crest in the roadway.
- **1901 Green Valley Road:** ISD is poor in both directions due to the hillside, vegetation, and vertical and horizontal curvature.
- **Unknown Driveway (Lion Entrance):** ISD is limited to the west because of horizontal and vertical curves and vegetation.
- **1937 Green Valley Road:** ISD is limited to the east because of vegetation, but would be improved with the trimming.
- **1960 Green Valley Road:** ISD is limited in both directions due to the vertical crest in the road and vegetation.
- **2001 Green Valley Road:** ISD is poor to the west due to vegetation, hillside, and vertical curvature. ISD is limited to the east due to the vertical curve of the roadway.
- **2020 Green Valley Road:** ISD is limited to the west because of a vertical crest in the roadway.
- **2045/2046 Green Valley Road:** ISD is limited to the west because of a vertical crest in the roadway.
- **2321 Green Valley Road:** ISD is limited to the west due to the vertical curve in the road, and poor to the east due to vegetation and combined vertical and horizontal curvature. Trimming of vegetation will likely not improve ISD.

- **Driveway east of 2801 Green Valley Road:** ISD is limited to the east because of the hillside, but improves by reducing the setback distance to 10 feet from the edge of pavement.

Limited Stopping Sight Distance

The following access points were identified with the stopping sight distance issues:

- **1530/1532/1540 Green Valley Road:** SSD for eastbound approaching vehicles was limited due to the horizontal and vertical curvature of the road.
- **1680 Green Valley Road:** Stopping sight distance for eastbound approaching vehicles was limited due to the horizontal and vertical curvature of the road.
- **1870/1880 Green Valley Road:** SSD for westbound vehicles approaching the driveway from the east was poor due to the vertical crest in the roadway.
- **1901 Green Valley Road:** SSD is limited for westbound approaching vehicles due to the hillside, vegetation, and horizontal curvature.
- **1960 Green Valley Road:** SSD is limited for westbound approaching vehicles because of vertical curvature and vegetation.
- **2001 Green Valley Road:** SSD is limited for westbound approaching vehicles because of vertical curvature and vegetation.
- **2321 Green Valley Road:** SSD is limited for westbound approaching vehicles due to the vertical crest in the road.
- **Travois Circle:** SSD is limited for westbound approaching vehicles due to the horizontal curve of the roadway.

The Purple Place Retail Center

The Purple Place Retail Center is located on the north side of Green Valley Road east of Sophia Parkway. In the westbound direction, Green Valley Road provides a 2% to 3% downgrade near The Purple Place. Motorists traveling in the westbound direction and wanting to enter The Purple Place Retail Center must decelerate to negotiate tight right-turn radii at the driveway. As a result, trailing motorists in the outside lane either slow down or move into the adjacent lane. This could potentially reduce roadway capacity and pose safety issues. Corner sight distance at the western driveway looking east was observed to be limited, primarily due to a horizontal curve. The eastern driveway has limited corner sight distance looking west due to a retaining wall.

Weekday AM and PM peak hour traffic volumes indicate that the western driveway was used more frequently relative to the eastern driveway.

Attachment #9

EL DORADO COUNTY
DEPARTMENT OF TRANSPORTATION

Count Summary Beginning: **January 30, 2013**

Count Station:	2000002	Counter ID:	73
City/Town:	Rescue	Mile Post:	**9.58**
Road Name:	**Green Valley Rd**	Location:	**500 ft E of Deer Valley Rd** (E)
Lanes:	2	Direction:	EASTBOUND

Date	3	4	5	30	31	1	2	Weekly	Wk Day
Day Time	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Average	Avg.
100	19	5	8	9	10	20	18	13	10
200	7	4	3	4	6	5	15	6	4
300	6	1	1	5	0	1	11	4	2
400	5	8	4	1	2	6	7	5	4
500	5	6	5	2	3	5	6	5	4
600	6	13	11	7	6	15	8	9	10
700	13	82	88	81	68	70	26	61	78
800	32	138	127	140	137	127	41	106	134
900	55	169	189	192	162	164	85	145	175
1000	95	108	120	117	118	123	105	112	117
1100	114	93	115	110	120	111	125	113	110
1200	142	111	119	135	123	124	155	130	122
1300	189	134	171	137	167	146	182	161	151
1400	179	161	152	140	132	159	165	155	149
1500	192	220	193	153	209	201	168	191	195
1600	184	181	240	232	212	233	173	208	220
1700	75	254	270	246	264	248	159	217	256
1800	68	204	247	234	271	270	184	211	245
1900	74	170	177	182	173	159	104	148	172
2000	47	104	117	73	93	89	96	88	95
2100	192	87	62	91	76	90	82	97	81
2200	73	50	61	59	63	63	68	62	59
2300	21	37	31	34	43	45	49	37	38
2400	14	8	21	19	10	27	22	17	17
Totals	1807	2348	2532	2403	2468	2501	2054	2302	2450
AM Peak Hr	12:00	9:00	9:00	9:00	9:00	9:00	12:00	9:00	9:00
AM Count	142	169	189	192	162	164	155	145	175
PM Peak Hr	3:00	5:00	5:00	5:00	6:00	6:00	6:00	5:00	5:00
PM Count	192	254	270	246	271	270	184	217	256

TOTAL ADT: **4,655**

Attachment #10

DROUGHT ACTION PLAN

This Drought Action Plan is a summary of drought stages and actions that are described, along with their development, in detail, in the balance of this Drought Preparedness Plan (Plan). This section is meant to be available as a stand-alone resource and reference.

El Dorado Irrigation District (EID) drought stage water supply conditions, objectives, and response actions including water use reduction targets, are summarized in Table 1. The Plan involves an introductory Stage 1 drought response during which all customers are informed of drought and total customer demand reduction is targeted for 15 percent. At Stage 2, water use decisions initially continue to be entrusted to the customer as long as the overall water use reduction goal of up to 30 percent is met; this is a voluntary/honor system approach. If this voluntary phase of Stage 2 fails, then a Stage 2 mandatory phase is initiated. In Stage 3, a strict allotment approach is implemented with a stiff penalty rate and a total demand reduction goal of up to 50 percent. Each of these stages and actions are further described in this section.

Table 1. Drought Preparedness Plan Summary

Water supply conditions	Drought stage	Objective	Response actions
Normal 0% Total Supply Reduction	Drought Stage Zero - Ongoing Conservation. Water waste prohibition in effect.	Public awareness	Normal actions
Slightly Restricted Water Supplies (below normal) Up to 15% Total Supply Reduction	Drought Stage 1 – Introductory Stage. Voluntary reductions in use	Initiate public awareness of predicted water shortage and encourage conservation	Encourage voluntary measures to decrease “normal” demand up to 15%
Moderately Restricted Water Supplies Up to 30% Total Supply Reduction	Drought Stage 2 – Voluntary Phase for water use reductions and potential subsequent Mandatory Phase with restrictions on use.	Increase public under standing of worsening water supply conditions, encourage voluntary conservation measures, and enforce some mandatory conservation measures	Encourage some voluntary measures and enforce mandatory measures and implement water rationing to decrease “normal” demand up to 30% Drought surcharge enacted (potential in-house trigger and board action)
Severely Restricted Water Supplies Up to 50% Total Supply Reduction	Drought Stage 3 – Mandatory restrictions (severe prohibitions) on use	Ensure that water use is limited to health and safety purposes	Enforce extensive restrictions on water use and implement water rationing to decrease demand up to 50% of “normal” demand

Ongoing Drought Preparedness Plan Implementation Actions

Ongoing Plan implementation actions will be implemented both during periods of non-drought and drought. These activities can be characterized as proactive actions that prepare for drought through monitoring, public outreach, and resource management practices.

Policy and Regulation

1. Review and update Plan every 5 years or as needed based on new supply, operational changes, or change in expected water demand.
2. Enforce water waste prohibition.
3. Continue conservation policies, including water-efficient plumbing retrofits.
4. Continue and advance Irrigation Management System (IMS) program.
5. Review and refine rate stabilization policy relating to drought impacts every 5 years.
6. Understand and comply with legal and regulatory requirements for drought management.
7. Suggest Domestic Irrigation customers have a water conservation plan on file with EID and update this plan every 5 years.
8. Suggest Agricultural Metered Irrigation (AMI) customers not participating in the IMS program to have a water conservation plan on file with EID and update this plan every 5 years.
9. Small Farms must submit a water conservation plan during the account certification to qualify for the Small Farm rate. The plan must be updated every 3 years during the re-certification process.

Monitoring

1. Run Drought Status Supply Remaining Index (SRI) model quarterly to assess drought status with updated demand and supply information. SRI Trigger Plan sequence shown in Figure 1. El Niño Southern Oscillation (ENSO) climate cycle episode is a secondary indicator.
2. Monitor system demands for consistency with SRI model assumptions.

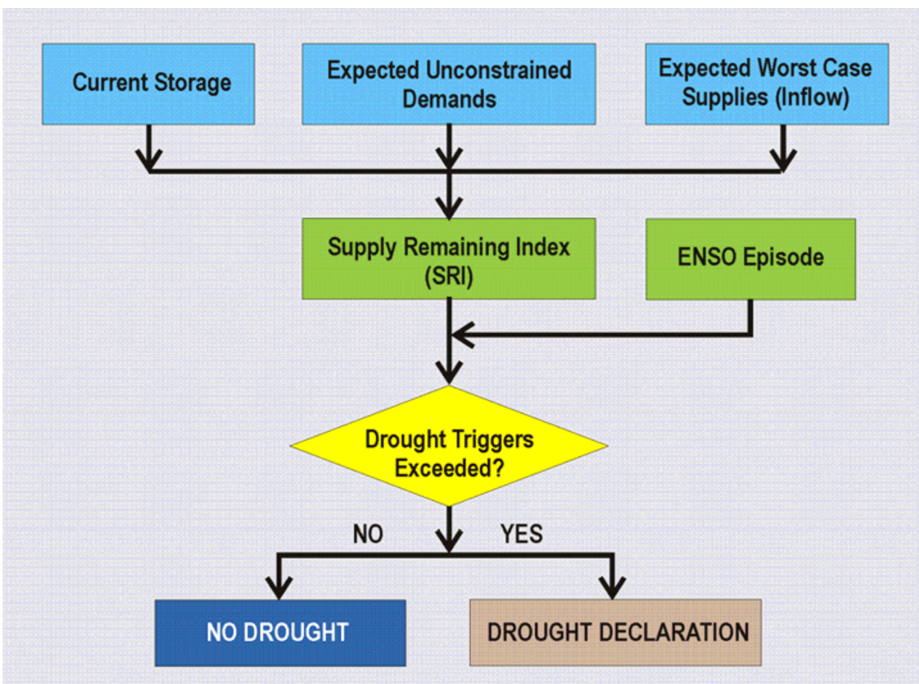


Figure 1. Drought Status SRI Trigger Plan Flow Chart

The EID SRI trigger plan is summarized in Table 2 and described below.

Table 2. SRI Trigger Plan Summary Table

Month	ENSO	SRI	Last month's stage	This month's stage
May	Any	<0.6	0	1
		<=0.75	1,2,3	Last month's stage
June - Sept	Any	<0.10	2	3
	<0.35*	<0.12	0,1,2	2
	<0.35*	<0.12	3	3
Any	Any	>0.75	0,1,2,3	0

* the ENSO average of three previous months must be less than 0.35

- If it's May and SRI is less than 0.6 go to Stage 1 (if in Stage 0); if already in drought and SRI is less than 0.75, stay at the stage from the month before.
- In June through September, if SRI is less than 0.10 and the previous month was in a Stage 2 drought, then go to Stage 3.
- In June through September, if the SRI is less than 0.12 and the average previous three months ENSO is less than 0.35, then go to Stage 2; if the previous month was in Stage 3 drought, stay in Stage 3.
- In all months if SRI is greater than 0.75, there is no drought curtailment. This either continues a period of no drought or ends the drought response of the month before.
- In all other cases, the drought stage this month is the same as the previous month.

Public Outreach

1. Develop and maintain drought awareness and public education materials, tools, and protocol.
2. Continue water efficiency programs including limiting sidewalk washing and car washing without a shutoff nozzle; and fixing leaks within 72 hours.
3. Develop website link for "Drought Stage" information.

Resource Management

1. Maintain interagency coordination annually as shown in Figure 2. Figure 2 depicts the type and frequency of interagency coordination activities that will be pursued by the Drought Interagency Coordination Committee (DICC).
2. Confirm and maintain commitment of Drought Advisory Committee (DAC) members as shown in Figure 3. Figure 3 depicts the suggested interagency organizational structure.
3. Pursue development of potential drought impact avoidance projects.
   - PL101-514 supply
   - Additional water conservation
   - Water loss reduction
   - Groundwater banking
   - White Rock Diversion
   - Sly Park flashboards
   - Alder Creek Reservoir
   - Texas Hill Reservoir
   - Capps Crossing Reservoir
4. Establish and maintain trucking contracts for water hauling (annually).
5. Construct and maintain tap manifolds for emergency water distribution through hydrants.
6. Establish procedure by which residents on wells within EID service area apply for emergency relief.

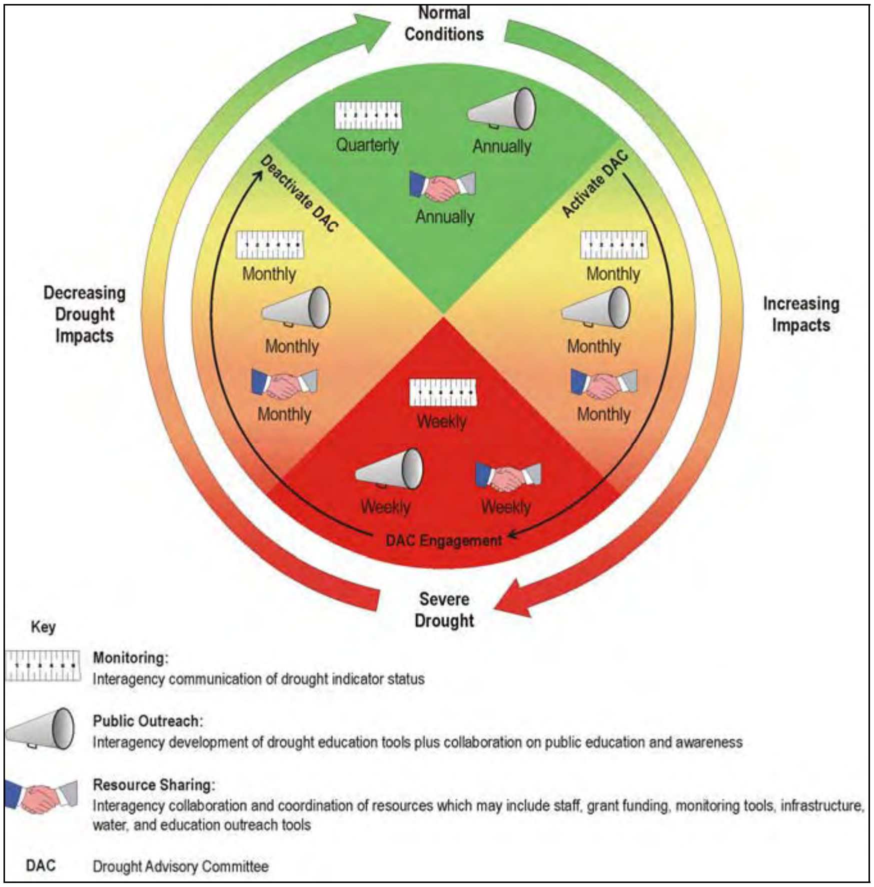


Figure 2. Drought Interagency Coordination Committee (DICC) Activities

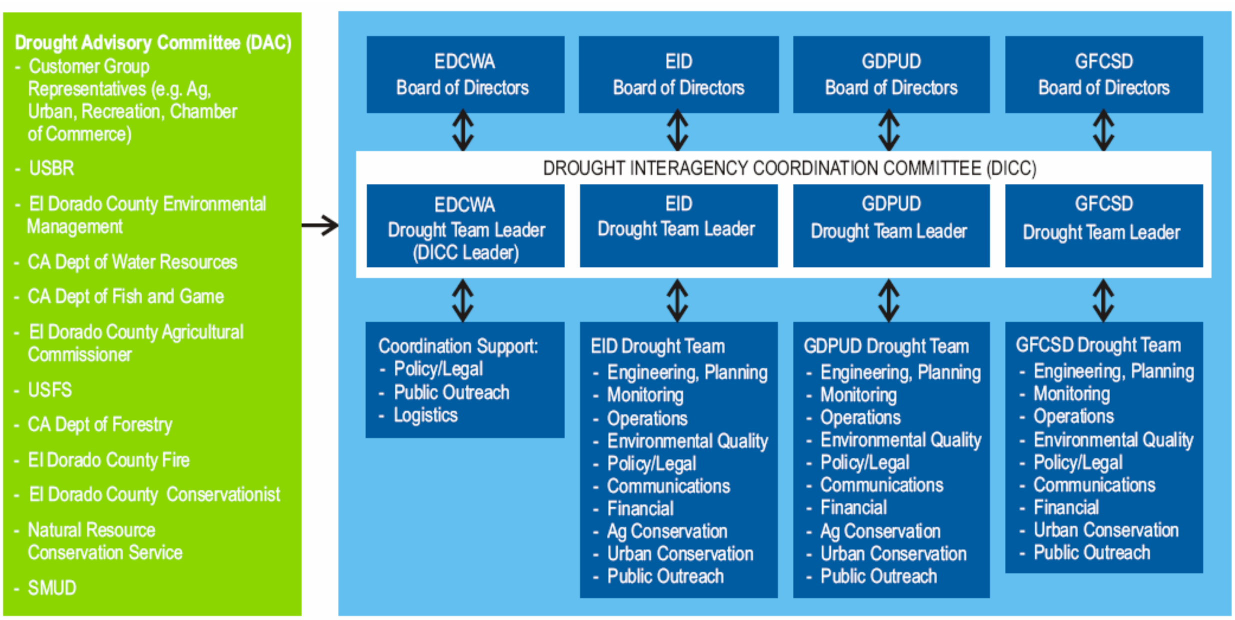


Figure 3. Drought Interagency Organization Structure

Drought Stage 1 Actions

Drought Stage 1 actions are intended to initiate public awareness of water shortages and encourage conservation. Stage 1 actions target up to 15 percent demand reduction through implementation of voluntary measures.

Policy and Regulation

1. Implement Stage 1 water shortage response measures. Customers are suggested to:
   - Apply irrigation water only during the evening and early morning hours (8 PM to 6 AM) to reduce evaporation losses.
   - Inspect all irrigation systems, repair leaks, and adjust spray heads to provide optimum coverage and eliminate avoidable over-spray.
   - Change the minutes of run-time for irrigation valves consistent with fluctuations in weather as determined by evapotranspiration (ET) data, obtained from EID or ET controllers.
   - Reduce minutes of run-time for each irrigation valve if water run-off (gutter flooding) is occurring.
   - Utilize water conservation incentive, rebate, and giveaway programs to replace high water-using plumbing fixtures and appliances with water efficient models.
   - Take advantage of the free information available from EID on how to use water efficiently, read a water meter, repair leaks, and irrigate efficiently.
   - Do not refill a swimming pool that had been drained.
   - Fix leaks.
   - Wash vehicles from a bucket. Use a hose equipped with a shutoff nozzle for a quick rinse (commercial car washes exempted).
2. Drought Team Leader provides monthly updates on drought status to EID management.
3. EID management provides monthly updates to Board.

Monitoring

1. Assess current drought stage monthly using Drought Status SRI Model with current demand and supply information.
2. Consider potential future hydrologic conditions in Drought Status SRI Model.
3. Monitor water demand monthly to assess water savings accomplished.

Public Outreach

1. Initiate community-oriented drought awareness with focus on community water use reduction goals and range of voluntary steps to accomplish savings.
2. Reacquaint customers with EID's Water Waste Prohibitions and introduce Stage 1 recommended water shortage response measures.
3. Provide monthly updates to public on current drought stage using the Drought Status SRI Model dashboard.
4. Provide monthly updates to public on community demand response status.

Resource Management

1. Monthly DICC meetings.
2. Confirm commitment by DAC members.

Drought Stage 2 Actions

Drought Stage 2 action items are intended to increase public understanding of worsening water supply conditions, encourage community-oriented voluntary conservation measures, enforce some mandatory conservation measures, and implement water use reduction measures to decrease "normal" demand by up to 30 percent. If the Stage 2 Voluntary Phase approach is not effective or becomes unfair to too many customers, then the Stage 2 Mandatory Phase will be implemented. Stage 2 activities include a continuation of activities described previously under Stage 1 and Ongoing actions. The achievement of the water use reduction goal is measured by overall performance of the entire customer population, based on EID production meters. It is important to note that user category demand reduction goals are not by individual customer, but are the goal for the customer category.

Policy and Regulation

1. Implement Stage 2 water shortage response measures, including a continuation of Stage 1 activities. The following are recommendations/restrictions to potable water customers.
    - Indoor residential use (excluding irrigation only use) is targeted to approximately 70 percent of the amount used when no water use reduction is required.
    - Any "irrigation only use" is targeted to approximately 55 percent of the amount used in the base year. (Higher demand reductions here to save water use in other areas that would force job cuts).
    - Commercial, industrial and institutional use is targeted to approximately 80 percent of the amount used by the customer in base year.
    - Restricted use of water from a fire hydrant - use limited to fighting fires, human consumption (hauling from designated sites allowed by persons whose wells have gone dry with EID Board approval), stock water, essential water quality flushing, and toxic clean-up purposes.
    - No watering of any existing turf grass, ornamental plants, garden, landscaped area, tree, shrub or other plant except by hand held hose or container, drip irrigation system, or other approved EID conservation practice.
    - No watering of new turf grass or replacement turf grass.
    - No initial filling of any swimming pool.
    - No automatic serving of drinking water at dining establishments except with patron request.

    Restrictions for agricultural customers are as follows:

    - Domestic Irrigation and AMI customers not participating in the IMS program, but have a water conservation plan on file with EID, will reduce water use by up to 15% of the base year or face financial penalty.
    - Domestic Irrigation and AMI customers not participating in the IMS program and do not have a water conservation plan on file with EID will reduce water use by up to 25% of the base year or face financial penalty.
    - Small Farm customers will reduce water use by up to 15% of the base year or face financial penalty.
    - New commercial crop plantings that are already in the ground will receive the full amount of water needed to ensure the survival of the crop.
    - New crops not already in the ground will not be irrigated using EID supplied water.
2. Drought Team Leader provides weekly updates on drought status to EID management.
3. EID management provides at least monthly updates to Board.

4. EID management provides the Board of Directors with an assessment of the need to enact a drought surcharge.

Monitoring

1. Assess current drought stage twice monthly using Drought Status SRI Model with current demand and supply information.
2. Consider potential future hydrologic conditions in Drought Status SRI Model.
3. Monitor water demand weekly to assess water savings accomplished under voluntary measuring.

Public Outreach

1. Accelerate community-oriented drought awareness with focus on community water use reduction goal and range of voluntary steps and mandatory requirements to accomplish savings.
2. Reinforce with customers the EID Water Waste Prohibitions and Stage 2 voluntary and mandatory recommended water shortage response measures.
3. Customers are informed that individual meter records will not be audited or fees levied if overall water use reduction goal is achieved.
4. Customers who can conserve more are strongly encouraged to help customers who would incur economic hardship if they met the water use reduction goal.
5. Provide weekly updates to public on current drought stage.
6. Provide weekly updates to public on community demand response status.

Resource Management

1. Weekly DICC meetings to coordinate on monitoring, public outreach, current status, and opportunities for resource sharing.
2. Enact participation by DAC members.

Drought Stage 3 Actions

The objective of Drought Stage 3 actions are to reduce water demand by up to 50 percent through effective and consistent public outreach, enforce extensive restrictions on water use, and implement water rationing. Protection of water supply for public health and safety purposes is the primary objective during Stage 3 drought conditions.

Policy and Regulation

1. Implement Stage 3 water shortage response measures which includes enforcing Stage 1 and Stage 2 recommended water shortage response measures. The following are restrictions to potable water customers.
   - Residential meters serving single family detached homes are granted a 68 gallons per day per person allotment.
   - Residential meters, serving multiple units are granted up to 50 percent of the amount used by the customer during the corresponding billing period in the base year.
   - Irrigation only meters: 35 percent of the amount used by the customer during the corresponding billing period in the base year.
   - Meters serving any non-residential use: 60 percent of the amount used by the customer during the corresponding billing period in the base year. (Note: Vital healthcare and public safety use is set at 65 percent).

   Agricultural customers will be affected as follows:
   - Domestic Irrigation and AMI customers not participating in the IMS program, but who have a water conservation plan on file with EID, will reduce water use by 30% of the base year or face financial penalty.
   - Domestic Irrigation and AMI customers not participating in the IMS program and who do not have a water conservation plan on file with EID will reduce water use by 50% of the base year or face financial penalty.
   - Small Farm customers will reduce water use by 30% of the base year or face financial penalty.
   - IMS Agricultural customers must utilize IMS program or surcharge enacted.

2. Drought Team Leader provides weekly updates on drought status to EID management.
3. EID management provides the Board of Directors with an assessment of the need to enact a drought surcharge.
4. EID management to provide recommendation to the Board of Directors on increasing the frequency on residential meter reading to monthly for accelerated assessment of demand reduction.

Monitoring

1. Assess current drought stage monthly using Drought Status SRI Model with current demand and supply information.
2. Consider potential future hydrologic conditions in Drought Status SRI Model.
3. Monitor water demand weekly to assess water savings accomplished.

Public Outreach

1. Accelerate community-oriented drought awareness with focus on community water use reduction goals, range of voluntary steps, and mandatory requirements to accomplish savings.
2. Reinforce with customers the EID Water Waste Prohibitions and Stage 3 mandatory water shortage response measures.
3. Provide weekly updates to public on current drought stage.
4. Provide weekly updates to public on community demand response status.
5. Continue with procedure for customer reporting of water waste.

Resource Management

1. Weekly DICC meetings to coordinate on monitoring, public outreach, current status, and opportunities for resource sharing.
2. Continue participation by DAC members.
3. Coordinate and schedule water hauling as needed.
4. Implement and monitor tap manifolds for emergency water distribution through hydrants as needed.

Attachment #11

EPA

U.S. EPA Asbestos Assessment for El Dorado Hills

U.S. ENVIRONMENTAL PROTECTION AGENCY • REGION 9 • SAN FRANCISCO, CALIFORNIA • MAY 2005

U.S. EPA and ATSDR Hold Asbestos Meetings

Two Asbestos Reports to be Released

This fact sheet was developed by the U.S. Environmental Protection Agency (U.S. EPA) to summarize findings of its October 2004 sampling for personal exposures to asbestos at three schools and the El Dorado Hills Community Park.

The information summarized here will be presented during part of the joint community meeting with the Agency for Toxic Substances and Disease Registry (ATSDR) and U.S. EPA to be held on Friday, May 6, 2005, from 7:00 p.m. - 10:00 p.m., at the Community Services District Gym, 1021 Harvard Way, El Dorado Hills.

During the Friday meeting, ATSDR will present findings from its Public Health Consultation on asbestos exposures at Oak Ridge High School. El Dorado County will present information on the county's plans to address asbestos.

On the following day, Saturday, May 7, representatives of ATSDR and U.S. EPA will be available from 10:00 a.m. - 2:00 p.m., at the Community Services District Gym to talk with the public. Additionally, ATSDR will be making presentations on the health effects of asbestos.

A third asbestos report, the Garden Valley Road Study conducted by the State of California Department of Toxic Substances Control (DTSC), was released on April 8, 2005. DTSC will be doing outreach in Garden Valley to notify residents of the results.

The U.S. EPA, ATSDR and DTSC are working together to coordinate the release of their reports and to provide technical assistance to the El Dorado Hills community.

Asbestos Public Meeting

May 6, 2005 • 7:00 pm - 10:00 pm

Location: Community Services District Gym

Availability Session

May 7, 2005 • 10:00 am - 2:00 pm

Location: Community Services District Gym

1021 Harvard Way, El Dorado Hills

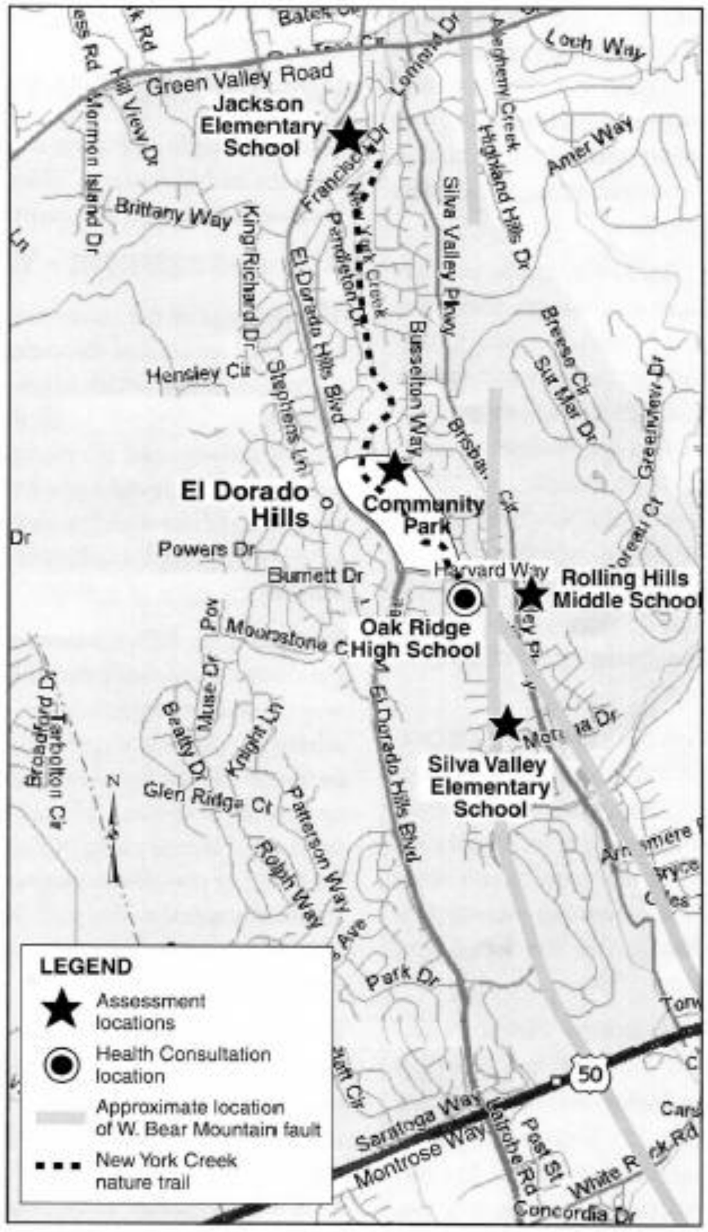


Figure 1: Assessment Locations and Health Consultation Locations

What is NOA? Why is EPA Involved?

Asbestos occurs in rock and soil as the result of natural geological processes, often near earthquake faults, as in El Dorado Hills and other parts of California. Disturbance of naturally occurring asbestos (NOA), through construction or recreational activities, for example, can release asbestos fibers into the air and lead to exposure for people engaged in these activities.

In California, there are two types of asbestos fibers that occur naturally in rock formations: amphibole and serpentine. Although both amphibole and serpentine asbestos are toxic, many scientists believe that amphibole asbestos fibers, which are found along the fault zone in El Dorado Hills, are more toxic than those found in serpentine.

Exposure to airborne asbestos can cause lung cancer and mesothelioma (a cancer of the lining of the chest cavity); it can also cause other life-threatening non-cancer diseases of the lungs and chest cavity.

Four factors that increase the risk of contracting asbestos-related disease are: (1) higher levels of asbestos fibers in the air, (2) higher frequency of exposure, (3) longer duration of exposure, and (4) the time that elapses after exposure.

What Was EPA Asked to Do?

In September 2003, U.S. EPA received a petition under the Superfund Law (also known as CERCLA) to assess asbestos exposure at public areas in El Dorado Hills near Oak Ridge High School. The petition was prompted by discovery of asbestos in the soil at Oak Ridge High School. U.S. EPA began working with State and local agencies to develop workplans and conduct the asbestos assessment.

What Sampling Areas Were Included in EPA's Assessment?

U.S. EPA's assessment was conducted at Silva Valley Elementary School, Rolling Hills Middle School, the Community Park, the New York Creek Nature Trail, and Jackson Elementary School. U.S. EPA focused on public areas where asbestos exposures to children could occur.

Why Did U.S. EPA Focus on Exposures to Children?

Children's activities often create higher personal exposures to dust, which may contain asbestos in NOA areas. The exposure of children to asbestos is of particular concern because their longer life expectancy exceeds the latency period for asbestos-related disease.

The Assessment - What Did U.S. EPA Do?

The purpose of the assessment was: (1) to measure personal exposures to asbestos during simulated sports and recreational activities of children and adults, (2) to determine which kinds of asbestos were present during exposure, (3) to collect nearby asbestos air samples outside the area of activity, and (4) to compare personal asbestos exposure levels during activities with the nearby asbestos air samples collected outside the areas of activity.

Previous U.S. EPA studies across the country indicated that the best way to measure exposures to asbestos in air was to perform personal monitoring during dust-generating activities. The asbestos content of the air samples from this monitoring provides a measure of personal exposure; this technique is called "activity-based personal air monitoring."

For the El Dorado Hills assessment, U.S. EPA simulated baseball, basketball and soccer games at the schools and the Community Park, running and biking on the New York Creek Nature Trail, playing in the children's playground at the Community Park, and gardening in the Jackson Elementary School garden. During the assessment, U.S. EPA personnel simulating these activities wore personal air samplers to collect dust from the breathing height of children and adults. Stationary air samplers were also set up to collect nearby asbestos samples outside the area of activity.

Understanding Risk

Asbestos occurs naturally in many Sierra foothill counties, including El Dorado County, as well as in many other parts of California. In any area of naturally occurring asbestos (NOA), it is likely there will be some low level risk associated with background concentrations of asbestos.

This is similar to the everyday risk that everyone experiences from different environmental factors such as air pollution in urban areas or earthquakes in earthquake-prone areas. It is impossible to completely eliminate these risks.

Reasonable and appropriate steps should be taken to reduce potential asbestos exposure. There are simple and practical steps that the entire community—county government, school districts, community services providers, business leaders and the public—can take to help manage this issue.

U.S. EPA conducted this activity-based personal monitoring from October 2 to October 10, 2004. Over 400 air samples were collected and approximately 180 soil samples. The air samples were analyzed by an internationally accepted technique (ISO 10312) for measuring asbestos fiber dimensions and identifying mineralogy.

What Did EPA Find?

U.S. EPA analyzed the asbestos fibers in two ways: PCME and AHERA. PCME is the acronym for a type of microscope used in asbestos investigations; AHERA is an acronym for the asbestos in schools regulation.

PCME fibers [1] are longer than 5 microns and are the basis for most health studies related to cancers in humans caused by asbestos exposure. PCME fibers are used by both U.S. EPA and Cal/EPA in asbestos cancer risk assessments.

U.S. EPA also measured total fibers, both short and long, called AHERA fibers, because there is some scientific concern that shorter fibers are important for non-cancer asbestos-related diseases.

U.S. EPA found that asbestos fibers were present in almost all El Dorado Hills air samples, whether from sports and play

OVERVIEW OF RESULTS
U.S. EPA Activity-Based Asbestos Exposure Sampling • October 2004

Location & Activity Scenario	Long Fibers (PCME) [1, 4]			Total Fibers (AHERA) [2, 4]		
	Ratio: Personal Exposure to Reference [3]	*Average of Personal Exposure (f/cc)*	*Average of Reference Concentration (f/cc)[5]*	*Ratio: Personal Exposure to Reference* [3]	*Average of Personal Exposure (s/cc)*	*Average of Reference Concentration (s/cc)[5]*
New York Trail,						
Child Biking Scenario	43	0.0336	0.0008	23	0.0564	0.0024
New York Trail,						
Adult Jogging Scenario-B	39	0.0212	0.0005	28	0.0439	0.0016
Adult Jogging Scenario-A	12	0.0197	0.0017	10	0.0347	0.0036
North Field Baseball Diamond, Community Park						
Child Baseball Game	22	0.0171	0.0008	21	0.0513	0.0024
South Field Baseball Diamond, Community Park						
Child Baseball Game A	22	0.0168	0.0008	217	0.5307	0.0024
Child Baseball Game B	5	0.0089	0.0017	37	0.1333	0.0036
Soccer Field, Community Park						
Child Soccer Game	16	0.0087	0.0005	11	0.0175	0.0016
Toddler Playground, Community Park,						
Typical Child Play Scenario	10	0.0067	0.0007	60	0.0816	0.0014
Silva Valley Baseball Diamond, Silva Valley Elementary School						
Child Baseball Game A	9	0.0062	0.0006	7	0.0144	0.0021
Child Baseball Game B	7	0.0032	0.0005	5	0.0066	0.0012
Baseball & Maintenance	4	0.0024	0.0006	NS	0.0041	0.0021
Rolling Hills Basketball Court, Rolling Hills Middle School						
Child Basketball Game	4	0.0017	0.0005	3	0.0043	0.0012
Rolling Hills Soccer Field, Rolling Hills Middle School						
Child Soccer Game	3	0.0013	0.0005	NS	0.0017	0.0012
Jackson Elementary School						
Child Basketball Game	3	0.0026	0.0010	3	0.0075	0.0022
Southern Reference, average.			0.0008			0.0021
Northern Reference, average.			0.0009			0.0021

Notes:
Statistical significance of elevated exposure determined by Z-test (AHERA) - "NS" = not significant
[1] PCME fibers = fibers longer than 5 microns with a width between 0.25 and 3 microns, and an aspect ratio (length to width) greater than 3:1
[2] "AHERA fibers" = fibers longer than 0.5 microns with an aspect ratio greater than 3:1 (Note this differs somewhat from the strict AHERA fiber definition.)
[3] Ratio = average asbestos concentration from personal samples collected during simulated activity divided by the average asbestos concentration from "reference" samples collected the same day at locations removed from the influence of the activity.
[4] Fiber counts are from direct analysis of PCM filters using ISO 10312 procedure.
[5] Reference Concentration refers to the average asbestos concentration measured on the same day by 5 stationary monitoring stations. These reference stations were located in the general study area, but outside of the zone of influence by the activity.

activities or from samples collected nearby, but outside the areas of the activity sampling. The dominant fiber type for most air samples, especially for the longer PCME fibers, was amphibole (mainly actinolite and tremolite). However, short chrysotile fibers were also present at high levels from activities at the Community Park baseball fields and at the children's playground.

U.S. EPA's results showed that personal exposure levels of asbestos were significantly higher during most sports and play activities as compared to nearby asbestos air samples taken outside the areas of activity.

U.S. EPA's validated data paints a consistent picture concerning asbestos fibers detected in air samples. A subset of U.S. EPA's data will be released before the May 6, 2005 community meeting. Copies will be available at the Information Repositories identified below and at the public meeting on May 6, 2005, and at the U.S. EPA's Availability Session on May 7, 2005.

Table 1 summarizes the comparative results. The values in Table 1 represent the amount by which personal asbestos exposures were greater than those nearby asbestos reference air samples collected outside the area of activity (the values come from the ratio of activity-based readings compared to those taken nearby, but outside the area of activity).

What Do the Results Mean?

U.S. EPA's results show that engaging in a variety of sports and play activities in the areas tested can expose individuals participating in those activities to significantly elevated levels of amphibole asbestos. In some cases, especially at the Community Park baseball fields, elevations in short-fiber chrysotile exposures were also observed.

U.S. EPA observed that play within the children's playground at the Community Park can generate elevated exposure levels for the children playing there. U.S. EPA also found that even when there is no activity at the toddler playground, asbestos levels there are higher because of activities elsewhere in the Community Park.

In most cases, these exposure levels are of concern because of the potential for long-term development of asbestos-related diseases.

U.S. EPA's concern is further heightened because this preliminary conclusion may not fully account for the higher toxicity of amphibole asbestos, as well as other uncertainties related to short-term, intermittent exposures early in life. Therefore, the actual risk potential may be higher - although current Agency risk assessments cannot specify exactly how much higher.

Figure 1: Contractor in protective gear simulates baseball activity

However, U.S. EPA does know that the risk of contracting an asbestos related disease increases with exposure, and that higher exposure and greater frequency and duration of exposure increases the risk. Because of their longer life expectancy, children have more time to develop asbestos related diseases that typically have a decades-long latency period and are therefore at higher risk than adults.

The Agency is recommending that all parties—federal/state/local government, the community and the private sector—work together to find ways to reduce these elevated exposures.

What Happens Next?

National Experts Panel - In the light of the risk uncertainties, and to help us understand the significance of these elevated exposures, U.S. EPA is putting together an independent panel of experts in the field of human health as it relates to asbestos to further evaluate U.S. EPA data.

Activity-Based Asbestos Sampling in Other Areas - U.S. EPA will be conducting limited activity-based asbestos sampling, similar to what was done in El Dorado Hills, in another NOA area in California, outside of El Dorado County. This sampling, and off-road vehicle activity asbestos sampling U.S. EPA is conducting at the Clear Creek Management Area in San Benito County, will be used to expand the knowledge base on the significance of NOA exposures in California.

Coordination with State and County Agencies - U.S. EPA will continue to coordinate with State and County agencies to address NOA exposures through regulatory and voluntary actions.

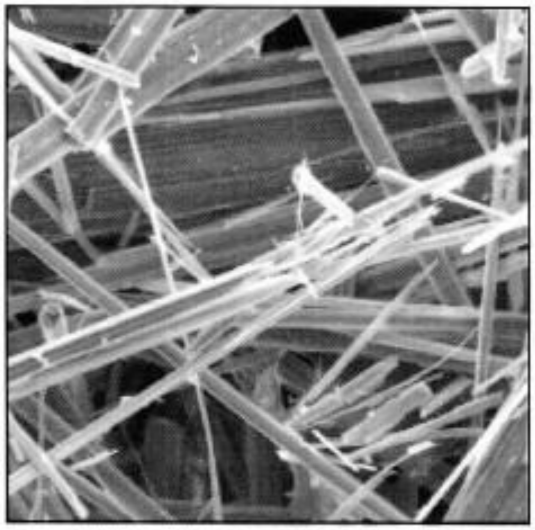


Figure 2: Amphibole asbestos fiber seen through a powerful microscope

Communication with the Community - U.S. EPA will continue to meet with the informal Community Advisory Committee and other stakeholders and community members to explain our data and steps that are being taken to control asbestos exposure.

Summary

U.S. EPA found asbestos fibers in almost all El Dorado Hills air samples, including those collected nearby, but outside the area of activity. In general, personal asbestos exposures from simulated sports and play activities were significantly elevated over levels observed in the nearby asbestos air samples taken outside the area of activity. The dominant asbestos fiber type detected was amphibole, which is considered to be more toxic than chrysotile.

U.S. EPA is concerned about long term health effects from asbestos exposure. The long term health effects related to intermittent, high level, environmental exposure to amphibole asbestos cannot be quantified, particularly when that exposure occurs at an early age.

However, we do know that the risk of contracting an asbestos related disease increases with the following factors: (1) higher levels of asbestos fibers in the air, (2) higher frequency of exposure, (3) longer duration of exposure, and (4) the time that elapses after exposure.

The exposure of children to asbestos is of particular concern because their longer life expectancy exceeds the latency period for asbestos related disease.

U.S. EPA believes that action is needed to reduce asbestos exposures. We know that there are ways to accomplish this goal. The entire community – regulators, schools, community service providers, the private sector, and the public – needs to get involved in solving this problem.

cut here

MAILING LIST COUPON

Naturally Occurring Asbestos in California — El Dorado Hills mailing list

Release my information for a local community group contact list: ☐ Please delete my contact information: ☐

Name: ______________________________

Address: ______________________________ Phone: ______________

City: ______________________________ State/ ZIP: ______________

E-mail address: ______________________________

U.S. EPA and ATSDR Hold Asbestos Meetings
Two Asbestos Reports to be Released

For More Information

U.S. EPA documents are available at El Dorado County libraries

The U.S. Environmental Protection Agency will maintain local information repositories, with copies of documents related to our work on naturally occurring asbestos, at two branches of the El Dorado County Library:

El Dorado County Library
Oak Ridge High School branch
1120 Harvard Way, El Dorado Hills

El Dorado County Library
Main branch
345 Fair Lane, Placerville

Selected documents are available from the USEPA's web site at http://www.epa.gov/region09/ toxic/noa. Please contact the Superfund Records Center at 415-536-2000 to request paper copies.

Please contact the people below if you have any questions or concerns

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U.S. Environmental Protection Agency, Region IX
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San Francisco, CA 94105
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Attachment #12

Mountain Democrat
Friday, January 23, 2015 PLACERVILLE, CALIFORNIA 99 CENTS

Serrano ‘finger’ residents get a choice

THE DISTRICT'S school statistician, Ken Reynolds of Schoolworks, presented myriad scenarios regarding school boundaries affecting Blackstone residents and those residents living in a portion of Upper Serrano dubbed "the finger." Democrat photo by Julie Samrick

By Julie Samrick

From page A5 | January 23, 2015 |

During the second portion of the meeting Tuesday in the Oak Ridge Multipurpose room, students living in “the finger” and the attendance path that would best serve them were discussed. The eastern Serrano neighborhood got its nickname when boundaries were redrawn in 2005 and their neighborhood, still under construction, jutted out farther to the east than the rest, depicting the shape of an isolated finger.

Jessica Garver, 12, and her mom Kelli said where Jessica would go to high school has weighed on the family since Jessica started kindergarten at Lakeview Elementary. Along with approximately 14 other children per year, students living in “the finger” are bused to Lakeview (feeder to Oak Ridge), then Marina Village Middle School (feeder to Oak Ridge), only to attend Ponderosa for high school.

“It’s always been hard for me to make friends,” Jessica said. “My first day at Marina I was scared but then I was OK once I saw familiar faces. I want the same thing to happen at Oak Ridge.”

“This world’s hard enough,” Kelli said. “I went to Oak Ridge. This area has been crowded since then. I can’t believe it’s still an issue.”

Serrano resident David Tierney put comfort aside and wanted to know where his Mello-Roos tax dollars are going.

"A smaller school is ideal, but I'm concerned there's 4,000 households in Serrano that pay a special tax to support our local school," he said. "Many would argue we're at the point we could support two high schools. If it could be done that would be the ideal option. Over 20 years we've paid close to $30 million. If a second high school won't be built at least our kids should be sent to local schools."

Another Serrano resident and Oak Ridge parent was angry. "Whatever option we decide, Oak Ridge will be over capacity," he said. "Where is the money we put in Serrano? These suggestions are a Band-Aid. We should have the right to attend Oak Ridge more than any other community in El Dorado Hills that doesn't pay a Mello-Roos tax."

District 1 Supervisor Ron Mikulaco said he'd like to see all Serrano parents and students have the same right given to Blackstone residents to choose.

The El Dorado Union High School District's statistician, Ken Reynolds of SchoolWorks, presented three boundary scenarios. Option B1 would provide for an optional attendance area between Ponderosa and Oak Ridge for those who live in the Marina Village or Rolling Hills attendance areas and west of Bass Lake Road. Option B2 provides for an optional attendance area between Ponderosa and Oak Ridge based on Rolling Hills and Marina Village Middle School current boundary lines. B3 would provide an optional attendance area between Oak Ridge and Ponderosa using middle school attendance boundaries plus all Serrano developments.

The board voted 5-0 for option B1 to provide the option of Ponderosa High School or Oak Ridge High School. With that option, at its peak projected enrollment in the 2019-20 school year, Oak Ridge would have a net increase of 90 students and Ponderosa would have a net decrease in comparison to current projections.

"However, these numbers won't be real projections in a system of choice," Reynolds said. "Only time will tell what happens."

Brown pointed out that any student may attend another high school in the district if their home school isn't impacted. "Even looking at the worst case scenario, (Oak Ridge is expected to be at 103 percent capacity in an optional attendance scenario) it hasn't happened yet," he said.

It may not happen yet, but Steve Wehr pointed out concerns for increased enrollment at Oak Ridge, which currently has 2,388 students and full capacity is 2,405. "Twenty-two percent of Oak Ridge teachers currently teach more than a full load to accommodate students," he said. There are also concerns about parking, cafeteria and classroom space. Portable classrooms cost approximately $150,000 each and Wehr estimated Oak Ridge would need four to five to accommodate projected enrollment.

"Personalizing the school experience is a challenge at a school this size," Wehr added, noting the nine years he was Oak Ridge's principal.

"I've always been a believer in neighborhood schools, but we're looking to impact a school that's already impacted," said Trustee David Del Rio.

Trustee Lori Veerkamp said she'd like to look at the cost for building a permanent structure at Oak Ridge instead of portables and she also mentioned looking into off-site athletic fields.

"Where's the breaking point?" asked Trustee Tim Cary. "Some could say we're already there and past it. We can add facilities, but again, making things bigger isn't always better."

Assistant Superintendent for Educational Services and Testing Chris Moore touted Oak Ridge for serving students despite its size. "The excellence at Oak Ridge is there from an educational-outcome perspective," he said. "The staff and administration are doing a great job."

"The only reason I'd vote for B1 is to promote choice, but I'm truly concerned," Cary said. "I'm not in favor of building more when we have excellent facilities in place that are under capacity."

Director Todd White drew applause when he said, "Using Mello-Roos funds, we have the money to pay for increased capacity in the short-term."

The board voted 5-0 to formally vote Feb. 10 to approve option B1, which would mean an optional attendance area between Ponderosa and Oak Ridge for those who live in the Marina Village or Rolling Hills attendance areas and west of Bass Lake Road, including those students living in "the finger."

"We are extremely grateful to those who took the time to attend this meeting and express their thoughts," Board President Kevin Brown said. "This two-way conversation with the community will allow us to make decisions that will benefit our students and families."

Mountain Democrat

Friday, January 23, 2015 PLACERVILLE, CALIFORNIA 99 CENTS

School choice wins in boundary fight

EDUHSD Board President Kevin Brown sits between Superintendent Stephen Wehr, right, and Director Todd White, left. Tuesday's meeting was a public workshop to decide on formal action to be taken Feb. 10. Democrat photo by Julie Samrick

By Julie Samrick

From page A1 | January 23, 2015 |

Oak Ridge High School's multipurpose room was filled during a special board meeting of the El Dorado Union High School district Tuesday night. During the four-hour public workshop, school attendance boundaries in the Blackstone region and an eastern Serrano neighborhood nicknamed "the finger" were discussed and different scenarios proposed.

Though no formal action could be taken during the public workshop, after the lengthy public comment period it was declared school choice won the night and the board of trustees unanimously voted to soften the school boundary lines that were redrawn in 2005 at their Feb. 10 board meeting.

Board president Kevin Brown opened the meeting by dispelling the rumor Union Mine is closing. "That's false," he said. Children in the El Dorado Hills Blackstone community south of White Rock Road are slated to attend Union Mine, but many parents were there to express their concern that the school, which is three towns to the east in Diamond Springs, is too far and that such a move separates their kids from their peer group.

Gillian Keane has been a Blackstone resident since 2012. Though her two young children won't be in the school system for several years, she came to Tuesday's meeting to learn what plan will be in place. "I want my children to be with a set of friends they move from school to school with so they can build lasting relationships," she said.

Their Realtor told the Keanes their children would go to Oak Ridge, but she, along with her neighbors, recently learned that's not the case. Current Blackstone children attend William Brooks Elementary (feeds to Oak Ridge), then Camerado Springs Middle School (feeds to Ponderosa) and finally Union Mine High School. "Those kids are torn apart three times," community activist and El Dorado Hills resident Catie Phemester said in an earlier report on this issue.

The El Dorado Union High School District's statistician, Ken Reynolds of SchoolWorks, presented various boundary scenarios, which outlined 10-year enrollment projections for all four of the district's high schools if the boundaries are redrawn or if they stay the same. Concerns about sending Blackstone children (as well as future children who live in future planned developments of Marble Valley, Valley View and Deer Creek) to Ponderosa instead of Union Mine, and eastern Serrano children to Oak Ridge instead of Ponderosa, lie primarily with the fact that Union Mine has room for 400 more students and is only at 71 percent capacity, while Ponderosa is currently at 80 percent capacity. Oak Ridge is at 98 percent capacity today, but is expected to exceed capacity (103 percent) by the 2019-2020 school year if the boundaries are redrawn.

While growth on the western slope continued after the recession, it stalled farther up the hill near El Dorado and Diamond Springs. Still, a fifth high school remains out of the question for now because it costs $150 million to build a new one and after 2020 all schools in the district are expected to see flat or declining enrollment.

During Reynolds' presentation he said that if Blackstone, Marble Valley, Valley View and Deer Creek students live in an optional attendance area between Ponderosa and Union Mine, there would be an increase of 83 students in the 2017-18 school year at Ponderosa, which would be an increase of 151 students in comparison to current projections. That could be a "pretty significant number," considering Union Mine is 71 percent filled with 1,000 students today, he said.

Not all parents and children there want to attend Ponderosa. A majority of the speakers at the meeting were actually there to tout the merits of Union Mine. Students, staff and parents said the commute to Union Mine is well worth it because of small class sizes, a 4X4 block schedule (four classes per semester) and sport opportunities, among other reasons.

Dave Wells said he has been involved in the local youth sports community for the past 15 years and his son thrived once he started Union Mine because there are fewer kids vying for the same spot on the team.

Blackstone resident Elizabeth Carluccio said she moved to Blackstone because of Union Mine and to please not change the boundary to Ponderosa. "My children willingly take that bus because they believe in that school," she said.

Retired educator Jack Jordan helped open Union Mine. "They are all good schools in this district," he said. "My issue is forcing kids to leave their cohort group. Instead of forcing kids to go to Union Mine, promote it instead. I know lots of kids would voluntarily go there for the smaller environment."

After nearly two hours of public comments, Brown presented the Board of Trustees with two options: keep the Blackstone and surrounding area school boundary as is or make it a dual boundary zone where families could choose between Ponderosa or Union Mine.

Trustee Tim Cary was the most hesitant about voting for optional attendance areas. “We don’t know how (future subdivisions) Deer Valley, Marble Valley and Valley View will build out,” he said. “Blackstone is here now. My vote for it is only because we have to take care of the kids affected now.

“Bigger isn’t better,” Cary continued. “In fact, I’m concerned about schools getting bigger.” That issue would be repeated later while discussing Oak Ridge.

Cary also clarified that the high school district does not set middle school boundaries.

“Is Union Mine viable if we do a dual attendance area for Blackstone?” Cary asked

High school district Superintendent Stephen Wehr replied, “I’d say yes, but we’ll have to look at how we support that.”

Brown said he was surprised so many Blackstone residents may opt to stay at Union Mine. “It’s not what I thought,” he said. “It sounds like only 50/50 or 60/40 will leave Union Mine for Ponderosa.”

What people choose to do is the question, but Reynolds said there is projected to be adequate space at Ponderosa (currently at 80 percent capacity) for at least the next 10 years due to the slowdown in development activity caused by the recession.

Wehr also confirmed that even in a dual boundary zone incoming freshmen would have to declare their school of athletic eligibility.

“We need to stop drawing boundary lines but talk about how to make existing schools more desirable,” Trustee Todd White said.

The Board of Trustees voted 5-0 in favor of an optional attendance area between Ponderosa and Union Mine for Blackstone, Valley View, Marble Valley and Deer Creek developments. It will formally vote to enact it at the Feb. 10 board meeting.

Parents Furious over El Dorado School Boundaries

POSTED 11:51 PM, DECEMBER 9, 2014, BY RINA NAKANO, UPDATED AT 11:50PM, DECEMBER 9, 2014

EL DORADO COUNTY-
Concerned parents and students filled the El Dorado Union High School board meeting room Tuesday night, to discuss the current boundaries.

The boundaries set eight years ago are causing a small percentage of students living in certain El Dorado Hills communities to change schools at every level, instead of going to presumed feeder schools in their neighborhoods.

Many parents and students voiced their concerns in tears at the meeting, explaining that frequent unnatural change in schools is illogical and cruel to the children.

“The boundaries are somewhat robbing our children of some of their high school experience,” one parent said. “At least one hour of sleep in the morning, and hours of activity for homework in the afternoon.”

The boundary set in 2006 forces students in the Serrano community commute ten miles to Ponderosa High School instead of natural feeder school, Oak Ridge High.

David Bicknell, whose son Drake now attends Marina Middle School, will be one of few students to attend Ponderosa High School.

“He is involved in multiple sports in the El Dorado Hills Community,” he said. “He went to elementary school there, goes to middle school there, and now he’s being asked to be bussed to a high school where he will know no one.”

Residents in the Blackstone Community will face a similar situation. Students there go to Union Mine High School instead of nearby Ponderosa High School.

Parents say this constant change in school and friends will most definitely affect their children’s social upbringing.

“Students that are most impacted by bullying are those with little friends, illness and disability,” Blackstone Community parent, Mysti Freyenberger said. “My son is in both those categories, so of course that is a fear of mine.”

Alyssa Rodne, 11, now attends Camerado Springs Middle School. She is slated to go to Union Mine High school in two years, while 97 percent of her classmates will attend Ponderosa.

“I’m scared when i go to a new school, I won’t make as many friends or have as many friends,” she said.

Board member Todd White agreed with these parents. He believes those in Blackstone should attend Ponderosa High, and Serrano residents should go to Oak Ridge High School.

“The students that are affected, the number is so low that I don’t think either school will be over impacted, and our own data suggests that,” he said.

His colleague, Tim Cary suggested discussions with everyone involved shoulda take place.

“I’m hearing about how some of these kids will have to travel 10 more miles, but if we were to close Union Mine, how about the kids who have to travel from Somerset over Latrobe?” he asked.

At the end of the meeting, the Board agreed with the Superintendent that a public workshop dedicated to this specific topic would be beneficial.

“I think some of thse suggestions that will come out of the meeting will make this process not seem so difficult,” Kevin Brown, President of the El Dorado Union High School District said.

The special public workshop will be held at the Ponderosa High School cafeteria at 5 p.m. on Jan. 20, 2015.

Attachment #13

Dixon Ranch

Wildland Fire Safe Plan

Prepared for:

Dixon Ranch Partners LLC

Prepared by:

CDS Fire Prevention Planning
William F. Draper
Registered Professional Forester
#898
4645 Meadowlark Way
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July 22, 2013
Revised

Dixon Ranch

Approved by:

8-12-13

Michael Lilienthal, DC
Fire Marshal
El Dorado Hills Fire Protection District

Date

8-12-13

Dario McFarlin, Fire Captain
Fire Prevention
California Department of
Forestry and Fire Protection

Date

Prepared by:

8-13-13

William F. Draper
RPF #898

Date

PROFESSIONAL FORESTER
WILLIAM F. DRAPER
No. 898
STATE OF CALIFORNIA

CONTENTS

I. PURPOSE AND SCOPE

Communities are increasingly concerned about wildfire safety. Drought years coupled with flammable vegetation and annual periods of severe fire weather insure the potential for periodic wildfires.

The purpose of this plan is to assess the wildfire hazards and risks of the Dixon Ranch subdivision, to identify measures to reduce these hazards and risks and protect the native vegetation. There are light to moderate fuel hazards and gentle topography associated with this proposed project both on and adjacent to the project.

The possibility of large fires occurring when the subdivision is complete will be greatly reduced. However, small wildfires in the open space areas and on the larger lots may occur due to the increase in public uses.

Incorporation of the fire hazard reduction measures into the design and maintenance of the future parcels will reduce the size and intensity of wildfires and help prevent catastrophic fire losses. State and County regulations provide the basic guidelines and requirements for fire safe mitigation measures and defensible space around dwellings. This plan builds on these basic rules and provides additional fire hazard reduction measures customized to the topography and vegetation of the development with special emphases on the interface of homes and wildland fuels.

The scope of the Dixon Ranch Wildland Fire Safe Plan recognizes the extraordinary natural features of the area and designs wildfire safety measures which are meant to compliment and become part of the community design. The Plan contains measures for providing and maintaining defensible space around future homes and open space. Plan implementation measures must be maintained in order to assure adequate wildfire protection.

Homeowners who live in and adjacent to the wildfire environment must take primary responsibility along with the fire services for ensuring their homes have sufficient low ignitability and surrounding fuel reduction treatment. The fire services should become a community partner providing homeowners with technical assistance as well as fire response. For this to succeed it must be shared and implemented equally by homeowners and the fire services.

II. FIRE PLAN LIMITATIONS

The Wildland Fire Safe Plan for Dixon Ranch development does not guarantee that wildfire will not threaten, damage or destroy natural resources, homes or endanger residents. However, the full implementation of the mitigation measures will greatly reduce the exposure of homes to potential loss from wildfire and provide defensible space for firefighters and residents as well as protect the native vegetation. Specific items are listed for homeowner’s attention to aid in home wildfire safety.

III. DIXON RANCH WILDLAND FIRE SAFE PLAN

1. PROJECT DESCRIPTION

The Dixon Ranch subdivision is located in between Green Valley Road, on the north, Aberdeen Lane, to the southwest and Green Springs Estates, to the south and east, in the El Dorado Hills area. The project will access Green Valley Road in two locations. Drive "A" enters Green Valley Road southeast of Lexi Way and Drive "C" intersects Green Valley Road just northwest of Lexi Way. Due to the close proximity of these two new intersections, additional emergency access is being provided. The project, as designed, meets the intent of Fire Safe and Division of Transportation standards. As designed, there are 3 emergency vehicle access (eva) roads being proposed. One would connect to Marden Drive while the second eva may connect in the future with East Green Springs Road and the third eva connects to Lima Way. The East Green Springs Road eva is only being constructed to the Dixon Ranch property line. The adjacent development will need to make the eva connection if desired. The eva's would have electric gates that would open by a telephone remote. That telephone number would be provided to the fire agencies and law enforcement. Law enforcement is responsible for evacuations. The gates shall also have Knox key switches that operate electronically. The gates shall lock open if there is a power failure. Road signs shall be posted stating emergency access routes. All roads will be constructed to El Dorado County Transportation Division (TD) and Fire Safe (LDMS) standards. Drive "A" and "C" will be 36' of travel surface and all the interior roads will be 30' wide. Drive "C" will have a 24' wide section as it crosses between the two ponds. The eva's would be a minimum of 20' and posted "No Parking". The project shall be served by El Dorado Irrigation District (EID). All fire hydrant locations and spacing shall be determined by El Dorado Hills Fire and the Residential Fire Code. There is not any road work anticipated to any existing roads beyond the normal encroachment and clearing of a fuel hazard reduction zone. Any private gate shall meet the requirements of El Dorado Hills Fire. A fuel hazard reduction zone along the entire length of the roads in and adjacent to the project and around the perimeter of the project will be needed. The project is proposing to split parcels APN: 126-020-01, 02, 03, 04, and 126-150-23 totaling 280 acres into 605 lots. Lot 1 is the existing Dixon Ranch. This lot will be exempt from the provisions of this plan but subject to all current Fire Safe Regulations, Fire District and County regulations/ordinances. There are 10 lots 1 acre or larger which are subject to clearance requirements (See Appendix A) that the small lots may not have to meet. Residential fire sprinklers shall be required by the Residential Building Code as it currently exists or amended at the time of construction.

A series of open space lots are incorporated into this subdivision. There are open space lots around the perimeter of the project and interspersed between the roads. They may finger up into the neighborhoods. Also, there are open space lots, Lot "A" and "B" that will serve as parks. There are two standards for treatment of the open space areas depending on the intended use. See the mitigating measures for these treatments. Trails within the open space shall be maintained, be posted "No Smoking" and have fire access. Access would be limited by the trail width, grade and fuel hazard reduction zone. All fencing adjacent to any open space shall be constructed from nonflammable material.

There are wet areas within the open space lots. Blackberries and gray pines are often associated with these areas. Special consideration needs to be given to the wet areas so that fuels do not accumulate. Grazing has kept the fuels in these areas to a minimum. Once grazing stops, the vegetation will expand their area of coverage and become more of a fire hazard.

A Community Service District (CSD), Lighting and Landscape District (LLD) or a Zone of Benefit (ZOB) shall be formed for the purpose of maintaining the fuel hazard reduction zones along the roads and open space areas and all eva gates. Annual maintenance is essential and required for keeping fire safe conditions viable.

The El Dorado Hills Fire Protection District provides all fire and emergency medical services to this project. The California Department of Forestry and Fire Protection (CALFIRE) has wildland fire responsibility in this state responsibility area (SRA).

2. PROJECT VEGETATION (FUELS)

For wildfire planning purposes the vegetation is classified as follows:

(a) ground fuels- annual grasses, blackberries and buckeye and downed limbs (Brush)
(b) overstory- scattered live oaks, blue oaks and gray pine.

The property has varied terrain ranging from flat to mostly gentle slopes. Slopes are generally north to east facing and up to 20%. There are steeper slopes in the open space stream zones up to 60%. Fire hazard reduction of the fuels will be extremely important to the house sites and surrounding areas. Much of the tree canopy is open grown oaks and gray pines. These trees typically have limbs and canopy reaching the ground creating ladder fuels. Ladder fuels will need to be eliminated. Limbing of trees is important to reduce their susceptibility from a ground fire. Tree spacing on the slopes is a critical component to attaining the required fire safe clearances. A separation of the brush fuels and trees are essential for creating the defensible space around the residence and along the perimeter. CALFIRE guidelines for the 100 foot clearance requirements are attached.

3. PROBLEM STATEMENTS

A. The brush fuels on the slopes will ignite and have a rapid rate of spread.

Fire in the grass and brush fuels on the slopes is the most serious wildfire problem for this project.

B. Risk of fire starts will increase with development.

The greatest risk from fire ignition will be along roads and on large lots as human activity increases in these areas.

C. Provisions must be made to maintain all fuel treatments.

The wildfire protection values of fuel reduction are rapidly lost if not maintained. Continued review of potential ladder fuels to maintain a fire safe environment is very important. Annual maintenance by June 1 of each year is necessary.

D. Typical home design and siting often does not recognize adequate wildfire mitigation measures.

A review of many wildfires has conclusively shown that most home losses occur when: (1) there is inadequate clearing of flammable vegetation around a house, (2) roofs are not fire resistant, (3) homes are sited in hazardous locations, (4) firebrand ignition points and heat traps are not adequately protected and (5) there is a lack of water for suppression.

4. GOALS

A. Modify the continuity of high hazard vegetation fuels.
B. Reduce the size and intensity of wildfires.

C. Ensure defensible space is provided around all structures.
D. Design fuel treatments to minimize tree removal.
E. Ensure fuel treatment measures are maintained.
F. Identify fire safe structural features.
G. Help homeowners protect their homes from wildfire.

5. <u>WILDFIRE MITIGATION MEASURES</u>

Wildfire mitigation measures are designed to accomplish the Goals by providing and maintaining defensible space and treating high hazard fuel areas. Fire hazard severity is reduced through these mitigation measures. The Wildland Fire Safe Plan places emphasis on defensible space around structures and project perimeter.

The residential construction materials, fire hydrant location and fuel treatment will be extremely important in the development of these new lots. Lot setback will vary depending on lot size and location.

Fuel hazard reduction zones (FHRZ) of at least 30 feet in width shall be installed around the perimeter of the project and a 10 foot fuel hazard reduction zone along both sides of all roads except for the eva routes. The FHRZ adjacent to the eva's shall also be 30 feet. All interior open space perimeters shall have a 20' FHRZ adjacent to backyards. Sidewalks and planted landscaping may be a part of the FHRZ. Any tree canopy over the roads and driveways will have 15' of vertical clearance over the roadways. Nonflammable fencing shall be used adjacent to all open space areas and the eva's.

All residences shall be required to have NFPA 13D fire sprinkler systems. The project is located in a Moderate Fire Hazard Severity Zone. Implementation of Wildland-Urban Interface Fire Areas Building Standards will be required for the construction of new residences. These standards address roofing, venting, eave enclosure, windows, exterior doors, siding, and decking.

Clearance along the road and around structures is very important and necessary. Fire Safe specifications state that all trees in the fuel hazard reduction zones shall be thinned so the crowns are not touching. Branches on remaining trees shall be pruned up 10 feet as measured on the uphill side of the tree. Brush shall be removed. Grasses shall be kept mowed to a 2 inch stubble annually by June 1. Any tree crown canopy over the driveways shall be pruned at least 15 feet up from the driveway surface.

This zone is in addition to the clearances required by state law. The State required Fire Safe clearances (PRC 4291) shall be implemented around all structures (See CALFIRE Guideline). <u>Clearances may be required at the time of construction by the County.</u>

More restrictive standards may be applied by approving El Dorado County Authorities. Approval of this plan does not by itself guarantee approval of this project. All mitigating measures in this plan while integrated must also stand alone. If one measure is determined to be invalid, all other measures shall remain in effect. The Wildland Fire Safe Plan shall be amended to correct any changes if necessary.

Mitigation Measures:

- **Driveways shall be 12 feet wide. Driveways shall comply with the DOT weight standards.**
  - **a. Responsibility- homeowner**

- **All private driveway gates shall be inset on the driveway at least 30 feet from the road. Gate opening shall be 2 feet wider than the driveway. Knox lock access shall be provided to the fire department.**
    a. **Responsibility- homeowner**

- **All homes shall have Class A listed roof covering.**
    a. **Responsibility- homeowner**

- **Decks that are cantilevered over the natural slope shall be enclosed.**
    a. **Responsibility- homeowner (See Appendix C for guidelines)**

- **The houses shall be constructed with exterior wall sheathing that shall be rated noncombustible.**
    a. **Responsibility-builder**

- **Windows and glass doors on the sides of the structure shall have tempered glass and fire resistant frames.**
    a. **Responsibility-builder**

- **Rafter tails shall be enclosed with noncombustible material on the sides of the structure.**
    a. **Responsibility-builder**

- **Gutters and downspouts shall be noncombustible.**
    a. **Responsibility-builder**

- **Attic and floor vents shall be covered with ¼ inch, or less, noncombustible mesh and horizontal to the ground.**
    a. **Responsibility-builder**

- **Lots 1 acre and larger shall be landscaped using the guidelines in Firescaping Standards Zones I and II. (See Appendix A)**
    a. **Responsibility- homeowner**

6. **<u>OTHER FIRE SAFE REQUIREMENTS</u>**

A. New roadways, turnouts and driveway shall be constructed only after consulting with El Dorado Hills Fire and TD. A design waiver may be requested.

B. Each new property owner prior to construction shall be required to contact El Dorado County Community Services Agency/Building Division to have the residential fire sprinklers plans approved. All fire sprinkler systems shall be designed and installed by a licensed contractor.

C. **Any new road and turnout shall be built to TD standards.**

D. 30' fuel hazard reduction zone along the perimeter of the project and eva's, 20' adjacent to backyard fences, 10' on both sides of the roads shall be installed and annually maintained by June 1 to the Fire Safe specifications. Sidewalks and landscaping is acceptable in the zone along the roadways. Tree canopy over the road and driveways shall be cleared up 15'.

E. The developer shall file with TD to get the roads named and have the names posted at the intersections.

F. A Community Facilities District (CFD), LLD or ZOB shall be formed for the specific purpose of maintaining the fuel hazard reduction zones along the road and in the open spaces and the eva gates, annually by June 1 in addition to other specific fire safety needs of the Fire District.

G. Roads 30' wide shall be posted "No Parking" on one side of the road unless a design waiver is approved. Posting on one side as determined by fire hydrant placement and consulting with the Fire Department. Rolled curbs should be used.

H. If a parking design waiver is granted, turnouts at each fire hydrant location shall be installed and meet fire department specifications.

I. A Notice of Restriction shall be filed with the final parcel map which stipulates that a Wildland Fire Safe Plan has been prepared and wildfire mitigation measures must be implemented.

J. The project shall meet all the Public Resource Codes 4290 as amended (the 1991 SRA Fire Safe Regulations- Article 2 Access, Article 3 Signing, Article 4 Water, Article 5 Fuels), County and Fire Department ordinances unless amended, revised or waived.

K. The home/property owners are responsible for any future fire safe or building code changes adopted by the State or local authority.

L. Only fire rated composite deck material, wood or non-combustibles shall be allowed for decks.

M. All fencing adjacent to open space and along the eva routes shall be noncombustible.

N. All active and passive parks shall be landscaped, comply with the Weed Abatement Resolution of the El Dorado Hills Fire Protection District or both.

O. All vacant lots shall be treated to the standard established by the Weed Abatement Resolution of the Fire District.

P. Any trail within the open space shall have Fire Department access (rolled curb). All trails shall be posted at access points "No Smoking". Access is limited by trail width and grade.

Q. All emergency vehicle access (eva) roads shall be posted "Emergency Access Route" and "No Parking".

R. Gates at each eva shall have a telephone activated automatic opener and a Knox key switch. The gate shall lock open if there is a power failure. The telephone number shall be provided to the fire agencies and law enforcement.

S. Eva gates shall be 2 feet wider than the roadway.

T. The El Dorado Hills Fire Protection District shall review the Wildland Fire Safe Plan every 5 years to determine if additional Fire Safe measures need to be implemented.

7. <u>OPEN SPACE GUIDELINES</u>

A. Remove all gray pines within 100' of all property lines (outer and inner lines).

B. Remove all dead trees within 100' of all property lines (outer and inner lines).

C. Remove all dead limbs from live trees that are within 10' of the ground.
D. Limb all trees within 30' of the inner property lines at least 10' above the ground as measured on the uphill side of the tree.

E. Remove all dead limbs and trees laying on the ground within 100' of all property lines (outer and inner lines).

F. Annually by June 1 cut or remove all grass and brush to a 4" stubble within 30' along the inner property lines adjacent to the residential lots and along streets.

G. All trails shall have a 10' fuel hazard reduction zone along each side of the trail. The zone shall be annually maintained by June 1.

H. Open space areas being used as a park shall be landscaped and irrigated or comply with the Weed Abatement Resolution of the Fire District.

I. All access points to open space shall have rolled curbs and be posted "No Parking" to allow fire vehicle access. A lockable barrier (knock down bullard) may be installed after consultation with the Fire District.

J. Mature or multi stemmed oaks can present a serious wildfire problem if untreated. Treat the oaks as to the following specifications: (a) remove all dead limbs and stems and (b) cut off green stems at 10' above the ground that arch over and are growing down towards the ground. Measure from the uphill side of the tree to determine the appropriate height.

K. Permanent wet areas within the open space lots may be allowed to have a variety of vegetation provided the wet areas are isolated with a fuel hazard reduction zone.

L. The high tension power lines in open space Lot "F" needs a fuel hazard reduction zone along any access road that may be in the area for line maintenance. A permanent agricultural crop may provide a sufficient fuel hazard reduction zone.

V. Appendix

APPENDIX A

DIXON RANCH
FIRESCAPING STANDARDS

Firescaping is an approach to landscaping to help protect homes from wildland fires. The goal is to create a landscape that will slow the advance of a wildfire and create a Defensible Space that provides the key point for firefighting agencies to defend the home. This approach has a landscape zone surrounding the home containing a balance of native and exotic plants that are fire and drought resistant, help control erosion, and are visually pleasing. Firescaping is designed not only to protect the home but to reduce damage to oaks and other plants.

Zone I

The zone extends to not less than 30 feet from the house **or to the property line whichever is less** in all directions and has a traditional look of irrigated shrubs, flowers gardens, trees and lawns. All dead trees, brush, concentrations of dead ground fuels (tree limbs, logs etc. exceeding 1inch in diameter) shall be removed. All native oak trees, conifers and brush species are pruned up to 10 feet above the ground as measured on the uphill side but no more than 1/3 of the live crown. The plants in this zone are generally less than 18 inches in height, must be slow to ignite from windblown sparks and flames. Such plants should produce only small amounts of litter and retain high levels of moisture in their foliage year around. Native and exotic trees are permitted inside the Zone, but foliage may not be within 10 feet of the roof or chimney. Grass and other herbaceous growth within this zone must be irrigated or if left to cure must be mowed to a 2 inch stubble, chemically treated or removed. Such treatment must be accomplished by June 1, annually. This zone has built in firebreaks created by driveways, sidewalks etc.

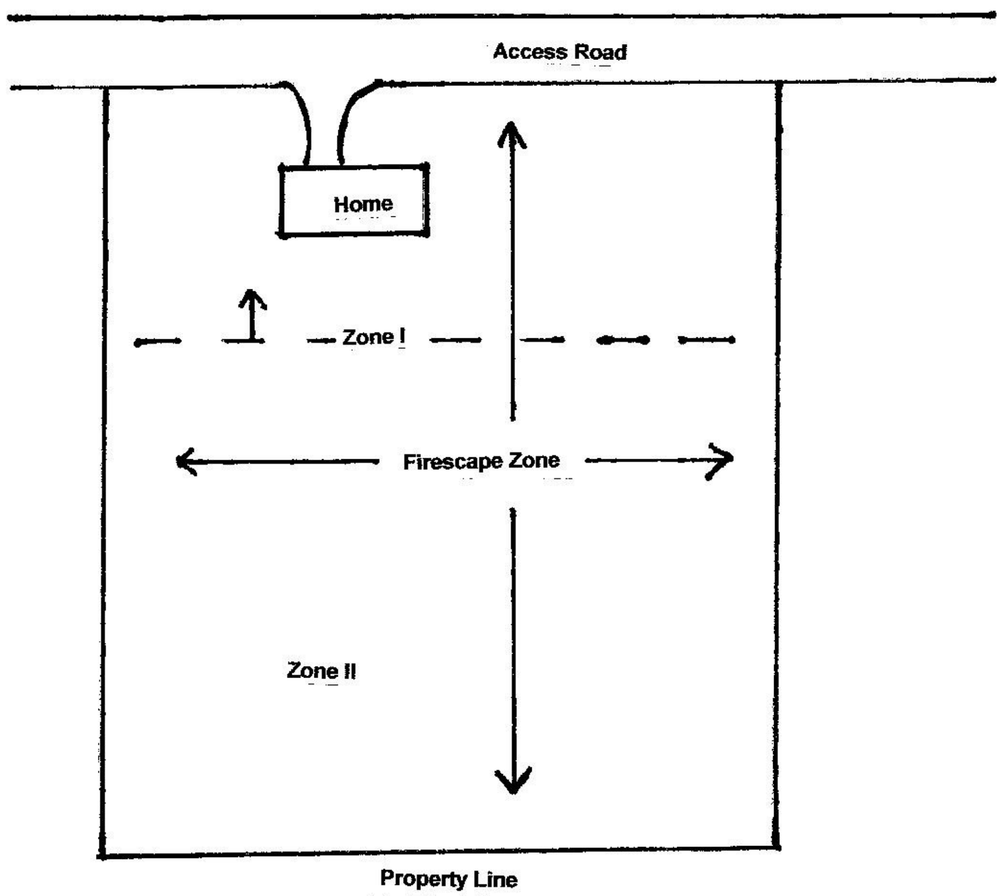
Zone II

This Zone adds 70 feet to Zone I and extends a minimum of 100 feet from the house in all directions, **or to the property line whichever is less,** and is a transition area to the outlying vegetation. The zone is a band of low growing succulent ground covers designed to reduce the intensity, flame length and rate of spread of an approaching wildfire. Irrigation may be necessary to maintain a quality appearance and retain the retardant ability of the plants. All dead trees, brush, concentration of dead ground fuels (tree limbs, logs etc.) exceeding 2 inches in diameter shall be removed. Annual grasses shall be mowed after they have cured to a 2 inch stubble by June 1, annually. Native trees and brush species may be preserved and pruned of limbs up to 8 feet above the ground as measured on the uphill side.

For All Zones With Oaks

Mature, multi stemmed Oaks can present a serious wildfire problem if untreated. Treat the Oaks as to the following specifications: (a) remove all dead limbs and stems and (b) cut off green stems at 10 feet above the ground as measured on the uphill side that arch over and are growing down towards the ground.

APPENDIX A-1
FIRESCAPING ZONES
EXHIBIT



Typical Lot in Oak Woodland
(Schematic, not to scale)

APPENDIX B

DIXON RANCH

FUEL TREATMENT SPECIFICATIONS
For
OAK WOODLAND

Within The Designated Fuel Treatment Areas

1. Leave all live trees where possible.

2. Remove all dead trees.

3. Remove all brush.

4. Prune all live trees of dead branches and green branches 10 feet from the ground as measured on the uphill side of the tree, except no more than 1/3 of the live crown is removed. All slash created by pruning must be disposed of by chipping or hauling off site.

5. Annually by June 1, reduce the grass or weeds to a 2 inch stubble by mowing, chemical treatment, disking or a combination of treatments.

6. Conifers within 30 feet of a house shall be removed. Those pines in the open space shall be isolated with no brush understory within the dripline of the tree.

APPENDIX C

DIXON RANCH

ENCLOSED DECK GUIDELINES

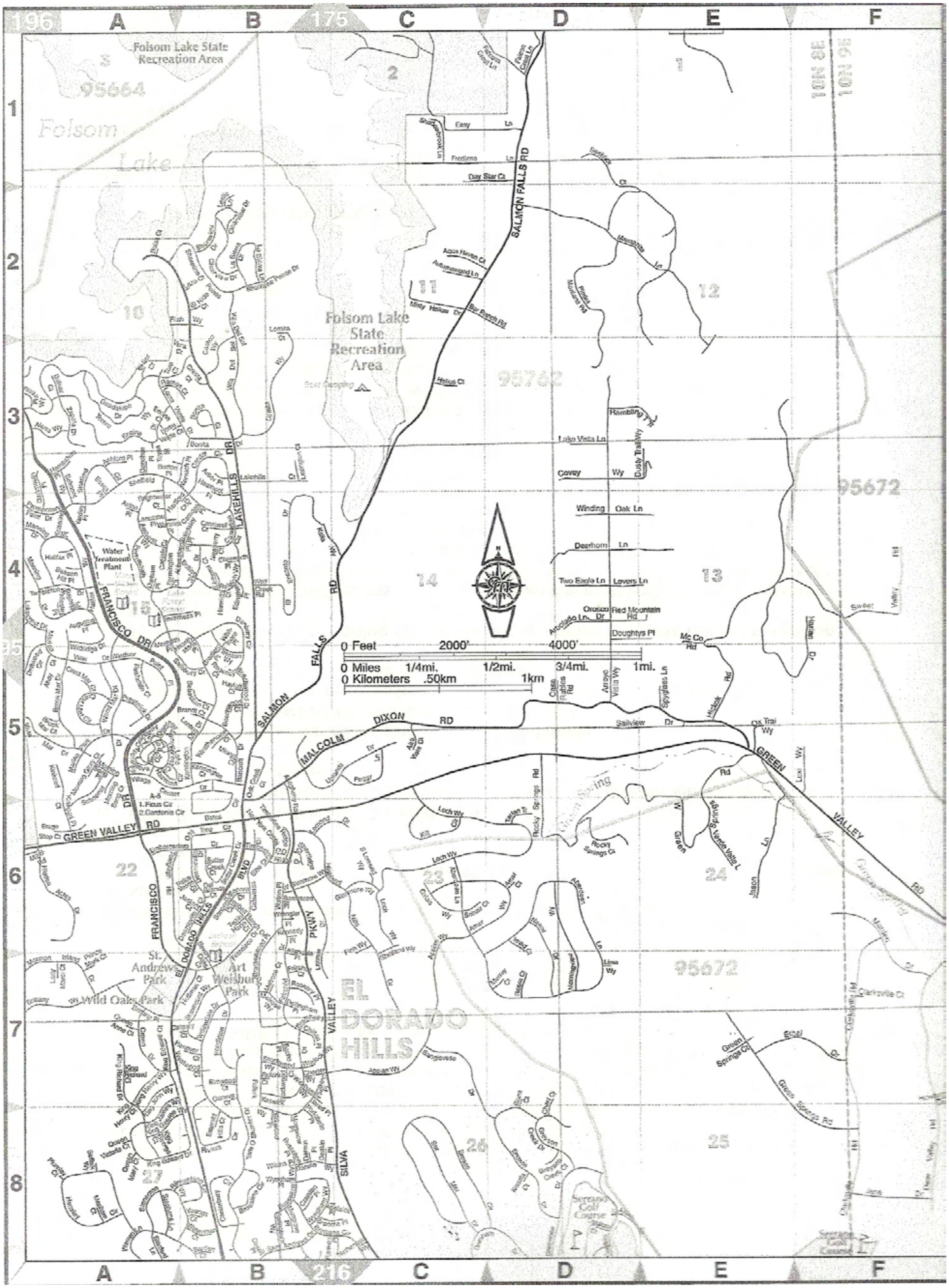
The purpose of enclosing the underside of decks that are cantilevered out over the natural slope is to help prevent heat traps and fire brands from a wildfire igniting the deck or fuels under the deck.

1. Does not apply to decks that are constructed using fire resistant materials such as concrete, steel, stucco etc.

2. Any deck shall not include non fire rated composite deck material.

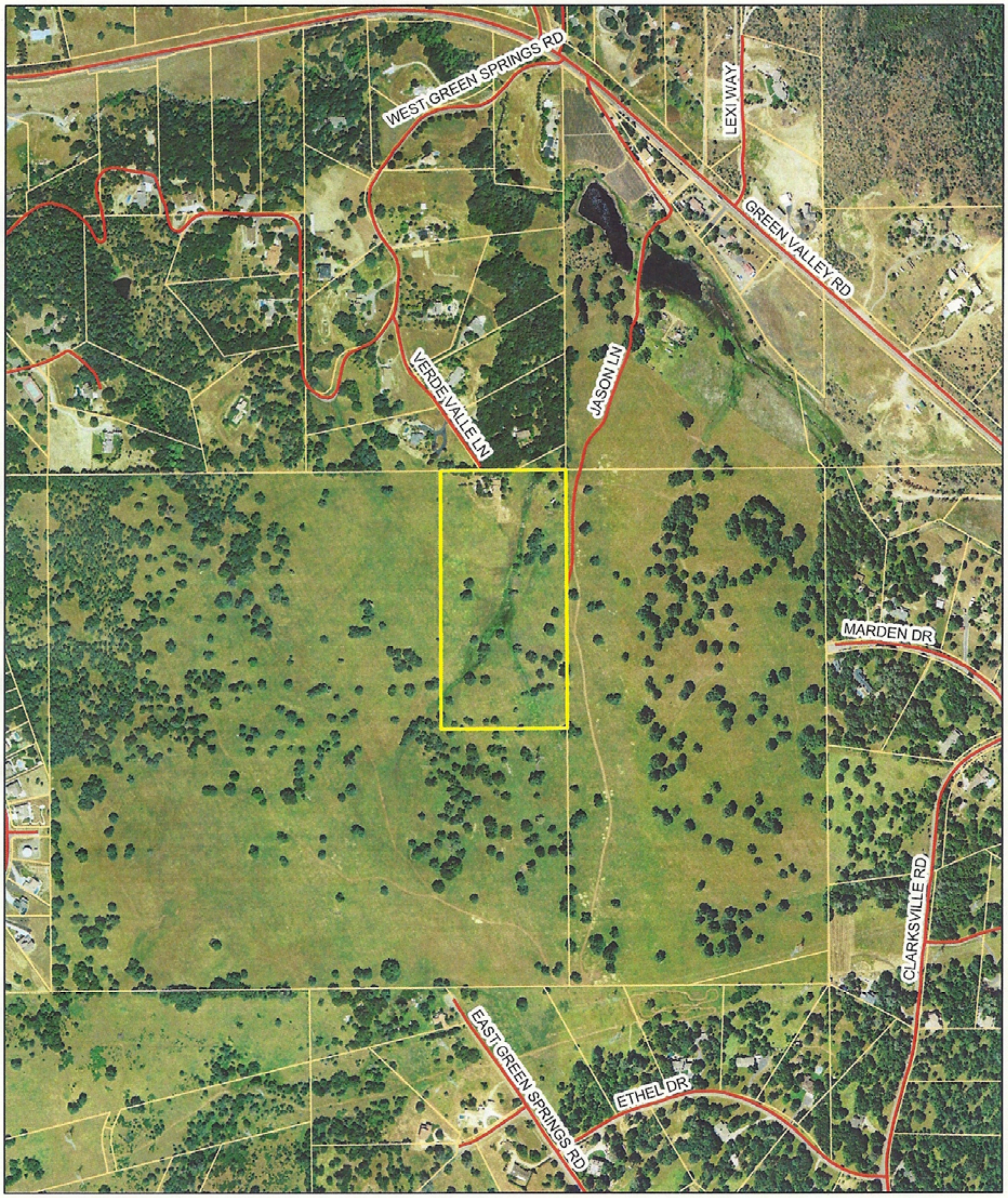
3. This applies to decks one story or less above natural slopes.

4. Combustible material must not be stored under the deck.



Folsom Lake State Recreation Area
95664
Folsom Lake
Folsom Lake State Recreation Area
95762
95672
SALMON FALLS RD
LAKEHILLS DR
FRANCISCO DR
GREEN VALLEY RD
MALCOLM DIXON RD
EL DORADO HILLS BLVD
SILVA VALLEY PKWY
EL DORADO HILLS
St. Andrews Park
Art Weisburg Park
Wild Oaks Park
Water Treatment Plant
0 Feet 2000' 4000'
0 Miles 1/4mi. 1/2mi. 3/4mi. 1mi.
0 Kilometers .50km 1km
10N 8E
10N 9E

APN 12602001

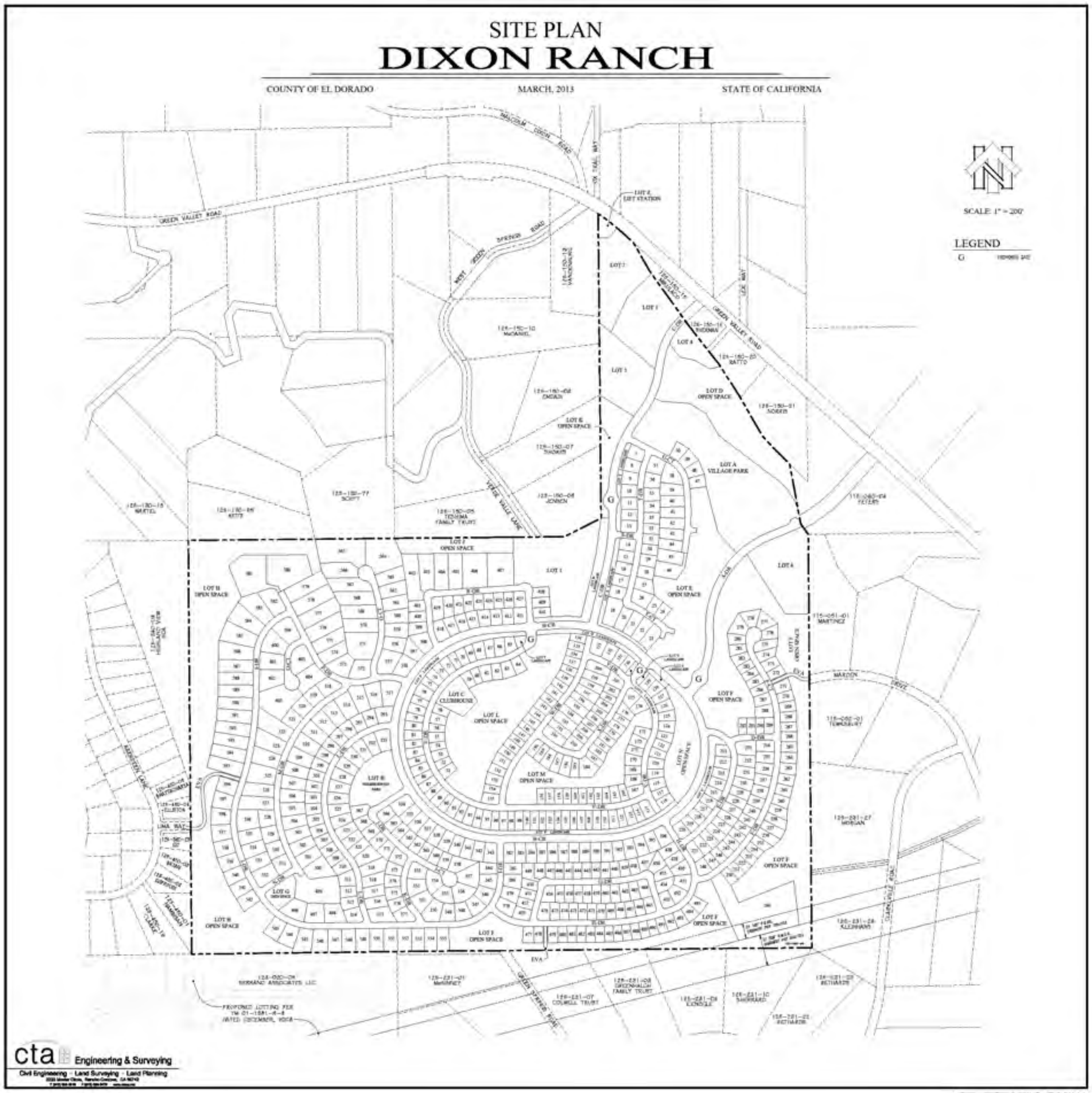


Disclaimer: This depiction was compiled from unverified public and private sources and is illustrative only. No representation is made as to accuracy of this information. Parcel boundaries are particularly unreliable. Users make use of this depiction at their own risk.

Printed on 7/5/2011 from El Dorado County Surveyor's Office

0 470 940 1,410
Feet

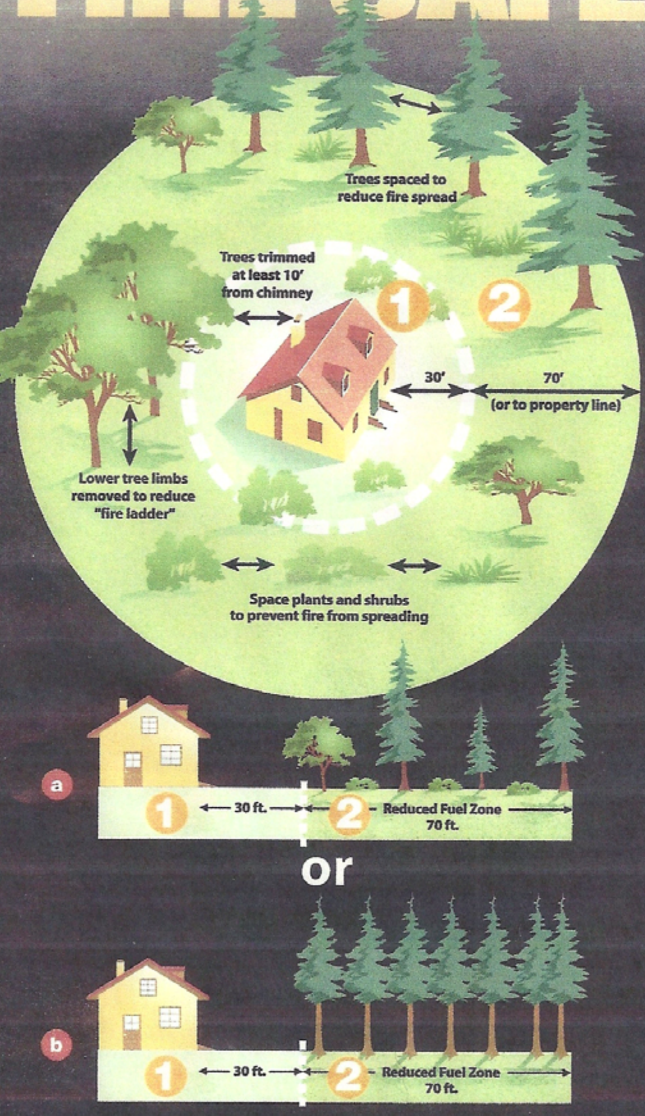
Map displayed in State Plane Coordinate System
(NAD 1983 California Zone 2, feet)


SITE PLAN
DIXON RANCH
COUNTY OF EL DORADO
MARCH, 2013
STATE OF CALIFORNIA
LEGEND
cta Engineering & Surveying
Civil Engineering · Land Surveying · Land Planning

CAL FIRE GUIDELINE

100' DEFENSIBLE SPACE

Make Your Home FIRE SAFE



Contact your local CDF office, fire department, or Fire Safe Council for tips and assistance.
www.fire.ca.gov

Why 100 Feet?

Following these simple steps can dramatically increase the chance of your home surviving a wildfire!

A **Defensible Space** of 100 feet around your home is required by law.[1] The goal is to protect your home while providing a safe area for firefighters.

1 "Lean, Clean and Green Zone."

– Clearing an area of 30 feet immediately surrounding your home is critical. This area requires the greatest reduction in flammable vegetation.

2 "Reduced Fuel Zone."

– The fuel reduction zone in the remaining 70 feet (or to property line) will depend on the steepness of your property and the vegetation.

Spacing between plants improves the chance of stopping a wildfire before it destroys your home. You have two options in this area:

- (a) Create horizontal and vertical spacing between plants. The amount of space will depend on how steep the slope is and the size of the plants.
- (b) Large trees do not have to be cut and removed as long as all of the plants beneath them are removed. This eliminates a vertical "fire ladder."

When clearing vegetation, use care when operating equipment such as lawnmowers. One small spark may start a fire; a string trimmer is much safer.

Remove all build – up of needles and leaves from your roof and gutters. Keep tree limbs trimmed at least 10 feet from any chimneys and remove dead limbs that hang over your home or garage. The law also requires a screen over your chimney outlet of not more than ½ inch mesh.

1. These regulations affect most of the grass, brush, and timber-covered private lands in the State. Some fire departmen jurisdictions may have additional requirements. Some activities may require permits for tree removal. Also, some activities may require special procedures for, 1) threatened an endangered species, 2) avoiding erosion, and 3) protection o water quality. Check with local officials if in doubt. Current regulations allow an insurance company to require additional clearance. The area to be treated does not extend beyond you property. The State Board of Forestry and Fire Protection has approved Guidelines to assist you in complying with the new law. Contact your local CDF office for more details.

April 2006

State of California
Department of Forestry and Fire Protection

NOTICE OF FIRE HAZARD INSPECTION

A fire department representative has inspected your property for fire hazards. You are hereby notified to correct the violation(s) indicated below.

Failure to correct these violations may result in a citation and fine.

Occupant:		Physical Address:		Phone #:	
Occupant Not Home: 1st Attempt: __/__/__	Occupant Not Home: 2nd Attempt: __/__/__	Refused Inspection: __/__/__	For Questions, Contact Inspector at: (____) ___ - ____		
Roof Construction Combustible/Non-Combustible	Exterior Siding Combustible/Non-Combustible	Window Panes Single Pane/Multi-Pane	Eaves Enclosed/Unenclosed	Decks or Porches Masonry/Composite/Wood	Location of Structure Flat Ground/Slope/Ridge Top

Checked boxes indicate violations. | Corrected

Defensible Space Zone (within 30 feet of all structures or to property line):

- ☐ 2 3 A. Remove all branches within 10 feet of any stovepipe or chimney outlet. PRC §4291(a)(4)
- ☐ 2 3 B. Remove leaves, needles or other vegetation on roofs, gutters, decks, porches and stairways etc. PRC §4291(a)(6)
- ☐ 2 3 C. Remove all dead or dying trees, branches, shrubs or other plants adjacent to or overhanging buildings. PRC §4291(a)(5)
- ☐ 2 3 D. Prune lower branches of trees to a height of 6 to 15 feet (or 1/3 tree height for trees under 18 feet). PRC §4291(a)(1)
- ☐ 2 3 E. Remove all dead or dying grass, leaves, needles or other vegetation. PRC §4291(a)(1)
- ☐ 2 3 F. Remove or separate live flammable ground cover and shrubs. PRC §4291(a)(1)

Reduced Fuel Zone (within 30 - 100 feet of all structures or to property line):

- ☐ 2 3 G. Mow dead or dying grass to a maximum of 4 inches in height. Trimmings may remain on the ground. PRC §4291(a)(1)
- ☐ 2 3 H. Live flammable ground cover less than 18 inches in height may remain, but overhanging and adjacent trees must be pruned to a height of 6 to 15 feet. PRC §4291(a)(1)
- ☐ 2 3 I. Reduce fuels in accordance with the Continuous Tree Canopy Standard (see back). PRC §4291(a)(1)
- ☐ 2 3 J. Reduce fuels in accordance with the Horizontal Spacing Standard (see back). PRC §4291(a)(1)

Defensible and Reduced Fuel Zone (within 100 feet of all structures or to property line):

- ☐ 2 3 K. Logs or stumps embedded in the soil must be removed or isolated from structures and other vegetation. PRC §4291(a)(1)
- ☐ 2 3 L. Remove all dead or dying brush and trees, and all dead or dying tree branches within 15 feet of the ground. PRC §4291(a)(1)

Other Requirements:

- ☐ 2 3 M. Clear all flammable vegetation, trash and other combustible materials 10 feet around and above propane tanks. CFC §3807.3
- ☐ 2 3 N. Address numbers shall be displayed in contrasting colors (4" Min. Size) and readable from the street or access road. CFC §505.1
- ☐ 2 3 O. Equip chimney or stovepipe openings with a metal screen having openings between 3/8 inch and 1/2 inch. CBC §2113.9.1

Recommendations:

- ☐ Clear 10 feet around and 15 feet above fuels (e.g. Woodpiles, lumber, scrap etc.). Move woodpiles as far as possible from structures.
- ☐ Remove flammable materials stored under decks and similar overhangs of structures.
- ☐ Clear vegetation 10 feet from sides and 15 feet above all driveways and turnaround areas.

☐ **No violations observed.**

Comments: ____

Additional Information on Back

1. Inspector: ________________ Date: __/__/__ A re-inspection will occur on/after: __/__/__
2. Inspector: ________________ Date: __/__/__ A re-inspection will occur on/after: __/__/__
3. Inspector: ________________ Date: __/__/__

Form LE-100 (2/11)

(White-Inspector, Canary-1st to Occupant, Pink-2nd to Occupant, Gold-3rd to Occupant)

Attachment #14

COUNTY OF EL DORADO

AGRICULTURAL COMMISSION

311 Fair Lane
Placerville, CA 95667
(530) 621-5520
(530) 626-4756 FAX

eldcag@co.el-dorado.ca.us

Greg Boeger, Chair – Agricultural Processing Industry
Lloyd Walker, Vice-chair – Other Agricultural Interests
Chuck Bacchi – Livestock Industry
Bill Draper, Forestry/Related Industries
Ron Mansfield – Fruit and Nut Farming Industry
John Smith – Fruit and Nut Farming Industry
Gary Ward – Livestock Industry

MINUTES

February 10, 2010
6:30 P.M.
Board of Supervisors Meeting Room
330 Fair Lane – Building A, Placerville

Members Present:	Boeger, Draper, Mansfield, Smith, Walker
Members Absent:	Bacchi, Ward
Ex-Officio Members Present:	William J. Stephans, Ag Commissioner/Sealer
Staff Members Present:	Charlene Carveth, Deputy Ag Commissioner/Sealer Chris Flores, Senior Agricultural Biologist Nancy Applegarth, Clerk to the Agricultural Commission
Others Present:	Mark Annis, Bill Bacchi, Sue Taylor

I. CALL TO ORDER

Chair Boeger called the meeting to order at 6: 30 P.M.

II. RE-APPOINTMENT OF AGRICULTURAL COMMISSION MEMBER, GARY WARD BY THE EL DORADO COUNTY BOARD OF SUPERVISORS (Continued from January 13, 2010)

The re-appointment of Gary Ward to a four year term as a representative for the Livestock Industry was made by the Board of Supervisors on February 2, 2010.

III. APPROVAL OF AGENDA

Bill Stephans requested an addition to Item VIII. Legislation, regarding AB 1721 (Swanson). He also mentioned that Peter Maurer, Development Services/Planning, has been assigned to oversee the Ranch Marketing Ordinance. Bill Stephans, Peter Maurer and several committee members met this week to discuss the draft of the ordinance. At the meeting, Mr. Maurer stated that the draft ordinance is a very good start. Additional clarifications will be discussed and updated for the Ag Commission's review and comment so that a final recommendation can be submitted back to Development Services with final submission to the Board of Supervisors.

Chair Boeger called for a voice vote for Approval of the Agenda with the additional information.

AYES: Draper, Mansfield, Smith, Walker, Boeger
NOES: None
ABSENT: Bacchi, Ward

IV. APPROVAL OF MINUTES

- Minutes of January 13, 2010

It was moved by Mr. Walker and seconded by Mr. Draper to Approve the Minutes as submitted.

AYES: Draper, Mansfield, Smith, Walker, Boeger
NOES: None
ABSENT: Bacchi, Ward

V. PUBLIC FORUM

- No comments were received

VI. S 09-0024 – Petra Winery (Mark A. Annis): a request for a special use permit for a micro winery consistent with 17.14.200.D.10 of the zoning ordinance. Production is based on the acres of wine grapes grown with a maximum production of 1,250 cases (2,972 gallons). Micro wineries are not allowed to have onsite tasting or sales. If it is determined that the project parcel contains a minimum of five acres of commercial vineyard, the project would be processed as a winery under 17.14.200.B.2.H of the zoning ordinance. No onsite sales or tasting room are proposed at this time. The property, identified by Assessor's Parcel Number 102-210-16, consists of 10.001 acres, and is located on the east side of Deer Valley Road approximately ½ mile northeast of the intersection with Green Valley Road, in the Rescue area. (District 4)

Staff reported on the site visit. The total acreage of this property is slightly over ten acres. It is not in an Ag District and not in a Community Region or Rural Center. The Land Use Designation of this parcel and surrounding parcels is Rural Residential (RR). The current zoning is Estate Residential Ten-Acre (RE-10). The adjacent parcel zoning is the same. The property is at an approximate elevation of 1,200 feet. The Soil Type is RfC: Rescue Very Stony Sandy Loam, 3 to 15% Slopes (Capability Class VI).

The applicants have requested a Special Use Permit for a winery, to be located at 2402 Deer Valley Road. The applicant has over 5 acres of grapes planted (varieties include Merlot, Zinfandel and Primitivo) with plans to plant 500 more vines. The vineyard is protected by deer fencing, is irrigated and trellised. The applicant proposes to crush and ferment the grapes on site, store the wine in tanks under the house, bottle the wine and store the case goods on site. A tasting room and on site sales are not proposed. There would be a maximum production of 1,250 cases of wine allowed by the SUP.

Relevant General Plan Policies: Policy 8.1.3.5 states that on any parcel 10 acres or larger identified as having an existing or potential agricultural use, the Agricultural Commission must consider and provide a recommendation on the agricultural use or potential of that parcel and whether the request will diminish or impair the existing or potential use prior to any discretionary permit being approved.

Relevant Zoning Ordinance: Section 17.14.200 El Dorado Winery Ordinance (application is consistent with 17.14.200 B.2.H – Lots zoned RE with a minimum lot size of 10 acres, a minimum of five acres of commercial vineyard, and not located within a General Plan Ag District require a Special Use Permit.)

Mark A. Annis was present for questions and review of the project.

John Smith mentioned a letter of opposition that was submitted to the Commission. A neighbor of the applicant wrote of their concern regarding an Administrative Relief from an Agricultural Setback on this project, however, relief from an Agricultural Setback is not being requested, a winery building is not being proposed, and all winery functions will take place near or in the existing single-family dwelling.

It was moved by Mr. Smith and seconded by Mr. Walker to recommend APPROVAL of S 09-0024, a Special Use Permit request for a winery to be located at 2402 Deer Valley Road (a ten acre parcel) in the Rescue area. The property has over 5 acres of grapes, has been producing grapes for the past two years, and the proposed use will not detract from or diminish the existing agricultural use.

Motion passed

AYES: Draper, Mansfield, Smith, Walker, Boeger
NOES: None
ABSENT: Bacchi, Ward

VII. VINEYARD SOILS REPORT

A handout and PowerPoint presentation was given to show the results of a GIS soil analysis of 54 El Dorado County vineyards. This report reveals that Capability Unit II and III soils or current classified El Dorado County "Choice Soils" are not a necessary requirement for producing quality grapes. Some of the oldest and best quality vineyards, in the county, are growing on Capability Class IV, Class VI, and Class VII soils. *The Procedure for Evaluating the Suitability of Land for Agriculture* assigns points to soils based on their Capability Class, with Class II and III soils scoring 40 points and Class VII and VIII soils scoring 0 points. General Plan Policy 8.1.1.4 states that "…*The Procedure for Evaluating the Suitability of Land for Agriculture* shall be used for evaluating the suitability of agricultural lands in Agricultural Districts and Williamson Act Contract lands (agricultural preserves)." After conducting the vineyard soil analysis, it appears that vineyard operations can be successful on a varying degree of soil types independent of Capability Class. Giving parcels a higher point value based on "Choice Soils" may not be an accurate representation of agricultural capability in lieu of this new information.

General Plan Policy 8.1.1.4 also states that *The Procedure for Evaluating the Suitability of Land for Agriculture* shall be developed, reviewed, and revised, as appropriate, by the Agricultural Commission, and approved by the Board of Supervisors. As requested at the January Agricultural Commission meeting, staff provided a draft version of Category I, (Soil Capability and Characteristics):

Points	**Criteria**
40	Capability Unit II & III Soils
35	If over 50% of parcel contains Capability Unit IV, VI & VII "Choice" Soils
30	If 50% of parcel contains Capability Unit IV, VI & VII "Choice" Soils
20	If 40% of parcel contains Capability Unit IV, VI & VII "Choice" Soils
10	If 30% of parcel contains Capability Unity IV, VI & VII "Choice" Soils
5	Capability Unit IV, VI & VII "Non-Choice" Soils
0	Capability Unit VIII Soils
Notes:	There are no Class I or Class V soils located in El Dorado County Soil "Capability Classes" are defined on page 38 of the *Soil Survey of El Dorado Area, California, Issued April 1974* El Dorado County "Choice Soils" are defined as soil types that exhibit "choice" agricultural characteristics as delineated by the USDA-SCS and a local ad-hoc committee.

John Smith stated that the idea that vineyards only grow in rich soils is a complete misunderstanding of what it takes to grow quality grapes. He feels it would be a mistake to restrict the understanding of that which allows for the absolute maximum quantity of grapes as opposed to the quality of grapes that can be produced in El Dorado County.

Bill Stephans gave a brief summary of this project. When staff began working on the analysis of parcels that could be included into the existing Ag Districts, as required by the General Plan, it was noted that there were some calculations that did not seem quite right. It was decided to do an analysis of the County's existing vineyards and their soil types. The analysis has shown that some of the best quality grapes in the County are being grown on "non-choice" Capability Class VI and VII soils. Staff has suggested that some of these "non-choice" soils be listed as "Soils of Local Importance for El Dorado County Vineyards". At the last Ag Commission meeting staff was directed to create a draft version of Category I (Soil Capability and Characteristics). Staff has created a draft that has removed soil depth and replaced it with percentages of choice soils.

Discussion took place regarding the soil types of several area vineyards and the draft version of Category I.

Bill Bacchi stated that this analysis will be a very useful tool when evaluating a parcel that is being considered for inclusion into an Ag District but expressed concern about the possible need to "re-analyze" the whole county based on this new criteria.

Discussion took place regarding Bill Bacchi's concern. Mr. Stephans reminded the Commission members that the vast majority of parcels recognized as possible additions to the Ag Districts, had scored over 60 points, using the current Category I soil analysis. The parcels that had scored lower could be re-analyzed based on a revised version.

Bill Stephans mentioned that this would not only be a tool to analyze parcels under consideration for inclusion into an Ag District. It would also be used when considering parcels going into Williamson Act Contracts. Staff has identified certain parcels that *could be* included into the current Ag Districts. Those who have objections for inclusion have been noted and the ultimate decision will be made by the Board of Supervisors. Mr. Stephans added that knowing which soils are important to vineyard development will help the Ag Department when people come in looking for advice regarding parcels they are considering for vineyard production.

Sue Taylor expressed a concern that only properties located within Ag Districts will be protected for agricultural use; that all other lands, in the County, will be available for subdivision or commercial development.

Chair Boeger asked staff to bring back the draft version of Category I, with revisions to the format.

It was moved by Mr Boeger and seconded by Mr. Smith that the following soil types be considered "Soils of Local Importance for El Dorado County Vineyards" and included in El Dorado County's list of "Choice Agricultural Soils"; AdD, AkC, AtD, AwD, AxD, AzE, BrE, CcE, HkE, HtE, JsE, JuE, MbE, RfC, and SdE.

Motion passed.

AYES: Draper, Mansfield, Smith, Walker, Boeger
NOES: None
ABSENT: Bacchi, Ward

VIII. LEGISLATIVE ISSUES

- Bill Stephans provided the Agricultural Commission with a copy of Assembly Bill 1721 (Swanson) Pesticides: school zones. Existing law generally regulates the application of pesticides. This bill would provide, subject to exceptions, that restricted-use pesticides used for purposes of production agriculture or a state pest eradication or control program may not be applied within ½ mile of a school safety zone, as defined, and that other pesticides, as specified, may not be applied within ¼ mile of a school safety zone, as defined, within 24 hours of when children are or will be present. .In his opinion, the general nature of this bill would make any pest control activities using pesticides problematic for any residence located within a quarter mile of a school.

  This bill, along with approximately 60 others pertaining to Agriculture, will be tracked this legislative session.

IX. CORRESPONDENCE

- None received

X. OTHER BUSINESS

- Bill Draper – Sustainable Forest Action Coalition update regarding the Camino Mill closure (nothing new to report)

XI. ADJOURMENT

- The meeting adjourned at 8:54 p.m.

APPROVED: Greg Boeger, Chair

Date: March 10, 2010

Attachment #15

Subject: Fw: TGPA, OZU

To The El Dorado County Board of Supervisors:
I am asking that the Board not approve the Chief Administrative Officers recommendations to:

1) Authorize staff to revise Attachment 4E, Draft Zoning Ordinance to include items identified on ERRATA Sheet #2 dated May 15, 2012;
2) Authorize staff to release the Notice of Preparation to inform of the County's intent to prepare an Environmental Impact Report (EIR) for the Targeted General Plan Amendment and Comprehensive Zoning Ordinance Update (CEQA Guidelines, Section 15082) and solicit preliminary comments from the public and public agencies; and
3) Approve the following schedule for next steps in the process:
– Weeks of June 18, 2012 and June 25, 2012 - Scoping Meetings within the Communities of; North County, South County, Myers, Camino/Pollock Pines, El Dorado/Diamond Springs, Cameron Park and El Dorado Hills.
– June 28, 2012 Planning Commission workshop for Public Agency Comments.
– Early July 2012 - Close Public Comment Period for NOP (45 days from release.)
– Week of July 16, 2012 - Board Zoning Ordinance Workshop.
– End of July 2012 - Board authorization to release project to consultant for preparation of final Project Description and draft Alternative.
(Refer 5/1/12, Item 38) (Est. Time: 90 Min.)
FUNDING: General Fund.
County

The public should understand more fully the logic and motivation behind these proposed GP Amendment changes and Zoning Ordinance changes.The ROI adopted by the Board back in Nov. 2011 and used as the framework of the scope for the TGPA & ZOU is heavily developer skewed and has not provided for public input regarding a balanced scope to be analyzed. There has not been any public scoping workshop meetings yet in El Dorado Hills as we've formality asked for and as the Board directed staff to do back in Feb. BOS Meeting. Only a initial outreach meeting held at the El Dorado Hills CDD March 5th, 2012 identifying the TGPA & ZOU process we were told by Shawna Purvines and Kim Kerr of the CAO's office that El Dorado Hills would get a public scoping meeting in April. It didn't happen. The last two BOS meetings we have made clear we want to have input on scope before approved to go to an EIR. The recommendation by the CAO have the scoping meeting after the approval and moving forward with analysis of the limited scope. This makes no sense and is not fair to the people. This being an election year and I would think it would be so important to show balance and inclusion especially when a focused group of residents looking to protect the interests of existing residents are so heavily involved and asking for transparency, fairness and representation. The CAO's office wants the Board to approve this description for the scope of the EIR of the TGPA on May 15th. This should not be hurried to the Board for approval before a more transparant and inclusive scope is included for analysis to achieve a more representative and balanced TGPA & ZOU.

There are many people voicing a concern that the CAO's office is rushing ahead with the process to put in place policies that will take away or lessen transportation requirements for developers of large projects in the Community Regions such as El Dorado Hills and as a way of encouraging them the County is looking for ways to reduce their costs by reduction in standards, reducing the requirement for when offsite traffic improvements are required, or not requiring any transportation off site improvements at all at occupancy, pushing out long term improvements from the 10 year CIP to 20 years to name a few. These are requests put forth by EDAC that will be analyzed in the TGPA & ZOU process . We also want our fair representation of the following to be included in the scope for analysis in the EIR of the TGPA & ZOU.

Submitted by Tara McCann

at Board Hearing of 5-15-12 #24

1. A Community Overay of El Dorado Hills inclusive of some localized Historic overlay/s to analyze zoning structure, compatibility's, required traffic safety improvements tied to discretionary projects that are site specific for Community Region needs as a result of the more dense community region corridors. Analyze worsen conditions and develop specific policy for mitigation's that are realistic and timely when approved for projects. Analyze densities in the Community Region of El DOrado Hills that still retain the character of Community Identity and Compatibility of existing Land Uses so that we don't end up with 8 houses per acre right along side the rural region or 5 acre parcels. Analyze Community Region specific Transportation Circulation Elements as a mechanism for determining when offsite improvements are warranted or needed for public safety such as left turn lanes and two way turn lanes in the middle between two lane of opposing traffic.
2. Standards overlay of El Dorado Hills.
3. Planned Development Policies to keep character of El Dorado Hills
4. Open Space requirement of 30% for all Planned Developements and not 86ing planned developments in the Community Regions. And no in lue of fees. More open space for higher densities.
5. Analyze no build on ridgelines and slopes over x%.
6. Analyze no unilateral zoning changes just because they are not consistant with the General Plan. The law states The General Plan and Zoning ordinance shall be consistant it does not state the Zoning Ordinace has to be consistant with the General Plan. If zoning can not be changed to make General Plan valid due to incompatibilty with existing land use or worsen conditions that can not be mitigated in a realistic time frame or are monetarily unrealistic then analyze a chnage in land use designation for the General Plan.
7. All Transportation Element changes, deletions, and reductions to be clearly identified as to why this benefits the impacted regions and who authored such change. (i.e. was it a Design Firm who also is doing the Engineerng and or acting as an Owners Agent for a large multi family Planned Development that would stand to benefit from such reductions in elements and standards.)
9. Add to page 19 of the Zoning Ordinance El Dorado Hills Community Plan Zones as is done with Meyers Community Plan Zones.
10. Recommend Design standards in final form (not Draft) before General Plan is approved and not move elements or policy's into any Draft documents.
11. Analyze economically by expanding Research & Development opportunity develop able sites in areas throughout the County. A large Industrial and R&D would be well suited for the Meyers area.
12. We are not in agreement with #1 of the Draft Zoning Ordinance's pg 54 17.24.010 definition to further the implimentation of the Gerneal Plan Community Region by distributing the residential growth in to this vague sentence they mean El Dorado Hills. We want a clearer definition and an equitable distribution. We now have HOV lanes to Placerville there is no reason not to distribute High Density.Placerville is 12 miles away.
14. How does pg 54 17.24.010 hold consistent for imposing the Community Regions with the highest intesity clustered densities ? That is inconsistant with doing away with planned developement, open space, reduced riparian setbacks, removal wildlife corridor protections not to mention one of the biggest issue of how are you funding and adaquately assuring the transportation improvements are being met especially safety improvements at occupancy.
15. Pg 73 Draft ZO 17.27.010 It is the intent of this Chapter to protect historic building and areas, enhance turism and the economy of the county by preserving the scenic resources along specified routes and define and maintain a sense of community identity. This is our basis for EDH historic overlay to be incorporated in the EL Dorado HIlls COmmunity Overlay. .
16. Design Review Community - provide for individual DRC to develop design review standards for the protection, enhancement and use of places, sites buildings and structures in order to ensure sense of community.
17. Provide project review procedures which by its character or location requires special site design to minimize asthetic impacts on adjacent properties.
Tara Mccann

RESOLUTION NO. 182-2011

OF THE BOARD OF SUPERVISORS OF THE COUNTY OF EL DORADO

RESOLUTION OF INTENTION TO AMEND THE GENERAL PLAN

WHEREAS, the County of El Dorado is mandated by the State of California to maintain an adequate and proper General Plan; and

WHEREAS, The County of El Dorado's General Plan and the various elements thereof must be continually reviewed and updated with current data, recommendations and policies; and

WHEREAS, on April 4, 2011, Development Services presented to the Board of Supervisors the first Five-Year Review of the General Plan with findings that support a need for a variety of revisions to policies related to the development of housing affordable to the moderate-income earner, the creation of jobs, improving sales tax revenues, further supporting the promotion and protection of Agriculture and to address recent changes in State law; and

WHEREAS, on July 25, 2011, Development Services presented to the Board of Supervisors a list of key issues and options for addressing identified General Plan amendment components discussed on April 4, 2011 as part of the General Plan 5 year review; and

WHEREAS, the Board of Supervisors directed staff to return with a comprehensive Resolution of Intention that included previously adopted Resolutions of Intentions to amend the General Plan including; 1) ROI 274-2008, adopted 10/7/2010 - Planned Development policies for 30 percent Open Space and requirement for a Planned Development when creating 50+ parcels; 2) ROI 110-2009 adopted 5/19/2009 - Community Region Boundary Change for Camino/Pollock Pines; 3) ROI 179-2010 adopted 12/7/10 - Historical Design Overlay for historical town sites of El Dorado and Diamond Springs; and

WHEREAS, the Board of Supervisors intends to have the above listed Resolutions superseded by this resolution.

NOW, THEREFORE, BE IT RESOLVED that the Planning Commission and Board of Supervisors will set public hearings to consider the following amendments:

LAND USE ELEMENT

Land Use Map

Camino/Pollock Pines Community Region Boundary amendment: consider amending the Camino/Pollock Pines Community Region Boundary to create three Rural Centers to allow for separate and distinct opportunities for each of the communities.

Policy 2.1.1.3

Commercial/Mixed Use: Consider amending allowable residential density by increasing residential use as part of a Mixed-use development from 16 units per acre to 20 units per acre to achieve CEQA streamlining benefits.

Policy 2.2.1.2 and Table 2-1

Table 2-1 & Commercial and Industrial Use: Consider amending General Plan Table 2-1 and Policy 2.2.1.2 for Commercial and Industrial to allow for commercial and industrial uses in the Rural Regions.

Commercial/Mixed Use: Consider deleting the sentence, "*The residential component of the project shall only be implemented following or concurrent with the commercial component.*"

Industrial Use: Consider deleting the requirement for Industrial Lands to be restricted to only industrial lands within, or in close proximity to Community Regions and Rural Centers. Delete the requirement that Industrial Lands in Rural Regions can only provide for on-site support of agriculture and natural resource uses.

Multi-Family Use: Consider amending density from 24 units per acre to 30 units per acre to comply with California Government Code 65583.2(c)(iv) and (e) which requires jurisdictions within Metropolitan Statistical Areas (MSA) of populations greater than 2,000,000 to allow for up to 30 units per acre when determining sites to meet the low and very low housing allocation categories. El Dorado County is located within the Sacramento MSA. Amend the Multi-Family land use to allow for commercial as part of a mixed use project. Amend the Multi-Family land use to encourage a full range of housing types including small lot single family detached design without a requirement for a Planned Development.

High Density Residential Use: Consider deleting requirement for a Planned Development application on projects of 3 or more units per acre.

Open Space: Consider amending policy to make reference to Objective 7.6.1

Table 2-2
Consider amending table to reflect changes in density for Commercial/Mixed Use from 16 units per acre to 20 units per acre and Multi-Family from 24 units per acre to 30 units per acre.

Policy 2.2.1.5 and Table 2-3
Consider amending Policy to direct the regulation of building intensities be established in the Zoning Ordinance and delete Table 2.3.

Policies 2.2.3.1, 2.2.3.2, 2.2.5.4
Consider amending the 30% open space requirement inside of Community Regions and Rural Centers to allow lesser area of "improved open space" on site, set criteria for options in meeting a portion of the requirement off-site or by an in lieu fee option as deemed necessary.

Table 2-4
Consider amending Table 2-4 to reflect Zoning Ordinance Update revision to zones.

Policy 2.2.4.1
Consider amending the Density Bonus policy which allows incentive for the creation of open space as part of residential projects, and implement policy specifics through Zoning Ordinance.

Policy 2.2.5.4
Consider deleting policy.

Policy 2.2.5.8
Consider amending the policy requirement for a Neighborhood Services Zone and allow for objectives to be meet in a related zone.

Policy 2.2.5.10

Consider deleting requirement for special use permit for Ag Support Services; incorporate standards and permitted uses into Zoning Ordinance

Policy 2.4.1.3
Consider amending policy to recognize the historical townsites of El Dorado/Diamond Springs and other historical townsites.

Policy 2.9.1.2, 2.9.1.3 and 2.9.1.4
Consider amending criteria for establishing Community Region and Rural Center boundaries. Amend timeframe for revision by the Board of Supervisors allowing for amendments to the boundaries to be completed by Board of supervisors on an as needed basis.

New Policies
Consider setting criteria for and identify Infill sites and Opportunity areas that will provide incentives substantial enough to encourage the development of these vacant/underutilized areas. This amendment would set criteria for CEQA streamlining opportunities but would not amend land uses or go beyond existing EIR growth projections or densities set by the General Plan. These policies may support the use of Traditional Neighborhood Design guidelines, Mixed Use, and Form Base Code.

TRANSPORTATION AND CIRCULATION ELEMENT

Policy TC-1a, TC-1b, and Table TC-1
Consider revising policies, and table to bring objectives into conformance with policy TC-1p, TC-1r, TC-1t, TC-1u, TC-1w, TC-4f, TC-4i, HO-1.3, HO-1.5, HO-1.8, HO-1.18, HO-5.1 and HO-5.2, to allow for narrower streets and road ways and to support the development of housing affordable to all income levels.

Policies TC-1m, TC-1n(B), TC-1w
Consider amending policies to clean up language including; TC-1m delete "of effort"; TC-1n(B) replace accidents with crashes; and TC-1w, delete word maximum.

Table TC-2, TC-Xband TC-Xd
Consider amending or deleting Table TC-2 and maintain list outside of General Plan and amending any policies referring to Table TC-2.

Policy TC-Xb(C)
Consider amending policy TC-Xb(C) to refer to Figure TC-1 when referencing the circulation diagram.

Policy TC-Xg
Consider amending to include that each development shall also design necessary improvements as well as construct or fund them.

Policy TC-Xi
Consider amending policy to allow for coordination of regional projects to be delivered on a schedule agreed to by related regional agencies and therefore not subject to meeting the scheduling requirements of the policies of this General Plan.

Policies TC-4a, TC-4d and TC-4f
Consider amending policies to clean up language to ensure consistency with subsequent adopted plans.

Policies TC 4i, TC-5a, TC-5b and TC-5c
Consider amending policies to provide more flexibility when requiring sidewalks.

New Goal
Consider a new goal and associated policies recognizing the requirements of California Government Code § 65080(b)(2)(I) implemented through the regional Metropolitan Transportation Plans to provide CEQA streamlining opportunities for qualified projects.

New Policy
Consider a new policy that supports the development of new or substantially improved roadways to accommodate all users, including bicyclists, pedestrians, transit riders, children, older people, and disabled people, as well as motorists consistent with appropriate code requirements. Add implementation measure to update the applicable manuals and standard plans to incorporate elements in support of all users. (Assembly Bill 1358 the Complete Streets Act of 2008)

PUBLIC SERVICES AND UTILITIES ELEMENT

Policy 5.1.2.2 and Table 5-1
Consider amending policy and table to provide flexibility when achieving minimum level of service requirements consistent with related policies being considered for amendment.

Policies 5.2.1.3 and 5.3.1.1
Consider amending policies to increase flexibility for the connection to public water and wastewater systems when projects are located in a Community Regions.

PUBLIC HEALTH, SAFETY AND NOISE ELEMENT

Policy 6.4.1.4 and 6.4.1.5
Consider amending policies and remove Attachment A to address recommendations by the Office of Emergency Services and Homeland Security regarding dam failure inundation.

Policy 6.5.1.11 and Tables 6-1 thru 6-5
Consider revising existing noise standards to establish attainable noise thresholds with regard to temporary nighttime construction activities and other temporary exceedences.

Objective 6.7.1 and 6.7.5
Consider amending the General Plan Objective 6.7.1 and 6.7.5 to reflect updated air quality plan opportunities that support the adoption of a separate Air Quality - Energy Conservation Plan. Create policy(s) to implement these objectives.

CONSERVATION AND OPEN SPACE ELEMENT

Policy 7.1.2.1
Consider amending the restrictions for development on 30% slopes, and set standards in the Zoning Ordinance and Grading Ordinance.

Objective 7.6.1.3(B)
Consider amending policy to delete specific references to zones to conform with the changes proposed in the Zoning Ordinance update.

AGRICULTURE & FORESTRY

Policy 8.1.3.2

Consider amending policy to provide a limited buffer for lands within a Community Region by adding language similar to 8.4.1.2 to 8.1.3.2 to bring the forest resources and agriculture lands buffering policies, in line with one another.

Policy 8.2.4.2
Consider amending policy to eliminate special use permit requirement for visitor-serving uses and establish standards and permitted uses in the Zoning Ordinance

Policy 8.2.4.4
Consider amending policy and any related policies to allow for ranch marketing activities on grazing lands.

BE IT FURTHER RESOLVED, the Board of Supervisors intends to analyze the following policies:

Policy 2.2.1.2
High Density Residential: Consider analyzing the effects of increasing High Density Residential Land use density from a maximum of 5 units per acre to 8 units per acre.

Policy 2.1.1.1 and 2.1.2.1
Consider analyzing the possibility of adding new, amending or deleting existing Community Regions or Rural Center planning areas.

TC-1y
Consider analyzing the potential for deleting the El Dorado Hills Business Park employment cap limits including option identified in TC-1v.

Policy TC-Xd, TC-Xe and TC-Xf
Consider revising the policies to clarify the definition of "worsen", what action or analysis is required if the threshold of "worsen" is met, clarification of the parameters of analysis (i.e. analyis period, analysis scenarios, methods), thresholds and timing of improvements.

Policy 7.2.1.2
Consider amending policy to clarify the Mineral Resource Zones that are required to be mapped.

BE IT FURTHER RESOLVED the Board of Supervisors hereby authorizes Planning Services under the management of the Chief Administator to procede with the preparation of all necessary documentation and CEQA review requirements pursuant to the requirements of the California Environmental Quality Act.

BE IT FURTHER RESOLVED that Resolutions ROI 274-2008, ROI 110-2009 and ROI 179-2010 are hereby superseded by this resolution.

BE IT FURTHER RESOLVED that the Planning Commission and Board of Supervisors will return in a public hearing to consider the proposed amendments.

PASSED AND ADOPTED by the Board of Supervisors of the County of El Dorado at a regular meeting of said Board, held the 14 day of November, 20 11, by the following vote of said Board:

Ayes: Sweeney, Briggs, Knight, Nutting, Santiago
Noes: none
Absent: none

Attest:
Suzanne Allen de Sanchez
Clerk of the Board of Supervisors

By: ______________________
Deputy Clerk

First Vice Chair, Board of Supervisors
John R. Knight

RESOLUTION NO. 183-2011

OF THE BOARD OF SUPERVISORS OF THE COUNTY OF EL DORADO

RESOLUTION OF INTENTION TO UNDERTAKE A COMPREHENSIVE UPDATE OF THE ZONING ORDINANCE

WHEREAS, the County of El Dorado is mandated by the State of California to maintain an adequate and proper General Plan; and

WHEREAS, the County of El Dorado adopted a General Plan in 2004; and

WHEREAS, many Policies, programs, and implementation measures are implemented through the Zoning Ordinance; and

WHEREAS, the Zoning Ordinance has not been comprehensively updated for over 30 years, yet has been amended an average of twice a year, resulting in a Zoning Ordinance that is a patchwork of provisions and dated regulations; and

WHEREAS, many State and federal regulations that affect the Zoning Ordinance are not accurately reflected in the Ordinance; and

WHEREAS, the Board of Supervisors adopted Resolution of Intention No. 44-2008,and

WHEREAS, the Board of Supervisors is considering amendments to the General Plan to address job creation, construction of housing for moderate-income families, the retention of sales taxes, and support of the agriculture and resource industries of the County that would be implemented by the Zoning Ordinance, and

WHEREAS, according to Section 17.10.010 the Zoning Ordinance amendment must be initiated by Board of Supervisors Resolution;

NOW, THEREFORE, BE IT RESOLVED that the County of El Dorado Board of Supervisors hereby authorizes the Development Services Department to proceed with the preparation of a Comprehensive Update of the Zoning Ordinance, addressing the following issues:

1. Conform the zoning map to the General Plan land use designations;

2. Eliminate conflicting provisions of the existing ordinance;

3. Include provisions in the ordinance to implement General Plan Implementation Measures LU-A, HO-6, HO-16, HS-K, CO-A, AF-A, ED-N, ED-P, ED-II, ED-JJ, ED-KK, and ED-QQ

4. Ensure that the ordinance is consistent with applicable state and federal laws;

5. Reorganize the ordinance for ease of use by the public, staff, and decision makers, including the use of tables to identify permitted uses and development standards, establishing specific use regulations for administrative review of specified uses, and providing rules of interpretation and a comprehensive glossary;

6. Create new zones to reflect current zoning needs and implement the General Plan, including the following zones: Rural Lands, Forest Resources, Agricultural Grazing, Neighborhood Service, and Limited Agriculture;

7. Delete obsolete zones, including Unclassified, Agriculture, Residential-Agricultural, and Planned Commercial;

8. Create overlay zones to more effectively implement General Plan policies;

9. Expand potential uses in the agricultural and rural lands zones to provide for opportunities for agricultural support, recreation, and rural commerce, including allowing ranch marketing on grazing land;

10. Provide a range of intensities for home occupations, based on size and zoning of parcels, addressing the use of accessory structures, customers, and employees.

11. Modify zoning for Williamson Act contracted and rolled out land to reflect the underlying General Plan land use designation;

12. Revise the zoning map to conform to standardized rule sets for zoning modifications based on the General Plan land use designations; and

13. Provide a range of commercial zones to specify and direct the type, design, and location of commercial uses.

BE IT FURTHER RESOLVED that the Board intends to have analyzed in the Environmental Impact Report for Comprehensive Zoning Ordinance Update the following options which may be included in the ordinance:

1. Create a Rural Commercial Zone that would be permitted within the Rural Regions planning concept area;

2. Increase potential uses to provide additional agricultural support, recreation, home occupation, and other rural residential, tourist serving, and commercial_uses in zones in the Rural Region;

3. Create standards (master plans) for mixed use and Traditional Neighborhood Design development to provide for a streamlined approval process and to protect the commercial viability of the site;

4. Include single family detached development standards in the Multi-Family zone. Allow up to 15% of the project area, for commercial uses as part of a mixed use development in multifamily zones.

5. Provide multiple industrial zones to specify and direct the type, design, and location of industrial uses;

6. Provide alternative means to any open space requirement as part of a planned development to provide more flexibility and incentives for infill development and focus on recreation in Community Regions and Rural Centers;

7. Amend Zoning map to include historical overlay on El Dorado and Diamond Springs in relationship to historical townsites but consistent with adopted General Plan and Zoning Ordinance policies; and

8. Codify standards for wetland and riparian setbacks.

BE IT FURTHER RESOLVED that Resolution of Intention No. 44-2008 is hereby incorporated into and superseded by this resolution.

BE IT FURTHER RESOLVED that the Planning Commission and Board of Supervisors will return in a public hearing to consider the proposed amendments.

PASSED AND ADOPTED by the Board of Supervisors of the County of El Dorado at a regular meeting of said Board, held the 14 day of November, 2011, by the following vote of said Board:

Ayes: Sweeney, Briggs, Knight, Nutting, Santiago
Noes: none
Absent: none

Attest:
Suzanne Allen de Sanchez
Clerk of the Board of Supervisors

By: ____________________
Deputy Clerk

____
First Vice Chair, Board of Supervisors
John R. Knight

RESOLUTION NO. 184-2011

OF THE BOARD OF SUPERVISORS OF THE COUNTY OF EL DORADO

RESOLUTION OF INTENTION TO UNDERTAKE A COMPREHENSIVE UPDATE OF THE ZONING ORDINANCE

WHEREAS, the County of El Dorado is mandated by the State of California to maintain an adequate and proper General Plan; and

WHEREAS, the County of El Dorado adopted a General Plan in 2004; and

WHEREAS, many Policies, programs, and implementation measures are implemented through the Zoning Ordinance; and

WHEREAS, the Zoning Ordinance has not been comprehensively updated for over 30 years, yet has been amended an average of twice a year, resulting in a Zoning Ordinance that is a patchwork of provisions and dated regulations; and

WHEREAS, many State and federal regulations that affect the Zoning Ordinance are not accurately reflected in the Ordinance; and

WHEREAS, the Board of Supervisors adopted Resolution of Intention No. 44-2008,and

WHEREAS, the Board of Supervisors is considering amendments to the General Plan to address job creation, construction of housing for moderate-income families, the retention of sales taxes, and support of the agriculture and resource industries of the County that would be implemented by the Zoning Ordinance, and

WHEREAS, according to Section 17.10.010 the Zoning Ordinance amendment must be initiated by Board of Supervisors Resolution;

NOW, THEREFORE, BE IT RESOLVED that the County of El Dorado Board of Supervisors hereby authorizes the Development Services Department to include with the preparation of a Comprehensive Update of the Zoning Ordinance the provision of opportunities for residential and recreational uses on Timber Production Zone land compatible with timber management and harvesting.

BE IT FURTHER RESOLVED that the Planning Commission and Board of Supervisors will return in a public hearing to consider the proposed amendments.

PASSED AND ADOPTED by the Board of Supervisors of the County of El Dorado at a regular meeting of said Board, held the 14 day of November, 2011, by the following vote of said Board:

Ayes: Sweeney, Briggs, Knight, Santiago
Noes: none
Absent:
Recused: Nutting

Attest:
Suzanne Allen de Sanchez
Clerk of the Board of Supervisors

By: Kathryn Tyler
Deputy Clerk

First Vice Chair, Board of Supervisors
John R. Knight

F. d: Public Comment for the Targeted General Plan Amendment and Zoning Ordinance Update

Shawna Purvines <shawna.purvines@edcgov.us> Tue, Jul 10, 2012 at 1:41 PM
To: TGPA-ZOU ZOU <TGPA-ZOU@edcgov.us>

---------- Forwarded message ----------
From: Lori Parlin <loriparlin@sbcglobal.net>
Date: Tue, Jul 10, 2012 at 10:37 AM
Subject: Public Comment for the Targeted General Plan Amendment and Zoning Ordinance Update
To: shawna.purvines@edcgov.us
Cc: loriparlin@sbcglobal.net

To: Shawna Purvines, Senior Planner

Development Services Department

2850 Fairland Court

Placerville, CA 95667

shawna.purvines@edcgov.us

From: Sam and Lori Parlin

3971 Crosswood Drive

Shingle Springs, CA 95682

loriparlin@sbcglobal.net

Re: Public Comment For the Targeted General Plan Amendment and Zoning Ordinance Update

We are requesting that the Update process be put on hold until some ver. serious issues are resolved and questions are answered, such as:

1. Why Kim Kerr was hired to lead the Update process when she was being investigated by the Amador County Grand Jury, which found in its 2012 Final Report that Ms. Kerr, as the former City Manager of Ione:

a. disregarded findings and recommendations of the 2010-2011 Grand Jury Report;

b. provided insufficient or misleading information for the City Council to cast intelligent votes;

c. did not maintain proper payment procedures for consultants;

d. created an unrealistic General Plan for the financial infrastructure in place at that time;

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e. did not demonstrate that she had the proper qualifications to perform the duties required of the City Manager position for 2007-2011.

2. Public comments are due by July 10, 2012, yet the Scoping meetings were held up until June 27, 2012. This left attendees of the June 27th meeting with only 13 days (including the July 4th holiday) to thoroughly research hundreds of pages of County documents, several maps, and as many outside sources as possible in order to make intelligent, meaningful comments.

3. The Scoping meetings were procedural and superficial and did not provide the public with any in-depth or project-specific information about how their neighborhoods would be affected by the new plan and policies.

4. Concerns have been raised by the public that the entire process is being hurried before the new Board of Supervisors is in place. It makes sense to put the process on hold so that the new Board can be part of the process, rather than handing them an updated Plan in which the public has no faith.

In the limited amount of time we had to make public comments, we were able to identify the following concerns:

1. We.ve heard it said repeatedly that people choose to live in El Dorado County because they like its rural characteristics; they like to be able to come home and escape the noise and congestion of nearby urban communities. We want the County to protect and preserve our rural lifestyle and reject projects that put high-density and/or mixed-use developments adjacent to or in the middle of medium- or low-density neighborhoods.

a. Our roadways cannot withstand the additional traffic and we do not want the additional emissions or noise from additional traffic.

b. Our county does not have enough living-wage jobs for its current residents, and a large number of existing residents drive to work outside our county. Increasing the population density will just exacerbate this problem.

c. These types of projects will cause more light pollution.

d. High-density and mixed-use infill projects were originally intended by CEQA for urban use, not suburban or rural uses.

2. We were told at the June 27th Scoping meeting that property owners should do their due diligence when choosing where to live. That would be possible if all we had to do was look at the zoning of the properties in the area. However, the Community Region land use designation is often used to justify the rezoning of properties, which is an injustice to existing property owners and long-time residents and makes due diligence impossible for prospective property owners. At the very least, the Community Region boundaries should be reevaluated and updated based on input from residents within and around the boundaries. Preferably, the Community Region land use designation and its current mapping boundaries would be completely removed from the General Plan as it is misleading and not transparent.

3. The current notification process used by the Planning Commission and Board of Supervisors is inadequate for our area and needs improvement. I have attended several meetings where people in the audience knew nothing about proposed projects right in their own neighborhood. The 500' distance for mailing notifications is inadequate in our area because of the large parcels and the fact that one person may own several adjacent parcels. The mailing notification distance should be lengthened for increased public awareness of proposed projects. In addition to a larger mailing distance, a road sign placed at main intersections near the site would give people affected by the change the opportunity to see the notification as they drove by the site.

Thank you for the opportunity to submit comments regarding this process.

Lori and Sam Parlin

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Shawna L. Purvines
Sr. Planner
Development Services
El Dorado Count.
Phone:(530) 621-5362
shawna.purvines@edcgov.us
www.edcgov.us

EDHAPAC TGPA/ZOU NOP Response Matrix

July 6, 2012

Issue			EDH-APAC Position	NOP Response	NOP Response
Policy 2.2.1.2 and Table 2-1-Major Concern Multi-Family Use: Consider amending density from 24 units per acre to 30 units per acre to comply with California Government Code 65583.2(c)(iv) and (e) which requires jurisdictions within Metropolitan Statistical Areas (MSA) of populations greater than 2,000,000 to allow for up to 30 units per acre when determining sites to meet the low and very low housing allocation categories. El Dorado County is located within the Sacramento MSA. Amend the Multi-Family land use to allow for commercial as part of a mixed use project. Amend the Multi-Family land use to encourage a full range of housing types including small lot single family detached design without a requirement for a Planned Development. High Density Residential Use: Consider deleting the requirement for a Planned Development application on projects of 3 or more units per acre.			Amending the density from 24 to 30 units would have a significant impact on site specific projects designated as multi-family use. This change would require that the infrastructure must be in place prior to development of the project. This may be appropriate for small developments on a single acre, but when creating more than 10 units in an area, a Planned Development is appropriate—especially if up to 8 units are on a single acre.	***Aesthetics** The increase in size of the buildings to accommodate the additional units could overwhelm the surrounding area. How will this be prevented? ***Air Quality** The County already often exceeds the State air quality limits to avoid health risks associated with air pollution. This increase density will cause higher levels of air pollution. How will this be prevented? ***Land Use/Planning** The increase density could exceed the surrounding infrastructure and services. Please analysis this issue. ***Noise** The increase in density will cause additional noise at these sites. How will this be mitigated?	***Population/Housing** The inclusion of the additional density per acre could exceed population balance for Community regional areas. How will this be prevented? ***Transportation/Traffic** The increase density could cause traffic congestion. The new traffic demand model should be used to analysis this impact.

Issue			EDH-APAC Position	NOP Response	NOP Response
Policies 2.2.3.1, 2.2.3.2 and 2.2.5.4- ***Major Concern*** Consider amending the 30% open space requirement inside of Community Regions and Rural Centers to allow lesser area of "improved open space" on site, set criteria for options in meeting a portion of the requirement off-site or by an in lieu fee option as deemed necessary.			This would allow too many discretionary decisions by county policy makers on open space issues. The collection of in lieu fees would reduce open spaces which are highly desirable. Regardless of the "improvement" of the open space, a reduction from 30% open space will dramatically change the feel of an area. Even worse, allowing open space to be off-site completely removes the rural feel of an area that is being developed and again violates the fundamental principles of the county's citizens.	***Aesthetics** ***Land Use/Planning** ***Noise**	

Issue			EDH-APAC Position	NOP Response	NOP Response
Policy 2.2.4.1-Major Concern Consider amending the Density Bonus policy which allows incentive for the creation of open space as part of residential projects, and implement policy specifics through Zoning Ordinance.			Density Bonus has encouraged developers to request higher density projects for increased profits instead of better projects. The policy change must be clearly defined before an EIR can assess the impacts of this amendment. It is not appropriate to have a Density Bonus in Medium Density and Low Density Residential land use areas. Instead, an owner should apply for a change in land use designation and be evaluated on a case by case basis. Otherwise, a Density Bonus in these zones amounts to a change in land use and would significantly change the intention of the land use in the General Plan		
Policy 2.2.5.4-Major Concern Policy 2.2.5.4 All development applications which have the potential to create 50 parcels or more shall require the application of the Planned Development combining zone district. However, in no event shall a project require the application of the Planned Development combining zone district if all of the following are true: (1) the project does not require a General Plan amendment; (2) the project has an overall density of two units per acre or less; and (3) the project site is designated High-Density Residential. Consider deleting policy.			The requirement for a Planned Development belongs in the General Plan as it is one of the fundamental principles of our county that ensures preservation of open space as well as having infrastructure in-place prior to the development. It is too important to be moved from the most important planning document of the county, the General Plan. This is how to get rid of the 30% open space requirement. If a PD is not required, then I don't believe <u>any</u> open space is required to develop a property. Pack-um and stack-um! Could look like inner-city development on any parcels that are left to be developed. Question, can EDH CSD create more stringent requirements than the County? Maybe we have the CSD pass an overlay on all CC&Rs for the community region.		

Issue			EDH-APAC Position	NOP Response	NOP Response
New Policies-Major Concern Consider setting criteria for and identify Infill sites and Opportunity areas that will provide incentives substantial enough to encourage the development of these vacant/underutilized areas			This could increase densities in infill areas without providing the required infrastructure. The proposed language by staff for "Promote Infill Development" item d) should have the following words added at the end of the sentence ", but only after all infrastructure is in place that will support such future development".		
Policy TC-1a, TC-1b, and Table TC-1-Major Concern Consider revising policies, and table to bring objectives into conformance with policy TC-1p, TC-1r, TC-1t, TC-1u, Tc-1w, TC-4f, TC-4i, HO-1.3, HO-1.5, HO-1.8, HO-1.18, HO-5.1, and HO-5.2, to allow for narrower streets and road ways and to support the development of housing affordable to all income levels.			Road widths should not be set by housing issues, but for public safety issues. Allowing narrower streets sacrifices safety of our citizens in a significant way. To do this for financial gain is not appropriate. Highway standards should be based strictly on safety and if a road cannot meet the standards, that becomes what limits the use and development of a parcel—we should not let the use and development of a parcel dictate the safety level		
Policy TC-1m, TC-1n(B), TC-1w-Moderate Concern Consider amending policies to clean up language including; TC-1m delete "of effort"' TC-1n(B) replace accidents with crashes; and TC-1w, delete word maximum.			Why replace the word "accidents" with the word "crashes"? Are they considered the same? Is one more inclusive of incidents that the other? Why not include both "accidents and crashes"? Or, are all accidents a subset of crashes? We need to make sure that this change does not reduce the need for safety improvements on our roads		Resolved.

Issue			EDH-APAC Position	NOP Response	NOP Response
Policy 7.1.2.1-Major Concern Consider amending the restrictions for development on 30% slopes, and set standards in the Zoning Ordinance and Grading Ordinance.			Construction of homes on 30% grade would cause additional environmental impacts on the area (grading, water runoff, and erosion). The existing language in the General Plan seems appropriate. If there are additional exceptions that are appropriate but not currently included, then add them to the General Plan. Keeping this in the general plan allows a proper EIR to be performed.		
Policy 2.2.1.2 -Major Concern High Density Residential: Consider analyzing the effects of increasing High Density Residential Land use density from a maximum of 5 units per acre to 8 units per acre			Increasing the density to 8 units per acre would put a tremendous load on the supporting infrastructure. This amounts to giving away the Density Bonus without earning it! The analysis for this type of density should be done through the Density Bonus provision.		
Policy 2.1.1.1 and 2.1.2.1-Major Concern Consider analyzing the possibility of adding new, amending or deleting existing Community Regions or Rural Center planning areas			These areas should be identified before analysis to determine public support for the change. The policy change must be clearly defined before an EIR can assess the impacts of this amendment.		
Policy 2.1.1.3 Mixed use developments which combine commercial and residential uses in a single project are permissible and encouraged within Community Regions. The maximum residential density of 20 dwelling units per acre may only be achieved where adequate infrastructure, such as water, sewer and roadway are available or can be provide concurrent with development.			Language should be added that stipulates that the number of APPROVED dwelling units will be dependent on approved traffic studies and the application of appropriate traffic mitigation measures concurrent with development.		
Policy 2.1.2.5 Mixed use developments which combine commercial and residential			Language should be added that stipulates that the number of APPROVED dwelling units will be dependent on approved traffic		

Issue			EDH-APAC Position	NOP Response	NOP Response
uses in a single project are permissible and encouraged within Community Regions. The maximum residential density shall be 10 dwelling units per acre in Rural Centers <u>in identified</u> mixed use areas as defined in <u>the Zoning Ordinance.</u> The residential component of a mixed use project may include a full rance of single and/or multi family design concepts. <u>The maximum residential density of 10 dwelling units per acre may only be achieved where adequate infrastructure, such as water, sewer and roadway are available or can be provide concurrent with development.</u>			studies and the application of appropriate traffic mitigation measures concurrent with development. "Identified" mixed use areas must be disclosed in the Zoning Ordinance before an EIR is prepared.		
Policy TC-Xd, TC-Xe, and TC-Xf- Major Concern Consider revising the policies to clarify the definition of "worsen", what action or analysis is required if the threshold of "worsen" is met, clarification of the parameters of analysis (i.e. analysis period, analysis scenarios, methods), thresholds and timing of improvements.			This should be a scientific term that has a measurable value and infrastructure trigger points must be established to prevent reduction of traffic circulation and degrading of service. Is the term being revisited to dilute impacts of increased traffic caused by new developments?		
Policy 10.2.1.5- Major Concern Don't see any ROI language indicating a desire to analyze a change in this policy	norm		The way staff has proposed to change this policy violates another fundamental principle. The proposed word change from "<u>shall</u>" to "<u>may</u>" could result in existing citizens subsidizing developers for the cost of facilities, infrastructure, and services. All development applications for subdivision must require a Public Facilities and Services Financing Plan that assures cost burdens do not fall on existing residents.		

Issue			EDH-APAC Position	NOP Response	NOP Response
Table TC-2, TC-Xb and, TC-Xd- Moderate Concern Consider amending or deleting table TC-2 and maintain list outside of General Plan and amending any policies referring to Table TC-2.			Traffic is one of the two most observable items to people in the county. A list of these roads belongs in the General Plan. If they are removed, an EIR would have to be performed every time a new road segment was added to the list or the Maximum V/C ratio was changed. The EIR needs to know what to evaluate now and cannot anticipate future changes by the County. In addition, Policy TC-Xf should not have the item "<u>or (2) ensure the commencement of construction of the necessary road improvements are included in the County's 10-year (or 20-year) CIP</u>". This second item should be eliminated since the CIP changes frequently and is budget dependent. The improvements might never be constructed and then the citizens would have to live with unbearable traffic forever. Or, expecting citizens to tolerate traffic and safety problems for 10 or more years is unreasonable.		

Issue			EDH-APAC Position	NOP Response	NOP Response
Policies 5.2.1.3 and 5.3.1.1- Moderate Concern Consider amending policies to increase flexibility for the connection to public water and wastewater systems when projects are located in a Community Region.			The proposal is to remove the word "shall" and replace with the word "may" in requirement of connecting to public water and public wastewater. This is not appropriate for a Community Region! The whole idea of a Community Region is that infrastructure is readily available. If a development cannot connect to both public water and public wastewater, it does not belong in the Community Region—especially for high-density residential and multifamily residential development. The use of the word "may" might be appropriate in the case of medium-density residential, commercial, industrial, and research and development projects. Also, the addition of the words "if reasonably available" should be replaced with "if appropriate", otherwise if public water and public wastewater are not "reasonably available" an applicant could claim that they are allowed to develop using well water and/or septic by right.		
Zoning Ordinance: ROI 183-2011- ;- ***Major Concern*** 6. Provide alternative means to any open space requirement as part of a planned development to provide more flexibility and incentives for infill development and focus on recreation in Community Regions and Rural Centers			This will allow too many discretionary decisions by county policy makers on open space issues. The policy change must be clearly defined before an EIR can assess the impacts of this amendment.		

Attachment #16

EL DORADO COUNTY DEVELOPMENT SERVICES
PLANNING COMMISSION
STAFF REPORT

Agenda of: February 14, 2008

Item No.: 8.

Staff: Jonathan Fong

GENERAL PLAN AMENDMENT/REZONE/PLANNED DEVELOPMENT/TENTATIVE SUBDIVISION MAP

FILE NUMBERS: A07-0005/Z07-0012/PD07-0007/TM07-1440, Summerbrook

APPLICANT: Imran Aziz & Amar Ghori/ Holloway Land Company

ENGINEER: CTA Engineering and Surveying/ Olga Sciorelli

REQUEST: The project consists of the following requests:

1. General Plan Amendment amending the General Plan land use designation from Rural Residential (RR) to Low Density Residential (LDR);

2. Rezone for parcel 102-210-12 from Exclusive Agricultural (AE) to Estate Residential Five-Acre/ Planned Development (RE-5/ PD) and rezone for parcel 102-220-13 from Estate Residential Five-Acre (RE-5) to Estate Residential Five-Acre/ Planned Development (RE-5/ PD);

3. Planned Development to allow use of the Density Bonus Planning Concept and to allow flexibility in the Development Standards of the RE-5 Zone District;

4. Tentative Subdivision Map, to create 29 lots ranging in size from 58,591 square feet (1.33-acres) to 97,184 square feet (2.23-acres) with approximately 35 acres of open space; and

5. Design Waiver request for the following: to reduce the right-of-way width requirement for A Street, B Street, C and D Courts from 60 feet to 50 feet.

LOCATION: The project is located on the north side of Green Valley Road 500 feet west of the intersection with Bass Lake Road, Supervisorial District IV. (Exhibit A)

APN: 102-210-12 & 102-220-13. (Exhibit D)

ACREAGE: 90.0 acres

GENERAL PLAN: APN: 102-210-12 Rural Residential (RR)
APN: 102-220-13 Rural Residential (RR)
(Exhibit B)

ZONING: APN: 102-210-12 Exclusive Agricultural (AE)
APN: 102-220-13 Estate Residential Five-Acre (RE-5)
(Exhibit C)

ENVIRONMENTAL DOCUMENT: Mitigated Negative Declaration

SUMMARY RECOMMENDATION: Recommend conditional approval

STAFF ANALYSIS: Staff has reviewed the project for compliance with the County's regulations and requirements. An analysis of the proposal and issues for Planning Commission consideration are provided in the following sections.

Project Description: The project request is for a General Plan Amendment, Rezone, Planned Development and Tentative Subdivision Map. Discussed below are important project characteristics.

General Plan Amendment: The project would require a General Plan Amendment to change the General Plan Land Use Designation from Rural Residential (RR) to Low Density Residential (LDR).

Rezone: The project would require a rezone to change the zoning of APN 102-210-12 from Exclusive Agriculture (AE) to Estate Residential Five-Acre/ Planned Development (RE-5/ PD). The zoning of APN 102-210-13 would be changed to add the Planned Development zoning overlay to change the parcel zoning to RE-5/PD.

Planned Development: The project request includes a Planned Development application which would allow flexibility in the Development Standards of the RE-5 zone district and would allow the utilization of the Density Bonus provisions. The project would create lots which do not meet the minimum parcel size requirements of the RE-5 zone district. As discussed in the General Plan section below, the project would be a clustered development. Planned Development findings have been made to allow for the flexible design. The Density Bonus would allow the project to exceed the maximum density allowed within the LDR land use designation. The density increase would be allowed due to the proposed 35-acres of open space proposed as part of the project.

Public Water/ Private Septic Systems: The project would be served by EID public water and individual septic systems. An EID water line is located in the project vicinity beneath Green Valley Road and would require connection to the project site. The proposed septic systems and disposal areas have been reviewed and approved by Environmental Management.

EID/ Cameron Park Community Services District (CSD) Annexation: In order to obtain EID public water service for the project, the site would require annexation into the EID service boundary. Due to the site location adjacent to the Cameron Park CSD Sphere of Influence boundaries, the CSD has requested the project annex into the CSD boundaries (Exhibit F). These annexations would require approval from LAFCO to extend the required district boundaries.

Road Improvements: The project would be conditioned to perform onsite and offsite road improvements. The project would be served by two points of access onto Green Valley Road and two cul-de-sac roads. ‘B’ Street would connect to ‘A’ circle which would be a one-way roundabout road connected to ‘C’ and ‘D’ Court and ‘A’ Street. ‘A’ Street would be a right-in/ right-out road onto Green Valley Road. The project would be required to perform road widening and bicycle lane improvements along the frontage on Green Valley Road. As recommended by the traffic study prepared for the project, the intersection at Green Valley and Deer Valley Road, would require signalization. The Department of Transportation has approved a Capital Improvement Project to widen the Green Valley Road/ Deer Valley Road intersection (Exhibit K). The required signalization would be consistent with the proposing improvements to the intersection. The project has been conditioned by DOT to install these improvements.

Site Description: The project site is comprised of 90-acres of undeveloped land. The parcels have been historically used as grazing lands for cattle and horses. As shown on the Community Region Boundary Map (Exhibit G), the project site abuts the Cameron Park Community Region to the east and to the south. Vegetation onsite is characterized by native grasslands and oak woodland habitat. Approximately 1.60-acres of Jurisdictional Waters of the U.S. are located onsite. The jurisdictional waters are made up of wetlands, seeps, and intermittent and ephemeral drainage channels (Exhibit H). Slopes are mild, with the majority onsite slopes falling below the 30 percent range.

Adjacent Land Uses

	Zoning	**General Plan**	**Land Use/Improvements**
Site	AE/RE-10	RR	Rural residential/grazing uses
North	RE-10	RR	Single-Family Residences
South	RE-5/R-20K	LDR/ PF/RR	Single-Family Residences/ School Site
East	AE/RE-10/R2A	RR/MDR	Single-Family Residences
West	RE-10	RR	Single-Family Residences

The project site is surrounded by medium and low density residential development and agricultural land uses. As discussed below, the project has been designed with minimum lot sizes and setbacks to buffer the proposed residential uses from the agriculturally-zoned parcels to the south. The project would be compatible with the surrounding residential land uses in the area.

General Plan: The project would require a General Plan Amendment from Rural Residential (RR) to Low Density Residential (LDR). The proposed 29 lot subdivision would also require use of the Density Bonus planning concept to allow density above the maximum permitted within the LDR land use designation. A detailed discussion has been provided below.

Planned Development: The application request includes a Planned Development which pursuant to **General Plan Policy 2.2.3.1** requires a minimum of 30% commonly owned open space. The project has dedicated approximately 39% of the site as open space. The following table demonstrates conformance with this requirement.

Planned Development Required Open Space

Project Size	90-acres
Required Open Space	30-acres
Proposed Open Space	35-acres
Percent Open Space Required	30% open space
Percent Open Space Proposed	39% open space

The proposed open space would comply with the General Plan requirements for Planned Developments.

Density Bonus: The project includes a request to utilize the Density Bonus provision. Use of the Density Bonus would allow the project to provide an increased residential density beyond that allowed within the proposed LDR land use designation. **General Plan Policy 2.2.4.1** establishes specific criteria associated with use of the Density Bonus provision. In addition to the number of base units permitted by the land use designation, one and one-half additional units may be allowed for each unit of developable land dedicated to public benefit. **General Plan Policy 2.2.3.2** specifically exempts bodies of water such as perennial lakes, streams and rivers from calculable developable land for the purposes of the Density Bonus provision.

The project site is 90-acres and includes a General Plan Amendment to change the project site land use designation to LDR. The Low Density Residential land use designation permits a density range of one dwelling unit per 5-10 acres (du/a). The 90-acre site would yield a maximum density of 18 residential units. A total of 35.32-acres of developable land would be dedicated within open space lots. The Delineation of Waters of the U.S. prepared for the project identified a total of 0.09-acres of land which would be excluded from the Density Bonus provision in accordance with **General Plan Policy 2.2.3.2.** This would yield a total of 35.23-acres of land eligible for the Density Bonus provision. The 35.23-acres of land would yield 7.05 base residential units consistent with the allowable density within the LDR land use designation and the proposed RE-5 Zone District. The Density Bonus would allow for one and one-half additional units or 10.6 additional residential units. The project request for 29 lots includes the 18 base residential units and the additional 10.6 Density

Bonus units to provide a project proposed 29 residential units. Therefore the proposed 29-lot subdivision would be consistent within the LDR land use designation utilizing the Density Bonus provision.

Oak Canopy Retention: The proposed project would impact oak woodland habitat, which pursuant to General Plan Policy 7.4.4.4 requires retention and replacement of the affected habitat. The initial arborist report identified 8.5-acres of oak woodland canopy on the site (*Initial Arborist Report and Inventory, Sierra Nevada Arborists, May 2006).* The project would remove 0.98-acres of oak woodland habitat from the project site. As established in the Interim Interpretative Guidelines for General Plan Policy 7.4.4.4, dead diseased or dying oak canopy may be excluded from the retention requirements of Policy 7.4.4.4. As determined by the arborist report, 0.57-acres of onsite canopy is determined to be dead, diseased, or dying. The project site contains approximately 8.5-acres of oak canopy which would require 90% retention. The project would remove 0.41-acres of healthy canopy which would require replacement.

Onsite replacement would be required as part of the project. The submitted Tree Preservation and Replacement Plan has identified sufficient areas to replace the impacted canopy. All healthy oak canopy removed from the site shall be replaced as specified in General Plan Policy 7.4.4.4 and the Interim Interpretative Guidelines for General Plan Policy 7.4.4.4. Replacement of the removed canopy shall be at a density of 200 tree saplings per acre, or 600 acorns per acre. A replanting and monitoring program would be required to ensure the long term survival of the replaced canopy. The project would include Mitigation Measures to ensure compliance with this policy (Mitigation Measure No. 5). The proposed removal and replacement would be consistent with the retention requirements of Policy 7.4.4.4.

Traffic and Circulation: The applicant was required to prepare a traffic study for the project to determine project related impacts to the road system in the area. The traffic study was prepared by Kimley-Horn and Associates dated April 2007. The study determined that onsite and offsite road improvements would be required as part of the project.

The Department of Transportation was distributed the project during the 30-day review period and recommended conditions of approval for the project. The project would be required to include road widening and sidewalk improvements along Green Valley Road consistent with **General Plan Policy TC-5a**. The intersection of Green Valley Road and Deer Valley Road would be signalized and acceleration and deceleration lanes would be constructed consistent with the approved Capital Improvement Project #66114. The onsite roads would be constructed to the provisions of Standard Plan 101C to provide for a 24 foot wide road surface.

Agricultural Compatibility: The project site is zoned Exclusive Agriculture and is located adjacent to agriculture-zoned lands which requires review by the Agricultural Commission. The project was presented to the Agriculture Commission on May 9, 2007. Pursuant to **General Plan Policy 8.1.4.1** the Agriculture Commission is required to forward recommendations to the approving authority regarding the impacts of the proposed development on agriculture uses. The Agricultural Commission recommended denial of the project based on the following findings:

1) *The project does not meet the allowable density within the Rural Residential Land Use Designation;*

2) *The project would create an island effect wherein agricultural lands would be negatively affected;*

3) *The project would significantly destroy the buffering effect of existing large parcels adjacent to agricultural lands; and*

4) *The project is proposed to be located on historical grazing lands which should be protected by 40-acre minimum parcel sizes.*

In accordance with **General Plan Policy 8.1.4.4** the following findings must be made by the approving authority prior to approval of the project:

A. Will not intensify existing conflicts or add new conflicts between adjacent residential areas and agricultural activities; and

B. Will not create an island effect wherein agricultural lands located between the project site and other non-agricultural lands will be negatively affected; and

C. Will not significantly reduce or destroy the buffering effect of existing large parcel sizes adjacent to agricultural lands.

As required by **General Plan Policies 8.1.3.1** and **8.1.3.2** a 200-foot buffer and 10-acre minimum parcel size would be required for parcels located adjacent to agriculture-zoned parcels. The required 200-foot setback and minimum parcel size has been shown on the Tentative Map.

The project parcel and the parcel to the south (APN 102-030-10) are the remaining agriculture-zoned parcels in the area (Exhibit L). A Pre-Application Meeting was held on August 14, 2007 for APN 102-030-10 to consider a General Plan Amendment and Tentative Map to allow for single-family residential and commercial land uses. The parcel is located at the intersection of Green Valley Road and the future extension of Silver Springs Parkway.

The project would create a residential project consistent with the surrounding residential land uses. The required buffers and minimum lot sizes for agricultural compatibility have been provided. Findings of Approval have been included in Attachment 2 of the staff report.

Rezone: The project request includes a rezone which pursuant to **General Plan Policy 2.2.5.3** requires that the following criteria to be evaluated prior to approval of a Rezone request:

1. Availability of an adequate public water source or an approved Capital Improvement Project to increase service for existing land use demands;

Discussion: The project would be served by EID public water and private septic systems. The Facilities Improvement Letter (FIL) submitted by EID dated November 2006 indicated that adequate public water is available to serve the project.

2. Availability and capacity of public treated water system;

Discussion: The project would not connect to public treated water systems.

3. Availability and capacity of public waste water treatment system;

Discussion: The project would not connect to public waste water treatment systems.

4. Distance to and capacity of the serving elementary and high school;

Discussion: The project site is located within the Rescue Union School District. Prior to building permit issuance for each of the proposed lots, payment of school fees would be required.

5. Response time from nearest fire station handling structure fires;

Discussion: The project site is located within the Rescue Fire Protection District. The District has reviewed the project and has determined with the requested conditions of approval, the District would be able to provide adequate fire protection to the site.

6. Distance to nearest Community Region or Rural Center;

Discussion: As shown on the Community Region Map (Exhibit G), the project site abuts the Cameron Park Community Region Boundary to the east and to the south.

7. Erosion hazard;

Discussion: The grading necessary for the onsite and offsite road improvements would be required to comply with applicable grading and erosion control policies established by the County. The Department of Transportation would review the grading plans to verify conformance with established policy. Adherence to these rules would ensure that erosion hazards would be prevented.

8. Septic and leach field capability;

Discussion: The project would be served by private septic wastewater facilities. The El Dorado County Department of Environmental Health reviewed the septic test reports submitted with the project and determined that the proposed systems would have adequate capacity to serve the proposed development.

9. Groundwater capability to support wells;

Discussion: The project would be served by public water and would not require wells.

10. Critical flora and fauna habitat areas;

Discussion: The project site is located within Rare Plant Mitigation Area 1 which is defined as lands not known to contain Special Status Plant Species, but with soil types capable of supporting them. As required by Section 17.71 of the Zoning Ordinance and Board of Supervisors Resolution 205-98 payment of the Mitigation Area 1 mitigation fee would be required prior to building permit issuance.

11. Important timber production areas;

Discussion: The project site does not contain or is adjacent to any important timber production areas.

12. Important agricultural areas;

Discussion: A portion of the site and the adjacent parcel to the south are zoned Exclusive Agriculture (AE). As discussed in the General Plan section above, the project includes a 200 foot setback and 10-acre minimum parcel size for parcels adjacent to the AE-zoned parcel to the south. The setback and minimum parcel size would be consistent with applicable General Plan policies.

13. Important mineral resource areas;

Discussion: The project site does not contain or is located adjacent to any important mineral resource areas.

14. Capacity of the transportation system serving the area;

Discussion: The Department of Transportation has reviewed the traffic study prepared for the project. DOT has determined that completion of the required road improvements and payment of Traffic Impact Mitigation Fees prior to building permit issuance would reduce impacts to the existing traffic system in the area.

15. Existing land use pattern;

Discussion: The project site is located directly adjacent to the Cameron Park Community Region boundary. The site is surrounded by existing residential development and to the south by an agriculture-zoned parcel. The residential lands are zoned RE-10, RE-5, and R2A. The project would allow for development consistent with the RE-5 zone district. The project would be consistent with the surrounding land use pattern.

16. Proximity to perennial water course;

Discussion: The project site is characterized by oak woodland habitat and wetland and drainage channels. A Jurisdictional Wetland Delineation was prepared by Foothill and Associates dated February 2007 which identified a total of 1.60-acres of wetlands and streams subject to regulation by the U.S. Army Corps of Engineers. As part of the project, portions of the onsite wetlands and streams would be filled to accommodate the development. As required by **General Plan Policy 7.3.3.4** and in accordance with the Clean Water Act, a 404 permit, Water Quality Certification and Streambed Alteration Agreement would be required for filling any jurisdictional wetlands. Mitigation Measures requiring these permits have been included as conditions of approval (Mitigation Measures No.2 and No.3).

A Biological Resource Assessment was performed by Foothill Associates dated December 2006 and a Focused Rare Plant Study was preformed by David Bise dated May 2007. The assessment did not identify Special Status Pine Hill Endemic Plant Species on the project site. The assessment did conclude that the onsite oak woodland habitat may provide suitable nesting areas for birds protected by the Migratory Bird Treaty Act. Mitigation Measures have been included as part of the project to require onsite surveys prior to construction activities to avoid disturbance of any protected species (Mitigation Measure No. 2).

Any perennial streams that would not be impacted would require a 100-foot setback as required by **General Plan 7.3.3.4.** A 50-foot setback would be required from wetlands and intermittent streams. The required setback from these onsite riparian features have been shown on the tentative map.

17. Important historical/archeological sites;

A Cultural Resources Study was prepared for the project which identified two significant cultural resources on the site. One of the resources includes a 700-foot dry-laid fieldstone rock wall. Portions of the wall would require removal to construct the proposed access roads. As recommended by the Cultural Resource Assessment, prior to removal of any portions of the wall, the applicant would be required to document the wall with the California Department of Parks and Recreation. The portions of the wall which would not require removal would remain. A Mitigation Measure requiring the applicant to document the wall prior to any road construction has been included as a condition of approval (Mitigation Measure No. 6). The project would be required to designate Conservation Easements to protect the portions of the wall not removed as part of road construction. This requirement has been included as a condition of approval (Mitigation Measure No. 7).

18. Seismic hazards and present of active faults;

Discussion: The project site does not contain or is adjacent to seismic hazards or active faults. Adherence to standard construction practices would prevent any seismic related hazards.

19. Consistency with existing Conditions, Covenants, and Restrictions;

Discussion: The project parcels do not have any existing CC&R's. CC&R's would be required for the maintenance of the onsite roads and preservation of the proposed open space lots. The CC&R's would require review and approval from DOT, Planning Services, and the Cameron Park Community Services District.

Noise: The project would be located along Green Valley Road, which would subject the proposed residential use to significant noise impacts. **General Plan Policy 6.5.1.8** establishes that new noise-sensitive land uses shall not be permitted in areas where transportation noise sources exceed the levels specified in Table 6-1. Table 6-1 establishes that the maximum allowable noise exposure for transportation noise sources for residential land uses is 60dB for outdoor activities and 45dB for interior spaces. The noise analysis prepared by Bollard Acoustical Consultants for the project dated November 2006 recommended the construction of a noise wall along the rear yards of the clusters nearest Green Valley Road and along the rear yard of Lot 6 which is located near Green Valley Road. The construction of these sound walls would reduce interior noise levels below the 45dB level as required by the General Plan. The sound walls would also reduce exterior noise levels below the 60dB level as required by the General Plan. A Mitigation Measure requiring the sound wall has been included as a condition of approval for the project (Mitigation Measure No. 8).

Air: An air quality assessment was prepared by Rimpo and Associates dated January 2007. The Air Quality Management District reviewed the assessment and determined that standard conditions of approval would minimize the potential impacts resulting from the project. These conditions have been included as part of the project and are included in Attachment 2 of the staff report.

Emergency Access and Protection: The project is located within the Rescue Fire Protection District. The Department was distributed the project and recommended conditions of approval. **General Plan Policies 6.2.3.1** and **6.2.3.2** require new development to demonstrate that adequate emergency access, water flow, and personnel are available to serve the project. As discussed above, the FIL prepared for the project has demonstrated that adequate fire flow would be available to serve the project.

Conclusion: Findings of consistency with the General Plan are provided in Attachment 2.

Zoning/ Planned Development: The project request includes a Planned Development Application. The PD would allow flexibility in the Development Standards of the RE-5 Zone District. The project would cluster the residential units to avoid additional impacts to the natural features of the site.

Development Standards: Section 17.28.210 A-H of the Zoning Ordinance establishes the requirements for development within the RE-5 Zone District:

A. Minimum lot area, five acres

The project would create 29 residential lots ranging in size from 58,591 square feet (1.33-acres) to 97,184 square feet (2.23-acres). The proposed lots would be less than the minimum lot area established for the RE-5 zone. The reduced lot sizes would be required to allow for the clustered development proposed. As discussed above, the project would dedicate approximately 39 percent of the site as open space. The open space area would avoid development impacts to oak habitat and riparian areas.

B. No maximum building coverage.

Future development of the residential lots would include single family residences and accessory buildings. The project would not conflict with this requirement.

C. Minimum Lot Width, one hundred feet.

The project request is for a clustered development which would result in varying lot widths and dimensions. The proposed lots would be consistent with the minimum lot width requirements of the RE-5 Zone District.

D. Minimum yard setbacks: front and rear, thirty feet; sides, thirty feet except the side yard shall be increased one foot for each additional foot of building height in excess of twenty-five feet (25'); (Ord. 4236, 1992)

As shown on the Tentative Map, the project would require modified setbacks. The proposed front and rear setbacks would comply with the required 30 foot setback; however, the side setback would be proposed at 15 feet. The reduced setbacks would be required due to smaller lot sizes proposed. As discussed in the General Plan section above, the project has been designed to comply with the required 200 foot setback and 10-acre minimum parcel size for parcels adjacent to the agriculture-zoned parcel to the south. The proposed parcels would be surrounded by open space to the north, south and west. The proposed parcels along the eastern portion of the site are adjacent to existing residential development.

E. Minimum agriculture structural setbacks of fifty feet on all yards;

The project would require reduced setbacks. As shown on the Tentative Map, the proposed setbacks would be 30 feet for the front and rear and 15 feet for the side setbacks. To be consistent with applicable General Plan polices, the required 10-acre minimum parcel size and 200 foot setback have been provided. Any non-compatible land uses would be required to adhere to the 200 foot setback from the Agriculture-zoned parcel to the south.

F. Maximum building height, forty- five feet (45') (Ord 4236, 1992)

No development is proposed on the lots. Future development on each lot would require compliance with the maximum height requirements of the RE-5 zone.

G. Minimum dwelling unit area, six hundred square feet of living area and two rooms:

Future development of each lot would require compliance with the minimum dwelling unit size of the RE-5 zone.

H. Location of the Parcel in Relation to Surrounding Land Use. The success and stability of agricultural enterprises can be profoundly influenced by the zoning and use of immediately adjacent lands. A buffer area of fifty feet will

> **be required on the inside of a boundary where land zoned estate residential five acres abuts planned agricultural zone lands which are currently not in horticultural and timber production. Variances to the above will be considered upon recommendation of the agricultural commission. The development of a dwelling or noncompatible use shall be one hundred feet from any existing horticultural or timber enterprises. Noncompatible uses are defined as, but not limited to:**
> **1. Residential structures,**
> **2. Nursing homes,**
> **3. Public and private schools,**
> **4. Playgrounds,**
> **5. Swimming pools,**
> **6. Fish ponds. (Ord. 3606 §15, 1986: Ord. 3366 §§10, 11, 1983; prior code §9412.2(e))**

The parcels that abut the Agriculture-zoned parcels would be recorded with a 200-foot setback as required by the General Plan. Any noncompatible land uses listed above would be required to be constructed outside of the recorded setback.

As mentioned above, the project includes the Planned Development application which allows modifications to the Development Standards of the Zoning Ordinance. Relief from this standard would be acceptable and Planned Development Findings of Approval have been included in Attachment 2.

Conclusion: The proposed lots would not be consistent with the Development Standards of the RE-5 Zone District. However, the Planned Development application would allow for flexibility in the application of those standards. The project would cluster the units in order to avoid impacts to the oak woodland habitat and riparian features onsite. The clustering would result in 39 percent of the site remaining as dedicated open space. The clustering of the units would potentially result in parking conflicts which has been addressed by the installation of guest parking onsite. The project meets the requirements of the Planned Development Planning concept and Planning Services finds the project is consistent with the Zoning Ordinance.

Design Waiver(s) Discussion: One Design Waiver has been requested as part of the project:

A. **Design Waiver request for the following: to reduce the right-of-way width requirement for A Street, B Street, C and D Courts from 60 feet to 50 feet.**

The onsite roads have been designed to comply with the County Design Manual Standards. The Department of Transportation has reviewed the Design Waiver request and has recommended approval of the request. Design Waiver findings have been included in Attachment 2 of the staff report.

ENVIRONMENTAL REVIEW

Staff has reviewed a Mitigated Negative Declaration (Exhibit M) prepared by Planning Services staff. Based on the Initial Study, staff finds that the project could have a significant effect on air quality, biological resources, cultural resources, air quality, noise and transportation. However, the project has been modified to incorporate the mitigation measures identified in the Initial Study which will reduce the impacts to a level considered to be less than significant. Therefore, a Mitigated Negative Declaration has been prepared.

This project is located within or adjacent to an area which has wildlife resources (riparian lands, wetlands, watercourse, native plant life, rare plants, threatened and endangered plants or animals, etc.), and was referred to the California Department of Fish and Game. In accordance with State Legislation (California Fish and Game Code Section 711.4), the project is subject to a fee of $1,926.75 after approval, but prior to the County filing the Notice of Determination on the project. This fee, less a $50.00 recording fee, is to be submitted to Planning Services and must be made payable to El Dorado County. The $1,876.75 is forwarded to the State Department of Fish and Game and is used to help defray the cost of managing and protecting the States fish and wildlife resources.

RECOMMENDATION: Staff recommends the Planning Commission recommend that the Board of Supervisors take the following actions:

1. Adopt the Mitigated Negative Declaration based on the Initial Study reviewed by staff;

2. Adopt the mitigation monitoring program in accordance with CEQA Guidelines, Section 15074(d), as incorporated in the conditions of approval and mitigation measures in Attachment 1;

3. Approve General Plan Amendment A07-0005 and Rezone Z07-0012 based on the findings in Attachment 2;

4. Approve Planned Development Application PD07-0007 and Tentative Subdivision Map Application TM07-1440, adopting the development plan as the official development plan, subject to the conditions in Attachment 1, based on the findings in Attachment 2; and

5. Approve the following design waivers since appropriate findings have been made as noted in Attachment 2:

   (1) Design Waiver request for the following: to reduce the right-of-way width requirement for A Street, B Street, C and D Courts from 60 feet to 50 feet.

SUPPORT INFORMATION

Attachments To Staff Report:

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ATTACHMENT 1
CONDITIONS OF APPROVAL

A07-0005/Z07-0012/PD07-0007/TM07-1440, Summerbrook

I. PROJECT DESCRIPTION

1. This Planned Development and Tentative Subdivision Map is based upon and limited to compliance with the project description, the Planning Commission hearing exhibits marked A-L dated February 14, 2008 and conditions of approval set forth below. Any deviations from the project description, exhibits or conditions must be reviewed and approved by the County for conformity with this approval. Deviations may require approved changes to the permit and/or further environmental review. Deviations without the above described approval will constitute a violation of permit approval.

The project description is as follows:

PD07-0007/ TM07-1440 consists of a Planned Development and Tentative Subdivision Map to create 29 residential lots ranging in size from 58,591 to 97,184 square feet. The Planned Development will allow for flexibility in the Development Standards of the RE-5 Zone District. The proposed lots will not meet the minimum parcel size, and setbacks of the zone district. The project will use the Density Bonus Planning Provision to allow for the increased density. Four open space lots would be created totaling 35.2-acres. Access shall be provided via a common access roadway providing two points of access onto Green Valley Road. The project shall connect to EID public water and private onsite septic systems.

One Design Waiver is approved to reduce the right-of-way width requirement for A Street, B Street, C and D Courts from 60 feet to 50 feet.

The lots shall conform to the table listed below:

Lot Number	Gross Area (S.F.)	Net Area (S.F.)
1	72,210	52,075
2	84,610	61,799
3	76,126	53,831
4	75,109	53,221
5	74,684	53,097
6	78,165	57,016
7	59,947	40,737
8	65,119	45,245
9	72,860	51,324
10	73,559	51,875

Lot Number	Gross Area (S.F.)	Net Area (S.F.)
11	68,425	47,618
12	71,492	49,314
13	87,828	58,614
14	66,605	45,983
15	65,076	44,053
16	64,296	43,315
17	69,338	46,722
18	65,294	44,058
19	69,631	44,231
20	84,794	60,053
21	97,184	56,799
22	78,828	46,876
23	71,325	44,745
24	72,277	51,315
25	91,113	67,809
26	76,837	52,584
27	58,591	39,367
28	62,775	41,096
E	74,379	52,642
A	826,816	Open Space
B	455,334	Open Space
C	190,580	Open Space
D	65,144	Open Space
R	270,072	Right-Of-Way

The grading, development, use, and maintenance of the property, the size, shape, arrangement, and location of structures, parking areas and landscape areas, and the protection and preservation of resources shall conform to the project description above and the hearing exhibits and conditions of approval below. The property and any portions thereof shall be sold, leased or financed in compliance with this project description and the approved hearing exhibits and conditions of approval hereto. All plans (such as Landscape and Tree Protection Plans) must be submitted for review and approval and shall be implemented as approved by the County.

II. CONDITIONS FROM THE MITIGATED NEGATIVE DECLARATION:

The following mitigation measures are required as means to reduce potential significant environmental effects to a level of insignificance:

2. Prior to onsite construction activities during the nesting season (February 1- August 31), a pre-construction survey shall be required to determine if active nests are present onsite. The

survey shall be completed no more than 30 days prior to the commencement of construction activities. If nests are found and considered active, construction activities shall not occur within 500 feet of the active nest until the young have fledged or a biologist until determines that the nests are no longer active. The survey results shall be submitted to the California Department of Fish and Game and Planning Services prior to issuance of a grading permit.

MONITORING: Planning Services shall verify that the above measure has been incorporated on the project grading plans prior to issuance of a grading permit. Planning Services shall coordinate with the applicant and/or biologist to verify conformance with this measure.

3. The applicant shall obtain a Streambed Alteration Agreement from the California Department of Fish and Game for each crossing or any activities affecting the onsite riparian vegetation. The agreement shall be submitted to Planning Services for review prior to issuance of a grading permit.

   MONITORING: Planning Service shall verify the agreement has been obtained and necessary mitigation measures incorporated on the plans prior to issuance of a grading permit.

4. Prior to issuance of a grading permit, the applicant shall obtain a 404 Permit from the U.S. Army Corps of Engineers and a Water Quality Certification from the Central Valley RWQCB. The project shall incorporate all conditions attached to the permit and certification into the project.

   MONITORING: Planning Services shall verify the required permit and certification has been obtained prior to issuance of a grading permit.

5. All healthy oak canopy removed from the site shall be replaced as specified in General Plan Policy 7.4.4.4 and the Interim Interpretative Guidelines for General Plan Policy 7.4.4.4. Replacement of the removed canopy shall be at a density of 200 tree saplings per acre, or 600 acorns per acre. A tree planting and preservation plan shall be required prior to issuance of a grading permit. A maintenance and monitoring plan shall be required for a minimum of 15 years after replanting to ensure a survival rate of at least 90%. The arborist report, planting and maintenance plan and all necessary documents to demonstrate compliance shall be provided to Planning Services prior to issuance of a grading permit.

   MONITORING: Planning Services staff shall review the arborist report, tree planting and replacement plan prior to issuance of a grading permit.

6. The applicant shall document the dry-laid fieldstone rock wall to the satisfaction of the California Department of Parks and Recreation and Planning Services. Planning Services

shall review and approve the documentation of the resource prior to issuance of grading permit.

MONITORING: Planning Services shall receive proof of documentation of the resource with the California Department of Parks and Recreation prior to issuance of a grading permit.

6. The applicant shall preserve all portions of the dry-laid fieldstone rock wall not removed as part of road construction. The rock wall shall be located within designated Conservation Easements and shall remain in perpetuity. Planning Services shall verify the placement of the Conservation Easements prior to filing the final map.

MONITORING: Planning Services shall review and approve the Conservation Easements prior to filing the final map.

8. The applicant shall construct a six-foot high sound wall along the rear yards of lot 6. The sound wall shall be constructed to the satisfaction of an Acoustical Consultant or appropriately certified professional prior to final building inspection of Lot 6. Planning Services shall verify location of sound wall on improvement plans prior to issuance of a permit.

MONITORING: Planning Services shall verify that the sound wall meets the requirements established by the Noise Assessment prepared for the project. The applicant shall show the sound wall on the improvement plans.. Planning Services shall verify the construction of the sound wall prior to issuance of a building permit for this Lot 6.

III. PROJECT CONDITIONS OF APPROVAL

<u>Planning Services</u>

9. The applicant shall provide a meter award letter or similar document by the water purveyor to Planning Services. Planning Services shall review the letter prior to filing the final map.

10. The subdivider shall be subject to a $150.^{00} .The appraisal fee payable to the El Dorado County Assessor for the determination of parkland dedication in-lieu fees.

The subdivision shall be subject to parkland dedication in-lieu fees based on values supplied by the County Assessor and calculated in accordance with Section 16.12.090 of the County Code. The applicant shall provide proof of payment of parkland dedication in-lieu fees to Planning Services prior to filing the final map.

11. All open space lots shall be dedicated to a Homeowner's Association or similar entity with an appropriate maintenance program. Planning Services shall review and approve the program prior to filing the final map.

12. All open space lots shall be dedicated prior to filing of a final map for any phase. Planning Services shall review and approve the open space lots prior to filing the final map.

13. CC & R's shall be subject to review and approval by County Counsel. The applicant shall submit the CC & R's to Planning Services prior to filing the final map.

14. The final map shall include a 100-foot non-building setback from all ponds and a 50-foot non-building setback from all wetlands at the subject site as delineated on Exhibit F. Planning Services shall review and approve the setbacks prior to filing the final map.

15. The final map shall include a 200 foot setback for all residential structures adjacent to agriculture-zoned lands. Planning Services shall verify the placement of the setback prior to filing the final map.

16. Construction activities shall be limited to the hours of 7 a.m. to 7 p.m. during weekdays and 8 a.m. to 5 p.m. on Saturday, Sunday, and federal holidays. Exceptions are allowed if it can be shown that construction beyond these times is necessary to alleviate traffic congestion and safety hazards. Planning Services shall verify this requirement is placed on the Grading Plans prior to issuance of a grading permit.

17. In the event that previously unknown cultural resources are discovered during construction, operations shall stop in the immediate vicinity of the find and a qualified archaeologist shall be consulted to determine whether the resource requires further study. The qualified archeologist shall make recommendations on the measures to be implemented to protect the discovered resources, including but not limited to excavation of the finds and evaluation of the finds, in accordance with § 15064.5 of the CEQA Guidelines. Cultural resources could consist of, but are not limited to, stone, bone, wood, or shell artifacts or features, including hearths, structural remains, or historic dumpsites.

18. In accordance with CEQA § 15064.5, should previously unidentified paleontological resources be discovered during construction, the project sponsor is required to cease work in the immediate area until a qualified paleontologist can assess the significance of the find and make mitigation recommendations, if warranted. To achieve this goal, the contractor shall ensure that all construction personnel understand the need for proper and timely reporting of such finds and the consequences of any failure to report them.

19 If human remains are encountered during earth-disturbing activities within the project area, all work in the adjacent area shall stop immediately and the El Dorado County Coroner's office shall be notified. If the remains are determined to be Native American in origin, both the Native American Heritage Commission (NAHC) and any identified descendants shall be

notified by the coroner and recommendations for treatment solicited (CEQA Guidelines § 15064.5; Health and Safety Code § 7050.5; Public Resources Code §§ 5097.94 and 5097.98).

20. In the event of any legal action instituted by a third party challenging the validity of any provision of this approval, the developer and landowner agree to be responsible for the costs of defending such suit and shall hold County harmless from any legal fees or costs County may incur as a result of such action, as provided in Section 66474.9(b) of the Government Code.

    The subdivider shall defend, indemnify, and hold harmless El Dorado County and its agents, officers, and employees from any claim, action, or proceeding against El Dorado County or its agents, officers, or employees to attack, set aside, void, or annul an approval of El Dorado County concerning a subdivision, which action is brought within the time period provided for in Section 66499.37.

    County shall notify the subdivider of any claim, action, or proceeding and County will cooperate fully in the defense.

21. All fees associated with the tentative subdivision map shall be paid prior to filing the final subdivision map.

22. Prior to issuance of a grading permit or commencement of any use authorized by this permit, the applicant shall provide a written description, together with appropriate documentation, showing conformance of the project with each condition imposed as part of the project approval. The applicant shall also schedule an inspection by Planning Services prior to issuance of a grading permit for verification of compliance with applicable conditions of approval.

<u>Department of Transportation</u>

23. The applicant shall construct or re-construct the following roadways. The improvements shall be substantially completed to the approval of the Department of Transportation or the applicant shall obtain an approved improvement agreement with security, prior to the filing the final map:

Table 1		
ROAD NAME	**ROAD WIDTH**	**EXCEPTIONS/NOTES**
Green Valley Road(on-site)	Overall 40 ft roadway (60 ft ROW), per Std. Plan 101B	12 foot through lanes, 8 foot shoulders, Type 2 vertical curb & gutter and 6 foot sidewalk, per DISM Std. Plan 104 & 110. Required turn pocket channelization and acceleration/deceleration lanes will necessitate additional roadway improvements and right of way.
A & B Street	36 ft roadway (50 ft ROW) per Std Plan 101B	Std Plan Type 1 rolled curb and gutter (no sidewalk). Std Plan Type 2 vertical curb & gutter shall extend from Green Valley Road to the gate structures.
A Circle	20 ft roadway (28 ft ROW) per Std Plan 101B	Std Plan Type 2 vertical curb and gutter (no sidewalk) and Std Plan Type 3 barrier curb on the interior radius. One way road. 40 ft minimum radius returns required @ roadway intersections
C & D Court	36 ft roadway (50 ft ROW) per Std Plan 101B	Std Plan Type 1 rolled curb and gutter (no sidewalk)

Notes for Condition 1 table:
Road widths in the preceding table are measured from curb face to curb face.
Curb face for rolled curb and gutter is 6" from the back of the curb.
*With approved waiver.

24. The applicant shall improve the existing signalized intersection on Green Valley to accommodate the primary access to this site (B Street) as the fourth leg of this signalized intersection. The applicant shall make all necessary modifications to this signalized intersection to meet current El Dorado County Standards. In addition, these signal modifications shall include signal timing coordination and or the placement of conduit to the proposed signal at the Green Valley/ Silver Springs Parkway intersection. The improvements shall be substantially completed to the approval of the Department of Transportation or the applicant shall obtain an approved improvement agreement with security, prior to the filing the final map.

25. The applicant shall design and construct a right in/right out at the intersection of A Street and Green Valley Road. This design shall include providing a raised traffic island, curbing, and/or striping to prevent left turn movements at this intersection according to the provisions of the Caltrans Highway Design Manual. The improvements shall be substantially completed, to the approval of the Department of Transportation or the applicant shall obtain an approved improvement agreement with security, prior to the filing the final map.

The applicant shall signalize the Green Valley/ Deer Valley Road intersection to meet current El Dorado County Standards, as required in the approved traffic study. These required improvements shall address all geometric issues, i.e. required right and left turn channelization and acceleration/deceleration lanes improvements and shall adhere to the Caltrans Highway Design Manual. The improvements shall be substantially completed to the approval of the Department of Transportation or the applicant shall obtain an approved improvement agreement with security, prior to the filing the final map.

The applicant shall sign and strip a Class 2 bike lane along both sides of Green Valley Road, from the signalized intersection at B Street to the intersection of Deer Valley Road. The Class 2 bike lane shall be constructed as required and according to the provisions of the El Dorado County Bicycle Transportation Plan. The striping and signing shall be substantially completed to the approval of the Department of Transportation or the applicant shall obtain an approved improvement agreement with security, prior to the filing the final map.

Funding and a bid-ready package for improvements to Green Valley Road, including reconstruction of the existing signal at the Green Valley Road/ ‘B’ Street intersection, all necessary turn pocket channelization and acceleration/deceleration lanes, additional frontage improvements including road widening, placement of curb, gutter, and sidewalk, and signing and striping of the Class 2 bike lane along Green Valley Road, from ‘B’ Street to Deer Valley Road, all underground utilities as required, together with a road improvement agreement, shall be submitted to the County Department of Transportation at a time sufficient to allow award of public construction contract prior to issuance of the first grading permit. Landscaping and irrigation plans shall be reviewed by the El Dorado Hills Community Services District and shall be reviewed and approved by the Department of Transportation.

The County will only assure award of the public contract between March 1 and September 1, and the Department of Transportation will schedule the bidding process for a bid opening date to occur within 70 days of receipt of the funding and bid-ready package if the package is received between January 1 and July 1. The term bid-ready presumes that the improvement plans, detailed schedule for improvements, and all other documents and processes have been thoroughly reviewed and approved by Department of Transportation staff prior to the submittal of the bid-ready package. The County Engineer, County Counsel, and the County Board of Supervisors are the final authority regarding the completeness of any bid-ready package.

Certificates of occupancy shall not be issued for any residential building until the improvements are substantially complete as determined by the Department of Transportation.

A complete bid-ready package shall include plans, specifications, right-of-way acquisition (if necessary), utility agreements executed with all impacted utility, relocation work completed/scheduled, environmental clearance for both on-site and off-site work complete, all necessary regulatory/encroachment permits secured, and all documents for bidding the contract signed and sealed by a registered civil engineer. If the funding and the complete bid-ready package for the improvements are provided to the County by the applicant prior to final map processing, the final maps can record without need for additional security for these improvements. The County will award and administer public contract(s) for this work.

The road improvement agreement or subdivision improvement agreement shall include provisions that the applicant provides supplemental funds to the County as necessary to pay for any change orders generated through the construction phase, that the developer’s engineer be available to provide engineering services in support of the project during construction, and that said designer will indemnify the County per the County's standard indemnification language.

The applicant may enter into a reimbursement agreement with the County for providing for reimbursement of the funds provided by the applicant and used for the construction, or for construction related activities, of the improvements to the extent they are included as eligible in the applicable County and Specific Plan fee programs. Reimbursement shall be consistent with the PFFP and the *El Dorado County Department Of Transportation Guidelines For Traffic Fee Program Reimbursement Projects*, including the requirement that the project is bid consistent with the State of California Public Contract Code.

In the event that the eminent domain process must be implemented to acquire right-of way, this right-of-way requirement shall be deemed satisfied by developer entering into an agreement for condemnation proceedings with the County Counsel together with a deposit of funds as required by County Counsel or alternative arrangement to the satisfaction of the Department of Transportation.

26. The applicant shall obtain an encroachment permit from DOT and shall construct the encroachments of the on-site access roadways onto Green Valley Road to the provisions of County Standard Plan 103D or as specified in the approved traffic study for this project.

27. As authorized in Table TC-1, note 2 of the General Plan, the applicant shall verify or irrevocably offer to dedicate (IOD), in fee, 30 feet of right of way plus additional right of way as noted in Table 1, for the on-site portion of Green Valley Road and the appropriate slope easements along the entire property frontage, prior to filing the final map. This offer will be accepted by the County.

28. A vehicular access restriction shall be established along the entire frontage of Green Valley Road, except for the proposed intersections of A & B Street and A Circle, except for the proposed intersections of A & B Street and C & D Court, prior to or concurrently to filing the final map.

29. A vehicular access restriction shall be established along A Circle except for the proposed intersections of A & B Streets and C & D Courts, prior to or concurrently to filing the final map.

30. The applicant shall join and/or form, prior to filing the final map, an entity satisfactory to DOT, to maintain all on-site roads and/or drainage facilities not maintained by the County, which is required for access to Green Valley Road.

31. All on and off-site road improvement requirements required as conditions of approval and/or mitigation measures shall be analyzed in the environmental document for this development project to the appropriate extent under CEQA . Any improvements that are not thoroughly analyzed shall include a discussion and justification under that particular impact analysis within the CEQA document as to the circumstances preventing such

analysis along with a method and time frame for any future analysis. Mitigation measures that are included in the 5 year CIP must have the CEQA processing completed to fulfill this condition as funded and programmed per the 2004 General Plan Policy TC-Xf.

32. As specified in the Conditions of Approval, the subdivider is required to perform off-site improvements. If it is determined that the subdivider does not have or cannot secure sufficient title or interest of such lands where said off-site improvements are required, the County may, at the subdivider's expense and within 120 days of filing the Final Map, acquire by negotiation or commence proceedings to acquire an interest in the land which will permit the improvements to be made, including proceedings for immediate possession of the property. In such cases, prior to filing of any final map or parcel map, the subdivider shall submit the following to the Department of Transportation Right of Way Unit, and enter into an agreement pursuant to Government Code Section 66462.5 and provide acceptable security to complete the offsite improvements, including costs of acquiring real property interest to complete the required improvements, construction surveying, construction management and a 20% contingency:

    a. A legal description and plat, of the land necessary to be acquired to complete the offsite improvements, prepared by a civil engineer or land surveyor.
    b. Approved improvement plans and specifications of the required off-site improvements, prepared by a civil engineer.
    c. An appraisal prepared by a certified appraiser of the cost of land necessary to complete the off-site improvements.

    In addition to the agreement the subdivider shall provide a cash deposit, letter of credit, or other acceptable surety in an amount sufficient to pay such costs including legal costs subject to the approval of county counsel.

33. The applicant shall adhere to all DOT standard conditions as specified on Attachment A that were provided to the applicant at the TAC on July 2, 2007.

<u>Air Quality Management District</u>

34. Prior to grading permit issuance, a fugitive dust plan shall be submitted to the Air Quality Management District (AQMD) for review and approval.

35. Burning of vegetative wastes that result from "Land Development Clearing" shall be permitted through the District Rule 300 Open Burning. Only vegetative waste materials are permitted to be disposed of using an open outdoor fire.

36. The applicant shall adhere to all District rules during project construction.

Rescue Fire Protection District:

37. The potable water system for the purpose of fire protection for this project shall provide a minimum fire flow of 2,000 gallons per minute. The fire flow must have a duration of two hours with no less than 20 psi residual pressure. The District shall verify that adequate fire flow is available prior to filing the final map.

38. The applicant shall install Mueller Dr Barrel fire hydrants conforming to El Dorado Irrigation District specifications for the purpose of providing water for fire protection. The spacing between hydrants in this development shall be determined by the Fire District. The District shall review and approve the location of fire hydrants prior to filing the final map.

39. Fire hydrants shall be painted with safety red enamel and marked in the roadway with a blue reflective marker as specified by the Fire District and Fire Safe Regulations. The District shall review and approve these improvements prior to filing the final map.

40. In order to provide this development with adequate fire and emergency medical response during construction, all access roadways and fire hydrant systems shall be installed and in service prior to framing of any combustible members as specified by the California Fire Code. The District shall review and approve these improvements prior to filing the final map.

41. The applicant shall prepare a Fuel Modification and Wildland Fire Safety Plan. The Plan shall be prepared by a Registered Forester. The District shall review and approve the Plan prior to filing the final map.

42. The minimum turning radius within cul-de-sac roads shall be designed to a 40-foot inside and 60-foot outside radius. The District shall review and approve the design of all cul-de-sac roads prior to filing the final map.

43. “A” Circle shall provide a minimum 20 foot roadway surface with a six foot truck apron. The District shall review and approve the design of “A” circle prior to filing the final map.

44. All roads less than 40 feet wide shall install “No Parking- Fire Lane” signage. The signage shall be in conformance with the California Fire Code. The District shall review and approve the signage prior to filing the final map.

45. All gates shall meet the Rescue Fire Protection District standards. The District shall review and approve the gates prior to filing of the final map.

46. All houses shall be setback 30 feet from all property lines. The District shall review and approve the location of all houses prior to issuance of a building permit.

47. The construction of this project shall comply with all codes and regulations as required by the California Building Code, Fire Code, and Fire Department Requirements. The District shall review and approve plans prior to issuance of any permit for this project.

Surveyor's Office

48. All survey monuments must be set prior to the presentation of the final map to the Board of Supervisors for approval; or the developer shall have the surety of work to be done by bond or cash deposit. Verification of set survey monuments, or amount of bond or deposit shall be coordinated with the County Surveyor's Office.

49. The roads serving the development shall be named by filing a completed road name petition with the County Surveyor's Office prior to filing the final map.

<u>ATTACHMENT 2</u>
FINDINGS

<u>FILE NUMBER A07-0005/Z07-0012/PD07-0007/TM07-1440, Summerbrook</u>

Based on the review and analysis of this project by staff and affected agencies, and supported by discussion in the staff report and evidence in the record, the following findings can be made pursuant to *Section 66472.1* of the *California Government Code*:

FINDINGS FOR APPROVAL

1.0 CEQA FINDINGS

1.1 El Dorado County has considered the Mitigated Negative Declaration together with the comments received during the public review process. The Mitigated Negative Declaration reflects the independent judgment of the County, has been completed in compliance with CEQA and is adequate for this project.

1.2 The Initial Study identifies that this project proposes a less than significant impact on the environment with specific mitigation outlined within the Biological Resources, Air Quality, Cultural Resources, Noise, and Transportation categories. By including mitigation for these categories, the effects on the Mandatory Findings of Significance section are also reduced below a level of significance for the this project.

1.3 The documents and other materials, which constitute the record of proceedings upon which this decision is based, are in the custody of the Development Services Department- Planning Services 2850 Fairlane Court Placerville, CA 95667.

1.4 Public Resources Code Section 21081.6 requires the County to adopt a reporting or monitoring program for the changes to the project which it has adopted or made a condition of approval in order to mitigate or avoid significant effects on the environment. The approved project description and conditions of approval, with their corresponding permit monitoring requirements, are hereby adopted as the monitoring program for this project. The monitoring program is designed to ensure compliance during project implementation.

2.0 TENTATIVE MAP FINDINGS

2.1 The proposed tentative map, including design and improvements, is consistent with the General Plan policies and land use map.

The project is designated as Rural Residential. The proposed 29-lot subdivision will be consistent with the allowed density in the proposed LDR land use designation with the application of the Density Bonus planning concept. The project will be consistent with General Plan policies relating to public utilities, traffic, noise, air quality, riparian impacts, and oak woodland habitat. The Mitigation Measures included as part of the project would minimize environmental impacts associated with the project.

2.2 The design or improvements of the proposed division are consistent with the General Plan.

The subdivision includes the Planned Development planning concept which is designed to minimize impacts to the natural resources on the project site. The proposed clustered development will be used to avoid additional impacts to the oak woodland habitat, wetlands onsite and buffering from the adjacent agriculture-zoned parcel to the south.

2.3 The site is physically suitable for the proposed type and density of development.

The project has been designed to utilize the developable areas of the site. Slopes exceeding 30 percent have been avoided and the project will minimize the impacts to the existing wetlands. All oak woodland habitat impacts will be consistent with the General Plan and Interim Interpretative Guidelines. Any natural resources that will not be impacted will be included in the require 30 percent open space areas.

2.4 The design of the subdivision or the proposed improvements are not likely to cause substantial environmental damage or substantial and avoidable injury to fish or wildlife or their habitats.

The project includes a Planned Development application which will allow the units to be clustered on the project site. The project will be designed to minimize the impacts to the natural resources on the site. Any environmental impacts will be minimized through the project design and implementation of Mitigation Measures.

2.5 The design of the subdivision or the improvements are not suitable to allow for compliance with the requirements of Section 4291 of the Public Resource Code (Section 4291 establishes criteria for fire and fuel breaks around buildings).

Adequate fire protection measures have been included as conditions of approval of the project. Adequate emergency access is available and additional fire hydrants will be required for the residential units. The public water system servicing the project will provide adequate fire flow for the project.

2.6 The design of the subdivision or the type of improvements will conflict with easements, acquired by the public at large, for access through or use of property within the proposed division.

The required road improvements will be consistent with the County Design Manual. The required signalization of Deer Valley Road and Green Valley Road will be consistent with the approved Capital Improvements Plan. All existing easements across the property for utilities and infrastructure would remain or be relocated in a manner acceptable to the affected agency.

3.0 PLANNED DEVELOPMENT FINDINGS

3.1 That the PD zone request is consistent with the general plan.

The PD would be consistent within the proposed LDR land use designation. The proposed use and density is allowed within the LDR land use designation and the application of the Density Bonus Planning Concept.

3.2 That the proposed development is so designed to provide a desirable environment within its own boundaries.

The clustered development will include 35-acres (39% of the site) of open space to preserve the oak woodland habitat and wetlands. The proposed road improvements would provide adequate access for the proposed lots.

3.3 That any exceptions to the standard requirements of the zone regulations are justified by the design or existing topography.

The modifications to the Development Standards of the RE-5 zone are justified by the clustered development. The reduced lot widths would be required in order to provide the proposed open site on the site.

3.4 That the site is physically suited for the proposed uses.

The project has been designed to utilize the developable areas to the greatest extent possible. The clustered development will minimize the potential impacts to the site.

3.5 That adequate services are available for the proposed uses, including, but not limited to, water supply, sewage disposal, roads and utilities.

Adequate public water services are available for the project. The required road improvements are consistent with the approved CIP project in the area.

3.6 That the proposed uses do not significantly detract from the natural land and scenic values of the site.

The project would preserve the oak woodland habitat not impacted as part of the project in an open space lot. The project has been designed to blend in with the existing features of the site.

4.0 AGRICULTURAL COMPATIBILITY FINDINGS

4.1 Will not intensify existing conflicts or add new conflicts between adjacent residential areas and agricultural activities.

The project site is currently adjacent to existing residential and agricultural land uses. The proposed residential development will be consistent with residential land uses. The required setbacks and minimum lot sizes will be provided as required by the General Plan.

4.2 Will not create an island effect wherein agricultural lands located between the project site and other non-agricultural lands will be negatively affected.

The project site is currently an island of agriculture-zoned parcels and is surrounded to the north, east and west by residential zoned lands. The project will maintain the required setback and minimum parcel size requirements from the agriculture-zoned parcel to the south.

4.3 Will not significantly reduce or destroy the buffering effect of existing large parcel sizes adjacent to agricultural lands.

The project site is surrounded by residential development. The site does not provide a buffering affect between agriculture lands and residential lands.

5.0 DESIGN WAIVER APPROVAL FINDINGS

To reduce the Right-of-Way widths for the onsite roads from 60 feet to 50 feet.

5.1 There are special conditions or circumstances peculiar to the property proposed to be divided which would justify the adjustment or waiver.

The proposed access road system meets the current County standards. The additional right-of-way will not be required.

5.2 Strict application of County design and improvement requirements would cause extraordinary and unnecessary hardship in developing the property.

The project includes a Planned Development application to allow for clustering of the units and reduced lot sizes. The additional right-of-way will not conflict with the objectives of the Planned Development to cluster the development away from the onsite natural resources.

5.3 The adjustment or waivers would not be injurious to adjacent properties or detrimental to the health, safety, convenience and welfare of the public.

The reduced right-of-way will not impede emergency access and will not result in a hazardous development. The proposed road system can be accommodated within the reduced right-of-way.

5.4 The waivers would not have the effect of nullifying the objectives of Article II of Chapter 16 of the County Code or any other ordinance applicable to the division.

The proposed road system is consistent with the Fire Safe Regulations and County Design Manual. The reduced right-of-way will not conflict with any applicable policies relating to roadway design.

Attachment #17

TOXICOLOGICAL PROFILE FOR ASBESTOS

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry

September 2001

DISCLAIMER

The use of company or product name(s) is for identification only and does not imply endorsement by the Agency for Toxic Substances and Disease Registry.

UPDATE STATEMENT

Toxicological profiles are revised and republished as necessary, but no less than once every three years. For information regarding the update status of previously released profiles, contact ATSDR at:

Agency for Toxic Substances and Disease Registry
Division of Toxicology/Toxicology Information Branch
1600 Clifton Road NE, E-29
Atlanta, Georgia 30333

FOREWORD

This toxicological profile is prepared in accordance with guidelines* developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The original guidelines were published in the *Federal Register* on April 17, 1987. Each profile will be revised and republished as necessary.

The ATSDR toxicological profile succinctly characterizes the toxicologic and adverse health effects information for the hazardous substance described therein. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous substance's toxicologic properties. Other pertinent literature is also presented, but is described in less detail than the key studies. The profile is not intended to be an exhaustive document; however, more comprehensive sources of specialty information are referenced.

The focus of the profiles is on health and toxicologic information; therefore, each toxicological profile begins with a public health statement that describes, in nontechnical language, a substance's relevant toxicological properties. Following the public health statement is information concerning levels of significant human exposure and, where known, significant health effects. The adequacy of information to determine a substance's health effects is described in a health effects summary. Data needs that are of significance to protection of public health are identified by ATSDR and EPA.

Each profile includes the following:

(A) The examination, summary, and interpretation of available toxicologic information and epidemiologic evaluations on a hazardous substance to ascertain the levels of significant human exposure for the substance and the associated acute, subacute, and chronic health effects;

(B) A determination of whether adequate information on the health effects of each substance is available or in the process of development to determine levels of exposure that present a significant risk to human health of acute, subacute, and chronic health effects; and

(C) Where appropriate, identification of toxicologic testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

The principal audiences for the toxicological profiles are health professionals at the Federal, State, and local levels; interested private sector organizations and groups; and members of the public.

This profile reflects ATSDR's assessment of all relevant toxicologic testing and information that has been peer-reviewed. Staff of the Centers for Disease Control and Prevention and other Federal scientists have also reviewed the profile. In addition, this profile has been peer-reviewed by a nongovernmental panel and was made available for public review. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.

Jeffrey P. Koplan

Jeffrey P. Koplan, M.D., M.P.H.
Administrator
Agency for Toxic Substances and
Disease Registry

*Legislative Background

The toxicological profiles are developed in response to the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public law 99-499) which amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund). This public law directed ATSDR to prepared toxicological profiles for hazardous substances most commonly found at facilities on the CERCLA National Priorities List and that pose the most significant potential threat to human health, as determined by ATSDR and the EPA. The availability of the revised priority list of 275 hazardous substances was announced in the *Federal Register* on November 17, 1997 (62 FR 61332). For prior versions of the list of substances, see *Federal Register* notices dated April 29, 1996 (61 FR 18744); April 17, 1987 (52 FR 12866); October 20, 1988 (53 FR 41280); October 26, 1989 (54 FR 43619); October 17, 1990 (55 FR 42067); October 17, 1991 (56 FR 52166); October 28, 1992 (57 FR 48801); and February 28, 1994 (59 FR 9486). Section 104(i)(3) of CERCLA, as amended, directs the Administrator of ATSDR to prepare a toxicological profile for each substance on the list.

QUICK REFERENCE FOR HEALTH CARE PROVIDERS

The Toxicological Profile for asbestos reflects a comprehensive and extensive evaluation, summary, and interpretation of available toxicologic and epidemiologic information on asbestos. Health care providers treating patients potentially exposed to asbestos will find the following information helpful for fast answers to often-asked questions.

Primary Chapters/Sections of Interest

Chapter 1: Public Health Statement: The Public Health Statement can be a useful tool for educating patients about possible exposure to a hazardous substance. It explains a substance's relevant toxicologic properties in a nontechnical, question-and-answer format, and it includes a review of the general health effects observed following exposure.

Chapter 2: Relevance to Public Health: The Relevance to Public Health Section evaluates, interprets, and assesses the significance of toxicity data to human health.

Chapter 3: Health Effects: Specific health effects of asbestos are reported by *type of health effect* (death, systemic, immunologic, reproductive), by *route of exposure*, and by *length of exposure* (acute, intermediate, and chronic). In addition, both human and animal studies are reported in this section.

NOTE: Not all health effects reported in this section are necessarily observed in the clinical setting. Please refer to the Public Health Statement to identify general health effects observed following exposure.

Pediatrics: Four new sections have been added to this Toxicological Profile to address child health issues:

Section 1.6 How Can Asbestos Affect Children?
Section 1.7 How Can Families Reduce the Risk of Exposure to Asbestos?
Section 3.7 Children's Susceptibility
Section 6.6 Exposures of Children

Other Sections of Interest:

Section 3.8 Biomarkers of Exposure and Effect
Section 3.11 Methods for Reducing Toxic Effects
Appendix F Consultation on Tremolite and Other Related Asbestos

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Other information available at ATSDR Information Center

Phone: 1-888-42-ATSDR or 1-404-498-0110 *Fax:* 1-404-498-0057
E-mail: atsdric@cdc.gov *Internet:* http://www.atsdr.cdc.gov

National Public Health Activities regarding Tremolite Asbestos Exposure: Medical Testing, Libby, Montana, Summer 2000 - Over 6,000 Libby, Montana, residents screened for asbestos-related diseases associated with living or working near a vermiculite mine contaminated with a fibrous amphibole. *National Assessment of Vermiculite Sites, Mortality Review of Cancer and Noncancer Cases Associated with Asbestos Exposure, and other projects*.

Case Studies in Environmental Medicine: Taking an Exposure History—The importance of taking an exposure history and how to conduct one are described, and an example of a thorough exposure history is provided. Other case studies of interest include *Reproductive and Developmental*

Hazards; Skin Lesions and Environmental Exposures; Cholinesterase-Inhibiting Pesticide Toxicity; and numerous chemical-specific case studies.

Managing Hazardous Materials Incidents is a three-volume set of recommendations for on-scene (prehospital) and hospital medical management of patients exposed during a hazardous materials incident. Volumes I and II are planning guides to assist first responders and hospital emergency department personnel in planning for incidents that involve hazardous materials. Volume III—*Medical Management Guidelines for Acute Chemical Exposures*—is a guide for health care professionals treating patients exposed to hazardous materials.

Fact Sheets (ToxFAQs) provide answers to frequently asked questions about toxic substances.

Other Agencies and Organizations

US Environmental Protection Agency (USEPA) - *Asbestos Ombudsman Office*: 1-800-368-5888. Addresses regulations concerning asbestos in public schools and other facilities containing asbestos that are being renovated or demolished. *Washington Office*: 202-260-2090.

The National Center for Environmental Health (NCEH) focuses on preventing or controlling disease, injury, and disability related to the interactions between people and their environment outside the workplace. *Contact:* NCEH, Mailstop F-29, 4770 Buford Highway, NE, Atlanta, GA 30341-3724 • Phone: 770-488-7000 • FAX: 770-488-7015.

The National Institute for Occupational Safety and Health (NIOSH) conducts research on occupational diseases and injuries, responds to requests for assistance by investigating problems of health and safety in the workplace, recommends standards to the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), and trains professionals in occupational safety and health. *Contact:* NIOSH, 200 Independence Avenue, SW, Washington, DC 20201 • Phone: 800-356-4674 or NIOSH Technical Information Branch, Robert A. Taft Laboratory, Mailstop C-19, 4676 Columbia Parkway, Cincinnati, OH 45226-1998 • Phone: 800-35-NIOSH.

*The National Institute of Environmental Health Sciences (*NIEHS) is the principal federal agency for biomedical research on the effects of chemical, physical, and biologic environmental agents on human health and well-being. *Contact:* NIEHS, PO Box 12233, 104 T.W. Alexander Drive, Research Triangle Park, NC 27709 • Phone: 919-541-3212.

Referrals

The Association of Occupational and Environmental Clinics (AOEC) has developed a network of clinics in the United States to provide expertise in occupational and environmental issues. *Contact:* AOEC, 1010 Vermont Avenue, NW, #513, Washington, DC 20005 • Phone: 202-347-4976 • FAX: 202-347-4950 • e-mail: AOEC@AOEC.ORG • Web Page: http://www.aoec.org/.

The American College of Occupational and Environmental Medicine (ACOEM) is an association of physicians and other health care providers specializing in the field of occupational and environmental medicine. *Contact:* ACOEM, 55 West Seegers Road, Arlington Heights, IL 60005 • Phone: 847-818-1800 • FAX: 847-818-9266.

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THE PROFILE HAS UNDERGONE THE FOLLOWING ATSDR INTERNAL REVIEWS:

1. Health Effects Review. The Health Effects Review Committee examines the health effects chapter of each profile for consistency and accuracy in interpreting health effects and classifying end points.

2. Minimal Risk Level Review. The Minimal Risk Level Workgroup considers issues relevant to substance-specific minimal risk levels (MRLs), reviews the health effects database of each profile, and makes recommendations for derivation of MRLs.

3. Data Needs Review. The Research Implementation Branch reviews data needs sections to assure consistency across profiles and adherence to instructions in the Guidance.

PEER REVIEW

A peer review panel was assembled for asbestos. The panel consisted of the following members:

1. Bruce Case, M.D., Associate Professor of Pathology, McGill University Faculty of Medicine, Montreal, Canada;

2. Philip Landrigan, M.D., Ethel H. Wise Professor of Community and Preventive Medicine, Mount Sinai School of Medicine, Mamaroneck, NY;

3. Morton Lippman, Ph.D., Director, Human Exposure and Health Effects Program, Nelson Institute of Environmental Medicine, New York University Medical Center, Tuxedo, NY;

4. William Nicholson, Ph.D., Professor Emeritus, Mount Sinai School of Medicine, Fair Lawn, NJ.

These experts collectively have knowledge of asbestos's physical and chemical properties, toxicokinetics, key health end points, mechanisms of action, human and animal exposure, and quantification of risk to humans. All reviewers were selected in conformity with the conditions for peer review specified in Section 104(I)(13) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

Scientists from the Agency for Toxic Substances and Disease Registry (ATSDR) have reviewed the peer reviewers' comments and determined which comments will be included in the profile. A listing of the peer reviewers' comments not incorporated in the profile, with a brief explanation of the rationale for their exclusion, exists as part of the administrative record for this compound. A list of databases reviewed and a list of unpublished documents cited are also included in the administrative record.

The citation of the peer review panel should not be understood to imply its approval of the profile's final content. The responsibility for the content of this profile lies with the ATSDR.

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1. PUBLIC HEALTH STATEMENT

This public health statement tells you about asbestos and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Asbestos has been found in at least 83 of the 1,585 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which asbestos is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to asbestos, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), the fiber type (mineral form and size distribution), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle (including whether you smoke tobacco), and state of health.

1.1 WHAT IS ASBESTOS?

Asbestos is the name given to a group of six different fibrous minerals (amosite, chrysotile, crocidolite, and the fibrous varieties of tremolite, actinolite, and anthophyllite) that occur naturally in the environment. One of these, namely chrysotile, belongs to the serpentine family of minerals, while all of the others belong to the amphibole family. All forms of asbestos are hazardous, and all can cause cancer, but amphibole forms of asbestos are considered to be somewhat more hazardous to health than chrysotile. Asbestos minerals consist of thin, separable fibers that have a parallel arrangement. Nonfibrous forms of tremolite, actinolite, and anthophyllite also are found naturally. However, because they are not fibrous, they are not classified as asbestos minerals. Amphibole asbestos fibers are generally brittle and often have a rod- or needle-like shape, whereas chrysotile asbestos fibers are flexible and curved. Chrysotile, also known as white asbestos, is the predominant commercial form of asbestos; amphiboles are of minor commercial importance. Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water or evaporate and are resistant to heat, fire, chemical and biological degradation. Because of these properties, asbestos has been mined for use in a wide range of manufactured products, mostly in building materials, friction products, and heat-resistant fabrics. Since asbestos fibers may cause harmful health effects in people who are exposed, all new uses of asbestos have been banned in the United States by the EPA.

See Chapters 4 and 5 for more information on the properties and uses of asbestos.

1.2 WHAT HAPPENS TO ASBESTOS WHEN IT ENTERS THE ENVIRONMENT?

Asbestos fibers do not evaporate into air or dissolve in water. However, pieces of fibers can enter the air and water from the weathering of natural deposits and the wearing down of manufactured asbestos products. Small diameter fibers and fiber-containing particles may remain suspended in the air for a long time and be carried long distances by wind or water currents before settling. Larger diameter fibers and particles tend to settle more quickly. Asbestos fibers are not able to move through soil. They are generally not broken down to other compounds in the environment and will remain virtually unchanged over long periods. However, the most common form of asbestos, chrysotile, may have some minor mineral loss in acidic environments. Asbestos fibers may break into shorter pieces or separate into a larger number of individual fibers as a result of physical processes. When asbestos fibers are breathed in, they may get trapped in the lungs. Levels of fibers in lung tissue build up over time, but some fibers, particularly chrysotile fibers, can be removed from or degraded in the lung with time.

See Chapters 5 and 6 for more information on the behavior of asbestos in the environment.

1.3 HOW MIGHT I BE EXPOSED TO ASBESTOS?

Asbestos minerals are widespread in the environment. They may occur in large natural deposits, or as contaminants in other minerals. For example, tremolite asbestos may occur in deposits of chrysotile, vermiculite, and talc. Asbestos may be found in soil that is formed from the erosion of asbestos-bearing rock. You are most likely to be exposed to asbestos by breathing in asbestos fibers that are suspended in air. These fibers can come from naturally occurring sources of asbestos or from the wearing down or disturbance of manufactured products including insulation, automotive brakes and clutches, ceiling and floor tiles, dry wall, roof shingles, and cement. However, these products do not always contain asbestos. Low levels of asbestos that present little, if any, risk to your health can be detected in almost any air sample. For example, 10 fibers are typically present in a cubic meter (fibers/m^3) of outdoor air in rural areas. (A cubic meter is about the amount of air that you breathe in 1 hour.) Health professionals often report the number of fibers in a milliliter (mL) (equivalent to a cubic centimeter [cm^3]) of air rather than in a cubic meter of air. Since there are one million cm^3 (or one million mL) in a cubic meter, there typically would be 0.00001 fibers/mL of asbestos in air in rural areas. Typical levels found in cities are about 10-fold higher.

Close to an asbestos mine or factory, levels may reach 10,000 fibers/m^3 (0.01 fibers/mL) or higher. Levels could also be above average near a building that contains asbestos products and that is being torn down or renovated or near a waste site where asbestos is not properly covered up or stored to protect it from wind erosion.

In indoor air, the concentration of asbestos depends on whether asbestos was used for insulation, ceiling or floor tiles, or other purposes, and whether these asbestos-containing materials are in good condition or are deteriorated and easily crumbled. Concentrations measured in homes, schools, and other buildings that contain asbestos range from about 30 to 6,000 fibers/m^3 (0.00003–0.006 fibers/mL). People who work with asbestos or asbestos-containing products (for example, miners, insulation workers, asbestos abatement workers, and automobile brake mechanics) without proper protection are likely to be exposed to much higher levels of asbestos fibers in air. In addition, custodial and maintenance workers who are making repairs or installations in buildings with asbestos-containing materials may be exposed to higher levels of asbestos. Since vermiculite and talc may contain asbestos, occupational workers and the general population may be exposed to asbestos when using these products.

You can also be exposed to asbestos by drinking asbestos fibers that are present in water. Even though asbestos does not dissolve in water, fibers can enter water by being eroded from natural deposits or piles of waste asbestos, from asbestos-containing cement pipes used to carry drinking water, or from filtering through asbestos-containing filters. Most drinking water supplies in the United States have concentrations of less than 1 million fibers per liter (MFL), even in areas with asbestos deposits or with asbestos-cement water supply pipes. However, in some locations, water samples may contain 10–300 million fibers per liter or even higher. The average person drinks about 2 liters of water per day.

See Chapters 3 and 6 for more information on how you could be exposed to asbestos.

1.4 HOW CAN ASBESTOS ENTER AND LEAVE MY BODY?

If you breathe asbestos fibers into your lungs, some of the fibers will be deposited in the air passages and on the cells that make up your lungs. Most fibers are removed from your lungs by being carried away or coughed up in a layer of mucus to the throat, where they are swallowed into the stomach. This usually takes place within a few hours. Fibers that are deposited in the deepest parts of the lung are removed more slowly. In fact, some fibers may move through your lungs and can remain in place for many years and may never be removed from your body. Amphibole asbestos fibers are retained in the lung longer than chrysotile asbestos fibers.

If you swallow asbestos fibers (either those present in water or those that are moved to your throat from your lungs), nearly all of the fibers pass along your intestines within a few days and are excreted in the feces. A small number of fibers may penetrate into cells that line your stomach or intestines, and a few penetrate all the way through and get into your blood. Some of these become trapped in other tissues, and some are removed in your urine.

If you get asbestos fibers on your skin, very few of these fibers, if any, pass through the skin into your body.

See Chapter 3 for more information on how asbestos enters and leaves your body.

1.5 HOW CAN ASBESTOS AFFECT MY HEALTH?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Information on the health effects of asbestos in people comes mostly from studies of people who were exposed in the past to levels of asbestos fibers (greater than or equal to 5 μm in length) in workplace air that were as high as 5 million fibers/m^3 (5 fibers/mL). Workers who repeatedly breathe in asbestos fibers with lengths greater than or equal to 5 μm may develop a slow buildup of scar-like tissue in the lungs and in the membrane that surrounds the lungs. This scar-like tissue does not expand and contract like normal lung tissue and so breathing becomes difficult. Blood flow to the lung may also be decreased, and this causes the heart to enlarge. This disease is called asbestosis. People with asbestosis have shortness of breath, often accompanied by a cough. This is a serious disease and can eventually lead to disability or death in people exposed to high amounts of asbestos over a long period. However, asbestosis is not usually of concern to people exposed to low levels of asbestos. Changes in the membrane surrounding the lung, called pleural plaques, are quite common in people occupationally exposed to asbestos and are sometimes found in people living in areas with high environmental levels of asbestos.

Effects on breathing from pleural plaques alone are usually not serious. There is conflicting evidence as to whether their presence in a person accurately predicts more serious disease development in the future.

Asbestos workers have increased chances of getting two principal types of cancer: cancer of the lung tissue itself and mesothelioma, a cancer of the thin membrane that surrounds the lung and other internal organs. These diseases do not develop immediately following exposure to asbestos, but appear only after a number of years. There is also some evidence from studies of workers that breathing asbestos can increase the chances of getting cancer in other locations (for example, the stomach, intestines, esophagus, pancreas, and kidneys), but this is less certain. Members of the public who are exposed to lower levels of asbestos may also have increased chances of getting cancer, but the risks are usually small and are difficult to measure directly. Lung cancer is usually fatal, while mesothelioma is almost always fatal, often within a few months of diagnosis. Some scientists believe that early identification and intervention of mesothelioma may increase survival.

The levels of asbestos in air that lead to lung disease depend on several factors. The most important of these are (1) how long you were exposed, (2) how long it has been since your exposure started, and (3) whether you smoked cigarettes. Cigarette smoking and asbestos exposure increase your chances of getting lung cancer. Also, there is a scientific debate concerning the differences in the extent of disease caused by different fiber types and sizes. Some of these differences may be due to the physical and chemical properties of the different fiber types. For example, several studies suggest that amphibole asbestos types (tremolite, amosite, and especially crocidolite) may be more harmful than chrysotile, particularly for mesothelioma. Other data indicate that fiber size dimensions (length and diameter) are important factors for cancer-causing potential. Some data indicate that fibers with lengths greater than 5.0 µm are more likely to cause injury than fibers with lengths less than 2.5 µm. (1 µm is about 1/25,000 of an inch.) Additional data indicate that short fibers can contribute to injury. This appears to be true for mesothelioma, lung cancer, and asbestosis. However, fibers thicker than 3.0 µm are of lesser concern, because they have little chance of penetrating to the lower regions of the lung.

The health effects from swallowing asbestos are unclear. Some groups of people who have been exposed to asbestos fibers in their drinking water have higher-than-average death rates from cancer of the esophagus, stomach, and intestines. However, it is very difficult to tell whether this is caused by asbestos or by something else. Animals that were given very high doses of asbestos in food did not get more fatal cancers than usual, although some extra nonfatal tumors did occur in the intestines of rats in one study.

Several government offices and regulatory agencies have considered all of the evidence regarding the carcinogenicity of asbestos. The Department of Health and Human Services (DHHS) has determined that asbestos is known to be a human carcinogen. The EPA has determined that asbestos is a human carcinogen. The International Agency for Research on Cancer (IARC) has determined that asbestos is carcinogenic to humans.

See Chapters 2 and 3 for more information on how asbestos can affect your health.

1.6 HOW CAN ASBESTOS AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans.

Asbestos exposure in both children and adults may occur while breathing air in or near buildings (public or private) containing asbestos building materials or near asbestos-related industrial operations. Children breathe differently and have different lung structures than adults. It is not known if these differences may cause a greater amount of asbestos fibers to stay in the lungs of a child when they are breathed in than in the lungs of an adult. Children drink more fluids per kilogram of body weight than adults and can also be exposed through asbestos-contaminated drinking water. Eating asbestos-contaminated soil and dust is another source of exposure for children. Certain children intentionally eat soil, and all young children eat more soil than adults through hand-to-mouth activities. Historically, family members have also been exposed to asbestos that was carried home on the clothing of other family members who worked in asbestos mines or mills. Breathing of asbestos fibers may result in difficulty in breathing, lung cancer, or mesothelioma (another form of cancer associated with asbestos exposure). These diseases usually appear many years following the first exposure to asbestos and are therefore not likely to be seen in children. But since it may take up to 40 or more years for the effects of exposure to be seen, people who have been exposed to asbestos at a young age may be more likely to contract these diseases than those who are first exposed later in life. In the small number of studies that have specifically looked at asbestos exposure in children, there is no indication that younger people might develop asbestos-related diseases more quickly than older people. Developing fetuses and infants are not likely to be exposed to asbestos through the placenta or breast milk of the mother. Results of animal studies do not indicate that exposure to asbestos is likely to result in birth defects.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO ASBESTOS?

If your doctor finds that you have been exposed to significant amounts of asbestos, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

The most important way that families can lower their exposures to asbestos is to be aware of the sources of asbestos in their homes and avoid exposure to these sources. The most important source of asbestos in a home is from damaged or deteriorating asbestos-containing insulation, ceiling, or floor tiles. Should you suspect that your house may contain asbestos, contact your state or local health department or the regional offices of EPA to find out how to test your home for asbestos and how to locate a company that is trained to remove or contain the fibers. Federal law requires schools to identify asbestos-containing material in school buildings and take appropriate action to control release of asbestos fibers.

If you live close to where asbestos and certain other ores are mined or processed, where a building that contains asbestos products is being torn down or renovated, or a waste site where asbestos is not properly covered, then the levels of asbestos in dust and wind-blown soil may be higher. Pets can also bring asbestos into the home by carrying dust or dirt on their fur or feet if they spend time in places that have high levels of asbestos in the soil. Swallowing of asbestos in house dust or soil is a potential exposure pathway for children. This problem can be reduced in many ways. Regular hand and face washing to remove asbestos-containing dusts and soil, especially before meals, can lower the possibility of asbestos fibers on the skin being accidentally swallowed while eating. Families can lower exposures to asbestos by regularly cleaning the home of dust and tracked in soil. Door mats can help lower the amount of soil that is tracked into the home; removing your shoes before entering will also help. Planting grass and shrubs over bare soil areas in the yard can lower the contact that children and pets may have with soil and reduce the tracking of soil into the home.

You can bring asbestos home in the dust on your hands or clothes if you work in the mining or processing of minerals that contain asbestos, in asbestos removal, or in buildings with damaged or deteriorating asbestos. Federal law regulates work practices to limit the possibility of asbestos being brought home in this way. Your occupational health and safety officer at work can and should tell you whether chemicals you work with are dangerous and likely to be carried home on your clothes, body, or tools, and whether you should be showering and changing clothes before you leave work, storing your street clothes in a separate area of the workplace, or laundering your work clothes at home separately from other clothes. Your employer should have Material Safety Data Sheets (MSDSs) for many of the chemicals used at your place of work, as required by the Occupational Safety and Health Administration (OSHA). Information on these sheets should include chemical names and hazardous ingredients, important properties (such as fire and explosion data), potential health effects, how you get the chemical(s) in your body, how to handle the materials properly, and what to do in an emergency. Your employer is legally responsible for providing a safe workplace and should freely answer your questions about hazardous chemicals. Either OSHA or your OSHA-approved state occupational safety and health program can answer any further questions and help your employer identify and correct problems with hazardous substances. OSHA and/or your OSHA-approved state occupational safety and health program will listen to your formal complaints about workplace health hazards and inspect your workplace when necessary. Employees have a right to seek safety and health on the job without fear of punishment.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO ASBESTOS?

The most common test used to determine if you have received sustained exposure to asbestos is a chest x-ray. A chest x-ray is recommended for detecting exposure to asbestos only in persons who have sustained relatively heavy exposure. A chest x-ray is of no value for detecting evidence of asbestos exposure in a person whose exposure to asbestos has been only brief or transient. The x-ray cannot detect the asbestos fibers themselves, but it can detect early signs of lung disease caused by asbestos. While other substances besides asbestos can sometimes produce similar changes in the lungs, this test is usually reliable for detecting asbestos-related effects produced by long-term exposures at relatively high concentrations of asbestos fibers. Other tests, such as gallium-67 lung scanning and high-resolution computed tomography, are also useful in detecting changes in the lungs. However, there are currently no means of detecting exposure-related effects from commonly encountered environmental exposures.

The most reliable test to determine if you have been exposed to asbestos is the detection of microscopic asbestos fibers in pieces of lung tissue removed by surgery, but this is a very invasive test. A test can also be run to determine the presence of asbestos fibers in material rinsed out of the lung. However, this test can cause some discomfort. Asbestos fibers can also be detected in mucus (sputum), urine, or feces, but these tests are not reliable for determining how much asbestos may be in your lungs. Low levels of asbestos fibers are found in these materials for nearly all people. Higher-than-average levels can show that you have been exposed to asbestos, but it is not yet possible to use the results of this test to estimate how much asbestos you have been exposed to, or to predict whether you are likely to suffer any health effects.

See Chapters 3 and 7 for more information about how asbestos can be measured in people and in the environment.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for asbestos include the following:

The federal government has taken a number of steps to protect citizens from exposure to asbestos. First, on July 12, 1989, EPA established a ban on new uses of asbestos. Uses established before this date are still allowable. Second, EPA has established regulations that require school systems to inspect for asbestos and, if damaged asbestos is found, to eliminate or reduce the exposure, either by removing the asbestos or by covering it up so it cannot get into the air. In addition, EPA provides guidance and support for reducing asbestos exposure in other public buildings. Third, EPA regulates the release of asbestos from factories and during building demolition or renovation to prevent asbestos from getting into the environment. EPA also regulates the disposal of waste asbestos materials or products, requiring these to be placed only in approved locations. Fourth, EPA has proposed a limit of 7 million fibers per liter on the concentration of long fibers (length greater than or equal to 5 µm) that may be present in drinking water. Fifth, FDA regulates the use of asbestos in the preparation of drugs and restricts the use of asbestos in food-packaging materials. NIOSH has recommended that inhalation exposures not exceed 100,000 fibers with lengths greater than or equal to 5 µm per m^3 of air (0.1 fibers/mL). OSHA has established an enforceable limit on the average 8-hour daily concentration of asbestos allowed in air in the workplace to be 100,000 fibers with lengths greater than or equal to 5 µm per m^3 of air (0.1 fibers/mL). Additional sources of information about asbestos are the 10 regional offices of the EPA. Most EPA regional offices have an asbestos coordinator.

See Chapter 8 for more information about regulations and guidelines to protect people from exposure to asbestos.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333

* Information line and technical assistance

Phone: 1-888-42-ATSDR (1-888-422-8737)
Fax: 1-404-498-0057

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

* To order toxicological profiles, contact

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000

2. RELEVANCE TO PUBLIC HEALTH

2.1 BACKGROUND AND ENVIRONMENTAL EXPOSURES TO ASBESTOS IN THE UNITED STATES

Asbestos is a generic term for a group of six naturally-occurring, fibrous silicate minerals that have been widely used in commercial products. These minerals are more commonly found in nonfibrous forms that are not asbestos. Asbestos minerals fall into two groups or classes, serpentine asbestos and amphibole asbestos. Chrysotile, a serpentine asbestos, possesses relatively long and flexible crystalline fibers that are capable of being woven. Amphibole asbestos has crystalline fibers that are substantially more brittle than serpentine asbestos. Amphibole asbestos includes amosite, crocidolite, and fibrous forms of tremolite, anthophyllite, and actinolite (see Chapter 4 and Appendix F for more information on chemical and physical properties of asbestos). Over 99% of asbestos used in the United States is chrysotile. As a result of its low cost and desirable properties such as heat and fire resistance, wear and friction characteristics, tensile strength, heat, electrical and sound insulation, adsorption capacity, and resistance to chemical and biological attack, asbestos has been used in a very large number of applications and types of products. In most of its applications, asbestos is bonded with other materials such as Portland cement, plastics, and resins. In other applications, asbestos is used as a loose fibrous mixture or woven as a textile. Use of asbestos in the United States has been declining for 2 decades largely due to health concerns. In 1997, asbestos consumption was 6% of what it was in 1980. The 1997 domestic consumption pattern was 48% for roofing products, 29% for friction products (automobile clutch, brake, and transmission components), and 17% for packing and gaskets (see Chapter 5 for more information on production, import, use, and disposal of asbestos).

Asbestos fibers are chemically inert—they do not evaporate, dissolve, burn, or undergo significant reactions with most chemicals. They do not undergo significant degradation in the environment. Although asbestos is not volatile, small fibers and clumps of fibers may be released to air as dust. Asbestos occurring in natural mineral deposits may be released to the atmosphere when these deposits are disturbed—as in mining operations or during building and construction (see Appendix F for information on occurrence of asbestos in other mineral deposits). Asbestos fibers may also be released during the processing of asbestos minerals and the manufacture, application, use, demolition, and disposal of asbestos-containing products. Asbestos released into the atmosphere will be transported by wind and settle on the ground. Small fibers may remain suspended for long periods of time and be transported long distances. Asbestos may be released into surface water by erosion and runoff, transported in water, and deposited in the sediment.

Numerous measurements have been performed to determine the concentration of asbestos fibers in environmental media, primarily air. These studies have reported results in a variety of units, including PCM f/mL (fibers per mL air=fibers per cm^3, measured by phase contrast microscopy) and TEM f/mL (fibers measured by transmission electron microscopy) (see Section 3.2.1 and Chapter 6 for additional information regarding exposure and exposure units). Definition of a fiber is critical in these methods. The most widely used definition of a fiber among health professionals is a particle that has a length $5 µm and a length/width ratio of $3:1. Although numerous exposure and health effects studies have employed the PCM method for analysis of airborne asbestos concentrations, the method is not capable of detecting fibers smaller in diameter than approximately 0.2–0.3 µm and these thinner fibers may pose a significant health threat (see Chapter 3 for additional information on the relationships between fiber size and health risk). The PCM method is also incapable of distinguishing between asbestos fiber types or between asbestos and nonasbestos fibers. TEM can be used to detect fibers with diameters as small as 0.01 µm and distinguish between asbestos and nonasbestos fibers, as well as fiber types. Although TEM is the preferred method for measuring air concentrations of asbestos, epidemiological studies of occupational exposure to relatively high levels of asbestos, such as those experienced prior to the institution of recent occupational exposure limits (currently 0.1 f/mL), employed PCM or midget impinger particle counting. Particle counting yielded measurements of mass of particles per volume of air. Reported health effects have predominantly been expressed in terms of PCM concentrations (see Section 3.2.1 for a discussion of the uncertainties in converting from midget impinger particle mass per volume to PCM f/mL). Therefore, comparisons between environmental exposure data and occupational exposures associated with adverse health effects can be most readily made using measurements expressed in terms of PCM.

Inhalation is the primary route by which the general population might be exposed to asbestos. Small quantities of asbestos fibers are ubiquitous in air, arising from natural sources (weathering of asbestos-containing minerals), from windblown soil from hazardous waste sites, deterioration of automobile clutches and brakes, or breakdown of asbestos-containing materials such as insulation (mainly chrysotile). The results of numerous measurements indicate that average concentrations of asbestos in ambient outdoor air are within the range of 10^{-8}– 10^{-4} PCM f/mL; levels in urban areas may be an order of magnitude higher than those in rural areas. Even higher concentrations (up to 0.4 f/mL) have been measured in ambient air surrounding Taiwanese factories that manufacture asbestos-containing products.

Indoor air concentrations of asbestos ranged from approximately 10^{-5} to 10^{-4} f/mL in a study of air concentrations measured in a total of 315 U.S. public and commercial facilities. See Chapter 6 and Appendix F for more detailed information regarding concentrations of asbestos in environmental media.

2.2 SUMMARY OF HEALTH EFFECTS

Epidemiological studies of asbestos-exposed workers and supporting animal studies indicate that inhalation of asbestos is the principal route of exposure of public health concern. Some epidemiological studies have also indicated that oral exposure may be linked to the development of gastrointestinal cancer. Depending largely on size and shape, deposition of inhaled asbestos fibers may occur in lung tissue. Some fibers may be removed by mucociliary clearance or macrophages while others may be retained in the lungs for extended periods. Inhalation exposure is, therefore, generally regarded as cumulative, and exposures have been expressed in terms of concentration of fibers over time or PCM fiber-years/mL (f-yr/mL). Studies in humans and animals indicate that inhalation exposure to asbestos fibers may lead to the development of pulmonary disease including asbestosis and/or lung cancer and mesothelioma of the pleura or peritoneum (see Chapter 2 and Appendix F for more detailed information on evidence for these health effects). In general, noncancer effects in other tissues have not been detected; however, the development of cancer in other tissues (e.g., gastrointestinal tissues) in some worker populations may be related to asbestos exposure. Asbestos-related lung diseases (malignant and nonmalignant) or signs of these diseases have been reported in groups of occupationally exposed humans with cumulative exposures ranging from about 5 to 1,200 f-yr/mL. Such cumulative exposures would result from 40 years of occupational exposure to concentrations ranging from 0.125 to 30 f/mL. Currently, U.S. OSHA regulations require that workplace air concentrations of asbestos not exceed 0.1 f/mL. Although asbestos-related effects have been primarily reported after chronic exposures to asbestos in an occupational setting, these effects have also been described following relatively brief occupational exposures. Exposures of this magnitude are usually not encountered by the general public.

Cancer. There is no doubt that inhalation of asbestos can lead to increased risk of lung cancer and mesothelioma. This has been conclusively demonstrated in numerous studies of occupationally exposed workers, and has been confirmed in a number of animal experiments. For lung cancer, the magnitude of the risk appears to be a complex function of a number of parameters, the most important of which are: (1) the level and the duration of exposure; (2) the time since exposure occurred; (3) the age at which exposure occurred; (4) the tobacco-smoking history of the exposed person; and (5) the type and size distribution of the asbestos fibers.

The last parameter is of special practical importance, since the variability in potency among fibers means that cancer risk from asbestos exposure may vary widely from location to location. Some of this variation may be attributable to differences between the mineral types, but fiber size (length and thickness) appear to be of prime importance. There is strong evidence from animal inhalation studies, intrathoracic and intraperitoneal dosing studies, and *in vitro* studies that long fibers are more carcinogenic than short fibers. However, this should not be construed to mean that shorter fibers are totally without carcinogenic potency. The relation between fiber size and carcinogenicity may vary between lung cancer and mesothelioma, but this is not yet clear.

There is some evidence from animal studies that asbestos-induced lung cancer stems from regions in the lung with advanced fibrosis (asbestosis); however, lung cancer with chrysotile was also produced at fiber concentrations that did not lead to detectable fibrosis.

Because of the large number of variables, it is difficult to make reliable predictions of the magnitude of the cancer risk that may result from exposures of the general population to asbestos levels that are likely to be encountered outside the workplace. Although there is considerable uncertainty in the estimates, EPA calculated, using a linear, no-threshold model, that lifetime exposure to asbestos dust containing 0.0001 fibers >5 μm in length per mL of air could result in about 2–4 excess cancer deaths (lung cancer plus mesothelioma) per 100,000 people. In 2001, EPA has been in the process of reviewing its cancer risk estimates for asbestos.

While lung cancer and mesothelioma are generally associated with chronic exposure to asbestos, there are several studies that indicate that short-term exposures are also of concern. For example, it has been noted that workers exposed to asbestos for only 1–12 months had an increased risk of developing lung cancer a number of years later. In animals, mesotheliomas developed in two rats exposed to high concentrations of amosite or crocidolite for only 1 day. These data are not extensive enough to define the dose- or time-dependency of health risks from short-term exposure to asbestos, but the data do indicate that short-term exposures should not be disregarded.

Asbestos exposure is also suspected of increasing the risk of cancer in the gastrointestinal tract, although the evidence is less consistent than for lung cancer or mesothelioma. Data supporting this view have been derived mainly from three types of studies. First, some studies of workers exposed to asbestos by inhalation have noted small excesses in death rates from gastrointestinal cancer. This is presumed to be due to the transfer of inhaled fibers from the lung to the gastrointestinal tract. Second, some studies suggest that populations with high levels of asbestos fibers in drinking water may have increased risk of gastrointestinal cancers. Third, one lifetime feeding study in rats indicated that intermediate-length chrysotile can increase the frequency of benign intestinal tumors in male rats. There are several findings, however, that do not support the association. The excess gastrointestinal mortalities noted in workers and in populations exposed through drinking water were usually quite small (from an epidemiological point of view), the follow-up period was of insufficient duration, and consistent results were not found across studies. Also, it is very difficult to determine whether the excesses are due to asbestos or to other factors (exposure to other chemicals, misdiagnosis, dietary factors, alcohol intake, etc.). With regard to the one positive tumorigenicity finding in animals, this must be balanced against the fact that the tumors were both infrequent and benign, and that no significant excess of gastrointestinal tumors was noted in a number of other adequate animal cancer bioassays.

There is some indication that asbestos exposure may have increased the risk of laryngeal cancer in some groups of asbestos workers, but the evidence is not as strong as that for lung cancer and mesothelioma. There is little evidence for the carcinogenicity of asbestos at other sites, although several cases of malignant mesothelioma of the tunica vaginalis testis have been reported in patients with histories of occupational exposure to asbestos.

Several government office and regulatory agencies have considered the evidence regarding the overall carcinogenicity of asbestos. The Department of Health and Human Services (DHHS) has determined that asbestos is known to be a human carcinogen. The EPA has determined that asbestos is a human carcinogen (Group A). In addition, the International Agency for Research on Cancer (IARC) has determined that asbestos is carcinogenic to humans (Group 1). These conclusions are based primarily on the evidence that asbestos causes lung cancer and mesothelioma. A number of researchers and regulatory groups have reviewed the weight-of-evidence on the issue of cancer at other sites after inhalation exposure to asbestos in the workplace, and have reached differing conclusions. For example, some believe that the data constitute substantial evidence that inhalation of asbestos in the workplace does increase risk of cancer at other sites. In contrast, others feel that the evidence is not adequate to reach a firm conclusion, and some believe that the apparent increases in gastrointestinal cancer are probably due to other factors (misdiagnosis, diet, alcohol, disease history, etc.) and cannot be attributed to asbestos. As these conflicting analyses illustrate, when epidemiological studies provide limited evidence for a small increase in cancer risk at a site, it is difficult to distinguish between two alternative interpretations: (1) the risk is real, and inconsistencies in the data are due to limitations in the sensitivity and accuracy of epidemiological studies; or (2) the risk is not real, and the apparent effects are attributable to other causes or reasons. In view of the limitations and uncertainties in the data available, it does not appear that a definitive distinction can currently be drawn between these alternatives. However, it seems only prudent to consider increased risk of gastrointestinal cancer an effect of concern. This conclusion is similar to that reached by a working group for the U.S. DHHS.

Respiratory Effects. Deposition of asbestos fibers in the lung can lead to substantial nonneoplastic fibrotic injury and may even cause death. This disease, termed asbestosis, results from a prolonged inflammatory response stimulated by the presence of the fibers in the lung. Alveolar macrophages, which normally phagocytize foreign bodies deposited in the lungs, seek to engulf the asbestos fibers and remove them. While short fibers may be cleared in this way, long fibers cannot be removed, and this results in an ongoing focal inflammatory response. With time, some fibers move from the lung to the interstitium where additional inflammatory events take place leading to the development of interstitial pulmonary fibrosis and a progressive loss of lung compliance and respiratory function.

Signs of lung fibrosis and increased mortality associated with asbestosis or nonmalignant respiratory disease have been observed in groups of workers with chronic cumulative exposures as low as 15–70 f-yr/mL for signs of lung fibrosis and 32–1,271 f-yr/mL for asbestosis-associated mortality. The mortality experience associated with asbestosis or nonmalignant respiratory disease in cohorts of exposed workers appears to provide the best available source for describing exposure-response relationships for the development of asbestos-related lung fibrosis. However, a major limitation with the resultant descriptions is that there is very limited information for responses at low levels of exposure experienced by modern workers in regulated nations (<0.1–0.2 f/mL) or at levels experienced in many nonoccupational exposure scenarios ($3x10^{-6}$–$6x10^{-3}$ f/mL). Uncertainty associated with this lack of information may be decreased with results from prospective cohort mortality studies of workers involved in asbestos-related occupations under currently regulated conditions or retrospective studies of workers who entered asbestos-related occupations after 1970 or 1980 when respective occupational limits of 5 and 2 f/mL were recommended in the United States.

Studies of two cohorts of workers exposed to chrysotile asbestos, one from a Carolina textile plant, and the other from Quebec mines and mills, appear to have received the most recent attention by the research and regulatory community because they represent quality studies that provide widely varying estimates of risk for the development of nonmalignant or malignant lung disease associated with the most common type of asbestos. The available data indicate that, at equivalent exposure levels, the risk is greater for textile workers than for miners or millers; these data have been used to develop statistical models that estimate low, but not negligible, risk (2/1,000) for asbestosis-related mortality with chronic exposure to current occupational exposure limits of 0.1 f/mL. Several authors consider the mortality experience of the Carolina textile cohort to be atypical relative to other asbestos-exposed cohorts and, in the absence of a reliable explanation of this uniqueness, have cautioned against its use in quantitative health assessments for other exposure scenarios to asbestos fibers (see Section 3.2.1.2 for further discussion). Further extrapolation to lower levels of asbestos typically found in ambient air or in the indoor air of homes or public buildings suggests that asbestosis may not be of concern for most people in the general population without occupational exposure to asbestos.

Another tissue that may be affected in humans exposed to asbestos in air is the pleura. The most common effect is the formation of thickened fibrous areas called plaques, but diffuse thickening and fibrosis may also occur, as may areas of pleural effusions. An increased incidence of pleural plaques has been noted at relatively low cumulative exposures (approximately 0.12 f-yr/mL). Localized pleural plaques are not thought to be of significant health concern, although diffuse pleural thickening and circumscribed pleural plaques are associated with impairment of respiratory function. This may also be due to subclinical alveolitis or interstitial fibrosis not detected by routine chest radiograms. These plaques are normally very mild, but may be severe in a few cases probably associated with high exposures.

A few studies have also reported an increased incidence of laryngitis in workers exposed to asbestos. These data suggest that the upper airways may also be affected by asbestos exposure.

Immunological and Lymphoreticular Effects. Studies of workers suffering from asbestos-related diseases such as asbestosis or mesothelioma indicate that the cellular immune system in such patients can be depressed. This is an effect of particular interest and concern since impaired immune surveillance may contribute to the increased incidence of cancer in asbestos-exposed people. Moreover, variation in immune system functional capability might be an important determinant of why some people develop cancer or asbestosis while others, with approximately equal exposures, do not. However, it is very difficult to distinguish whether the alterations in immune function noted in such studies are the cause or the result of asbestos-induced disease. The frequency of impaired cellular immunity in exposed workers without clinically-apparent disease is generally low, although some studies have noted alterations in lymphocyte distribution and impairment of natural killer (NK) cells. This could mean that the immunological changes do not occur until the disease develops (i.e., the changes are the result of the disease). Alternatively, it could mean that workers with immune systems that are not impaired by asbestos do not get serious disease, while workers whose immune systems are injured by asbestos do tend to develop disease (i.e., effects on the immune system are the cause of the disease). Available data do not allow a firm distinction between these alternatives at present, but the possible immunotoxic effects of asbestos are of clear concern. Results from animal studies provide supporting evidence of direct and indirect effects of asbestos on the immune system, although the specific roles of these effects in the etiology of asbestos-induced pulmonary diseases are not well understood and are under current investigation. For example, experiments with mice indicate that asbestos exposure decreases the number and cytotoxic activity of interstitial pulmonary NK cells and that genetically impaired cell-mediated immunity may be a predisposing factor in asbestos fibrosis.

2.3 MINIMAL RISK LEVELS

Inhalation MRLs

No MRLs were derived for inhalation exposure to asbestos for any duration. Results from epidemiological studies of cohorts of workers chronically exposed to airborne asbestos fiber concentrations ranging from about 5 to 20 f/mL provide convincing evidence of the development of asbestos-induced lung fibrosis, but a chronic MRL was not derived due to the large degree of uncertainty in extrapolating from the available data to levels of exposure that may be several orders of magnitude lower than current U.S. occupational exposure limits (0.1 f/mL). Data regarding the adverse health effects associated with acute- or intermediate-duration exposure to asbestos are lacking or are too limited to support the derivation of an MRL.

Oral MRLs

No MRLs were derived for oral exposure to asbestos for any duration. No studies were located regarding noncancer health effects in humans orally exposed to asbestos fibers, although asbestos cement pipes have been used in some community water systems for many years. Because ingested asbestos fibers are poorly absorbed, the tissue most highly exposed to ingested asbestos is the gastrointestinal tract epithelium. A few studies reported some histological or biochemical changes in gastrointestinal tract cells of rats chronically exposed to oral doses of asbestos, but, in an extensive series of lifetime dietary exposure studies in rats and Syrian hamsters, comprehensive microscopic evaluation of tissues and organs found no excess nonneoplastic lesions in the gastrointestinal epithelium or in other tissues or organs in animals exposed to daily doses as high as 500–830 mg/kg/day. The weight of evidence indicates that asbestos ingestion does not cause any significant noncarcinogenic effects in the gastrointestinal tract or other tissues, and supports the generally held perception that oral exposure to asbestos does not present a high priority public health concern for noncancer effects.

3. HEALTH EFFECTS

3.1 INTRODUCTION

The primary purpose of this chapter is to provide public health officials, physicians, toxicologists, and other interested individuals and groups with an overall perspective on the toxicology of asbestos. It contains descriptions and evaluations of toxicological studies and epidemiological investigations and provides conclusions, where possible, on the relevance of toxicity and toxicokinetic data to public health.

A glossary and list of acronyms, abbreviations, and symbols can be found in Chapter 10 and Appendix C.

The profile also contains a health consultation on tremolite asbestos, a name that has been used in the popular press to refer to fibrous amphibole that occurs in vermiculite ore from Libby Montana (Appendix F).

It is important to recognize that asbestos is not a single substance, but is the generic name for a family of six related polysilicate fibrous minerals of which one (chrysotile) belongs to the serpentine family and five (actinolite, amosite, anthophyllite, crocidolite, and tremolite) belong to the amphibole family. These minerals differ from each other in physical and chemical properties, and each mineral can exist in a wide range of fiber sizes. These differences between fiber type and, more importantly, fiber size (length and diameter) are believed to be important determinants of the health risks posed by asbestos.

3.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE

To help public health professionals and others address the needs of persons living or working near hazardous waste sites, the information in this section is organized first by route of exposure (inhalation, oral, and dermal) and then by health effect (death, systemic, immunological, neurological, reproductive, developmental, genotoxic, and carcinogenic effects). These data are discussed in terms of three exposure periods: acute (14 days or less), intermediate (15–364 days), and chronic (365 days or more).

Levels of significant exposure for each route and duration are presented in tables and illustrated in figures. The points in the figures showing no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs) reflect the actual doses (levels of exposure) used in the studies. LOAELS have been classified into "less serious" or "serious" effects. "Serious" effects are those that evoke failure in a biological system and can lead to morbidity or mortality (e.g., acute respiratory distress or death). "Less serious" effects are those that are not expected to cause significant dysfunction or death, or those whose significance to the organism is not entirely clear. ATSDR acknowledges that a considerable amount of judgment may be required in establishing whether an end point should be classified as a NOAEL, "less serious" LOAEL, or "serious" LOAEL, and that in some cases, there will be insufficient data to decide whether the effect is indicative of significant dysfunction. However, the Agency has established guidelines and policies that are used to classify these end points. ATSDR believes that there is sufficient merit in this approach to warrant an attempt at distinguishing between "less serious" and "serious" effects. The distinction between "less serious" effects and "serious" effects is considered to be important because it helps the users of the profiles to identify levels of exposure at which major health effects start to appear. LOAELs or NOAELs should also help in determining whether or not the effects vary with dose and/or duration, and place into perspective the possible significance of these effects to human health.

The significance of the exposure levels shown in the Levels of Significant Exposure (LSE) tables and figures may differ depending on the user's perspective. Public health officials and others concerned with appropriate actions to take at hazardous waste sites may want information on levels of exposure associated with more subtle effects in humans or animals (LOAELs) or exposure levels below which no adverse effects (NOAELs) have been observed. Estimates of levels posing minimal risk to humans (Minimal Risk Levels or MRLs) may be of interest to health professionals and citizens alike.

Levels of exposure associated with carcinogenic effects (Cancer Effect Levels, CELs) of asbestos are indicated in Tables 3-1, 3-2, and 3-3 and Figures 3-1, 3-2 and 3-3. Because cancer effects could occur at lower exposure levels, Figures 3-1 and 3-4 show a range for the upper bound of estimated excess risks, ranging from a risk of 1 in 10,000 to 1 in 10,000,000 (10^{-4} to 10^{-7}), as developed by EPA.

A User's Guide has been provided at the end of this profile (see Appendix B). This guide should aid in the interpretation of the tables and figures for Levels of Significant Exposure and the MRLs.

3.2.1 Inhalation Exposure

Units of Exposure. Consideration and comparison of quantitative data on asbestos inhalation studies are complicated by the fact that a number of different methods have been used to measure asbestos levels in air. Currently, the standard method for measuring asbestos concentrations in workplace air employs phase contrast microscopy (PCM). A particle visible under PCM is counted as a fiber if it is $5 micrometers (µm) long and has a length/thickness ratio of $3:1. However, the method cannot detect fibers thinner than about 0.3 µm and cannot distinguish between asbestos fibers and other fibers (NIOSH 1987). Nevertheless, because currently available risk factors for asbestos are expressed in terms of PCM fibers, all air concentration data in this section are expressed in terms of PCM fibers/milliliter (f/mL) unless otherwise noted. It should be noted, however, that PCM analytical methods have improved substantially since early asbestos studies were performed, with an increase in numbers of fibers detected (Rickards 1994).

When data on airborne levels are available only in terms of mass/volume (e.g., mg/m^3), it is not possible to accurately convert these to units of PCM fibers/mL, because the ratio between mass and fiber number depends on fiber type and size distribution and because of the measuring technique employed. For the purposes of making rough calculations when a more accurate conversion factor is not available, it has been assumed that a concentration of 1 mg/m^3 in air is equal to 33 PCM f/mL (EPA 1986a).

Older occupational studies measured dust exposure in units of million particles per cubic foot (mppcf). This method did not distinguish fibrous from nonfibrous particles and used relatively low magnification, so only the largest particles and fibers were detectable. When a more accurate value is not available, it has been assumed that a concentration of 1 mppcf is equal to 3 PCM f/mL (BOHS 1968).

Overview of Health Effects. Studies in humans and animals indicate that inhalation of asbestos fibers may lead to fibrotic lung disease (asbestosis), pleural plaques and thickening, and cancer of the lung, the pleura, and the peritoneum. It may also increase the risk of cancer at other sites, but the evidence is not strong. Significant effects on other tissues have not been detected. A number of researchers have found that the occurrence of asbestosis and lung cancer correlates with cumulative exposure (that is, the product of concentration [PCM fibers/mL] multiplied by years of exposure). Therefore, human exposures are expressed below as PCM f-yr/mL. Animal data are provided in terms of exposure level (PCM f/mL) and duration, and the cumulative exposure can be found simply by calculating the product. However, due to differences in clearance rates and lifespan as well as other differences, cumulative doses in animals are not expected to be directly comparable to cumulative doses in humans. Studies that provide reliable dose-response information on the inhalation effects of asbestos in humans are summarized in Table 3-1 and Figure 3-1, and data in animals are summarized in Table 3-2 and Figure 3-2. The findings are discussed below.

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL: Less serious (f-yr/mL)	LOAEL: Serious (f-yr/mL)	Reference/ chemical form[b]
INTERMEDIATE EXPOSURE							
Systemic							
1	Human	6 mo aver. (occup)	Resp		25.1 M (increased incidence of parenchymal & pleural radiographic abnormalities, > 20 yr after first exposure)		Ehrlich et al. 1992 AM
2	Human	12.7 mo, mean (1 d to 17.3 yr, range) (occup)	Resp			54 M (increased risk for fatal nonmalignant respiratory disease)	Levin et al. 1998 AM
3	Human	8 mo (SD= 14.9) (occup)	Resp		53.2 M (minor parenchymal & pleural radiographic changes in about 10% & 30% of subjects, 20 years after exposure)		Shepherd et al. 1997 AM
Cancer							
4	Human	12.7 mo, mean (1 d to 17.3 yr, range) (occup)				54 M (CEL: increased SMRs for lung cancer & pleural mesothelioma)	Levin et al. 1998 AM

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL Less serious (f-yr/mL)	LOAEL Serious (f-yr/mL)	Reference/ chemical form[b]
CHRONIC EXPOSURE							
Systemic							
5	Human	7.9 yrs, median (occup)	Resp			32 M (slightly increased incidence of fatal nonmalignant or malignant respiratory disease with 20-40 year latency)	Albin et al. 1996 CH AM CR
6	Human	10+ yr (occup)	Resp	25 M	38 M (increased percentage (7%) of workers with early signs of respiratory impairment)		BOHS 1983 CH
7	Human	>20 yr, most cases	Resp			1271 M (autopsied cases of asbestosis with median lung fiber concentration, 41 f/ug tissue)	Case and Dufresne 1997 CH
8	Human	<10, 11-20, >20 yr (occup)	Resp	20 M	62 M (increased incidence of subjects with parenchymal & pleural abnormalities in chest x-ray)		Dave et al. 1997 NS
9	Human	1.1-2.7 yr (occup)	Resp	23 M		71 M (increased risk for fatal asbestosis)	de Klerk et al. 1991 CR
10	Human	10-30 yr (occup)	Resp	17		68 (increased SMRs for fatal pneumoconiosis)	Dement et al. 1994; Brown et al. 1994 CH
11	Human	>15 yr (occup)	Resp	2.6 M			Demers et al. 1998 NS

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL Less serious (f-yr/mL)	LOAEL Serious (f-yr/mL)	Reference/ chemical form[b]
12	Human	6-14 yr (occup)	Resp		30 M (increased prevalence of breathlessness)	616 M (increased prevalence of breathlessness and low FVC)	Enarson et al. 1988 CH
13	Human	>9 yr (occup)	Resp			100 M (increased prevalence of fatal asbestosis & non-malignant respiratory disease)	Finkelstein 1983 CH CR
14	Human	9.9 & 7.5 yr, M&F (occup)	Resp	4	22 M (increased score for pulmonary fibrosis in autopsy cases; 3.3 on a scale of 12)	73 M (increased score for pulmonary fibrosis autopsy cases; 7.9 on a scale of 12)	Green et al. 1997 CH
15	Human	3-51 yr (occup)	Resp			300 M (increased prevalence of fatal asbestosis)	Henderson and Enterline 1979 CH CR AM
16	Human	3.8 yr aver. (occup)	Resp			99 M (fatal asbestosis with latency of +20 yr)	Hughes et al. 1987 CH CR AM
17	Human	1->20yr (occup)	Resp		70 M (5% excess of subjects with lung parenchymal abnormalities)		Irwig et al. 1979 CR AM
18	Human	19.7-21.1 yr (2.3-51 yr)	Resp	5 M	20 M (increased risk for profusion of opacities & wall thickening in chest x-rays)		Jakobsson et al. 1995b CH CR AM
19	Human	5-31 yr (occup)	Resp	18	207 (significantly increased incidence of chronic laryngitis)		Kambic et al. 1989 AM CH CR
20	Human	(occup)	Resp	45		195 M (increased rate of fatal pneumoconiosis)	Liddell et al. 1997 CH

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL Less serious (f-yr/mL)	LOAEL Serious (f-yr/mL)	Reference/ chemical form[b]
21	Human	1-20 yr (occup)	Resp	15 M		45 M (increased rate of fatal nonmalignant respiratory disease)	McDonald et al. 1982 CH AM CR
22	Human	1-20 yr (occup)	Resp	90 M		180 M (increased rate of fatal nonmalignant respiratory disease)	McDonald et al. 1983 CH
23	Human	20+ yr (occup)	Resp			450 M (increased rate of fatal asbestosis)	Nicholson et al. 1979 CH
24	Human	>5 yr (occup)	Resp			170 M (increased rate of fatal nonmalignant respiratory disease)	Peto et al. 1985 CH CR
25	Human	NS (occup)	Resp	3.5		15 M (increased incidence of autopsy cases with slight to severe asbestosis, 16-30 yr after first exposure)	Sluis-Cremer 1991 CR AM
26	Human	15 yr aver. (occup)	Resp			20 M (cases of pulmonary fibrosis with functional impairment)	Wollmer et al. 1987 CH
	Cancer						
27	Human	> 3 mo (occup; full range not reported				26 M (CEL: mesothelioma)	Albin et al. 1990a CH CR AM
28	Human	7.9 yrs, median (occup)				32 M (CEL: mesothelioma)	Albin et al. 1996 CH AM CR

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL Less serious (f-yr/mL)	LOAEL Serious (f-yr/mL)	Reference/ chemical form[b]
29	Human	1-20 yr (occup)				400 M (CEL: lung cancer, mesothelioma)	Amandus and Wheeler 1987 TR AC
30	Human	40 yr residential (20-70 yr, range)				27 M (CEL: 4 M & 2F cases of mesothelioma in a 10-yr period among <200 villagers)	Coplu et al. 1996 TR
31	Human	1.0, 1.6 yr (occup)				55 M (CEL: lung cancer)	de Klerk et al. 1991; 1996 CR
32	Human	10-30 yr				5 M (CEL: increased SMRs for lung cancer)	Dement et al. 1994; Dement and Brown 1994; Brown et al. 1994 CH
33	Human	(occup)				180 M (CEL: lung cancer, gastrointestinal cancer, mesothelioma)	Enterline et al. 1987 CH CR AM
34	Human	>9 yr (occup)				44 M (CEL: lung cancer, mesothelioma)	Finkelstein 1983 CH CR
35	Human	1- >60 mo				14 M (CEL: mesothelioma)	Hansen et al. 1998 CR
36	Human	3-51 yr (occup)				180 M (CEL: lung cancer, mesothelioma)	Henderson and Enterline 1979 CH CR AM
37	Human	3.8 yr aver. (occup)				50 M (CEL: lung cancer, mesothelioma)	Hughes et al. 1987 CH CR AM

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL Less serious (f-yr/mL)	LOAEL Serious (f-yr/mL)	Reference/ chemical form[b]
38	Human	NS (occup)				0.7 B (CEL: significant association between pleural malignant mesothelioma & asbestos occupational exposure; case/control study)	Iwatsubo et al. 1998 NS
39	Human	1->20 yr (occup)				1050 M (CEL: lung cancer)	Liddell et al. 1997 CH
40	Human	1-20 yr (occup)				90 M (CEL: lung cancer)	McDonald et al. 1982 CH AM CR
41	Human	1-20 yr (occup)				90 M (CEL: lung cancer)	McDonald et al. 1983 CH
42	Human	>2 yr (occup)				10 (CEL: lung cancer, gastrointestinal cancer and mesothelioma)	Newhouse and Berry 1979 CR CH AM
43	Human	20+ yr (occup)				450 M (CEL: lung cancer, mesothelioma)	Nicholson et al. 1979 CH
44	Human	>5 yr (occup)				72 M (CEL: lung cancer, mesothelioma)	Peto et al. 1985 CH CR

TABLE 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human Studies (continued)

Key to figure[a]	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (f-yr/mL)	LOAEL Less serious (f-yr/mL)	LOAEL Serious (f-yr/mL)	Reference/ chemical form[b]
45	Human	<2 - >10 yr (occup)				450 M (CEL: lung cancer, mesothelioma)	Weill et al. 1979 CH CR AM

[a]The number corresponds to entries in Figure 3-1.
[b]The first type of asbestos listed below represents that which predominated in the workplace air; other secondary types that may have been present follow.

AC = actinolite; AM = amosite; aver. = average; B = both (male/female); CEL = cancer effect level; CH = chrysotile; CR = crocidolite; d = day(s); F = female; f/ug = fibers per microgram; FVC = forced vital capacity; f-yr/mL = fiber-years per milliliter; LOAEL = lowest-observed-adverse-effect-level; M = male; mo = month(s); NOAEL = no-observed-adverse-effect-level; NS = not specified; (occup) = occupational; Resp = respiratory; SD = standard deviation; SMR = standard mortality ratio; TR = tremolite; yr = year(s)

Figure 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human studies

Intermediate (15-364 days)

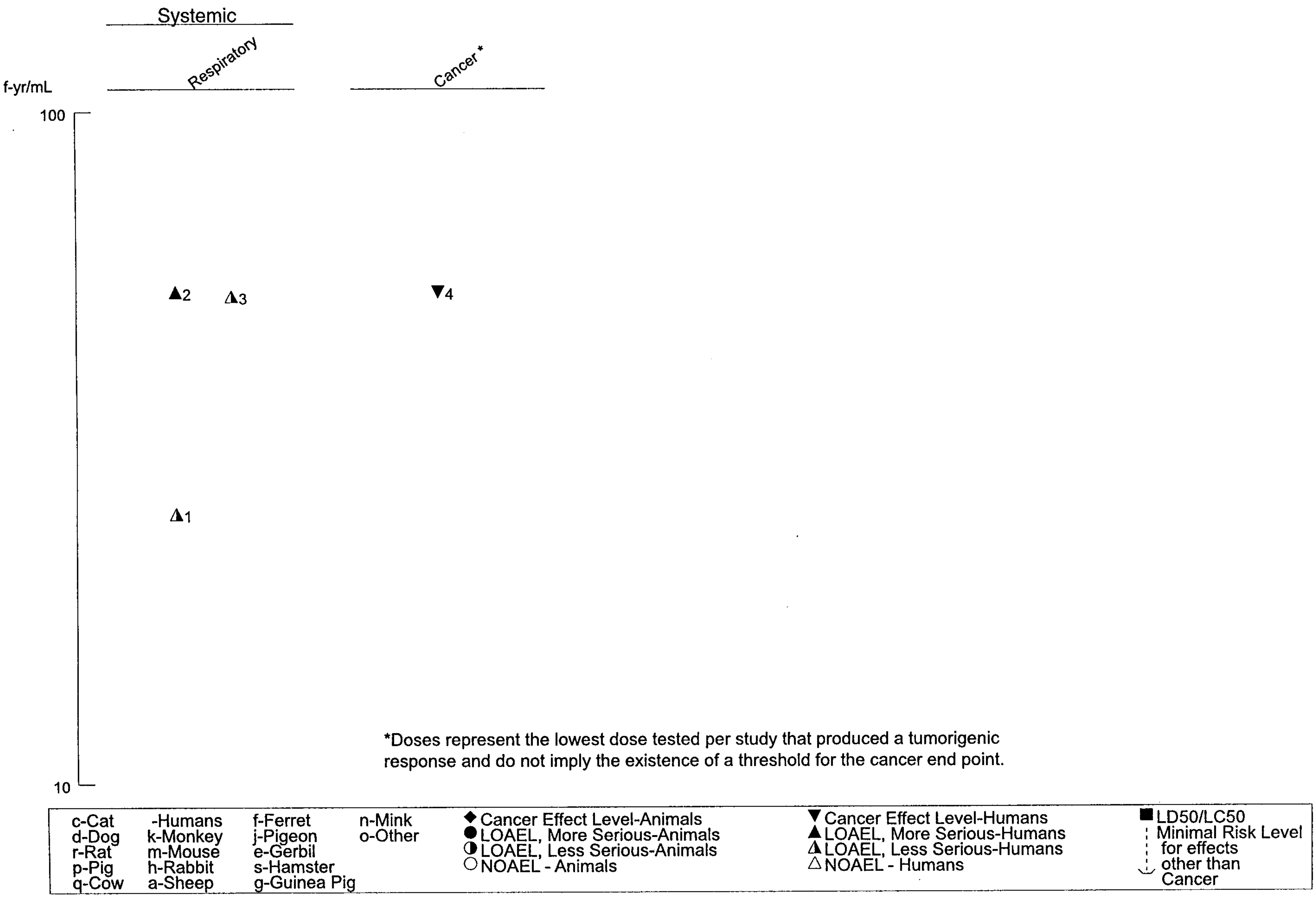


Figure 3-1. Levels of Significant Exposure to Asbestos - Inhalation - Human studies (*continued*)

Chronic (≥365 days)

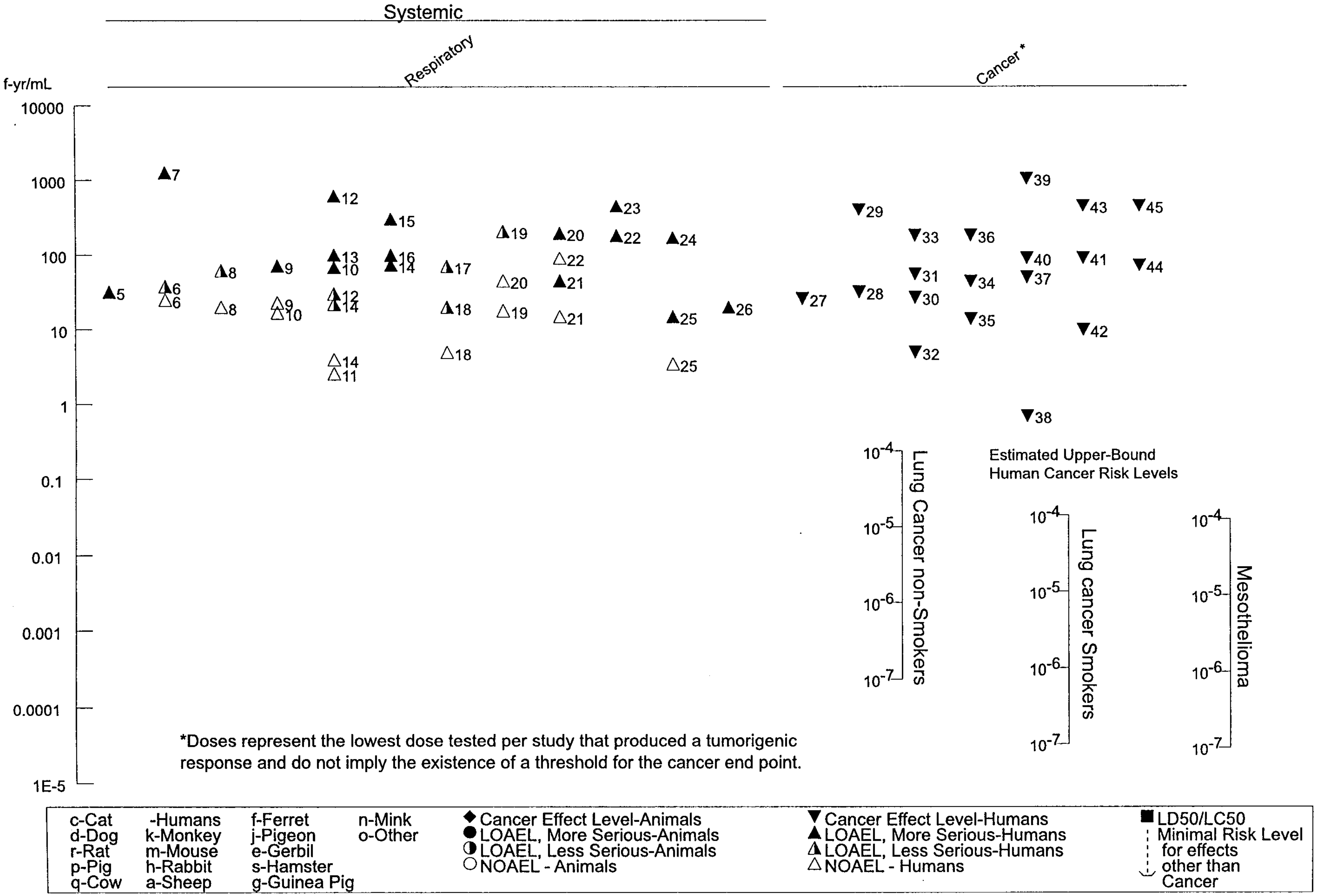


TABLE 3-2. Levels of Significant Exposure to Asbestos - Inhalation - Animal Studies

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (PCM f/mL)	LOAEL Less serious (PCM f/mL)	LOAEL Serious (PCM f/mL)	Reference/ chemical form
ACUTE EXPOSURE							
Systemic							
1	Mouse B10.D2/nSn	5 hr	Resp			132 M (fibrosis)	McGavran et al. 1989 CH
INTERMEDIATE EXPOSURE							
Systemic							
2	Rat PVG	15 wk 5 d/wk 7 hr/d	Resp			330 M (diffuse fibrosis)	Donaldson et al. 1988a CH
CHRONIC EXPOSURE							
Systemic							
3	Rat Wistar	1 yr 1-5 d/wk 7 hr/d	Resp			70 M (fibrosis)	Davis et al. 1980a CH
4	Rat Wistar	1 yr 1-5 d/wk 7 hr/d	Resp			330 M (fibrosis)	Davis et al. 1980a AM
5	Rat NS	12 mo	Resp			330 (fibrosis)	Davis et al. 1980b AM CH
6	Rat Wistar	12 mo 5 d/wk 7 hr/d	Resp			1600 M (fibrosis)	Davis et al. 1985 TR
7	Rat Wistar	12 mo 5 d/wk 7 hr/d	Resp			2060 M (fibrosis)	Davis et al. 1986a AM-L

TABLE 3-2. Levels of Significant Exposure to Asbestos - Inhalation - Animal Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (PCM f/mL)	LOAEL Less serious (PCM f/mL)	LOAEL Serious (PCM f/mL)	Reference/ chemical form
8	Rat CD	2 yr 4 d/wk 4 hr/d	Resp			54 (fibrosis)	Reeves et al. 1974 CH
9	Rat CD	2 yr 4 d/wk 4 hr/d	Resp			1105 (fibrosis)	Reeves et al. 1974 CR
10	Rat NS	2 yr 4 d/wk 4 hr/d	Resp			860 (fibrosis)	Reeves et al. 1974 AM
11	Rat Wistar	24 mo 5 d/wk 7 hr/d	Resp			350 (fibrosis)	Wagner et al. 1974 AM AN CR CH
12	Rat Wistar	12 mo 5 d/wk 7.5 hr/d	Resp			430 (fibrosis)	Wagner et al. 1980a CH
Cancer							
13	Monkey Baboon	4 yr 5 d/wk 6 hr/d				1110 M (CEL: mesothelioma)	Goldstein and Coetzee 1990 AM
14	Monkey Baboon	4 yr 5 d/wk 6 hr/d				1130 (CEL: mesothelioma)	Goldstein and Coetzee 1990 CH CR
15	Monkey Baboon	6 hr/d 5 d/wk up to 898 d				1100 M (CEL: pleural and peritoneal mesothelioma)	Webster et al. 1993 AM
16	Rat Wistar	1 yr 5 d/wk 7 hr/d				1170 (CEL: lung adenoma, adenocarcinoma, and mesothelioma)	Davis and Jones 1988 CH-S

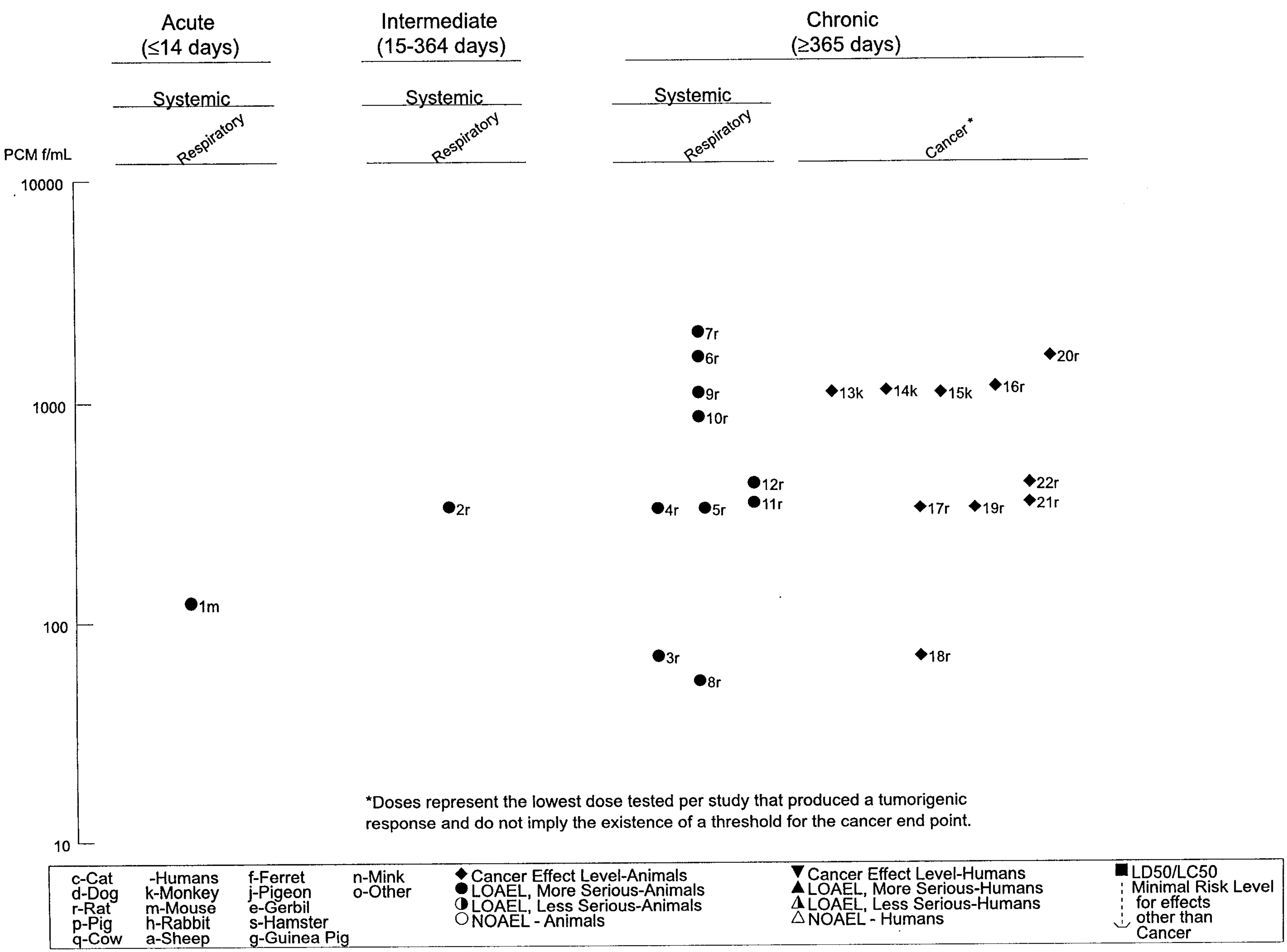
TABLE 3-2. Levels of Significant Exposure to Asbestos - Inhalation - Animal Studies (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (PCM f/mL)	LOAEL Less serious (PCM f/mL)	LOAEL Serious (PCM f/mL)	Reference/ chemical form
17	Rat Wistar	1 yr 1-5 d/wk 7 hr/d				330 M (CEL: lung carcinomas, adenocarcinomas)	Davis et al. 1980a AM
18	Rat Wistar	1 yr 1-5 d/wk 7 hr/d				70 M (CEL: lung adenomas, adenocarcinomas, and squamous carcinomas)	Davis et al. 1980a CH
19	Rat NS	12 mo				330 (CEL: lung adenomas and carcinomas)	Davis et al. 1980b AM CH
20	Rat Wistar	12 mo 5 d/wk 7 hr/d				1600 M (CEL: lung adenoma, adenocarcinoma, squamous carcinoma, and mesothelioma)	Davis et al. 1985 TR
21	Rat Wistar	24 mo 5 d/wk 7 hr/d				350 (CEL: lung adenoma, adenocarcinoma, squamous carcinoma, and mesothelioma)	Wagner et al. 1974 AM AN CR CH
22	Rat Wistar	12 mo 5 d/wk 7.5 hr/d				430 (CEL: lung adenoma, adenocarcinoma, squamous carcinoma, and mesothelioma)	Wagner et al. 1980a CH

[a]The number corresponds to entries in Figure 3-2.

AM = amosite; AN = anthophyllite; CEL = cancer effect level; CH = chrysotile; CR = crocidolite; d = day(s); PCM f/mL = phase contrast microscopy fibers per milliliter; hr = hour(s); L = long; LOAEL = lowest-observed-adverse-effect-level; M = male; mo = month(s); NOAEL = no-observed-adverse-effect-level; Resp = respiratory; S = short; TR = tremolite; wk = weeks(s); yr = year(s)

Figure 3-2. Levels of Significant Exposure to Asbestos - Inhalation - Animal studies



3.2.1.1 Death

No studies were located in which acute- or intermediate-duration inhalation exposure to asbestos led to lethality in humans or animals. Inhalation exposure to asbestos can lead to death or a shortened lifespan from asbestosis or cancer, as discussed in Sections 3.2.1.2 and 3.2.1.8, respectively.

3.2.1.2 Systemic Effects

No studies were located regarding significant hematological, musculoskeletal, hepatic, renal, endocrine, dermal, ocular, body weight, or metabolic effects in humans or animals after inhalation exposure to asbestos. Systemic effects observed after inhalation exposure and discussed below include respiratory, cardiovascular, and gastrointestinal effects. The highest NOAEL values and all LOAEL values from each reliable study for systemic effects are summarized in Tables 3-1 and 3-2, and plotted in Figures 3-1 and 3-2.

Respiratory Effects. Numerous studies in humans have established that inhalation exposure to asbestos fibers can lead to a characteristic pneumoconiosis termed asbestosis. Published definitions of asbestosis generally concur that it is a diffuse interstitial fibrosis of the lungs caused by the inhalation of asbestos fibers (American Thoracic Society 1986; International Expert Meeting on Asbestos 1997; Mossman and Churg 1998). Persons with fully developed asbestosis have shortness of breath (dyspnea), often accompanied by rales or cough (Churg 1986a; Enarson et al. 1988; Finkelstein 1986), and display deficits in pulmonary function variables such as forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC) (Glencross et al. 1997; Kilburn and Warshaw 1994; Miller et al. 1994; Rom 1992; Schwartz et al. 1994; Shepherd et al. 1997). In severe cases, impairment of respiratory function may ultimately result in death, and asbestosis has been associated with excess mortality in a number of groups of asbestos workers (Armstrong et al. 1988; de Klerk et al. 1991; McDonald et al. 1983; Peto et al. 1985; Selikoff et al. 1979).

Available evidence indicates that all asbestos fiber types are fibrogenic, although there may be some differences in potency among fiber types (Bignon and Jaurand 1983; Churg 1993; Davis 1972; EPA 1986a; Kamp and Weitzman 1997; McDonald et al. 1999). Most studies in humans have involved exposure to predominantly chrysotile, the most widely used type of asbestos (Albin et al. 1996; Berry et al. 1979; BOHS 1983; Case and Dufresne 1997; Cullen and Baloyi 1991; Dement et al. 1983; McDonald et al. 1983, 1984, 1999; Nicholson et al. 1979), but asbestosis has also been noted in populations exposed mainly to amosite (Seidman et al. 1979), crocidolite (Armstrong et al. 1988; de Klerk et al. 1991, 1996; Luo et al. 1992; Sluis-Cremer 1991; Wignall and Fox 1982), tremolite (McDonald et al. 1986a), and anthophyllite (Meurman et al. 1974; Sluis-Cremer 1991). A number of animal studies have indicated that long fibers (e.g., 5 µm or more) have a higher fibrogenic activity, while short fibers have a lower fibrogenic activity (Adamson and Bowden 1987a, 1987b; Davis and Jones 1988; Davis et al. 1986a; Platek et al. 1985). This relationship may be associated with the inability of macrophages to engulf and remove fibers that are significantly larger than themselves (Bignon and Jaurand 1983).

Results from human studies, however, suggest that short asbestos fibers may also play a role in pulmonary fibrosis. In autopsy studies of groups of chrysotile miners and millers (Churg et al. 1989a) and amosite-exposed shipyard and insulation workers (Churg et al. 1990) with asbestosis, histologically-graded fibrosis was positively correlated with mean amphibole fiber concentration in lung tissue, but was negatively correlated with mean amphibole fiber length. Churg et al. (1989a, 1990) noted that the inverse relationship between degree of fibrosis and amphibole fiber length was suggestive that short fibers may be more important in the genesis of pulmonary fibrosis than was commonly believed based on the findings from animal studies showing a positive relationship between fiber length and fibrogenic activity. Case (1994) noted, however, that men with asbestosis in the group of autopsied chrysotile miners and millers showed lung concentrations of tremolite fibers longer than 8 µm that were higher than concentrations in men without asbestosis, and that six of seven miners/millers having any chrysotile or tremolite fibers longer than 20 µm had asbestosis. The latter observations suggest the importance of longer fibers. Case (1994) hypothesized that the greater concentrations of long tremolite fibers in these cases of asbestosis might also produce increased levels of shorter fibres (at autopsy) due to fiber breakage with time of retention in the lung. Case (1994) suggested that the counting method employed by Churg et al. (1989a, 1990) (that included short fibers down to the limits of detection) may more accurately quantify short fiber fragments, and that the fiber size class that is most responsible for fibrosis is unclear. Case (1994) further hypothesized that long fibers may initiate events, and that shorter fiber fragments, once they are present, may have increased effects on macrophage activity and subsequent fibrosis. Surface area has been proposed to play a role in amphibole fiber toxicity (Lippmann 1988), and, since shorter, thinner fibers have proportionally greater surface areas than longer, thicker fibers, may be involved in the inverse relationship observed by Churg et al. (1989a, 1990).

As shown in Table 3-1 and Figure 3-1, cumulative exposure levels that have been associated with radiographic, histologic, spirometric, or clinical signs of lung fibrosis in groups of chronically exposed workers include 38 f-yr/mL in British asbestos textile factory workers (BOHS 1983), 62 f-yr/mL in

Indian asbestos cement workers (Dave et al. 1997), 30 f-yr/mL in British Columbian chrysotile miners and millers (Enarson et al. 1988), 22 f-yr/mL in autopsied cases of deceased South Carolina chrysotile textile factory workers (Green et al. 1997), 10–30 f-yr/mL (midpoint=20 f-yr/mL) in Swedish asbestos cement workers (Jakobsson et al. 1995b; Wollmer et al. 1987), 70 f-yr/mL in South African crocidolite and amosite miners (Irwig et al. 1979), and 15 f-yr/mL in autopsied cases of deceased crocidolite and amosite miners and millers (Sluis-Cremer 1991).

Table 3-1 and Figure 3-1 also show that significantly increased mortality rates associated with asbestosis or other nonmalignant respiratory disease have been reported in groups of exposed workers with cumulative exposure estimates ranging from 32 to 1,271 f-yr/mL (Albin et al. 1996; Brown et al. 1994; Case and Dufresne 1997; de Klerk et al. 1991; Dement et al. 1994; Finkelstein 1983; Henderson and Enterline 1979; Hughes et al. 1987; Liddell et al. 1997; Nicholson et al. 1979; Peto et al. 1985; Sluis-Cremer 1991).

Whereas these studies involved chronic exposure to asbestos, increased incidences of radiographic abnormalities indicative of pulmonary fibrosis have been found in studies of New Jersey and Texas workers involved in the manufacture of amosite-insulated materials who were predominantly exposed for intermediate durations (medians of 6–12 months) at fiber concentrations that were as high as 5–100 f/mL, many fold higher than the current U.S. permissible exposure limit for workplace air, 0.1 f/mL (Ehrlich et al. 1992; Levin et al. 1998; Shepherd et al. 1997). These studies add to the evidence that asbestos-induced respiratory disease can take a long time (10–20 years) to develop and, in some individuals, continues to progress long after exposure has ceased (Finkelstein 1986; Mossman and Churg 1998; Wagner et al. 1974). Churg (1993) noted that early cases of asbestosis, when workplace air fiber concentrations were very high, had shorter latent development periods (5–6 years), compared with estimates of 10–20 years latency from studies of workers more recently exposed to lower fiber concentrations. This comparison suggests that there is an inverse relationship between intensity of exposure and time of disease development.

Several of the studies of occupationally exposed workers in Table 3-1 and Figure 3-1 provide general descriptions of exposure-response relationships for asbestos-induced nonmalignant respiratory effects, showing increasing severity or incidence of disease with increasing cumulative exposure and providing some indications of no-effect levels ranging from 2.6 to 90 f-yr/mL for signs of asbestosis or increased mortality associated with asbestosis (BOHS 1983; Dave et al. 1997; de Klerk et al. 1991; Dement et al. 1994; Demers et al. 1998; Green et al. 1997; Jakobsson et al. 1995b; Liddell et al. 1997; McDonald et al.

1983; Sluis-Cremer 1991; Wollmer et al. 1987). There are several complexities, however, in defining exposure-response relationships for asbestos-induced pulmonary fibrosis that make it difficult to derive reliable risk estimates for low-level exposure from the available studies. The complexities include uncertainties in exposure assessments for the studied workers, the variability among estimates of risk from various studies, inconsistent adjustment across studies for the possible confounding effect of tobacco smoking on development of pulmonary fibrosis, the possibility of differences in potency among different types of asbestos, the possibility of differential misdiagnosis and/or different end points in different studies, the likelihood of disease progression after exposure ceases, and the likelihood that mortality studies underestimate occurrence of asbestosis since asbestosis does not always cause death.

Another difficulty arises from the use of cumulative exposure (the product of exposure duration x intensity) as a surrogate exposure metric in the available studies. Finkelstein (1995) noted that the use of cumulative exposure requires the assumption that duration and intensity are equally important in determining the effective dose. Finkelstein further noted that if exposure estimates are inaccurate or inconsistently measured (which can be the case for many retrospective epidemiology studies), a finding of a statistically significant association between cumulative exposure and a health outcome can mislead one in having confidence in an apparent exposure-response relationship that is principally influenced by duration of exposure and not by exposure intensity.

In a recent review of the epidemiological evidence for asbestosis exposure-response relationships, the World Health Organization Task Group on Environmental Health Criteria for Chrysotile Asbestos (WHO 1998) concluded that “asbestotic changes are common following prolonged exposures of 5 to 20 f/mL” (these correspond to cumulative exposures of 50–200 f-yr/mL for a 10-year exposure) and that “the risk at lower exposure levels is not known.” This group further concluded that although there may be subclinical respiratory changes induced by chrysotile at current levels of occupational exposure, “they are unlikely to progress to the point of clinical manifestation.”

Presenting an alternative viewpoint, Stayner et al. (1997) statistically analyzed updated asbestosis-related mortality data for a cohort of South Carolina asbestos textile workers (the same data reported by Brown et al. 1994 and Dement et al. 1994) and predicted, by extrapolation, an excess lifetime risk of 2/1,000 for asbestosis mortality in white men exposed for 45 years at the Occupational Safety and Health Administration (OSHA) permissible exposure level for all forms of asbestos of 0.1 f/mL (4.5 f-yr/mL). Stayner et al. (1997) noted five major areas of uncertainty associated with this estimate including the extrapolation from relatively high exposure intensity to low intensity (average for the cohort was about

6 f/mL), the questionable accuracy of the exposure estimates for the cohort members, the absence of information on individual smoking habits in this cohort, the likelihood of disease misclassification, and the selection of an appropriate statistical model.

Several authors consider the mortality experience of the Carolina textile cohort to be atypical relative to other asbestos-exposed cohorts and, in the absence of a reliable explanation of this uniqueness, have cautioned against its use in quantitative health assessments for other exposure scenarios to asbestos fibers (Case et al. 2000; Hodgson and Darnton 2000). Estimates of lung cancer risk based on the South Carolina cohort are notably higher than estimates derived from other occupational cohorts exposed to predominately chrysotile asbestos (e.g., the Quebec chrysotile miner and miller cohort) or to mixed types of asbestos in other textile operations (Dement et al. 1994; Hodgson and Darnton 2000; Liddell et al. 1997, 1998; McDonald 1998b; Stayner et al. 1997). Stayner et al. (1997) acknowledged this difference, but concluded that “it would be prudent” to use estimates of risk from both cohorts to predict a range of potential risks for current occupational scenarios. The reasons for the difference are unknown, but may apply to both asbestosis and lung cancer. Proposed explanations include the possibility of uniform underestimation of exposure in the Carolina cohort, the possibility of exposure to longer and thinner fibers in the Carolina textile mill, and the possibility that mineral oil that was used to spray the raw fiber in Carolina (as a dust suppression measure) may have contributed to the increased incidence of lung cancer, but evidence for or against any of these possibilities is not strong (Case et al. 2000; Dement et al. 1994; McDonald 1998b; Stayner et al. 1997). For example, comparison of lung fiber concentrations in autopsied individuals from the Carolina and Quebec cohorts provide confirmatory information that the Quebec cohort was likely exposed to higher air concentrations of asbestos fibers of all length categories (including those >18 μm in length) than the Carolina cohort, although when all fibers were considered together, the mean fiber length of detected fibers in the Carolina group was greater than that of the Quebec cohort (Case et al. 2000; Sebastien et al. 1989). In an internal case-control analysis of the Carolina textile mortality experience, odds ratios for lung cancer were not significantly different among groups of subjects with different probable levels of oil exposure (Dement et al. 1994), but others have questioned the ability to correctly assign subjects in the cohort to oil exposure categories (Hodgson and Darnton 2000; McDonald 1998b).

A chronic inhalation MRL for asbestos-induced nonmalignant respiratory disease has not been derived (as reflected by a lack of MRL designation in Table 3-1 and Figure 3-1), because of the large degree of uncertainty in extrapolating to low levels of exposure from the available epidemiological data for workers with high levels of exposure (see also Chapter 2). The use of the data for the South Carolina textile workers, the Quebec chrysotile miners and millers, or other occupational cohorts to estimate risk for development of fatal asbestosis with chronic exposure to asbestos at fiber concentration ranges likely to be encountered in ambient, nonoccupational outdoor or indoor air (about $3x10^{-6}$ to $6x10^{-3}$ PCM f/mL, see Chapter 6 for more information) would require additional extrapolation, and be even more uncertain, than the risk estimate for exposure to 0.1 f/mL from the Stayner et al. (1997) analysis.

Inhalation of asbestos fibers can lead not only to injury to the lung parenchyma, but also to a number of changes in the pleura (Boutin et al. 1989; Churg 1986a; Ehrlich et al. 1992; Jones et al. 1988b). The most common lesions are pleural plaques. These are generally oval areas of acellular collagen deposits, usually located on the inferior and posterior surfaces of the pleura. Diffuse thickening and fibrosis of the pleura may also occur, as may pleural effusions. The incidence of pleural abnormalities (usually detected by x-ray examination) is often quite high (10–60%) in people employed in asbestos-related occupations for subchronic (Ehrlich et al. 1992) and chronic durations (Amandus et al. 1987; Anton-Culver et al. 1989; Baker et al. 1985; Bresnitz et al. 1993; Gibbs 1979; Hsiao et al. 1993; Jarvholm et al. 1986; McDonald et al. 1986b; Ohlson et al. 1985; Ren et al. 1991; Viallat and Boutin 1980). Pleural abnormalities are also common in household contacts and family members of asbestos workers (where exposure is presumably due to asbestos carried home on the work clothes) (Anderson et al. 1976, 1979), in people living in areas where tremolite asbestos-containing whitewash materials have been used (Baris et al. 1988b; Constantopoulos et al. 1985, 1987b; Çöplü et al. 1996; Dumortier et al. 1998; Metintas et al. 1999; Sakellariou et al. 1996; Yazicioglu et al. 1980), and in people who live in regions with high asbestos levels in the soil (Boutin et al. 1989; Churg and DePaoli 1988; Jarvholm et al. 1986; Luo et al. 1992; Rey et al. 1993). An elevated incidence of pleural abnormalities (3.7%) was noted in long-time (70-year) residents of an area with elevated levels of asbestos in soil (Boutin et al. 1989). Cumulative exposure to asbestos in these residents was estimated to be 0.12 f-yr/mL. The incidence of pleural abnormalities (specifically, pleural thickening) in members of the general population of the United States was found to be 2.3% in males and 0.2% in females, most of which is probably due to occupational exposure to asbestos (Rogan et al. 1987). The health significance of asbestos-induced pleural abnormalities is not precisely defined; some researchers consider pleural plaques to be essentially benign (Jones et al. 1988b; Ohlson et al. 1984, 1985), whereas others have noted isolated pleural plaques to be associated with decreased ventilatory capacity (Bourbeau et al. 1990). In addition, some investigators (Edelman 1988c; Hillerdal 1994; Hillerdal and Henderson 1997; Nurminen and Tossavainen 1994) have suggested that pleural plaques are predictors of increased risk for lung cancer, whereas another analysis (Weiss 1993) have suggested that they are not. Diffuse pleural thickening can lead to decreased ventilatory capacity, probably because of the restrictive effect of pleural fibrosis (Baker et al. 1985; Britton 1982; Churg

1986a; Jarvholm and Larsson 1988; Jones et al. 1988b; McGavin and Sheers 1984; Miller et al. 1992; Rom and Travis 1992; Schwartz et al. 1990). In some cases, pulmonary impairment from pleural thickening can be very severe, even causing death (Miller et al. 1983).

Asbestos exposure may also produce adverse effects in the upper airways. A statistically significant higher incidence of laryngitis was noted in workers with chronic cumulative exposures >27 f-yr/mL compared with controls and exposed workers with cumulative exposures <18 f-yr/mL (Kambic et al. 1989; Parnes 1990). Although this effect has not been reported in a large number of studies, it is consistent with the idea of asbestos acting as an irritant on the laryngeal mucosa.

Fibrosis has been produced in animals by inhalation or by intratracheal exposure to chrysotile (Chang et al. 1988; Davis et al. 1980a, 1980b; Donaldson et al. 1988a; Green et al. 1986; Hesterberg et al. 1995, 1996, 1997; Mast et al. 1994, 1995; McGavran et al. 1989; Wagner et al. 1980a), amosite (Davis et al. 1986a; Reeves et al. 1971, 1974; Webster et al. 1993), anthophyllite (Wagner et al. 1974), crocidolite (Reeves et al. 1971, 1974; Wagner et al. 1974), and tremolite (Davis et al. 1985; Green et al. 1986; Sahu et al. 1975). There are some data from animal studies to suggest that crocidolite causes more severe inflammatory disease than chrysotile and is retained longer within the lungs (Berube et al. 1996; McConnell et al. 1994). As shown in Table 3-2 and Figure 3-2, fibrosis has been noted in rodents after exposure to 132 f/mL for 5 hours (McGavran et al. 1989), exposure to 330 f/mL for 7 hours/day, 5 days/week for 15 weeks (Donaldson et al. 1988a), and chronic exposure to 54–2,060 f/mL (Davis et al. 1980a, 1980b, 1985, 1986a; Reeves et al. 1974; Wagner et al. 1974, 1980a). In animals, histological signs of tissue injury can be detected at the site of deposited fibers within a few days, although in humans, measurable abnormalities of lung function do not usually appear for a number of years (Dement et al. 1983; Hughes et al. 1987; Kagan 1988; Schwartz et al. 1993).

Studies in animals indicate that asbestosis stems from the inflammatory response triggered in the lung by the deposition of asbestos fibers (Davis 1970; Quinlan et al. 1995), and that the inflammatory response to asbestos is enhanced by multiple exposures to asbestos fibers (Coin et al. 1996). Fibers deposited in the ciliated portion of the airway are removed by mucociliary transport (see Section 3.4.4) and do not appear to injure the lung. However, fibers deposited in the terminal bronchioles and alveoli are not cleared as rapidly, and these can stimulate an influx of macrophages (Chang et al. 1988), which then release a variety of inflammatory mediators (chemoattractants, lysosomal enzymes, activated oxygen species, growth factors, etc.) (Davis 1972; Hansen and Mossman 1987; Kagan 1988; Miller et al. 1978; Schwartz et al. 1993). This is thought to be responsible for the gradual loss of some epithelial cells and the deposition of collagen by fibroblasts (Davis and Jones 1988; Davis et al. 1986c). With continued duration of exposure to asbestos fibers, increasing amounts of fibers are found in the lung interstitium and are associated with progressive interstitial fibrotic reactions (Pinkerton et al. 1984).

One of the many growth factors found in fibrotic lungs is tumor necrosis factor α (TNF-α). TNF-α is a powerful inducer of epithelial and mesenchymal cell proliferation which has been suggested as a central mediator of fibrotic lung disease. A recent study has demonstrated that genetically-altered mice without TNF-α receptor fail to develop fibro-proliferative lesions in response to asbestos exposure (Liu et al. 1998).

Cardiovascular Effects. No studies were located regarding a direct effect upon the cardiovascular system in humans after inhalation exposure to asbestos. However, increased ($p<0.01$) mortality from cardiovascular disease in workers exposed to asbestos has been reported (Doll 1955). Fibrosis of the lung can lead to increased resistance to blood flow through the pulmonary capillary bed, leading in turn to pulmonary hypertension and compensatory hypertrophy of the right heart (Selikoff and Lee 1978). This condition is known as cor pulmonale. Cor pulmonale may be detected by standard clinical and radiological tests of cardiac function and by changes in the electrocardiogram (Kokkola and Huuskonen 1979), although this is not a very sensitive test (Selikoff and Lee 1978). Cor pulmonale is usually associated with severe cases of asbestosis (Lemen et al. 1980), although pulmonary hypertension has been reported in some cases prior to measurable decreases in respiratory function (Tomasini and Chiappino 1981). Limited data from case reports suggest that constrictive pericarditis due to fibrous thickening may result from asbestos exposure (Davies et al. 1991).

No studies were located regarding cardiovascular effects in animals after inhalation exposure to asbestos.

Gastrointestinal Effects. The majority of asbestos fibers that are deposited in the respiratory tract during inhalation exposure are transported by mucociliary action to the pharynx, where they are swallowed (see Section 3.4). Consequently, the gastrointestinal epithelium is also directly exposed to fibers. While there is some evidence that inhalation exposure to asbestos may increase the risk of gastrointestinal cancer in humans (see Section 3.2.1.8), no information was located to indicate that any nonneoplastic effects occur in the gastrointestinal system after inhalation exposure.

No studies were located regarding gastrointestinal effects in animals after inhalation exposure to asbestos.

3.2.1.3 Immunological and Lymphoreticular Effects

A number of studies have investigated the status of the immune system in humans who have been exposed to asbestos. Although there is some variability, most studies indicate that cell-mediated immunity (measured by tests of dermal sensitization *in vivo* and lymphocyte responsiveness and function *in vitro*) is depressed in workers who have radiological evidence of asbestosis (deShazo et al. 1988; Gaumer et al. 1981; Kagan et al. 1977; Lange et al. 1986). For example, natural killer (NK) cells (unique lymphocytes thought to be a first line of defense against cancer cells) isolated from peripheral blood of patients with asbestosis had impaired cytotoxic potency (Kubota et al. 1985; Tsang et al. 1988). Additionally, decreased NK cell activity and increased NK cell number were noted in the peripheral blood of retired asbestos cement workers (Froom et al. 2000). Alterations in lymphocyte (Sprince et al. 1991, 1992) and leukocyte (Hurbankova and Kaiglova 1993) distribution have been noted in asbestos-exposed workers. Increased numbers of lymphocytes and $CD4^+$ cells were reported in men with occupational exposure to asbestos (Rom and Travis 1992), although numbers of total circulating lymphocytes were similar in asbestos workers compared to controls in another study (Al Jarad et al. 1992). Mediastinal lymph node enlargement has been reported in asbestosis patients (Sampson and Hansell 1992). Increased levels of IgA and IgG have been reported in asbestos-exposed individuals (Hurbankova and Kaiglova 1993; Nigam et al. 1993), and concentrations of autoantibodies (rheumatoid factor, antinuclear antibodies) tend to be abnormally high in asbestos-exposed workers (Anton-Culver et al. 1988; Pernis et al. 1965; Warwick et al. 1973; Zerva et al. 1989). In some cases, increased autoantibodies can lead to rheumatoid arthritis (Caplan's Syndrome), although this is more common in coal miners and workers with other pneumoconioses than in workers with asbestosis (Constantinidis 1977; Greaves 1979). Immunological abnormalities are usually mild or absent in asbestos-exposed workers who have not developed clinical signs of asbestosis (deShazo et al. 1988; Kagan 1988; Selikoff and Lee 1978; Warwick et al. 1973). Although the biological significance of these immunological changes is difficult to judge, they are of special concern because depressed immune function might be a factor in the etiology of asbestos-induced cancer (Lew et al. 1986). Exposures to asbestos associated with immunological effects generally have not been quantified.

Results from animal studies provide supporting evidence of direct and indirect effects of asbestos on the immune system, although the specific roles of these effects in the etiology of asbestos-induced pulmonary diseases are not well understood and are under current investigation. In support of observations of suppressed activity of peripheral natural killer cells in patients with asbestosis, the number and cytotoxic activity of interstitial pulmonary natural killer cells were found to be decreased in mice exposed to inhaled chrysotile fibers (13.3 mg/m^3) 3 hours/day for 3 days compared with nonexposed controls (Rosenthal et al. 1998). In support of asbestos-induced hyperactivity of humoral immunity, humans occupationally exposed to crystalline asbestos display elevated serum γ-globulins (Lange et al. 1974). Results from experiments with genetically immunodeficient mice support the hypotheses that T lymphocytes may play a protective role against asbestos-induced lung inflammation and subsequent fibrotic responses, and that impaired cell-mediated immunity may be a predisposing factor in asbestos fibrosis. In these experiments, immunodeficient mice showed a larger increase in cell numbers in pulmonary lavage fluid (predominantly due to increase in neutrophils) and increased severity of pulmonary lesions in response to inhaled asbestos compared with immunologically normal mice of the same background or immunologically deficient mice that were "reconstituted" with lymphocytes (Corsini et al. 1994).

No studies were located regarding the following effects in humans or animals after inhalation exposure to asbestos:

3.2.1.4 Neurological Effects
3.2.1.5 Reproductive Effects
3.2.1.6 Developmental Effects

3.2.1.7 Cancer

A voluminous body of evidence establishes that inhalation exposure to asbestos increases the risk of lung cancer and mesothelioma in humans and animals. Some evidence suggests that inhalation exposure to asbestos increases the risk of cancer at other sites as well (especially the gastrointestinal tract). Each of these carcinogenic effects are discussed separately below.

Lung Cancer. Evidence for the role of asbestos in human lung cancer is derived primarily from studies of the cause of death of occupationally-exposed workers. For example, the causes of death in a very large cohort of insulation workers (17,800 men) in the United States and Canada have been studied (Selikoff et al. 1979). Between 1967 and 1976, there were 2,271 deaths in this group, of which 486 were attributable to lung cancer. This is 4.6 times the number of lung cancer deaths that would have been expected in this group based on the lung cancer rates in the average male population of the United States. Similar findings have been reported in a very large number of analogous studies under a wide variety of occupational circumstances. In a review, a statistically significant ($p<0.05$) increase in lung cancer death rates had been reported in 32 of 41 recent studies (EPA 1986a). In a recent meta-analysis of 69 asbestos-exposed occupational cohorts reporting on cancer morbidity and mortality, Goodman et al. (1999) calculated a lung cancer meta-standard mortality ratio (SMR) of 1.63 (95% confidence interval [CI]=1.58–1.69); the highest meta-SMR (1.92, CI=95%=1.76–2.09) was among asbestos products manufacturing workers. Lung cancer has also been reported in household contacts and family members of asbestos workers, where exposure is presumably due to asbestos carried home on the work clothes (Magnani et al. 1993).

There is little doubt that all types of asbestos can cause lung cancer. For example, statistically significant increases in lung cancer mortality have been reported in workers exposed primarily to chrysotile (Case and Dufresne 1997; Dement et al. 1983, 1994; Huilan and Zhiming 1993; Liddell et al. 1997, 1998; McDonald et al. 1980, 1983, 1984, 1993, 1997; Nicholson et al. 1979), amosite (Seidman et al. 1979), crocidolite (Armstrong et al. 1988; de Klerk et al. 1989, 1991, 1996; Sluis-Cremer 1991; Wignall and Fox 1982), anthophyllite (Meurman et al. 1974, 1994), and tremolite (Amandus and Wheeler 1987; Kleinfeld et al. 1974; McDonald et al. 1986a), or to multiple fiber types (Albin et al. 1996; Enterline et al. 1987; Henderson and Enterline 1979; Hughes et al. 1987; Magnani and Leporati 1998; McDonald et al. 1982; Newhouse and Berry 1979; Peto et al. 1985; Weill et al. 1979).

As with most carcinogenic agents, there is a substantial latency period (10–40 years in humans) between the onset of exposure to asbestos and the occurrence of lung cancer (Dement et al. 1983; Huilan and Zhiming 1993; McDonald et al. 1983; Nicholson et al. 1979; Selikoff et al. 1979; Sluis-Cremer 1991). After sufficient time (e.g., 20 years), the risk of lung cancer in exposed workers is generally observed to increase in proportion to the cumulative exposure (f-yr/mL). Most researchers have found that the chances that asbestos exposure will lead to lung cancer depends not only on the cumulative dose of asbestos, but also on the underlying risk of lung cancer due to other factors (Enterline et al. 1987; EPA 1986a; McDonald et al. 1982, 1983; Peto et al. 1985). For example, asbestos exposure results in a greater increase in lung cancer risk in smokers than nonsmokers, possibly because smokers have a higher underlying risk of lung cancer than nonsmokers. Alternatively, the greater increase in lung cancer risk in smokers may be due to a synergism between tobacco smoke and asbestos fibers. (see Section 3.9 for additional discussion of the interaction between smoking and asbestos).

Using a predictive model based on an analysis of 11 sets of lung cancer mortality data for groups of textile production workers (Dement et al. 1983; McDonald et al. 1982, 1983; Peto 1980), friction products workers (Berry and Newhouse 1983; McDonald et al. 1984), insulation products workers (Seidman 1984; Selikoff et al. 1979), and cement products workers (Finkelstein 1983; Henderson and

Enterline 1979; Weill et al. 1979), EPA (1986a) estimated that continuous lifetime exposure to air containing 0.0001 f/mL of asbestos would result in about two cases of lung cancer per 100,000 smokers, a factor of 10 higher than that estimated for nonsmokers (0.2 per 100,000). EPA (1986a) excluded available data for asbestos miners and millers (McDonald et al. 1980; Nicholson et al. 1979; Rubino et al. 1979) from the analysis, based on the judgement that fiber characteristics of "preprocessed" asbestos in these environments would be different from those of "processed" asbestos fibers in the general environment. The corresponding cumulative lifetime exposures associated with excess risks of 10^{-7}–10^{-4} are shown in Figure 3-1. For smokers, cumulative exposures of 0.000035, 0.00035, 0.0035, and 0.035 f-yr/mL represent excess lung cancer risks of 10^{-7}, 10^{-6}, 10^{-5}, and 10^{-4} respectively. For nonsmokers, cumulative exposures of 0.00035, 0.0035, 0.035, and 0.35 f-yr/mL represent excess lung cancer risks of , 10^{-7}, 10^{-6}, 10^{-5}, and 10^{-4} respectively. Appendix D provides further details on the derivation of these risk estimates. While these values have been considered to be the best available for assessing risk from environmental exposures to airborne asbestos, the range of uncertainty is probably a factor of 2.5–10 (EPA 1986a). Currently (in 2001), EPA is in the process of reviewing their cancer risk estimates for asbestos fibers.

Several authors have suggested that the EPA model may overestimate the lung cancer risk from exposure to asbestos (Camus et al. 1998; Hughes 1994; Lash et al. 1997). An alternative statistical analysis of studies relating occupational cumulative exposure to asbestos and lung cancer mortality arrived at lung cancer potency estimates that were 4- to 24-fold lower than the EPA model potency estimate (Lash et al. 1997). Hughes (1994) noted that exclusion of the chrysotile asbestos miner and miller data in the EPA analysis led to a higher estimate of potency (i.e., slope of the exposure-response relationship) than would have been obtained if the data were included, and suggested that a lower potency estimate would be more appropriate for populations exposed to nontextile chrysotile such as that used in buildings. Camus et al. (1998) reported that the EPA model predicted a relative risk for death from lung cancer in a group of nonoccupationally exposed women who lived in two regions of Quebec with chrysotile mines that was at least 10-fold higher than the observed upper range for excess lung cancer deaths for this group. No statistically significant lung cancer excess was observed in this group of women. The SMR was 0.99 (95% CI 0.78–1.25), based on 71 observed lung cancer cases among 2,242 deaths from all causes (Camus et al. 1998). In defense of the EPA model predictions, Landrigan (1998) noted that "the strong possibility exists that the Camus calculations underestimate the risk of asbestos exposure", due to "1) the average fiber diameter in the Quebec mining townships is probably larger than average diameter encountered in industrial operations in the United States, because asbestos in the Quebec townships had not been subjected to the extensive machining that asbestos found in U.S. textile factories typically undergoes; and 2) prevalence of cigarette smoking is much lower among women in rural Quebec than among blue-collar workers in the American south."

Although a number of studies seem to suggest that not all asbestos fibers types are equally likely to lead to lung cancer, the human evidence is disputed (see Hodgson and Darnton 2000, McDonald and McDonald 1997, and Stayner et al. 1996 for differing views on the evidence for differing lung cancer potency among asbestos fiber types). Some of this variation in potency between fibers may be due to differences between mineral types with respect to surface properties such as surface charge density (Bonneau et al. 1986; Davis et al. 1988), iron content (Lund and Aust 1992), and durability (Lippmann 1990), but the bulk of the available data indicate that fiber size (fiber thinness and length) may be the most important determinant of carcinogenic potential (see Section 3.5).

Some epidemiological studies have detected little or no increase in lung cancer risk until the cumulative dose of asbestos exceeds 25–100 f-yr/mL (Berry and Newhouse 1983; Hughes and Weill 1980; McDonald et al. 1980; Weill et al. 1979), and this has led to the proposal that there may be a dose threshold for asbestos-induced lung cancer (Browne 1986a, 1986b; Hodgson and Darnton 2000). However, a number of other studies indicate that lung cancer risk is linearly related to cumulative dose without any obvious threshold (Dement et al. 1983; Finkelstein 1983; Henderson and Enterline 1979; Hughes et al. 1987; McDonald et al. 1983; Seidman et al. 1979). In general, dose-response data from epidemiological studies lack the statistical power to detect small effects at low doses, so it is not possible to conclude from such data that a hazardous chemical does (or does not) have a threshold dose.

Studies in animals have reported increased incidence of lung cancer following chronic inhalation exposure to chrysotile (Davis and Jones 1988; Gross et al. 1967; Reeves et al. 1974; Wagner et al. 1974, 1980a), amosite (Davis et al. 1980a, 1980b, 1986a; Reeves et al. 1974), crocidolite (Reeves et al. 1971, 1974; Wagner et al. 1974), anthophyllite (Wagner et al. 1974), and tremolite (Davis et al. 1985). Exposure levels that have resulted in increased lung tumor frequency in animals range from 70 to 1,600 PCM f/mL. In general, tumors were characterized as adenomas, adenocarcinomas, and squamous cell carcinomas. There is some evidence from animal studies that mineral-fiber lung tumors arise from fibrotic areas of the lung (Davis and Cowie 1990).

Mesothelioma. Mesotheliomas are tumors arising from the thin membranes that line the chest (thoracic) and abdominal cavities and surround internal organs. Mesotheliomas are relatively rare in the general population, but are often observed in populations of asbestos workers. For example, in the mortality study of insulation workers (in which 2,227 total deaths were analyzed), there were 175 deaths attributable to mesotheliomas, 63 arising from the pleural membrane, and 112 arising in the peritoneum (Selikoff et al. 1979). In contrast, published estimates of annual general population incidences of mesothelioma deaths include 2.8 and 0.7 per million for North American males and females, respectively, in 1972 (McDonald and McDonald 1980), an average of 1.75 per million in the U.S. for the period 1987–1996 (NIOSH 1999), and, for United States white males (the U.S. group with the highest mortality rate), 3.61 per million in 1987 and 2.87 per million in 1996 (NIOSH 1999). Mesotheliomas are often difficult to diagnose, so use of death certificate information may lead to an underestimate (Selikoff et al. 1979) or an overestimate (Bignon et al. 1979) of the true incidence of this disease.

Case-control studies have observed strong associations between the development of mesothelioma and occupational exposure to asbestos fibers (McDonald and McDonald 1980; McDonald et al. 1997; Spirtas et al. 1988, 1994; Teschke et al. 1997; Teta et al. 1983). For example, in a case-control study of 208 cases of malignant mesothelioma and 533 controls (who died of other noncancer causes) registered by the Los Angeles County Cancer Surveillance Program, the New York State Cancer Registry, and 39 large Veteran's Administration Hospitals, an elevated odds ratio of 9.8 (95% CI 4.7–21.1) was found for mesothelioma in men who reported ever having been occupationally exposed to asbestos (Spirtas et al. 1994). In a study of 344 North American malignant mesothelioma cases and 344 matched controls, employment for 10 or more years in the following trades was associated with increased relative risks of 46.0 (confidence intervals were not reported) for insulation work, 6.1 for asbestos production and manufacture, 4.4 for heating trades, 2.8 for shipyard work, and 2.6 for construction work (McDonald and McDonald 1980). In a study of 51 mesothelioma cases and 154 population-based controls from British Columbia, elevated odds ratios were found for several occupations likely to have involved asbestos exposure including sheet metal workers (OR=9.6, 95% CI 1.5–106), plumbers and pipe fitters (OR=8.3, 95% CI 1.5–86), and shipbuilding workers (OR=5.0, 95% CI 1.2–23) (Teschke et al. 1997).

Analyses of trends in mesothelioma mortality in Britain and Western Europe (Peto et al. 1995, 1999) indicate that the worst-affected birth cohort is men born around 1945–1950 (1/150 were projected to die of mesothelioma), whereas similar analyses of trends in the United States (Price 1997) indicate that the worst affected cohort is the 1925–1929 male birth cohort (with an estimated lifetime risk of 2/1,000). These trends mirror trends in raw asbestos consumption and a reduction in workplace airborne asbestos levels, with maximum exposure in the United States from the 1930s to the 1960s and in Britain and Western Europe in the 1970s (Peto et al. 1995, 1999; Price 1997). NIOSH (1999) has reported that age-adjusted mortality rates for malignant neoplasm of the pleura in U.S. males showed a decline during the 1987–1996 period from 3.61 per million in 1987 to 2.87 per million in 1996.

Cases of mesothelioma have been reported in adults who had no occupational exposure to asbestos, but who lived with a parent, spouse, or sibling who was an asbestos worker and presumably carried asbestos home on the work clothes (Anderson et al. 1976; Inase et al. 1991; Magee et al. 1986; Magnani et al. 1993; McDonald and McDonald 1980; Voisin et al. 1994). As with other asbestos-related respiratory health effects, asbestos-induced mesothelioma appears to have a long latent period of development. For example, Anderson et al. (1976) described two cases of women who presumably experienced household contact with asbestos as children, when their fathers worked with asbestos, and developed clinically detected pleural mesothelioma more than 30 years later. In a review of 1,105 cases of malignant mesotheliomas associated with occupational exposure to asbestos, Lanphear and Buncher (1992) reported that 99% had a latent period >15 years, and calculated a median latent period of 32 years.

Cases of death from mesothelioma have been reported in studies of workers or in persons exposed environmentally to each of the main types of asbestos, including predominantly chrysotile (Albin et al. 1990a, 1990b; Berry 1997; McDonald et al. 1993; Selcuk et al. 1992; Tulchinsky et al. 1992), amosite (Levin et al. 1998; Seidman et al. 1979), crocidolite (Armstrong et al. 1988; de Klerk et al. 1989; Edward et al. 1996; Hansen et al. 1998; Jones et al. 1980a), tremolite (Amandus and Wheeler 1987; Baris et al. 1988a, 1988b; Constantopoulos et al. 1987a; Erzen et al. 1991; Kleinfeld et al. 1974; Langer et al. 1987; Luce et al. 2000; Magee et al. 1986; McConnochie et al. 1987; Metintas et al. 1999; Sahin et al. 1993; Sakellariou et al. 1996; Schneider et al. 1998; Selcuk et al. 1992; Yazicioglu et al. 1980), and a nonspecified asbestos type (Iwatsubo et al. 1998).

Although these findings suggest that all asbestos types can cause mesothelioma, there are several studies that suggest that amphibole asbestos (asbestiform tremolite, amosite, and crocidolite) may be more potent than chrysotile (Berry and Newhouse 1983; Churg 1986b; Churg and Wright 1989; Henderson and Enterline 1979; Hodgson and Darnton 2000; Hughes et al. 1987; Jones et al. 1980a; McDonald et al. 1989, 1997; Newhouse and Sullivan 1989; Rödelsperger et al. 1999; Rogers et al. 1991; Sluis-Cremer et al. 1992; Weill et al. 1979). For example, a group of workers in a friction materials plant that used mainly chrysotile, but also used crocidolite on two occasions, has been studied (Berry and Newhouse 1983). In a case-control analysis, it was found that the workers dying from mesothelioma (11 cases) were 8 times more likely to have been exposed to crocidolite than workers dying from other causes (Berry and Newhouse 1983). In case-control analyses of fiber concentrations in autopsied lungs of mesothelioma subjects and subjects who died of other causes, relative risk for mesothelioma was significantly related to increasing concentrations of amphibole fibers longer than 5 µm (Rödelsperger et al. 1999), 8 µm (McDonald et al. 1989), or 10 µm (Rogers et al. 1991); significant relationships with increasing concentrations of chrysotile fibers were less apparent in these studies. In another approach, the chrysotile and amphibole content of lungs from persons dying from mesothelioma was examined, and it was found that mesotheliomas occurred in amphibole workers with much lower fiber burdens than those observed for chrysotile workers. The authors concluded that amphiboles were two orders of magnitude more potent for inducing mesothelioma than chrysotile (Churg and Wright 1989). This has led to the hypothesis that many cases of mesothelioma in chrysotile-exposed workers are actually due to the presence of amphibole contamination (Churg 1988; McDonald et al. 1989). However, it is difficult to draw strong inferences regarding the relative potency of different mineral types from lung burden data, because amphiboles are more stable in lung tissue than chrysotile (see Section 3.4.3.1). Based on an analysis of the ratio of excess deaths from mesothelioma to excess deaths from lung cancer in a number of studies, EPA concluded that crocidolite could be 2–4 times more potent for mesothelioma than chrysotile, but that this difference was generally overshadowed by differences in fiber size distribution and differences between cohorts (EPA 1986a). In a more recent analysis of exposure-response relationships for mesothelioma mortality in studies of 17 asbestos-exposed occupational cohorts, Hodgson and Darnton (2000) concluded that relative potencies ("exposure specific risk of mesothelioma") are in a ratio of 1:100:500 for chrysotile, amosite, and crocidolite, respectively.

Several studies (Newhouse and Berry 1976, 1979; Nicholson et al. 1982; Peto et al. 1982) have indicated that the risk of mesothelioma from a given level of exposure to asbestos depends primarily upon the time elapsed since exposure (latency), with risk increasing exponentially with time after a lag period of about 10 years. Whereas early studies indicated that diagnosis with mesothelioma was fatal within a short period of time, other studies indicate that survival time after diagnosis may be influenced by exposure intensity. In contrast to the situation for lung cancer, the effect of asbestos on mesothelioma risk does not appear to be increased by smoking (Berry et al. 1985; Hammond et al. 1979; Selikoff et al. 1980).

Using a predictive model developed from mesothelioma data from studies of asbestos insulation workers (Peto et al. 1982), asbestos textile workers (Peto 1980), amosite factory workers (Seidman 1984), and asbestos-cement workers (Finkelstein 1983), EPA (1986a) estimated that continuous lifetime exposure to air containing 0.0001 f/mL of asbestos would result in about 2–3 cases of mesothelioma per 100,000 persons. The corresponding cumulative lifetime exposures associated with excess risks of 10^{-4}–10^{-7} are shown in Figure 3-1. Cumulative exposure levels of 0.031, 0.0031, 0.00031, and

0.000031 f-yr/mL represent excess mesothelioma risks of 10^{-7}, 10^{-6}, 10^{-5}, and 10^{-4}, respectively. Appendix D provides further details on the derivation of these risk estimates. Currently (in 2001), EPA is in the process of reviewing their cancer risk estimates for asbestos fibers.

In a recent analysis of the mesothelioma mortality data among 17 asbestos-exposed cohorts, Hodgson and Darnton (2000) estimated that cumulative exposures of 0.005, 0.01, or 0.1 f-yr/mL to crocidolite would produce about 10, 20, or 100 mesothelioma deaths per 100,000, respectively; for amosite, the respective mesothelioma risk estimates were 2, 3, or 15 deaths per 100,000. For chrysotile, Hodgson and Darnton (2000) concluded that mesothelioma risks were "probably insignificant", but noted that "highest arguable estimates" were insignificant, 1, and 4 deaths per 100,000 for cumulative exposure levels of 0.005, 0.01, and 0.1 f-yr/mL.

Animal studies also indicate that inhalation exposure to asbestos produces mesotheliomas. Mesotheliomas have been observed in rats exposed to chrysotile, amosite, anthophyllite, crocidolite, or tremolite at concentrations ranging from 350 to 1,600 f/mL for 1–2 years (Davis and Jones 1988; Davis et al. 1985; Wagner et al. 1974, 1980a) and in baboons exposed to either 1,110–1,220 f/mL for 4 years (Goldstein and Coetzee 1990) or 1,100–1,200 f/mL for up to 898 days (Webster et al. 1993). Incidences of mesothelioma ranged from 0.7 % to 42% in these studies.

Cancer at Other Sites. Mortality studies of asbestos workers have revealed small increases in the incidence of death from cancer at one or more sites other than the lung, the pleura, or the peritoneum, mostly in tissues of the gastrointestinal system. For example, a total of 99 deaths from cancers of the esophagus, stomach, colon, or rectum were observed in a cohort of 17,800 insulation workers, while only 59.4 deaths of this sort were expected (Selikoff et al. 1979). Similarly, 26 deaths from gastrointestinal cancer were observed in a group of 2,500 asbestos textile workers, where only 17.1 were expected (McDonald et al. 1983). In this study, there was an approximately linear increase in gastrointestinal cancer death rate with cumulative exposure to asbestos. Similar increases in gastrointestinal cancer rates in asbestos workers have been reported in other studies (Armstrong et al. 1988; Enterline et al. 1987; Gerhardsson de Verdier et al. 1992; Jakobsson et al. 1994; Kang et al. 1997; Neugut et al. 1991; Newhouse and Berry 1979; Pang et al. 1997; Raffn et al. 1989, 1996b; Seidman et al. 1979, 1986). Other mortality studies (e.g., Albin et al. 1990a; Hughes et al. 1987; McDonald et al. 1993; Peto et al. 1985) of asbestos workers, however, found no significantly increased risk for gastrointestinal or colorectal cancer. In a meta-analysis of available cohort studies, Frumkin and Berlin (1988) calculated, for cohorts having latent periods of 10–20 years and displaying SMRs for lung cancer greater than 2, pooled SMRs of

1.46 (95% CI, 1.00–2.13) for gastric cancer, 1.68 (1.34–2.09) for colorectal cancer, and 1.66 (1.32–2.08) for all gastrointestinal cancers. Homa et al. (1994) found similar results in another meta-analysis of the data. Homa et al. (1994) concluded that the results "suggested that exposure to amphibole asbestos maybe associated with colorectal cancer, but these findings may reflect an artifact of uncertification of cause of death". Homa et al. (1994) also concluded that "the results also suggest that serpentine asbestos is not associated with colorectal cancer." Other reviewers have concluded that the available data do not establish a causal relationship between occupational exposure to asbestos and the development of gastrointestinal cancers (Doll and Peto 1985, 1987; Edelman 1988a, 1989; Goodman et al. 1999; Weiss 1995).

Some studies have also noted excess deaths from, or reported cases of, cancers at other sites, such as the kidney (Enterline et al. 1987; Selikoff et al. 1979), brain (Kishimoto et al. 1992), and bladder (Bravo et al. 1988). Several cases of malignant mesothelioma of the tunica vaginalis testis have been reported in patients with histories of occupational exposure to asbestos (Fligiel and Kaneko 1976; Huncharek et al. 1995; Serio et al. 1992). Several epidemiological studies have also reported an increased risk of laryngeal cancer in workers exposed to asbestos (Muscat and Wynder 1991; Parnes 1990; Raffn et al. 1989; Smith et al. 1990). In contrast, a number of other epidemiological studies have not detected statistically significant associations between increased risk of cancers at sites other than the lung, pleura, or peritoneum and asbestos exposure (Acheson et al. 1982; de Klerk et al. 1989; Hughes et al. 1987; McDonald et al. 1984; Meurman et al. 1974; Molinini et al. 1992; Nicholson et al. 1979; Wignall and Fox 1982; Wortley et al. 1992).

Reviewers of the available evidence for asbestos-related cancer at sites other than the lung, pleura, and peritoneum appear to concur that the evidence is not strong. For example, Doll and Peto (1985, 1987) concluded from their review of the available epidemiological data and biological evidence that misdiagnosis or chance may be the simplest and most plausible explanation of asbestos-related cancer at any other site than the lung, pleura, or peritoneum. Kraus et al. (1995) concluded from a meta-analysis of 31 cohort studies and 24 case-control studies that most studies did not find a statistically significant association between occupational exposure to asbestos and laryngeal cancer and that the evidence of a causal relationship was weak. A separate meta-analysis (Goodman et al. 1999) of asbestos-exposed occupational cohorts resulted in a meta-SMR for laryngeal cancer of 1.57 (95% CI 0.95–2.45), suggestive of a possible association between asbestos and laryngeal carcinoma. In this meta-analysis, there was no clear association with urinary, reproductive, lymphatic, or hematopoietic cancers. Browne and Gee (2000) reviewed all identified studies of asbestos workers providing data on laryngeal disease and concluded that the evidence did not indicate a positive association between asbestos exposure and laryngeal cancer.

All Cancer Effect Level (CEL) values from each reliable study for cancer are summarized in Tables 3-1 and 3-2, and plotted in Figures 3-1 and 3-2.

3.2.2 Oral Exposure

Units of Exposure. The principal way that humans are exposed to asbestos by the oral route is through ingestion of asbestos-contaminated drinking water (see Chapter 6). As discussed in Section 6.4.2, most asbestos fibers in water are chrysotile and are <5 μm in length. The concentration of asbestos in water is generally determined by transmission electron microscopy (TEM), and the results are expressed as millions of TEM fibers per liter (MFL). Although most laboratories currently count fibers as those particles with lengths >5 μm and aspect ratios >3:1 (in concordance with most regulatory definitions of an asbestos fiber), some studies have reported fiber concentrations using a lower length criterion. Since it is very difficult to convert from MFL to other units of dose, human exposure to asbestos via drinking water is reported below simply in terms of exposure level (MFL). In contrast, animal studies usually describe oral exposure in terms of mass (mg/day), and it is not often possible to accurately convert from this dose to units of exposure equivalent to those used for humans. Consequently, animal doses are reported below in units of mg/kg/day, and information on fiber dimensions is included when available.

Overview of Oral Health Effects. Studies in humans and animals indicate that ingestion of asbestos causes little or no risk of noncarcinogenic injury. However, there is some evidence that acute oral exposure may induce precursor lesions of colon cancer, and that chronic oral exposure may lead to an increased incidence risk of gastrointestinal tumors. Studies that provide quantitative data on the effects of ingested asbestos are summarized in Table 3-3 and Figure 3-3, and the data are discussed below.

3.2.2.1 Death

No studies were located regarding death in humans or animals after acute or intermediate oral exposure to asbestos. Feeding studies in rats and hamsters indicate that ingestion of high amounts (1% in the diet, equivalent to doses of 500–800 mg/kg/day) of chrysotile, amosite, crocidolite, or tremolite does not cause premature lethality, even when exposure occurs for a lifetime (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c).

TABLE 3-3. Levels of Significant Exposure to Asbestos - Oral

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (mg/kg/day)	LOAEL Less serious (mg/kg/day)	LOAEL Serious (mg/kg/day)	Reference/ chemical form[b]
INTERMEDIATE EXPOSURE							
Reproductive							
1	Rat F344/N	2-12 wk		500			NTP 1985, 1988, 1990b, 1990c CH CR TR AM
2	Hamster Syrian	3-6 wk		830			NTP 1983, 1990a CH AM
Developmental							
3	Rat F344/N	2-12 wk		500			NTP 1985, 1988, 1990b, 1990c CH CR TR AM
4	Mouse CD-1	15 d Gd1-15		33 F			Schneider and Maurer 1977 CH
5	Hamster Syrian	3-6 wk		830			NTP 1983, 1990a CH AM
CHRONIC EXPOSURE							
Systemic							
6	Rat Wistar	25 mo	Gastro	100 M			Bolton et al. 1982a AM CR CH
7	Rat Sprague-Dawley	1.5 yr	Gastro		20 M (altered permeability of the intestines)		Delahunty and Hollander 1987 CH

TABLE 3-3. Levels of Significant Exposure to Asbestos - Oral (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (mg/kg/day)	LOAEL Less serious (mg/kg/day)	LOAEL Serious (mg/kg/day)	Reference/ chemical form[b]
8	Rat NS	21 mo	Resp	2500 M			Gross et al. 1974 CH
			Cardio	2500 M			
			Gastro	2500 M			
			Hemato	2500 M			
			Musc/skel	2500 M			
			Hepatic	2500 M			
			Renal	2500 M			
			Dermal	2500 M			
9	Rat MRC Hooded	15 mo	Gastro		140 M (increased DNA synthesis)		Jacobs et al. 1978b CH
10	Rat F344/N	lifetime	Resp	500			NTP 1985, 1988, 1990c CH CR TR
			Cardio	500			
			Gastro	500			
			Hemato	500			
			Musc/skel	500			
			Hepatic	500			
			Renal	500			
			Endocr	500			
			Dermal	500			
			Bd Wt	500			

TABLE 3-3. Levels of Significant Exposure to Asbestos - Oral (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (mg/kg/day)	LOAEL: Less serious (mg/kg/day)	LOAEL: Serious (mg/kg/day)	Reference/ chemical form[b]
11	Rat F344/N	lifetime	Resp	500			NTP 1990b AM
			Gastro	500			
			Hepatic	500			
			Renal	500			
			Bd Wt		500 M (15 (at weaning) to 37% (at 8 weeks) decreased mean body weight gain)		
			Bd Wt		500 F (15 (at weaning) to 25% (at 8 weeks) decreased mean body weight gain)		
12	Hamster Syrian	lifetime	Resp	830			NTP 1983, 1990a CH AM
			Cardio	830			
			Gastro	830			
			Hemato	830			
			Musc/skel	830			
			Hepatic	830			
			Renal	830			
			Endocr	830			
			Dermal	830			
			Bd Wt	830			
Neurological							
13	Rat F344/N	lifetime		500			NTP 1985, 1988, 1990b, 1990c CH CR TR AM
14	Hamster Syrian	lifetime		830			NTP 1983, 1990a CH AM

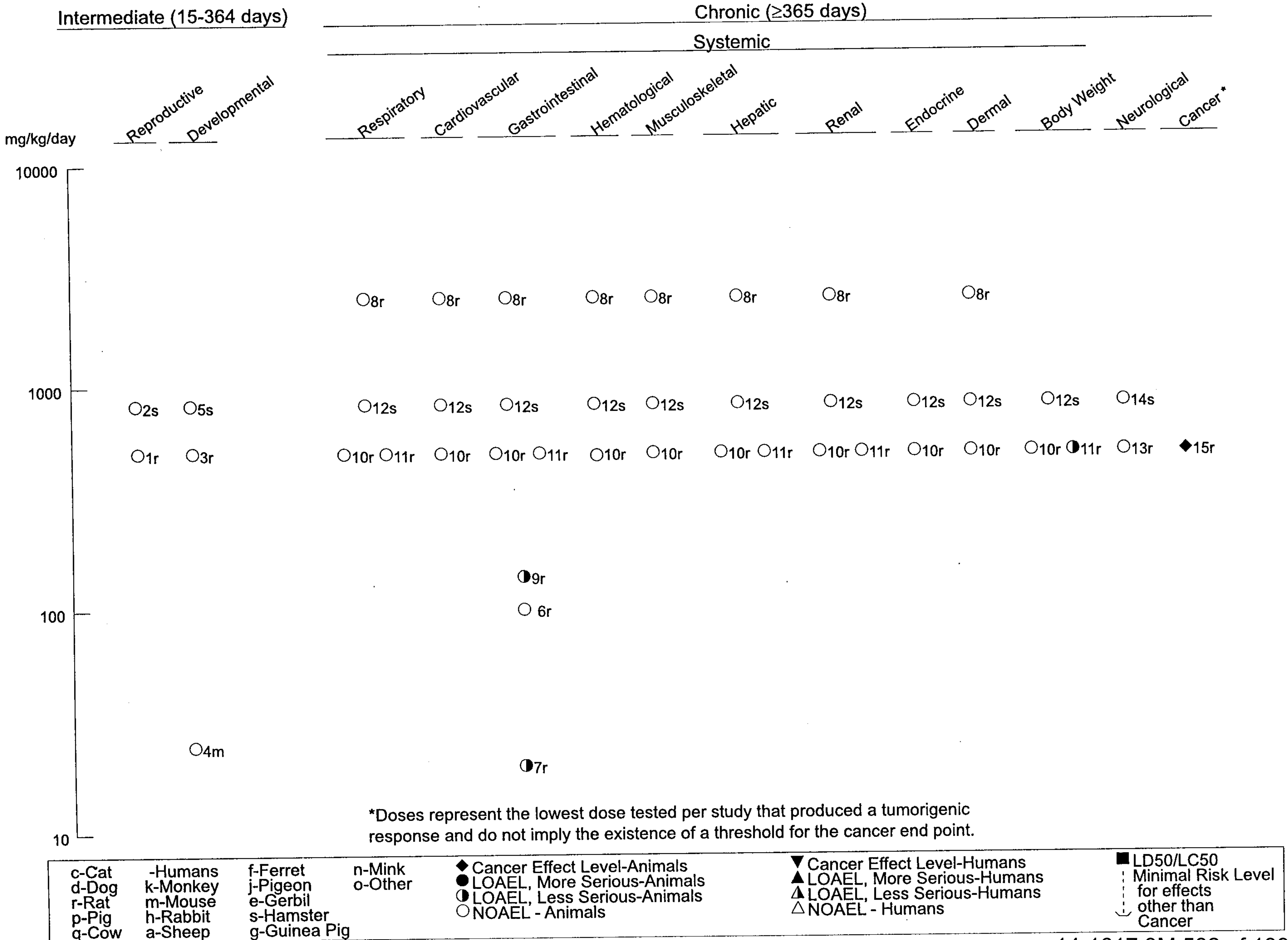
TABLE 3-3. Levels of Significant Exposure to Asbestos - Oral (continued)

Key to[a] figure	Species/ strain	Exposure/ duration/ frequency	System	NOAEL (mg/kg/day)	LOAEL: Less serious (mg/kg/day)	LOAEL: Serious (mg/kg/day)	Reference/ chemical form[b]
	Cancer						
15	Rat F344/N	lifetime				500 M (CEL: intestinal polyps)	NTP 1985 CH-I

[a]The number corresponds to entries in Figure 3-3.

AM = amosite; Bd Wt = body weight; Cardio = cardiovascular; CEL = cancer effect level; CH = chrysotile; CR = crocidolite; d = day(s); DNA = deoxyribonecleic acid; Endocr = endocrine; (F) = feed; F = female; Gastro = gastrointestinal; Gd = gestation day; Hemato = hematological; I = intermediate; LOAEL = lowest-observed-adverse-effect-level; M = male; mg/kg/day = milligrams per kilogram per day; mo = month(s); Musc/skel = musculoskeletal; NOAEL = no-observed-adverse-effect-level; NS = not specified; Resp = respiratory; TR = tremolite; (W) = water; wk = week(s); yr = year(s)

Figure 3-3. Levels of Significant Exposure to Asbestos - Oral



3.2.2.2 Systemic Effects

No studies were located regarding the respiratory, cardiovascular, hematological, musculoskeletal, hepatic, renal, endocrine, dermal, ocular, or metabolic effects in humans after oral exposure to asbestos. Studies in rats and hamsters exposed to high doses (1% in the diet) of chrysotile, amosite, crocidolite, or tremolite have not detected histological or clinical evidence of injury to any systemic tissues (Gross et al. 1974; NTP 1983, 1985, 1988, 1990a, 1990b, 1990c), with the possible exception of mild effects on the gastrointestinal tract (see below). These findings are consistent with the concept that very few asbestos fibers cross from the gastrointestinal lumen into the blood (see Section 3.4.1), and that the risk of noncarcinogenic injury to tissues such as lung, heart, muscle, liver, kidney, skin, or eyes is negligible. The highest NOAEL values and all LOAEL values from reliable studies for systemic effects are summarized in Table 3-3 and plotted in Figure 3-3.

Gastrointestinal Effects. No studies were located regarding gastrointestinal effects in humans after oral exposure to asbestos. Because most ingested asbestos fibers are not absorbed into the body following oral exposure (see Section 3.4.1), the tissue most directly exposed to ingested asbestos is the gastrointestinal epithelium. A few studies in rats have described some histological or biochemical alterations in cells of the gastrointestinal tract after chronic exposure to oral doses of 20–140 mg/kg/day of chrysotile (Delahunty and Hollander 1987; Jacobs et al. 1978a, 1978b). Increased numbers of aberrant crypt foci, putative precursors of colon cancer, were induced in rats that were administered by gavage either a single dose (70 mg/kg/day) of chrysotile, a single dose (40 mg/kg/day) of crocidolite, or 3 doses (33 mg/kg/day) of crocidolite, although no dose-response was noted in the single dose of crocidolite regimen (Corpet et al. 1993). Mice that were administered either a single dose (100 mg/kg) of chrysotile or three doses (50 mg/kg/day) of crocidolite did not show increases in aberrant crypt foci (Corpet et al. 1993). However, no excess nonneoplastic lesions of the gastrointestinal epithelium have been detected in a number of other animal feeding studies (Bolton et al. 1982a; Donham et al. 1980; Gross et al. 1974), including an extensive series of lifetime studies in rats and Syrian hamsters in which such effects were carefully investigated (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c). Thus, the weight of evidence indicates that asbestos ingestion does not cause any significant noncarcinogenic effects in the gastrointestinal system.

Body Weight Effects. A single study reported a 15–37% decrease in body weight gain in rats exposed to 500 mg/kg/day amosite (NTP 1990b). Changes in food consumption do not explain the decreased body weight gain since treated rats had slightly higher food intakes than controls. Effects on body weight gain have generally not been observed in other studies (Gross et al. 1974; NTP 1983, 1985, 1988, 1990a, 1990c). The significance of this finding, therefore, is uncertain.

3.2.2.3 Immunological and Lymphoreticular Effects

No studies were located regarding immunological or lymphoreticular effects in humans or animals after oral exposure to asbestos.

3.2.2.4 Neurological Effects

No studies were located to indicate that ingestion of asbestos leads to neurological effects in humans. No histological or clinical evidence of neurological injury was detected in rats or hamsters chronically exposed to high doses (500 and 830 mg/kg/day, respectively) of chrysotile, amosite, crocidolite, or tremolite in the diet (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c). No clinical signs of neurological damage were noted after acute exposure of rats and mice to crocidolite (160 and 50 mg/kg/day, respectively) or to chrysotile (70 and 100 mg/kg/day, respectively) (Corpet et al. 1993).

3.2.2.5 Reproductive Effects

No studies were located regarding reproductive effects in humans after oral exposure to asbestos. In animals, no histopathological changes in reproductive organs or effects on fertility were observed in rats or Syrian hamsters exposed to chrysotile, amosite, crocidolite, or tremolite (500 and 830 mg/kg/day, respectively) in the diet during gestation and lactation (through parental exposure) and throughout life until spontaneous death (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c). The highest NOAEL values from reliable studies for reproductive effects are summarized in Table 3-3 and plotted in Figure 3-3.

3.2.2.6 Developmental Effects

No studies were located regarding developmental effects in humans after oral exposure to asbestos. No teratogenic effects were noted in rats or hamsters exposed to chrysotile, amosite, crocidolite, or tremolite (500 and 830 mg/kg/day, respectively) during gestation, lactation (though parental exposure), and throughout their lives until spontaneous death (NTP 1983, 1985, 1988, 1990b, 1990c), although standard developmental toxicity examinations of intrauterine contents at the end of gestation were not conducted in these bioassays. A slight reduction in pup birth weight was noted in some cases (NTP 1985, 1990a), but it seems unlikely that this was the result of any direct effect on the fetus. In the only available standard developmental toxicity study, no exposure-related effects on pregnancy outcome, percentages of resorptions, fetal weight, or number of malformed fetuses were found in mice exposed from gestation days 1 through 15 to drinking water containing 0, 1.43, 14.3, or 143 μg chrysotile asbestos/mL in drinking water (approximate doses of 0, 0.3, 3.3, and 33 mg/kg/day, respectively) (Schneider and Maurer 1977). The highest NOAEL values from reliable studies for developmental effects are summarized in Table 3-3 and plotted in Figure 3-3.

3.2.2.7 Cancer

As discussed in Section 3.2.1.8, a number of epidemiological studies of workers exposed to asbestos fibers in workplace air suggest that workers may have an increased risk of gastrointestinal cancers. It is usually assumed that any effect of asbestos on the gastrointestinal tract after inhalation exposure is most likely the result of mucociliary transport of fibers from the respiratory tract to the gastrointestinal tract (see Section 3.4.4). Because of these findings, a number of researchers have investigated the carcinogenic risk (especially the risk of gastrointestinal cancer) in humans and animals when exposure to asbestos occurs by the oral route.

Human Studies. A number of epidemiological studies have been conducted to determine if human cancer incidence is higher than expected in geographical areas where asbestos levels in drinking water are elevated (usually in the range of 1–300 MFL) (Andersen et al. 1993; Conforti et al. 1981; Howe et al. 1989; Kanarek et al. 1980; Levy et al. 1976; Polissar et al. 1982, 1984; Sadler et al. 1984; Sigurdson et al. 1981; Toft et al. 1981; Wigle 1977). Most of these studies have detected increases, some of which were statistically significant, in cancer death or incidence rates at one or more tissue sites (mostly gastrointestinal) in populations exposed to elevated levels of asbestos in their drinking water. However, the magnitudes of the increases in cancer incidence are usually rather small, may be related to other risk factors such as smoking, and there is relatively little consistency in the observed increases, either within studies (i.e., between sexes) or between studies.

The basis of these inconsistent findings is not certain. On one hand, it seems likely that at least some of the apparent associations are random or are due to occupational exposures (Polissar et al. 1982, 1984; Toft et al. 1981; Wigle 1977). On the other hand, failure of some studies to detect effects may be due to lack of statistical power, stemming from limitations regarding study design, exposure level and duration, latency since exposure, population size and mobility, population density, exposure to other risk factors, differences in sensitivity between sexes and groups, differences in asbestos fiber types and size, and numerous other possible confounding factors. In a review of data from eight independent epidemiological studies, it was concluded that the number of positive findings for neoplasms of the esophagus, stomach, pancreas, and prostate were unlikely to have been caused by chance alone (Marsh 1983). In another review, Kanarek (1989) noted that there were relatively consistent findings for increased stomach and pancreatic cancer among the studies. However, none of the studies provided a basis for identification of an oral exposure level that may be definitely stated as having caused increased death from cancer. Part of the uncertainty may be attributable to differences in analytical methods used in the different studies to measure fiber concentrations in drinking water (e.g., differences in selection of dimensional criteria for definition of a fiber, in sampling techniques, and in processing techniques). In a more recent review, Cantor (1997) concluded that results from epidemiologic studies of populations exposed to high concentrations of asbestos in drinking water are inconsistent and are not adequate to evaluate cancer risk from asbestos in drinking water, but noted that some of the results are suggestive of elevated risks for gastric, kidney, and pancreatic cancer. Cantor (1997) further noted that the issue of asbestos in drinking water causing these types of cancer warrants further investigation.

Animal Data. Early animal studies on gastrointestinal cancer from ingested asbestos were mostly negative (Cunningham et al. 1977; Gross et al. 1974), although some studies yielded increases in tumor frequency that were not statistically significant (Bolton et al. 1982a; Donham et al. 1980; Ward et al. 1980). More recently, a series of large scale, lifetime feeding studies have been performed by the National Toxicology Program (NTP). In this series of studies, animals were exposed during gestation and lactation (through parental diets) and throughout their lives until spontaneous death occurred. These studies have also yielded mostly negative results, although some suggestive increases in tumor frequencies did occur (see Table 3-4). An increased incidence of benign adenomatous polyps of the large intestine was observed in male rats exposed to 500 mg/kg/day intermediate range chrysotile (65% of all fibers over 10 μm) in the diet (NTP 1985). These tumors were not observed either in female rats or in

Table 3-4. Summary of NTP Lifetime Asbestos Feeding Studies

Asbestos type	Species	Median length (µm)	Size distribution	Carcinogenic effects	Comments	Conclusion	Reference
Amosite	Rat	4.37	74% >6 µm	Increased C-cell carcinoma (males)	Not considered treatment related	Not carcinogenic	NTP 1990b
				Increased leukemia (males)	Questionable biological and statistical significance		
	Syrian hamster	4.37	74% >6 µm	None		Did not cause a carcinogenic response	NTP 1983
Crocidolite	Rat	10	73% >8 µm	None		Did not cause a carcinogenic response	NTP 1988
Tremolite	Rat	No data	22% >5 µm	None		Did not cause a carcinogenic response	NTP 1990c
Chrysotile (short range)	Rat	0.66	30% >4.5 µm	None		No evidence of carcinogenicity	NTP 1985
Chrysotile (intermediate range)	Rat	0.82	60% >5.4 µm	Benign intestinal polyps (males)	Not significant based on concurrent controls; highly significant based on historical controls	Some evidence of carcinogenicity	NTP 1985
				Clitoral gland neoplasm (females)	Not significant compared to historical controls	No evidence of carcinogenicity	

Table 3-4. Summary of NTP Lifetime Asbestos Feeding Studies *(continued)*

Asbestos type	Species	Median length (µm)	Size distribution	Carcinogenic effects	Comments	Conclusion	Reference
Chrysotile (short range)	Syrian hamster	0.66	30% >4.5 µm	Adrenal cortical adenomas (males)	Not significant compared to historical controls	Not carcinogenic	NTP 1990a
Chrysotile (intermediate range)	Syrian hamster	0.82	60% >5.4 µm	Adrenal cortical adenomas (males and females)		Not carcinogenic	NTP 1990a

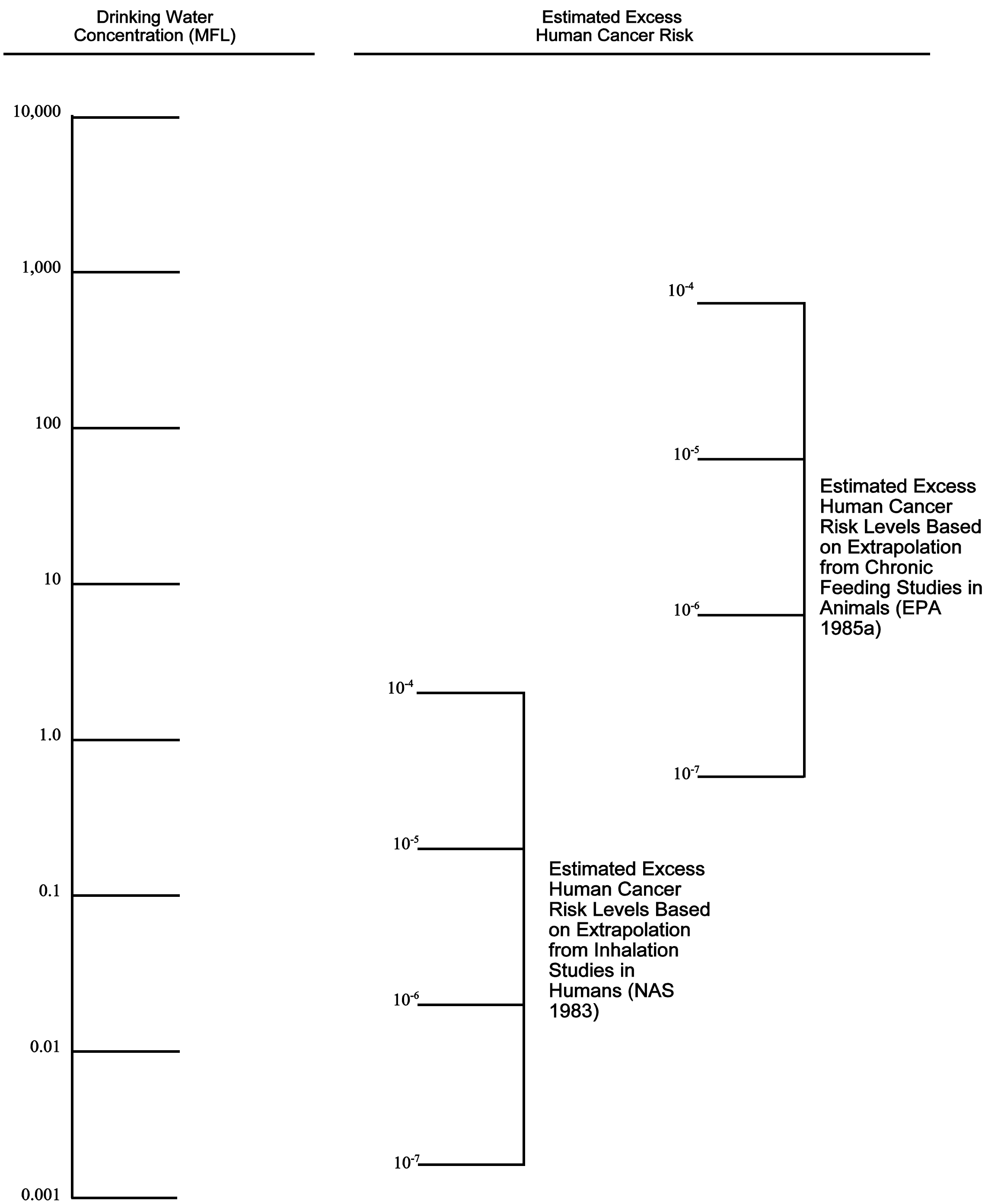
Syrian hamsters exposed to the same diet. Aberrant crypt foci, putative precursors of colon cancer, were induced in rats given acute doses of chrysotile (70 mg/kg/day) or crocidolite (33 mg/kg/day) by gavage (Corpet et al. 1993). Overall, however, the data were interpreted as providing "some evidence" of carcinogenicity for intermediate range chrysotile fibers. No tumorigenicity was noted for short-range chrysotile (NTP 1985).

Quantitative Risk Estimate. None of the available epidemiological studies of cancer risk in humans exposed to asbestos in drinking water are suitable for estimating quantitative dose-response relationships. However, both EPA and the National Academy of Sciences (NAS) have sought to estimate the risk of gastrointestinal cancer after oral exposure by extrapolating dose-response data from occupational studies (EPA 1980a; NAS 1983). As noted before, this approach rests on the assumption that the observed excess gastrointestinal cancer risk in the occupational studies is due to the swallowing of fibers that have been deposited in the respiratory tract. These calculations indicate that lifetime ingestion of water containing 1.0 MFL would produce an excess gastrointestinal cancer risk of about $3x10^{-5}$–$1x10^{-4}$ (EPA 1980a; NAS 1983). It should be noted that this approach requires a number of assumptions, and that the risk estimates should be considered to be only approximate. It is also important to note that if these risk estimates are correct, then the expected relative risk of gastrointestinal cancer in populations consuming drinking water at concentrations of 1–200 MFL would be quite low, and would likely not be consistently detectable in epidemiological studies (NAS 1983).

Another quantitative estimate of gastrointestinal cancer risk has been calculated based on the incidence of benign intestinal polyps in male rats exposed to 500 mg/kg/day of chrysotile (65% >10 μm long) in the diet (EPA 1985a). This calculation indicates that the lifetime excess risk from ingesting water containing 1.0 MFL would be about $1.4x10^{-7}$.

Figure 3-4 summarizes the risk estimates of NAS (1983) and EPA (1985a). It should be noted that these estimates differ by several orders of magnitude. Based on extrapolation from human inhalation studies, exposure levels of 0.0011, 0.011, 0.11, and 1.1 MFL in drinking water represent excess gastrointestinal cancer risks of 10^{-7}, 10^{-6}, 10^{-5}, and 10^{-4}, respectively. Based on animal data, exposure levels of 0.71, 7.1, 71, and 710 MFL in drinking water represent excess gastrointestinal cancer risks of 10^{-7}, 10^{-6}, 10^{-5}, and 10^{-4}, respectively. There are many possible reasons for this substantial difference, including uncertainty in each model's assumptions or conversion factors, differences in fiber potency (due to differences in type and/or length), and inherent differences between humans and rats. Appendix D provides further details

Figure 3-4. Summary of Calculated Gastrointestinal Cancer Risks from Ingestion of Asbestos



on the derivation of these risk estimates. Currently (2001), EPA is in the process of reviewing their cancer risk estimates for exposure to asbestos fibers.

3.2.3 Dermal Exposure

The only adverse health effect that has been reported after dermal contact with asbestos is the formation of small "warts" or corns. No quantitative dose-response data are available, but in a group of workers installing amosite insulation in ships, nearly 60% of the people had one or more of these lesions, mostly on the hands (Alden and Howell 1944). All of the workers with lesions reported an original pricking sensation and the feeling of a small splinter-like foreign body. This strongly indicates that the lesions are associated with penetration of the skin by a macroscopic spicule, although histological examination of the corns did not reveal the presence of a fiber. The corns develop within about 10 days and are painful at first. They later become highly cornified and do not appear to be of pathological concern (Alden and Howell 1944; Dupre et al. 1984; Selikoff and Lee 1978).

No studies were located regarding the following health effects in humans or animals after dermal exposure to asbestos:

3.2.3.1 Death
3.2.3.2 Systemic Effects
3.2.3.3 Immunological and Lymphoreticular Effects
3.2.3.4 Neurological Effects
3.2.3.5 Reproductive Effects
3.2.3.6 Developmental Effects
3.2.3.7 Cancer

3.3 GENOTOXICITY

The genotoxicity of asbestos has been investigated *in vivo*, as summarized in Table 3-5, and *in vitro*, as summarized in Table 3-6.

Studies of exposed asbestos workers, residentially exposed Turkish villagers, mesothelioma patients, and lung cancer patients suggest that asbestos is genotoxic. The number of chromosomal aberrations and the rate of sister chromatid exchange were significantly elevated in the peripheral blood lymphocytes of

Table 3-5. Genotoxicity of Asbestos *In Vivo*

Species (test system)	End point	Results	Reference	Form
Mammalian cells:				
Human blood leukocytes	DNA strand breakage	+	Marczynski et al. 1994a	NS
Human blood leukocytes	DNA damage	+	Marczynski et al. 2000a	NS
Human blood leukocytes	DNA damage	+	Marczynski et al. 2000b	NS
Human blood lymphocytes	Chromosomal aberration	+	Fatma et al. 1991	NS
Human blood lymphocytes	Sister chromatid exchange	+	Donmez et al. 1996	AC
Human blood lymphocytes	Sister chromatid exchange	(+)	Rom et al. 1983	NS
Human blood lymphocytes	Sister chromatid exchange	(+)	Lee et al. 1999	CH
Human mesothelioma cells	Chromosomal aberration	+	Hansteen et al. 1993	CR, AM, AN
Human mesothelioma cells	Chromosomal aberration	+	Tiainen et al. 1989	CR, AM, AN
Human mesothelioma cells	Chromosomal aberration	+	Tammilehto et al. 1992	NS
Human mesothelioma cells	Chromosomal aberration	+	Pelin-Enlund et al. 1990	NS
Human mesothelioma cells	Chromosomal aberration	–	Segers et al. 1995	CR, CH
Human mesothelioma cells	Gene mutation (p53)	–	Kitamura et al. 1998	NS
Human mesothelioma cells	Gene mutation (p53)	–	Ni et al. 2000	NS
Human lung carcinoma cells	Gene mutation (FHIT)	+	Nelson et al. 1998	NS
Human lung carcinoma cells	Gene mutation (p53)	+	Guinee et al. 1995	NS
Human lung carcinoma cells	Gene mutation (p53)	+	Nuorva et al. 1994	NS
Human lung carcinoma cells	Gene mutation (p53)	+	Wang et al. 1995b	NS
Rat leukocytes	DNA strand breakage	–	Marczynski et al. 1994b	CR
Rat lung and liver cells	DNA strand breakage	+	Marczynski et al. 1994b	CR
Rat lung and liver cells	DNA strand breakage	+	Marczynski et al. 1994c	CR
Rat bone marrow cells	Chromosomal aberration	+	Fatma et al. 1992	CH
Rat mesothelioma cells	Chromosomal aberration	+	EPA 1988j	CH
Rat mesothelioma cells	Gene mutation (p53)	–	Ni et al. 2000	CR
Rat bone marrow cells	Sister chromatid exchange	–	Varga et al. 1996a	AN
Rat bone marrow cells	Sister chromatid exchange	–	Varga et al. 1996b	CR
Mouse lung cells	Gene mutation (*lacI*)	(+)	Rihn et al. 2000	CR

Table 3-5. Genotoxicity of Asbestos *In Vivo* *(continued)*

Species (test system)	End point	Results	Reference	Form
Nonmammalian cells:				
Drosophila	Chromosomal aberration	+	Osgood and Sterling 1991	AM, CH
Drosophila	Chromosomal aberration	–	Osgood and Sterling 1991	CR, TR

– = negative result; + = positive result; (+) = weakly positive; AC = actinolite; AM = amosite; AN = anthophyllite; CH = chrysotile; CR = crocidolite; FHIT = a tumor suppressor gene; NS = not specified; p53 = a tumor suppressor gene; TR = tremolite

Table 3-6. Genotoxicity of Asbestos *In Vitro*

Species (test system)	End point	Results: With activation	Results: Without activation	Reference	Form
Prokaryotic organisms:					
Salmonella typhimurium	Gene mutation	No data	–	Chamberlain and Tarmy 1977	CR, CH, AM,
S. typhimurium TA102	Gene mutation	No data	+	Faux et al. 1994	AN
Escherichia coli CP2	Gene mutation	No data	–	Chamberlain and Tarmy 1977	CR, AN
Mammalian cells:					
Human mesothelial cells	Chromosomal aberrations	No data	+	Olofsson and Mark 1989	CR, CH, AM
Human mesothelial cells	Chromosomal aberrations	No data	+	Dopp et al. 1997	AM, CR, CH
Human mesothelial cells	Chromosomal aberrations	No data	(+)	Pelin et al. 1995a	AM
Human mesothelial cells	Chromosomal aberrations	No data	+	Takeuchi et al. 1999	CR
Human lymphocytes	Chromosomal aberrations	No data	+	Valerio et al. 1980	CH
Human fibroblasts	Chromosomal aberrations	No data	–	Sincock et al. 1982	CH
Human lymphoblastoid cells	Chromosomal aberrations	No data	+	Sincock et al. 1982	CH
Human blood lymphocytes	Chromosomal aberrations	No data	+	Korkina et al. 1992	CH
Human lymphocytes	Chromosomal aberrations	No data	+	Emerit et al. 1991	CH
Human amniotic fluid cells	Chromosomal aberrations	No data	+	Dopp and Schiffman 1998	AM, CR, CH
Human promyelotic leukemia cells	Chromosomal aberrations	No data	–	Takeuchi et al. 1999	CR
Human fibroblasts	Sister chromatid exchange	No data	–	Casey 1983	NS
Human lymphoblastoid cells	Sister chromatid exchange	No data	–	Casey 1983	NS
Human peripheral lymphocyte	Gene mutation (HLA-A)		–	Both et al. 1994	CH
Human peripheral lymphocyte	Gene mutation (HLA-A)	No data	+	Both et al. 1994	CR
Human TK6 cells	Gene mutation (HGPRT; T)	No data	–	Kelsey et al. 1986	CR

Table 3-6. Genotoxicity of Asbestos *In Vitro (continued)*

Species (test system)	End point	Results: With activation	Results: Without activation	Reference	Form
Human-hamster hybrid cells	Gene mutation (HGPRT)	No data	+	Hei et al. 1992	CH
Human mesothelioma cells	Gene mutation (HLA-A)	No data	+	Both et al. 1995	CR
Human bronchial cells	DNA strand breakage	No data	–	Lechner et al. 1983	CR, CH, AM
Human mesothelial cells	DNA strand breakage	No data	+	Ollikainen et al. 1999	CR
Rat pleural mesothelial cells	Chromosomal aberrations	No data	+	Kravchenko et al. 1998	CH
Rat pleural mesothelial cells	Chromosomal aberrations	No data	+	Yegles et al. 1995	CH, CR, AM
Rat liver epithelial cells	Gene mutation (HGPRT)	No data	–	Reiss et al. 1982	CR, CH, AM
Rat fibroblast cells	Gene mutation (*lacI*)	No data	+	Lezon-Geyda et al. 1996	CH
Rat mesothelial cells	Sister chromatid exchange	No data	–	Kaplan et al. 1980	NS
Rat embryo cells	DNA strand breakage	No data	+	Libbus et al. 1989	CR
Rat mesothelial cells	Unscheduled DNA synthesis	No data	+	Dong et al. 1994	CH,CR
Rat mesothelial cells	Aneuploidy	No data		Yegles et al. 1993	CR
Mouse fibroblasts	Cell transformation	No data	–	Brown et al. 1983	CR,AM
Hamster tracheal epithelial	DNA strand breakage	No data	–	Mossman et al. 1983a	CR, CH
Chinese hamster CHO xrs-5	DNA strand breakage	No data	+	Okayasu et al. 1999a	CH
Chinese hamster CHO–K1 cells	Chromosomal aberrations	No data	+	Sincock 1977	CR, CH,
Chinese hamster CHO–K1 cells	Chromosomal aberrations	No data	+	Sincock and Seabright 1975	AM, AN
Chinese hamster CHO cells	Chromosomal aberrations	No data	+	Kenne et al. 1986	CR
Chinese hamster CHO cells	Chromosomal aberrations	No data	+	Kelsey et al. 1986	CR
Chinese hamster CHO cells	Chromosomal aberrations	No data		Sincock et al. 1982	CH
Chinese hamster V79 cells	Chromosomal aberrations	No data	+	EPA 1988j; Palekar et al. 1987	CR, CH
Chinese hamster V79 cells	Chromosomal aberrations	No data	+	Trosic et al. 1997	CH

Table 3-6. Genotoxicity of Asbestos *In Vitro (continued)*

Species (test system)	End point	Results: With activation	Results: Without activation	Reference	Form
Chinese hamster CHO cells	Chromosomal aberrations	No data	+	Donaldson and Golyasnya 1995	AM
Chinese hamster CHO cells	Gene mutation (HGPRT)	No data	–	Kenne et al. 1986	CR, CH, AM
Chinese hamster CCL 39 cells	Gene mutation (HPRT)	No data	(+)	Huang 1979	CR, CH, AM
Chinese hamster CHO cells	Sister chromatid exchange	No data	–	Kelsey et al. 1986	CR
Chinese hamster CHO cells	Sister chromatid exchange	No data	–	Casey 1983	NS
Chinese hamster CHO cells	Sister chromatid exchange	No data	+	Livingston et al. 1980	CR, CH, AM
Chinese hamster CHO cells	Sister chromatid exchange	No data	+	Babu et al. 1980	CH
Chinese hamster V79–4 cells	Sister chromatid exchange	No data	+	Price-Jones et al. 1980	CR
Chinese hamster V79 cells	Sister chromatid exchange	No data	–	Lu et al. 1994a	CH
Chinese hamster V79 cells	Sister chromatid exchange	No data	+	Trosic et al. 1997	CH
Chinese hamster V79 cells	Micronucleus assay	No data	+	Lu et al. 1994a	CH
Chinese hamster V79 cells	Micronucleus assay	No data	+	Lu et al. 1994b	CH
Chinese hamster V79 cells	Micronucleus assay	No data	+	Keane et al. 1999	CH
Syrian hamster cells	Chromosomal aberrations	No data	+	Lavappa et al. 1975	CH
Syrian hamster cells	Chromosomal aberrations	No data	+	Oshimura et al. 1986	CH
Syrian hamster embryo cells	Chromosomal aberrations	No data	+	Dopp et al. 1995a, 1995b	AM, CR, CH
Syrian hamster embryo cells	Chromosomal aberrations	No data	+	Dopp and Schiffman 1998	AM, CR, CH
Syrian hamster embryo cells	Cell transformation	No data	+	Hesterberg and Barrett 1984	CH, CR
Syrian hamster embryo cells	Cell transformation	No data	–	DiPaolo et al. 1983	AM, AN, CH, CR
Calf thymus DNA	DNA damage	No data	+	Adachi et al. 1992a	CR, CH, AM

– = negative result; + = positive result; (+) = weakly positive result; AM = amosite; AN = anthophyllite; CH = chrysotile; CHO = Chinese hamster ovary; CR = crocidolite; DNA = deoxyribonucleic acid; HGPRT and HPRT = hypoxanthine-guanine phosphribosyl transferase genetic locus; HLA-A = human lymphocyte antigen A genetic locus; NS = not specified; T = thymidine kinase genetic locus asbestos workers compared to a control population (Fatma et al. 1991). The mean sister chromatid exchange rate was significantly increased ($p=0.002$) in nonsmoking asbestos insulators compared to a control population (Rom et al. 1983). The increase in sister chromatid exchange rate was not statistically significant in smoking asbestos insulators, and for the whole group (smokers and nonsmokers), the increase approached statistical significance ($p=0.056$). A marginally significant difference ($p=0.069$) in mean sister chromatid exchange rate between chrysotile-exposed workers and controls became significant ($p=0.0473$) after controlling for the effects of age and smoking (Lee et al. 1999). A group of residents from a Turkish village in which actinolite asbestos was used to paint walls and floors of homes had an elevated mean sister chromatid exchange rate in lymphocyte cells compared with a nonexposed control population (Donmez et al. 1996). An increased incidence of DNA double-strand breaks was noted in the leukocytes of asbestos workers compared to controls (Marczynski et al. 1994a). Increased incidences of DNA double strand breaks in lung and liver tissue (Marczynski et al. 1994b, 1994c) and chromosomal gaps and breaks in bone marrow cells (Fatma et al. 1992) were observed in rats exposed via intratracheal instillation of crocidolite instilled intratracheally with suspensions of crocidolite and chrysotile asbestos, respectively. In other studies, no increased frequency of sister chromatid exchange was found in bone marrow cells from rats orally exposed to anthophyllite or crocidolite (Varga et al. 1996a, 1996b). Asbestos induced aneuploidy in *Drosophila* (Osgood and Sterling 1991). In this assay system, chrysotile was more effective than amosite, whereas crocidolite and tremolite were relatively ineffective. Several studies have reported either chromosomal aberrations in the pleural effusion of mesothelioma patients (Hansteen et al. 1993) or significant correlations between specific chromosomal abnormalities and lung burden of asbestos in mesothelioma patients (Pelin-Enlund et al. 1990; Tammilehto et al. 1992; Tiainen et al. 1989). However, it is uncertain as to whether these chromosomal abnormalities were responsible for the development of mesothelioma, or whether the abnormalities were a result of the disease. Chromosomal aberrations in mesothelioma cells were not found in one study of human patients (Segers et al. 1995). Significant increases in the excretion of the DNA adduct 8-hydroxydeoxyguanosine, a marker of DNA damage, have been observed in the white blood cells and urine of asbestos workers (Marczynski et al. 2000a, 2000b; Tagesson et al. 1993). Abnormal p53 protein accumulation (suggestive of mutation in the p53 tumor suppressor gene) was detected significantly more often ($p=0.027$) in primary tumor tissue from lung cancer patients exposed to asbestos than in lung cancer patients without exposure (Nuorva et al. 1994). Mutations in the p53 gene occurred more frequently in two studies of primary tumor tissue from lung cancer patients with asbestos exposure compared with lung cancer patients without asbestos exposure (Guinee et al. 1995; Wang et al. 1995b). In another study of tumor tissue from lung cancer patients, asbestos exposure and smoking duration were each significantly associated ($p<0.01$) with deletions in the protein coding regions of another candidate tumor suppressor gene, FHIT (Nelson et al. 1998). In contrast, mutations in the p53 gene were not found in tumor tissue samples from small numbers of mesothelioma patients (Kitamura et al. 1998; Ni et al. 2000) with definite histories of asbestos exposure or in rats with crocidolite-induced mesotheliomas (Ni et al. 2000).

Tests for gene mutations have been mixed, both *in vivo* and *in vitro*. Asbestos fibers were not mutagenic in initial tests of standard strains of *Salmonella typhimurium* and *Escherichia coli* (Chamberlin and Tarmy 1977), but mutagenic responses were found in a *S. typhimurium* strain, TA102, that is especially sensitive to oxidative mutagens (Faux et al. 1994).

In vitro tests on human peripheral lymphocytes and mesothelioma cells have been mixed with both positive and negative results for tests with crocidolite and chrysotile (Both et al. 1994, 1995; Hei et al. 1992; Kelsey et al. 1986). Studies by Both and coworkers (Both et al. 1994, 1995) suggest that crocidolite is a more potent mutagen than chrysotile, and that asbestos susceptibility is cell line specific. Cell line specificity may be due to differential phagocytic activity, with those cells exhibiting high levels of phagocytosis (e.g., mesothelioma cells) being more susceptible to asbestos (Takeuchi et al. 1999) than cells without such activity (e.g., lymphocytes). Studies in animal systems present a similar picture. Hei and coworkers reported an increased frequency of mutations in human-hamster hybrid cells exposed to chrysotile (Hei et al. 1992). These mutations consisted primarily of large deletions, which may not be detected as easily in other assay systems. Marginal evidence for weak mutagenicity of chrysotile, crocidolite, and amosite in Chinese hamster ovary (CHO) cells was reported by Huang (1979).

A large number of studies indicate that asbestos fibers can cause chromosomal aberrations in Chinese hamster ovary (CHO) and Syrian hamster embryo (SHE) cells. The aberrations include aneuploidy (usually polyploidy), fragmentation, breaks, rearrangements, gaps, dicentrics, inversions, and rings (Donaldson and Golyasnya 1995; Kelsey et al. 1986; Kenne et al. 1986; Lavappa et al. 1975; Oshimura et al. 1986; Palekar et al. 1987, 1988; Sincock 1977; Sincock and Seabright 1975; Sincock et al. 1982; Trosic et al. 1997). Aneuploidy was also induced in rat mesothelial cells *in vitro* using crocidolite (Yegles et al. 1993). Chromosomal aberrations have been produced by chrysotile in eight studies using human mesothelial, lymphocyte, and amniotic fluid cells (Dopp and Schiffmann 1998; Dopp et al. 1997; Emerit et al. 1991; Korkina et al. 1992; Olofsson and Mark 1989; Pelin et al. 1995b; Takeuchi et al. 1999; Valerio et al. 1980), but not in two others that used fibroblast and promyelocytic leukemia cells (Sincock et al. 1982; Takeuchi et al. 1999). The mechanism by which these clastogenic effects occur may be related to physical interference with chromosome segregation by the asbestos fiber during the mitotic process (Barrett et al. 1989; Malorni et al. 1990; Palekar et al. 1987).

Results of tests for other genotoxic effects (increased sister chromatid exchange, DNA strand breaks, DNA hydrolysis, cell transformations) have been mixed, with both negative (Brown et al. 1983; Casey 1983; DiPaolo et al. 1983; Kaplan et al. 1980; Kelsey et al. 1986; Lechner et al. 1983; Lu et al. 1994a; Mossman et al. 1983a; Price-Jones et al. 1980) and positive (Adachi et al. 1992a; Babu et al. 1980; Dong et al. 1994; Hesterberg and Barrett 1984; Libbus et al. 1989; Livingston et al. 1980; Okayasu et al. 1999a; Ollikainen et al. 1999; Trosic et al. 1997) results being noted. Adachi et al. (1992a) reported DNA damage as indicated by the formation of 8-hydroxy-2'-deoxyguanosine when fibers were incubated with calf thymus DNA and hydrogen peroxide. DNA strand breaks were noted in rat embryo cells exposed to crocidolite and CHO exposed to chrysotile (Okayasu et al. 1999a; Osgood and Sterling 1991). Emerit et al. (1991) reported that chrysotile induces the formation of a clastogenic factor when cultured rat pleural mesothelioma cells are exposed to the fibers *in vitro*, as ultrafiltrates of culture media from these cells induced chromosome damage in cultures of human lymphocytes used as a test system. These effects are equivocal, however, as there was no dose-response. Chrysotile induced increased numbers of cells with micronuclei (Keane et al. 1999; Lu et al. 1994b) and with two or more nuclei (Lu et al. 1994a) in Chinese hamster lung (V79) cells. Increases in unscheduled DNA synthesis have been reported using rat pleural mesothelial cells after exposure to crocidolite and chrysotile (Dong et al. 1994). Of special interest, the cell transformation reported by Hesterberg and Barrett (1984) was abolished when the fibers were milled to a short length.

These observations, especially the findings of cytogenotoxicity, are consistent with the greater observed carcinogenic potential of long asbestos fibers, and support possible mechanisms by which asbestos might be acting.

3.4 TOXICOKINETICS

Asbestos fibers may enter the body after inhalation or oral exposures. It is unlikely that any appreciable uptake of asbestos will occur after dermal exposure. The deposition and fate of the fiber in the lungs is largely dependent on its size and shape. Fibers that are deposited in the respiratory tract may be removed by mucociliary clearance or by macrophages, or they may be retained in the lung. Very few of the long fibers are likely to move through the lungs and be distributed to tissues other than the mesothelium. Longer fibers that are retained in the lung may undergo a number of processes including translocation, dissolution, fragmentation, splitting, or protein encapsulation. Long fibers that reside in the lung can become encapsulated in protein, forming what is often referred to as an "asbestos body" (the term "ferruginous body" is used when the nature of the core fiber is not known). These bodies are golden brown in appearance, owing to the presence of iron. The protein coat is rich in ferritin (an iron storage protein) possibly arising from macrophages and giant cells. The formation of asbestos bodies may represent an attempt of macrophages to digest long fibers extracellularly (Koerten et al. 1990a, 1990b). Fibers that are retained in the lung or mesothelium for long periods of time are capable of producing chronic inflammation and fibrotic and tumorigenic effects. These effects may be mediated by direct interactions between the fiber and key cellular macromolecules, or they may be mediated by the production of reactive oxygen species and other cellular factors originating from alveolar macrophages. Fibers that enter the gastrointestinal tract, either by ingestion or mucociliary transport from the lungs, are mostly excreted in the feces, although a small fraction of the fibers may become lodged in cells or penetrate the gastrointestinal lining and enter other tissues.

3.4.1 Absorption

3.4.1.1 Inhalation Exposure

When asbestos fibers are inhaled, many are deposited on the epithelial surface of the respiratory tree. The number of fibers that are deposited, and the location within the airway where deposition occurs, is a function of the aerodynamic properties of the fibers. In humans, the fibers depositing in the upper airway consist mainly of relatively thick fibers (greater than about 3 μm), with thinner fibers being carried deeper into the distal airways and alveolar regions (Timbrell 1982). In rats, about 30–40% of typical fibers of chrysotile, amosite, and crocidolite, are retained, with most of these (about 60%) being deposited in the upper airways (nose, throat, and trachea) (Evans et al. 1973; Morgan et al. 1975). The median length for these fibers was 1–2 μm, while the median diameter was 0.2–0.4 μm. After intratracheal administration of chrysotile and amosite asbestos fibers in hamsters, chrysotile fibers were found to be primarily located near air duct bifurcations, while amosite fibers tended to be more distributed over the bronchial surface (Kimizuka et al. 1992). Many of these smaller fibers deposit preferentially at bifurcations in the terminal bronchioles and alveolar ducts (Brody 1986; Evans et al. 1973), with the number of fibers deposited at each location decreasing in proportion to the preceding airway path length and the number of preceding branch points (Pinkerton et al. 1986).

3.4.1.2 Oral Exposure

Animal studies indicate that most asbestos fibers that are ingested are not absorbed across the walls of the gastrointestinal tract (Gross et al. 1974). However, electron micrographic studies indicate that some fibers penetrate into the gastrointestinal epithelium (Storeygard and Brown 1977; Westlake et al. 1965). In addition, some fibers pass through the gastrointestinal wall and reach blood, lymph, urine, and other tissues (Carter and Taylor 1980; Cunningham and Pontefract 1973; Cunningham et al. 1977; Hallenbeck and Patel-Mandlik 1979; Patel-Mandlik and Millette 1983; Sebastien et al. 1980b; Weinzweig and Richards 1983). The mechanism by which asbestos fibers pass through the gastrointestinal wall is not known with certainty, but it has been noted that a wide variety of very small particles (i.e., 1 µm or less; e.g., starch granules, cellulose particles, pollen) can cross the gut by passing between (not through) the cells of the epithelial layer in a process termed persorption, and it seems likely that this may account for uptake of asbestos fibers as well (Volkheimer 1974). Available data are not sufficient to make a precise estimate of the fraction of ingested fibers that pass through the gastrointestinal wall, but there is agreement that it is a very small amount (Sebastien et al. 1980b; Weinzweig and Richards 1983). Several researchers have found that the average length of fibers in extra-gastrointestinal tissues or fluids is shorter than the average length of the fibers ingested (Cunningham et al. 1977; Patel-Mandlik and Millette 1983; Weinzweig and Richards 1983), suggesting that short fibers pass through the gastrointestinal epithelium more easily than long fibers.

3.4.1.3 Dermal Exposure

As discussed above (see Section 3.2.3), asbestos fibers can penetrate into the skin, producing asbestos warts. No studies were located that indicate that asbestos fibers can pass through the skin into the blood.

3.4.2 Distribution

3.4.2.1 Inhalation Exposure

As noted above, only a tiny fraction of inhaled fibers penetrate through the epithelial layer of the lungs. No quantitative studies were located regarding the distribution of these fibers in the rest of the body after inhalation exposure, but some appear to be retained in the pleura, with others passing into the lymphatics (Brody 1993; Hillerdal 1980; Holt 1983; Rudd 1989). Those fibers that enter the lymphatics are presumably able to reach other tissues of the body. Dogs exposed by nose-only inhalation to neutronactivated crocidolite were found to have small amounts of radioactivity in the blood, liver, head, and gastrointestinal tract (Griffis et al. 1983). However, it is also possible that some small proportion of fibers originally deposited in the respiratory tract may reach other tissues following mucociliary transport of fibers to the gastrointestinal tract and uptake from that tissue (see Section 3.4.1.2).

Distribution of asbestos fibers within the lung has been investigated in a number of studies. Most fibers deposited in the airways are removed from the lung by mucociliary transport or by macrophages (see Section 3.4.4), but a small fraction remain in the lung for long periods (Jones et al. 1988a). In addition, some fibers appear to pass from the lung to the pleura (Boutin et al. 1996; Hillerdal 1980; Rudd 1989; Viallat et al. 1986). In humans, the presence of asbestos fibers in the pleura after inhalation exposure has been demonstrated by a number of researchers (Boutin et al. 1996; Jones et al. 1980b; Roggli and Longo 1991; Sebastien et al. 1980a; Stephens et al. 1987), but some concerns have been discussed of the possibility of contamination of tissues during pathological processing and fiber analysis (Case 1994). Available data are not sufficient to estimate the fraction of deposited asbestos fibers that penetrate the lung in this way, but it is probably quite small.

Intracellularly, asbestos fibers tend to be located near the nucleus. *In vitro* studies have indicated that during endocytosis, asbestos fibers were observed to be transported along the microtubule network to the perinuclear region (Cole et al. 1991; Malorni et al. 1990). The proximity of asbestos fibers to the nucleus may be an important factor regarding their genotoxicity and carcinogenicity.

Providing limited evidence that some transplacental transfer of asbestos fibers may occur, one group of investigators has reported that asbestos fibers were detected more frequently and at higher mean concentrations in human fetal and placental tissues associated with stillborn infants compared with placental tissue associated with liveborn infants from the same hospital (Haque et al. 1991, 1992, 1996, 1998). In the latest study from this group, asbestos fibers were found in 50% of fetal digests and 23% of placental digests from stillborn infants compared with 15% of liveborn placentas. Mean fiber concentrations in stillborn tissues and placenta tissues were comparable to one another (30,000–60,000 f/g), but were much greater than mean fiber concentration in liveborn placentas (19 f/g) (Haque et al. 1998). The source of maternal exposure in these studies was unknown, but was presumed by Haque et al. (1998) to be a mix of oral and inhalation environmental (not occupational) exposure. It is unknown if the increased number of fibers in the stillborn fetuses is attributable to increased maternal exposure to asbestos or to changes in fetal or placental factors, unrelated to asbestos exposure, influencing fiber tissue accumulation.

3.4.2.2 Oral Exposure

Asbestos fibers have been detected in blood (Weinzweig and Richards 1983) and lymph (Sebastien et al. 1980b) of rats exposed to oral doses of asbestos, suggesting that fibers penetrating the gut might be carried to tissues throughout the body. In support of this, asbestos fibers have been detected in the lung, kidney, liver, brain, heart, and spleen of rats that had been exposed to asbestos in the diet (Cunningham et al. 1977; Pontefract and Cunningham 1973). Highest levels of fibers were found in the omentum (a fold of the peritoneum connecting abdominal viscera to the stomach), supporting the idea that the fibers were emanating from the gastrointestinal tract. Although the diet fed to the animals was prepared using corn oil to minimize asbestos fiber inhalation, the possibility that some fiber inhalation took place cannot be eliminated (Cunningham et al. 1977).

3.4.2.3 Dermal Exposure

No studies were located regarding distribution of asbestos fibers after dermal exposure. It is generally considered that dermal uptake of asbestos is not significant.

3.4.2.4 Other Routes of Exposure

The distribution of asbestos fibers has been investigated in a number of studies after exposure via intratracheal or intravenous injection. The translocation of chrysotile fibers from the lung to the pleura and mesothelium has been observed in rats exposed by intratracheal injection (Fasske 1988; Viallat et al. 1986). Following intravenous injection of chrysotile fibers into pregnant rats, fibers were detected by electron microscopy at higher levels in liver and lung tissue in fetuses of exposed dams compared with levels in fetuses from nonexposed dams (Cunningham and Pontefract 1974). Asbestos fibers also were detected in digests of fetal and placental tissue following intravenous injection of pregnant mice with single doses of crocidolite suspensions (Haque and Vrazel 1998). These findings support those of Haque et al. (1991, 1992, 1996, 1998), suggesting that some transplacental transfer of asbestos fibers may occur.

3.4.3 Metabolism

3.4.3.1 Inhalation Exposure

Asbestos fibers are not metabolized in the normal sense of the word, and amphibole fibers that are retained in the lung do not appear to undergo any major changes (Bellmann et al. 1987; Carter and Taylor 1980; Roggli et al. 1987a). However, chrysotile fibers appear to undergo some type of breakdown or alteration in the lung. This conclusion is based primarily on measurements of asbestos levels in the lung as a function of exposure duration. With continuing exposure of animals, amphibole levels tend to rise linearly, whereas chrysotile levels reach a steady-state concentration within several months (Wagner et al. 1974) (see also Section 3.5.1). These data from animal studies are supported by a number of human studies in which the ratio of amphibole to chrysotile concentration in lung tissue was much higher than expected based on the composition of the inhaled fibers (Jones et al. 1980a, 1980b; Pooley 1976; Stephens et al. 1987; Wagner et al. 1982a, 1982b, 1986). Long chrysotile fibers (>10 or 18 μm) are expected to accumulate in humans with continued exposure, based on observations of an association between duration of exposure of chrysotile miners and millers and lung chrysotile fiber concentrations >18 μm in length (Case et al. 2000) and estimations of long clearance half times (>8 years) for lung-sequestered fibers in chrystotile miners and millers (Finkelstein and Dufresne 1999). Finkelstein and Dufresne (1999) discerned patterns in their data suggestive that lung concentrations of chrysotile fibers would reach plateaus in humans after decades of exposure under occupational conditions.

The basis of this apparent loss of chrysotile fibers is not clear, but it may be related to a slow dissolution of the fibers in tissue fluids or in macrophages (Fasske 1988; Jaurand et al. 1984), or to a separation of the fibers into much finer component fibrils (Bellmann et al. 1987; Coin et al. 1992, 1994; Cook et al. 1982; Roggli et al. 1987a). In the latter case, the apparent loss of fibers could be an artifact due to the inability of normal methods for fiber isolation and quantification in tissues to detect very fine fibrils. Loss of chrysotile has been reported to be related to the fragmentation of long fibers, resulting in the formation of smaller fibers (Churg et al. 1989a, 1989b). There appears to be preferential clearance of short asbestos fibers compared to long ones (Coin et al. 1992; Finkelstein and Dufresne 1999). For example, based on an analysis of lung fiber concentrations in 72 chrysotile miners and millers, years of exposure, and time since last exposure, long-term clearance half-times were estimated to be about 4 and 8 years for chrysotile fibers <5 μm and >10 μm in length, respectively (Finkelstein and Dufresne 1999). In contrast, clearance half-times were about 8 and 16 years for tremolite fibers <5 μm and >10 μm in length, respectively. (Short-term clearance times could not be measured in this analysis of lung fiber concentrations in chronically exposed miners and millers.) Long fibers that reside in the lung can form asbestos bodies. The formation of asbestos bodies might represent an attempt by macrophages to digest these fibers extracellularly (Koerten et al. 1990a, 1990b).

3.4.3.2 Oral Exposure

No studies were located regarding any changes in asbestos fibers in the gastrointestinal tract *per se.* However, chrysotile fibers incubated in simulated gastric juice underwent leaching of magnesium ion from the silica framework, with a resultant change in net fiber charge from positive to negative (Seshan 1983), and chrysotile fibers with altered appearance and x-ray diffraction patterns were detected in the urine of animals (Hallenbeck and Patel-Mandlik 1979; Patel-Mandlik and Millette 1983). These observations, although limited, suggest that chrysotile fibers undergo some metal ion exchange and alterations in gross structure in biological fluids after oral exposure. Asbestos bodies have been detected is tissues such as the colon (Ehrlich et al. 1992), suggesting that this process may occur in extrapulmonary tissues as well.

3.4.3.3 Dermal Exposure

No studies were located regarding any changes in asbestos fiber composition or structure after dermal exposure.

3.4.3.4 Other Routes of Exposure

As stated above, asbestos fibers are not metabolized in the true sense of the word; however, a number of animal studies indicate that chrysotile fibers are physically altered in the lung after intratracheal injection. Following phagocytosis, chrysotile fibers were observed to decrease in size, become transparent, and, in some cases, break into fragments (Fasske 1988). Longitudinal splitting, resulting in a greater number of thinner fibers was noted for actinolite and amosite (Cook et al. 1982), and fragmentation, resulting in shorter fibers, was observed for chrysotile (Churg et al. 1989a, 1989b). These changes in fiber shape and size may directly impact fiber clearance and toxicity in the lung.

3.4.4 Elimination and Excretion

3.4.4.1 Inhalation Exposure

The principal pathway by which fibers are removed from the respiratory tract is mucociliary transport. This is mediated by ciliated epithelial cells that produce and move the layer of mucus coating the epithelial tissue upwards toward the throat, where it is swallowed. Fibers deposited in this mucus layer are swallowed into the alimentary canal and most are ultimately excreted in the feces (Cunningham et al. 1976; Evans et al. 1973; Griffis et al. 1983; Morgan et al. 1978). However, a small number of fibers may penetrate through the epithelial layers of the lung and/or the gastrointestinal tract and are transferred to the blood and eventually to the kidney, where some of them may be excreted in the urine (Finn and Hallenbeck 1984). In addition, some fibers are not cleared from the lung, leading to a gradual accumulation with time (Case et al. 2000; Finkelstein and Dufresne 1999; Jones et al. 1988a; Wagner et al. 1974).

Animal studies indicate that clearance of fibers from the upper airways generally occurs within a few hours (Bolton et al. 1983; Evans et al. 1973). However, clearance from the lower airways is slower, with half-times ranging up to 160 days (Bellmann et al. 1987; Coin et al. 1992; Evans et al. 1973; Morgan et al. 1978). This slow clearance is mediated largely by macrophages, which engulf fibers in the bronchioles and alveoli (which are not ciliated), and carry them to the ciliated portion of the airway for transport upward (Holt 1974). Macrophages may also translocate some fibers from the lung to the pleura (Holt 1983). The clearance of chrysotile fibers from the lungs is dependent on fiber length. Animal and human data indicate that long fibers (in excess of 5 or 10 μm) are cleared from the lower airways more slowly than short fibers (Bellmann et al. 1987, 1994; Davis et al. 1986a, 1988; Finkelstein and Dufresne 1999; Morgan et al. 1978; Roggli et al. 1987a; Searl 1997; Warheit et al. 1997), probably because long fibers cannot be easily engulfed and moved by a single macrophage (Morgan et al. 1978). Fibers less than 1 μm in length were cleared from the rat lung with a half-life of less than 10 days, whereas fibers longer than 16 μm were cleared with a half-life of greater than 100 days (Coin et al. 1992; Searl 1997). Pulmonary clearance half-times for asbestos fibers must be viewed with caution, however, as a first-order kinetic model is generally not an adequate fit for the data (Hesterberg et al. 1996; Searl 1997). The preferential clearance of chrysotile over amphiboles (Finkelstein and Dufresne 1999; Jones et al. 1994) may be attributed to fragmentation of long fibers, resulting in the formation of shorter fibers which are more readily engulfed and moved by a single macrophage (Jones et al. 1994).

3.4.4.2 Oral Exposure

Nearly all asbestos fibers that are ingested are excreted in the feces. This is essentially complete within 48 hours following a single oral dose (Gross et al. 1974). Small numbers of fibers may also be excreted in the urine (Boatman et al. 1983; Hallenbeck and Patel-Mandlik 1979), but this accounts for only a very small fraction of the ingested dose (Cook and Olson 1979).

3.4.4.3 Dermal Exposure

No studies were located regarding excretion of asbestos fibers after dermal exposure. It is generally considered that dermal exposure does not result in uptake of asbestos.

3.4.4.4 Other Routes of Exposure

Similar to observations made in inhalation studies, studies in which animals were exposed by intratracheal injection indicate that chrysotile fibers are preferentially cleared from the lung over amphiboles (Churg et al. 1989a, 1989b; Sebastien et al. 1990). The enhanced clearance was generally attributed to fragmentation of fibers, rather than dissolution. The resulting fibers are shorter and more readily engulfed and moved by alveolar macrophages.

3.4.5 Physiologically Based Pharmacokinetic (PBPK)/Pharmacodynamic (PD) Models

Physiologically based pharmacokinetic (PBPK) models use mathematical descriptions of the uptake and disposition of chemical substances to quantitatively describe the relationships among critical biological processes (Krishnan et al. 1994). PBPK models are also called biologically based tissue dosimetry models. PBPK models are increasingly used in risk assessments, primarily to predict the concentration of potentially toxic moieties of a chemical that will be delivered to any given target tissue following various combinations of route, dose level, and test species (Clewell and Andersen 1985). Physiologically based pharmacodynamic (PBPD) models use mathematical descriptions of the dose-response function to quantitatively describe the relationship between target tissue dose and toxic end points.

PBPK/PD models refine our understanding of complex quantitative dose behaviors by helping to delineate and characterize the relationships between: (1) the external/exposure concentration and target tissue dose of the toxic moiety, and (2) the target tissue dose and observed responses (Andersen et al.

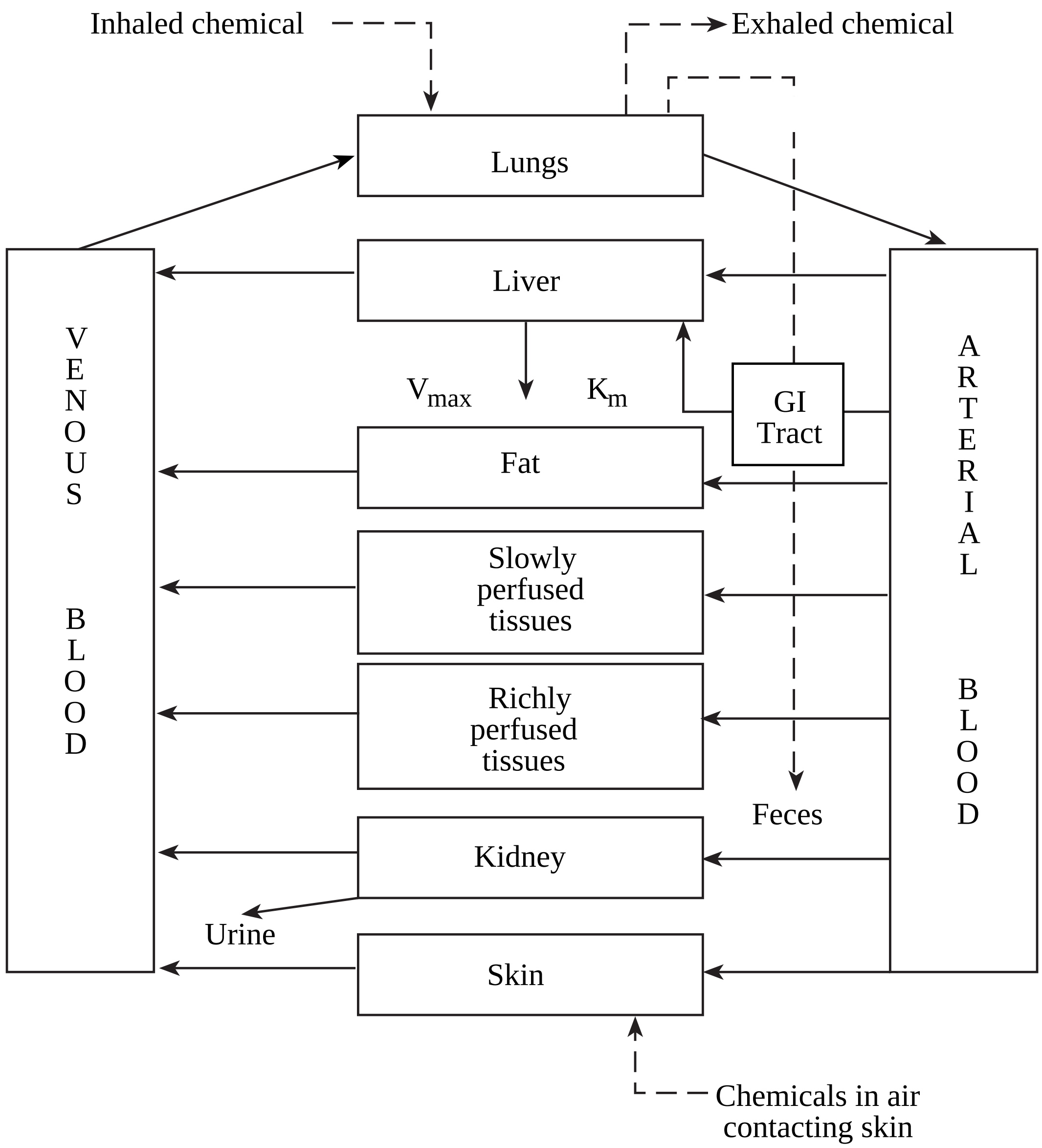
1987; Andersen and Krishnan 1994). These models are biologically and mechanistically based and can be used to extrapolate the pharmacokinetic behavior of chemical substances from high to low dose, from route to route, between species, and between subpopulations within a species. The biological basis of PBPK models results in more meaningful extrapolations than those generated with the more conventional use of uncertainty factors.

The PBPK model for a chemical substance is developed in four interconnected steps: (1) model representation, (2) model parametrization, (3) model simulation, and (4) model validation (Krishnan and Andersen 1994). In the early 1990s, validated PBPK models were developed for a number of toxicologically important chemical substances, both volatile and nonvolatile (Krishnan and Andersen 1994; Leung 1993). PBPK models for a particular substance require estimates of the chemical substance-specific physicochemical parameters, and species-specific physiological and biological parameters. The numerical estimates of these model parameters are incorporated within a set of differential and algebraic equations that describe the pharmacokinetic processes. Solving these differential and algebraic equations provides the predictions of tissue dose. Computers then provide process simulations based on these solutions.

The structure and mathematical expressions used in PBPK models significantly simplify the true complexities of biological systems. If the uptake and disposition of the chemical substance(s) is adequately described, however, this simplification is desirable because data are often unavailable for many biological processes. A simplified scheme reduces the magnitude of cumulative uncertainty. The adequacy of the model is, therefore, of great importance, and model validation is essential to the use of PBPK models in risk assessment.

PBPK models improve the pharmacokinetic extrapolations used in risk assessments that identify the maximal (i.e., the safe) levels for human exposure to chemical substances (Andersen and Krishnan 1994). PBPK models provide a scientifically sound means to predict the target tissue dose of chemicals in humans who are exposed to environmental levels (for example, levels that might occur at hazardous waste sites) based on the results of studies where doses were higher or were administered in different species. Figure 3-5 shows a conceptualized representation of a PBPK model.

Figure 3-5. Conceptual Representation of a Physiologically Based Pharmacokinetic (PBPK) Model for a Hypothetical Chemical Substance



Source: adapted from Krishnan et al. 1994

Note: This is a conceptual representation of a physiologically based pharmacokinetic (PBPK) model for a hypothetical chemical substance. The chemical substance is shown to be absorbed via the skin, by inhalation, or by ingestion, metabolized in the liver, and excreted in the urine or by exhalation.

3.4.5.1 Summary of PBPK Models

No PBPK models specific for asbestos were located. While a number of physiologically-based models for deposition and clearance of inhaled insoluble material have been developed (ICRP 1994; Phalen et al. 1991; Stober and McClellan 1997; Stober et al. 1994), a direct application of these models to the kinetics of asbestos fibers in humans has not been reported.

3.4.5.2 Asbestos PBPK Model Comparison

The available models for evaluating the dispositional kinetics of insoluble materials vary considerably in their level of complexity, but they are predominantly based on similar basic concepts (for recent review, see Stober and McClellan 1997). Recent models for fiber deposition in rats (Asgharian and Anjilvel 1998) have been reported, as have several models for clearance (for recent review, see Stober and McClellan 1997). Many models focus on either deposition or clearance processes, rather than combining the two, although recent efforts have developed lung retention models for fibers in humans and rats that include deposition and clearance processes (Yu et al. 1996, 1997).

The most successful models divide the respiratory system into a number of compartments, with each compartment having a distinct set of deposition or clearance parameters. Deposition models generally divide based on the bronchiolar branch pattern, whereas clearance models tend to divide based on anatomical clearance pathways. For example, material deposited in the tracheobronchial region clears predominantly through the larynx and eventually to the gastrointestinal tract, doing so at a faster overall rate than clearance from the pulmonary region. As additional knowledge of the physiology of the various compartments is discovered, subcompartments are added, each with an additional set of parameters. By combining the parameters from the various subcompartments and estimating the overall contribution of that subcompartment to the total, an estimation of the overall kinetics of exposure can be achieved. The most recent example of this approach is the POCK (physiology-oriented compartmental kinetics) model (Stober et al. 1994), which has a large number of subcompartmental parameters, each with equations to model particle clearance. This would allow for the modeling of disease states wherein specific aspects of deposition and/or clearance are altered without significantly affecting the others (i.e., particle overload of alveolar macrophages). However, to date, the majority of models have focused primarily on particles rather than fibers (see Section 3.4.5.3 for further explanation).

3.4.5.3 Discussion of Model

Because the biopersistence of fibers, including asbestos, is a key determinant of their toxicity, the most appropriate models for the estimation of toxic responses are likely to be those that model the deposition and clearance of the inhaled fibers. Existing models lack a number of features that have prevented them from being adequately utilized to model the kinetics of asbestos exposures in humans. Perhaps the greatest hindrance to the development of PBPK models for asbestos (i.e., their parameterization, simulation, and validation) has been the lack of accurate exposure data to link with lung fiber burden data in humans. Exposure assessments in human studies have been primarily based on estimates made from descriptions of environmental conditions in the workplace, rather than direct measurements of airborne asbestos concentration. Additionally, measurements of pulmonary fiber content in humans are generally performed after the subject has died, often a number of years following the cessation of exposure. These two factors combine to make accurate modeling of asbestos deposition and clearance from the existing human data more difficult.

The majority of the existing kinetic models for describing the fate of fibers and particles within the respiratory system were developed based on inhalation studies in rats. While this has undoubtedly led to more accurate modeling, as the rat database is considerably more extensive than the human one, several aspects of rodent anatomy and physiology differ significantly from the corresponding human system. In particular, the respiratory system in rats is structured differently than humans. The rat lung possesses a different branching pattern, which is likely to affect the deposition of the asbestos fibers. The bronchial tree of the rat is also physically smaller than that of man. When combined with the fact that rats are obligate nose-breathers, which is not the case for humans, this results in fibers that are respirable by humans being not respirable by most rodents (Hofmann et al. 1989). These factors decrease the utility of the rodent models in predicting human disposition under similar exposure conditions.

An additional difficulty with many models lies in the fact that they were developed for modeling particles, not fibers. Differences in physical properties in these insoluble materials can influence deposition and clearance processes in the respiratory tract. For example, particles that are too large to be phagocytized by alveolar macrophages generally do not reach the deep lung, but instead deposit by impaction in the nasal passages or airways. In contrast, long, thin fibers (>15 μm in length, but <3 μm in diameter) are respirable and can reach the deep lung where they are unable to be phagocytized by macrophages, and thus, are unable to be effectively cleared. The decreased clearance rate of fibers with increasing fiber length is also not considered in the majority of the particle-based clearance models. Fiber breakdown, lengthwise or transverse, is also not factored into particle-based models. These deficiencies make utilization of particle-based models of deposition and clearance for the prediction of the behavior of fibers, including asbestos, problematic.

Recently, mathematical models have been developed for the deposition and retention of refractory ceramic fibers in the alveolar region of lungs of rats (Yu et al. 1994, 1995, 1996) and humans (Yu et al. 1994, 1995, 1997). The development of the rat model was based on exposure and lung burden data (including information on distribution of fiber sizes) from studies of rats exposed chronically to airborne refractory ceramic fibers. The models include descriptions of deposition rates with tidal volume, breathing frequency, air concentration of fibers of specific diameters and lengths, and alveolar deposition fraction (a function of airway structure, lung morphometry, and ventilation parameters for fibers of specific diameters and lengths) as explanatory variables and description of rates of three simultaneous clearance processes (alveolar macrophage-mediated clearance, dissolution of fibers in the lung fluid, and breakage of long fibers into shorter fibers). Rates for the removal processes in humans were extrapolated from the rat data. The developed human model predicted lung burdens that were in general agreement with lung fiber counts for three workers exposed to refractory ceramic fibers (Yu et al. 1997). The development of similar rat and human models for asbestos fiber lung deposition and clearance may be useful to more accurately predict human health risks from available data from rat inhalation bioassays. The most useful models for deposition and clearance of asbestos fibers are likely to be complex and should account for differences associated with different types of asbestos fibers and different size distributions of fibers.

3.5 MECHANISMS OF ACTION

Fibers that persist within the lung or the mesothelium are capable of producing fibrogenic and tumorigenic effects in these tissues. Although the precise mechanisms by which asbestos fibers cause toxic injury have not been determined, data are available that indicate that both direct interaction between fibers and cellular components and cell-mediated pathways may be involved. In addition, the physical-chemical nature of the fiber appears to be an important determinant of toxicity. Though the various mechanisms are likely to interact extensively, they will be discussed individually below.

3.5.1 Pharmacokinetic Mechanisms

A number of physical and chemical properties such as fiber size, durability, and iron content are important determinants of asbestos toxicity. The dependence of toxicity on these fiber properties is discussed below.

Fiber Size. The size (length and diameter) of an asbestos fiber appears to be one of the most important determinants of its toxicity. Fiber size dictates respirability, deposition, and clearance from the lung. In general, only fibers <3 μm thick are capable of reaching lower airways (Timbrell 1982). Fibers longer than approximately 5–10 μm are generally cleared more slowly than fibers shorter than 5 μm (Bellmann et al. 1987; Finkelstein and Dufresne 1999; Hesterberg et al. 1996; Morgan et al. 1978; Roggli et al. 1987a; Searl 1997; Warheit et al. 1997). The maximum fiber length that can be engulfed by a single macrophage is approximately 16–17 μm (Coin et al. 1992; Lippmann 1990). Asbestos-associated diseases are attributable to fibers of different sizes. The strongest evidence for this conclusion comes from studies in animals, where chronic inhalation exposure to dust clouds rich in long fibers (those in excess of 5 μm) produces higher incidence of lung cancer than exposure to dust clouds rich in short fibers (mostly <5 μm) (Davis and Jones 1988; Davis et al. 1986a). Asbestosis has been associated with fibers longer than 2 μm, mesothelioma with fibers longer than 5 μm, and lung cancer with fibers longer than 10 μm (Lippmann 1988, 1990). The dose-response relationships for the production of mesothelioma in rats intraperitoneally injected with amosite, chrysotile, and crocidolite were similar when doses were expressed in terms of the number of long (>4–8 μm), thin (<0.25 μm) fibers (Davis et al. 1991a; Stanton et al. 1981). Lippman (1988, 1990) noted that, in general, fiber widths <0.1 μm have been associated with mesothelioma, but can be larger for asbestosis and lung cancer. It should be noted, however, that rats exposed to populations of relatively shorter and broader tremolite fibers (lengths greater than 4 μm and width up to 1.5 μm) showed a high incidence of mesothelioma (American Thoracic Society 1990; Stanton et al. 1981). Ultimately, the size of the fiber determines its residence time in the lung. Longer fibers remain in the lung or mesothelium, whereas shorter fibers are cleared (Coin et al. 1992; Searl 1997). Fibers with lengths >15–20 μm are incompletely ingested and dissolved by pulmonary macrophages, which is thought to lead to chronic and persistent inflammation and tissue damage (Coin et al. 1992; Davis 1989; Davis et al. 1986a; Eastes and Hadley 1996; Lippmann 1994).

Interestingly, Churg et al. (1989a, 1990) reported that the severity of fibrosis in asbestos workers exposed primarily to tremolite and chrysotile, or amosite was positively correlated with lung fiber concentrations, but was negatively correlated with fiber length. The negative correlation (while not establishing causation between short fibers or fiber fragments and fibrosis) suggests that short fibers may be more important to some aspects of asbestos-mediated toxicity than previously thought. As discussed by Case (1994) (see also Section 3.2.1.2), observation of the negative correlation of fibrosis score with fiber length may be dependent on the selection of fiber length counting criterion. Case (1994) has hypothesized that long fibers may initiate events and shorter fiber fragments, once formed in the lung, may increase effects on macrophage activity and subsequent fibrosis. Another possible explanation for this observation is that fiber size is also related to fiber surface area (Lippman 1988, 1990). As mentioned above, fiber surface properties are important to toxicity. Smaller thinner fibers have a greater surface area per unit mass than larger thicker fibers, thereby allowing for greater interaction with cell macromolecules. In addition, increased surface area may be important to providing more catalytically active iron sites (see below) for hydroxyl radical formation from reactive oxygen species.

Fiber Durability. Fiber biopersistance is believed to be a major mechanism of fiber-induced pathogenicity (Hesterberg et al. 1998a, 1998b). Numerous studies have indicated that some asbestos fibers, particularly chrysotile fibers, undergo fragmentation (latitudinal breakage) and/or splitting (longitudinal breakage) (Bellmann et al. 1987; Churg et al. 1989a, 1989b; Coin et al. 1992; Cook et al. 1982; Fasske 1988; Roggli et al. 1987a). The importance of fiber size and surface area with respect to toxicity is discussed above. Both fragmentation and splitting serve to increase the number of fibers and fiber surface area; therefore, toxicity of the resulting fibers is likely to increase as well. However, fiber fragmentation results in shorter fibers which are more readily cleared from the lungs by alveolar macrophages, whereas fiber splitting is likely to result in no change in fiber clearance. Differences in fiber durability may account for the differences observed in fiber potency between chrysotile and amphiboles.

Fiber Type. A diversity of opinion exists regarding relative potencies of various asbestos fiber types with respect to fibrogenicity and carcinogenicity. Some investigators have proposed that amphibole fibers, such as tremolite, are more potent than chrysotile fibers in inducing fibrotic lung disease and lung cancer (Hodgson and Darnton 2000; McDonald 1998a; McDonald and McDonald 1997; McDonald et al. 1999; Mossman et al. 1990a). Others have suggested that the differences in the potency of chrysotile and amphibole fibers in inducing lung cancer cannot be reliably discerned from available data (Stayner et al. 1996). It is generally agreed that exposure to amphibole fibers can produce mesothelioma, and that the potency of amphibole fibers to produce mesothelioma is greater than that of chrysotile. Some investigators have indicated that mesotheliomas among chrysotile-exposed workers are largely caused by small amounts of tremolite fibers found in mined and processed chrysotile (Churg 1988; Churg et al.

1993; Lippmann 1994; McDonald 1998a; McDonald et al. 1997). Others indicate that chrysotile fibers may also induce mesothelioma (Frank et al. 1998; Langer and Nolan 1998; Smith and Wright 1996). In a statistical analysis of mesothelioma and lung tumor data from a series of studies in which rats were exposed to airborne asbestos fibers of different types (chrysotile, amosite, crocidolite, and tremolite), Berman et al. (1995) concluded that amphibole fibers were more potent than chrysotile in inducing mesotheliomas, but no difference could be discerned in potencies of these fiber types to induce lung tumors. Apparent differences in potency among fiber types may be related to differences in lung retention. Amphibole fibers appear to be retained in the lung for longer periods than chrysotile fibers (Albin et al. 1994; Churg 1994; Churg et al. 1993; Davis 1989; Wagner et al. 1974). It has been suggested that such differences in retention may serve as a partial explanation of why amphibole fibers appear to be more potent in producing mesotheliomas than chrysotile fibers (Mossman et al. 1990a; American Thoracic Society 1990) (see also Section 3.4.3.1).

Iron Content. Iron is a redox-active metal and can catalyze the formation of hydroxyl radicals from superoxide and hydrogen peroxide via the Haber-Weiss reaction (the potential role of oxidant species in asbestos toxicity is discussed in Section 3.5.2). Evidence supporting the importance of iron in asbestos-induced toxicity include the success of iron chelators (desferrioxamine) in inhibiting the production of reactive oxygen species and subsequent toxicity (Goodglick et al. 1989; Kamp et al. 1992; Lund and Aust 1991b; Mahmood et al. 1993; Simeonova and Luster 1995). Desferrioxamine has also been shown to decrease the ability of asbestos fibers to induce DNA single-strand lesions (Chao and Aust 1994; Kienast et al. 2000). Silicate fibers capable of producing pneumoconiotic changes were also able to serve as Haber-Weiss catalysts, whereas silicate fibers that were nonpneumoconiotic lacked this activity (Kennedy et al. 1989).

There are several possible sources of iron in the lung that may contribute to asbestos toxicity. One source of iron is the fiber itself. Crocidolite and amosite asbestos may contain levels of 26–36% iron by weight (Lund and Aust 1991a). A second source of iron is as a contaminant of asbestos. Iron-containing minerals such as pyrite, magnetite, nemalite, and iron ore often occur as contaminants of asbestos and can be deposited in the lung along with asbestos fibers (Fontecave et al. 1990). A third possible source of iron is from within the exposed animal. Ferritin (an iron-containing protein) is present in macrophages and giant cells. Iron metabolism was found to be altered in these cells by the presence of poorly digestible fibers (Koerten et al. 1990a). Iron is also a component of the protein-coat covering asbestos bodies (Ghio et al. 1997; Koerten et al. 1990a, 1990b). The extent to which each of these sources of iron contribute to the catalysis of hydroxyl radical formation *in vivo* is uncertain and warrants further investigation.

3.5.2 Mechanisms of Toxicity

This section provides an overview of several potential mechanisms involved in the development of asbestos-induced health effects (direct interaction with macromolecules, active oxygen mechanisms, and other cell-mediated mechanisms). An expert panel convened by IARC concluded in 1996, "Overall, the available evidence in favor or against any of these mechanisms leading to the development of lung cancer and mesothelioma in either animals or humans is evaluated as weak" (IARC Expert Panel 1996). Pulmonary inflammatory factors (a subset of other cell-mediated mechanisms) were considered by the IARC panel as having the most support among the potential mechanisms involved. For additional information on the molecular mechanisms of asbestos-induced pulmonary disease discussed below, including potential interactions between a number of the mechanisms, see recent reviews (Kamp and Weitzman 1999; Kinnula 1999; Lee and Testa 1999; Murthy and Testa 1999; Robledo and Mossman 1999).

Direct Interaction. Asbestos fibers can adsorb to a variety of cellular macromolecules (e.g., proteins, membrane lipids, RNA, DNA). In rat lung microsomes, chrysotile fibers were found to bind to cytochrome P-450, thereby decreasing mono-oxygenase activity (Khan et al. 1992; Rahman et al. 1990). Chrysotile and crocidolite fibers were found to bind to artificial lipid membranes *in vitro*, thereby increasing membrane rigidity (Gendek and Brody 1990). This effect was also noted in erythrocytes, and may be responsible in part for the *in vitro* hemolytic activity of asbestos fibers. The interaction between asbestos fibers and cell membranes was mediated in part by surface charge (positively charged chrysotile fibers can become associated with negatively charged membrane constituents), and also fiber binding to fibronectin, a glycoprotein found in abundance in the alveolar lining fluid (Brown et al. 1991). Dielectric changes in membrane properties and cell interiors have been observed in cultured human mesothelial cells exposed to crocidolite fibers (Dopp et al. 2000). Peterson et al. (1993) noted that the integrity of cultured human lung epithelial cells was compromised by chrysotile, resulting in increases in epithelial permeability that occurred in the absence of cell death and inflammatory cells. The coulombic forces between the asbestos fiber and macromolecules (DNA, RNA, and protein) may induce conformational changes (Brown et al. 1998; Chang et al. 1990), and these changes could affect protein function and chromosomal fidelity. Surface charge density may also be an important factor in fiber potency (Bonneau et al. 1986; Davis et al. 1988). In some studies, asbestos fibers were observed to interfere with cytokinesis (Jensen and Watson 1999). Fibers found to be translocated near the nucleus can interact with the cytoskeleton and interfere with chromosome segregation (Ault et al. 1995; Malorni et al. 1990) or with micronucleus formation (Lu et al. 1994a). Deletions of chromosome segments (particularly the short arm of chromosome 3 and portions of chromosomes 1, 6, 9, 15, and 22) have been noted in human mesothelioma cells or cell lines (Balsara et al. 1999; Barrett et al. 1989; Bell et al. 1997; Cheng et al. 1993, 1994; Flejter et al. 1989; Lee et al. 1996; Lu et al. 1994b; Taguchi et al. 1993), and interference with chromosome segregation may at least partially account for this (Barrett et al. 1989). Recent work by J.R. Testa and coworkers (see Murthy and Testa 1999) indicates that certain tumor suppressor genes are frequently altered in the regions of asbestos-induced deletions, although underlying mechanisms have not been clearly elucidated.

Additional evidence supporting the importance of fiber surfaces comes from studies in which the fiber surfaces have been altered. Modification of asbestos fiber surfaces with certain dyes, alkyl groups, or phosphate was found to decrease their *in vitro* hemolytic and cytotoxic activity (Awadalla et al. 1990; Brown et al. 1990, 1991; Habashi et al. 1991). However, relative to untreated chrysotile fibers, alteration of the fiber surface chemistry (via HCl treatment) did not significantly alter the results of a genotoxicity test that assessed the induction of micronuclei in Chinese hamster lung fibroblasts treated *in vitro* (Keane et al. 1999). Cyclical stretching of cultured human alveolar cells during exposure to asbestos fibers (as might occur during normal breathing) resulted in increased production of the proinflammatory cytokine interleukin-8, presumably in response to a direct mechanical interaction between asbestos fibers and the alveolar cells. This response was enhanced when the fibers were coated with fibronectin (Tsuda et al. 1999). In general, these data suggest that direct interactions between asbestos fibers and key cellular molecules may be responsible, at least in part, for asbestos-related health effects.

Active Oxygen Mechanism. In response to asbestos fibers, alveolar macrophages produce reactive oxygen species in an attempt to digest the fiber. The reactive oxygen species include hydrogen peroxide and superoxide radical anion (O_2^-) (Cantin et al. 1988; Case et al. 1986; Hansen and Mossman 1987; Nyberg and Klockars 1991; Roney and Holian 1989). These reactive oxygen species are relatively mild oxidants. However, they can spontaneously react with each other, producing hydroxyl radicals that are much more potent oxidants. This reaction is often referred to as the Haber-Weiss or Fenton reaction (Garcia et al. 1988; Weitzman and Graceffa 1984; West 1985). The Haber-Weiss reaction is greatly enhanced in the presence of redox-active metals such as iron. Numerous *in vitro* studies have linked the production of reactive oxygen species to asbestos-induced lipid peroxidation (Fontecave et al. 1990; Goodglick et al. 1989; Yano 1988), cytotoxicity (Garcia et al. 1988; Goodglick and Kane 1990; Iguchi and Kojo 1989; Kennedy et al. 1989; Shatos et al. 1987), cell proliferation (Marsh and Mossman 1991), genotoxicity (Chao et al. 1996; Fung et al. 1997a; Kienast et al. 2000; Korkina et al. 1992; Lund and Aust 1991a, 1992; Xu et al. 1999), and apoptosis (Broaddus et al. 1996, 1997). *In vitro* studies have also shown that the effects of asbestos are diminished by the addition of catalase and superoxide dismutase (enzymes that catalyze the decomposition of reactive oxygen species), free radical scavengers (ascorbic acid, bemitil, mannitol, salicylate, 5,5'-dimethyl-1-pyroline N-oxide, rutin, vitamin E) (Brown et al. 1998; Faux and Howden 1997; Garcia et al. 1988; Goodglick and Kane 1990; Goodglick et al. 1989; Iguchi and Kojo 1989; Kienast et al. 2000; Korkina et al. 1992; Lund and Aust 1992; Yano 1988), or calcium channel inhibitors (Ishizaki et al. 1997; Lim et al. 1997). Cell membrane lipids have been shown to undergo peroxidation, resulting in increased membrane permeability in rat lung fibroblasts cultured with asbestos (Iguchi et al. 1993). Additional evidence supporting the involvement of reactive oxygen species in asbestos toxicity comes from *in vivo* studies. Intratracheal instillation of chrysotile asbestos in rats has been shown to lead to hydroxyl radical formation (Schapira et al. 1994). Activities of superoxide dismutase, glutathione peroxidase, and catalase were significantly elevated in rats exposed to crocidolite by inhalation (Janssen et al. 1992). Decreases in a number of antioxidants known to protect against oxidative stress were observed in alveolar macrophages or the bronchoalveolar lavage of rats exposed to asbestos fibers via intratracheal instillation (Abidi et al. 1999; Kaiglová et al. 1999). Levels of superoxide dismutase and plasma malondialdehyde (an indicator of lipid peroxidation) were significantly elevated in asbestos workers compared to controls (Kamal et al. 1989, 1992). Lipid peroxidation was noted in cells and fluid from bronchoalveolar lavage of rats after exposure to crocidolite (Ghio et al. 1998; Petruska et al. 1991); endogenous peroxidase activity was noted in macrophages from pleural lavage of mice after intraperitoneal injection of crocidolite (Branchaud et al. 1993). Cytotoxic and oxidative responses indicative of oxidative stress were observed in alveolar macrophages and peripheral red blood cells (RBCs) of rats exposed to crocidolite or chrysotile fibers via intratracheal instillation (Afaq et al. 1998). Interestingly, uptake of asbestos fibers into epithelial cells is increased by reactive oxygen species (Hobson et al. 1990; Peterson and Kirschbaum 1998). Overall, the data collectively indicate that the production of reactive oxygen species is likely to be an important component of the mechanism of asbestos-induced toxicity.

Other Cell-Mediated Mechanisms. In addition to the release of active oxygen species, alveolar macrophages and other cells, including pleural mesothelial and lung cells, release a number of cellular factors in response to asbestos exposure. These factors are mediators of a number of cellular reactions including inflammation, macrophage recruitment and cell proliferation (for reviews, see Driscoll et al. 1997; Xing et al. 1999). Chronic stimulation of these pathways can result in a gradual loss of some epithelial cells, proliferation and deposition of collagen by fibroblasts, or alterations of cellular phenotype (Davis and Jones 1988; Davis et al. 1986c; Holian et al. 1997; Lasky et al. 1996). These data suggest that the effects of asbestos exposure may be mediated by stimulation of the autocrine (same cell) and paracrine (different cell) systems.

Recent work has suggested potentially important mechanistic roles for a number of nuclear regulatory proteins, oncogenes, proto-oncogenes, and second messenger proteins. Among these are nuclear factor-κβ (NF-κβ) (Barchowsky et al. 1998; Cheng et al. 1999b; Driscoll et al. 1998; Faux and Howden 1997; Luster and Simeonova 1998; Mossman et al. 1997; Oettinger et al. 1999; Simeonova and Luster 1996), activator protein-1 (AP-1), including its subunits of c-fos, c-jun, and fra-1 (Faux and Howden 1997; Fung et al. 1997b; Heintz et al. 1993; Janssen et al. 1995; Mossman et al. 1997; Sandhu et al. 2000; Zanella et al. 1999), p53 (Hayashi et al. 1996; Johnson and Jaramillo 1997), *ras* (Hayashi et al. 1996; Nelson et al. 1999), tyrosine kinases (Peterson and Kirschbaum 1998), and protein kinase c (PKC) (Fung et al. 1997b; Lim et al. 1997; Simeonova and Luster 1996). Interestingly, a number of these factors have been shown to influence the production of other cellular factors (Barnes 1997; Blackwell and Christman 1997; Cheng et al. 1999b). Additionally, cellular oxidant status has been shown to influence the behavior of AP-1 and NF-κβ (Janssen and Sen 1999; Janssen et al. 1995; Simeonova et al. 1997). The latter two observations have served to further the view that NF-κβ and AP-1 play roles in asbestos-induced lung injury, as they would allow for the integration of several of the mechanisms proposed above (i.e., asbestos-associated iron could generate oxygen radicals, leading to the increased activity of nuclear factors, which induce cytokine genes, leading to cell infiltration and proliferation).

A number of the factors mentioned above also participate in the pathways regulating pulmonary inflammation. Although poorly understood, the inflammatory response is thought to play an important role in the development of asbestos-induced pulmonary disease and is the one mode of toxic action for which there are supporting human data from *in vitro* and *in vivo* studies (IARC Expert Panel 1996). Asbestos exposure has been shown to elicit a complement-dependant increase in the number of alveolar macrophages at sites of asbestos deposition (Warheit et al. 1984, 1985, 1986, 1988). Other chemotactic factors include leukotrienes (Dubois et al. 1989; Garcia et al. 1989; Hayes et al. 1990), prostaglandins (Bissonnette et al. 1989, 1990; Garcia et al. 1988), and interleukins (Boylan et al. 1992; Griffith et al. 1994; Luster and Simeonova 1998; Perkins et al. 1993). One factor that has been particularly well-studied with regards to its role in the asbestos-induced inflammatory response is TNF-α. A number of studies have demonstrated a role of TNF-α in the inflammatory response following asbestos exposure in animals (Dubois et al. 1989; Liu et al. 1998; Simeonova and Luster 1995) and humans (Zhang et al.

1993). Asbestos-associated TNF-α has been shown both to induce and to be induced by oxidant species (Pietarinen-Runtti et al. 1996; Simeonova and Luster 1995). Reduction of TNF-α *in vivo* results in a protection from asbestos-induced fibrotic changes (Brass et al. 1999; Liu et al. 1998). Some of the asbestos-induced inflammatory reactions may be related to fiber type. For example, crocidolite, but not chrysotile, induced increased production of TNF-α and interleukin 1β in cultured rat alveolar macrophages exposed for up to 14 days, whereas chrysotile, but not crocidolite, increased production of superoxide anion and nitric oxide radicals (Mongan et al. 2000).

3.5.3 Animal-to-Human Extrapolations

The vast majority of experimental studies of asbestos have been performed in rodent model systems. Results from inhalation studies indicate that rats are suitable qualitative models for asbestos-induced pulmonary diseases, demonstrating chronic inflammation, pulmonary fibrosis (see Section 3.2.1.2), lung cancer (see Section 3.2.1.8), and mesothelioma (see Section 3.2.1.8) following chronic asbestos exposure. Hamsters seem to be more sensitive than rats to mesothelioma development, but less sensitive to the development of pulmonary tumors (Warheit and Hartsky 1994).

Some investigators have suggested that rats may be less sensitive to the development of asbestos-related mesotheliomas than humans. Rödelsperger and Woitowitz (1995) reported, based on the studies of McDonald et al. (1989, 1993) and Doll and Peto (1985), an increased risk in humans for mesothelioma at pulmonary fiber burdens as low as 0.2 f/μg dry weight, whereas a 44-week rodent exposure yielded a 6,000-fold higher lung fiber burden (1,250 f/μg), but less than a 1% incidence of mesothelioma. One possible explanation for this putative difference in sensitivity is that the shorter lifespan of rodents compared to humans, combined with the long latency period for asbestos-related diseases (generally $10 years), does not allow for late-developing respiratory effects to develop in rodents. Alternately, it may relate to differences in deposition and clearance patterns between rats and humans (Asgharian et al. 1995; Hofmann et al. 1989). However, this alternative explanation is difficult to verify because the deposition and clearance patterns for asbestos in humans are poorly described. Additional research on deposition and clearance of asbestos fibers in humans may help to properly address this issue.

3.6 ENDOCRINE DISRUPTION

Recently, attention has focused on the potential hazardous effects of certain chemicals on the endocrine system because of the ability of these chemicals to mimic or block endogenous hormones, or otherwise interfere with the normal function of the endocrine system. Chemicals with this type of activity are most commonly referred to as endocrine disruptors. Some scientists believe that chemicals with the ability to disrupt the endocrine system are a potential threat to the health of humans, aquatic animals, and wildlife. Others believe that endocrine disrupting chemicals do not pose a significant health risk, particularly in light of the fact that hormone mimics exist in the natural environment. Examples of natural hormone mimics are the isoflavinoid phytoestrogens (Adlercreutz 1995; Livingston 1978; Mayr et al. 1992). These compounds are derived from plants and are similar in structure and action as endogenous estrogen. While there is some controversy over the public health significance of endocrine disrupting chemicals, it is agreed that the potential exists for these compounds to affect the synthesis, secretion, transport, binding, action, or elimination of natural hormones in the body that are responsible for the maintenance of homeostasis, reproduction, development, and/or behavior (EPA 1997). As a result, endocrine disruptors may play a role in the disruption of sexual function, immune suppression, and neurobehavioral function. Endocrine disruption is also thought to be involved in the induction of breast, testicular, and prostate cancers, as well as endometriosis (Berger 1994; Giwercman et al. 1993; Hoel et al. 1992).

No studies were located regarding endocrine disruption in humans or animals after exposure to asbestos. No *in vitro* studies were located regarding endocrine disruption by asbestos.

3.7 CHILDREN'S SUSCEPTIBILITY

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans, when all biological systems will have fully developed. Potential effects on offspring resulting from exposures of parental germ cells are considered, as well as any indirect effects on the fetus and neonate resulting from maternal exposure during gestation and lactation. Relevant animal and *in vitro* models are also discussed.

Children are not small adults. They differ from adults in their exposures and may differ in their susceptibility to hazardous chemicals. Children's unique physiology and behavior can influence the extent of their exposure. Exposures of children are discussed in Section 6.6 Exposures of Children.

Children sometimes differ from adults in their susceptibility to hazardous chemicals, but whether there is a difference depends on the chemical (Guzelian et al. 1992; NRC 1993). Children may be more or less susceptible than adults to health effects, and the relationship may change with developmental age (Guzelian et al. 1992; NRC 1993). Vulnerability often depends on developmental stage. There are critical periods of structural and functional development during both prenatal and postnatal life and a particular structure or function will be most sensitive to disruption during its critical period(s). Damage may not be evident until a later stage of development. There are often differences in pharmacokinetics and metabolism between children and adults. For example, absorption may be different in neonates because of the immaturity of their gastrointestinal tract and their larger skin surface area in proportion to body weight (Morselli et al. 1980; NRC 1993); the gastrointestinal absorption of lead is greatest in infants and young children (Ziegler et al. 1978). Distribution of xenobiotics may be different; for example, infants have a larger proportion of their bodies as extracellular water and their brains and livers are proportionately larger (Altman and Dittmer 1974; Fomon 1966; Fomon et al. 1982; Owen and Brozek 1966; Widdowson and Dickerson 1964). The infant also has an immature blood-brain barrier (Adinolfi 1985; Johanson 1980) and probably an immature blood-testis barrier (Setchell and Waites 1975). Many xenobiotic metabolizing enzymes have distinctive developmental patterns. At various stages of growth and development, levels of particular enzymes may be higher or lower than those of adults, and sometimes unique enzymes may exist at particular developmental stages (Komori et al. 1990; Leeder and Kearns 1997; NRC 1993; Vieira et al. 1996). Whether differences in xenobiotic metabolism make the child more or less susceptible also depends on whether the relevant enzymes are involved in activation of the parent compound to its toxic form or in detoxification. There may also be differences in excretion, particularly in newborns who all have a low glomerular filtration rate and have not developed efficient tubular secretion and resorption capacities (Altman and Dittmer 1974; NRC 1993; West et al. 1948). Children and adults may differ in their capacity to repair damage from chemical insults. Children also have a longer remaining lifetime in which to express damage from chemicals; this potential is particularly relevant to cancer.

Certain characteristics of the developing human may increase exposure or susceptibility, whereas others may decrease susceptibility to the same chemical. For example, although infants breathe more air per kilogram of body weight than adults breathe, this difference might be somewhat counterbalanced by their alveoli being less developed, which results in a disproportionately smaller surface area for alveolar absorption (NRC 1993).

As discussed in Section 3.2 and Chapter 2, numerous studies of occupationally-exposed adult workers identify respiratory effects including interstitial fibrosis, lung cancer, and pleural and/or peritoneal mesotheliomas, as critical health effects, of concern from exposure to airborne asbestos. Typically, these health effects follow chronic exposures and exhibit latencies of 10–40 years, although some cases of asbestosis and pleural plaques have been reported following subchronic exposure.

Some investigators have associated childhood exposures (e.g., from asbestos-laden clothing of occupationally-exposed family members or close childhood proximity to asbestos mining operations) with development of asbestos-related respiratory diseases in adulthood (Anderson et al. 1976; Inase et al. 1991; Magee et al. 1986; McDonald and McDonald 1980; Voisin et al. 1994; Wagner et al. 1960). Malignant mesothelioma is a rare childhood neoplasm that does not appear to be associated with asbestos exposure, in contrast to mesothelioma in adults. Only 80 suspected cases were identified in the literature as of 1988 (Fraire et al. 1988); of these, only 2 girls (3 and 17 years of age) had a history of possible exposure to asbestos. In a more recent published case report, mesothelioma was diagnosed in a 17-year-old boy who lived in a rural setting, had no familial relations with an asbestos worker, and had been exposed daily to asbestos fibers in a cosmetic talc from about 9–12 years of age (Andrion et al. 1994). There was no information regarding the asbestos level in the talc, but the boy exhibited a lung tissue asbestos concentration of 0.51×10^6 f/g dry tissue (62% chrysotile and 38% tremolite). It is not recommended that this value be compared to the mean lung asbestos fiber concentration of 0.11×10^6 f/g , reported by Case et al. (1994) for 60 U.S. children, because there are appreciable variations in lung burden methods and results between laboratories. Andrion et al. (1994) noted, however, that based on lung fiber concentrations determined by their referring laboratory for 85 general autopsy cases of adult subjects living in a polluted urban setting, the boy's asbestos fiber burden was unusually high for a rural dweller and was within the range for the highest 16th percentile of this sample of urban dwellers (range from 0.2 to 3.0×10^6 f/g). The estimated latency period of 8 years is short relative to a latency period of greater than 15 years in 99% of 1,105 adult cases of asbestos-induced mesotheliomas in occupationally-exposed workers reviewed by Lanphear and Buncher (1992). It is uncertain if the relatively short latency period in this case was related to an increased age-related susceptibility, a relatively high exposure level, or an individual susceptibility unrelated to age.

A cohort of 4,659 former residents of Wittenoom, Western Australia, who had lived there between 1943 and 1993 for at least 1 month, and were environmentally, but not occupationally, exposed to asbestos (crocidolite), was studied by Hansen et al. (1998). The rate of mesothelioma in the cohort increased significantly with time from first environmental exposure, duration of exposure, and cumulative exposure.

However, incidence of mesothelioma was not significantly related to age of first exposure (treated as a continuous variable and adjusting for all other variables). Those first exposed as children under 10 years of age exhibited a lower incidence of mesothelioma than those first exposed at an older age.

The lack of reports of asbestos-related respiratory diseases in children suggest that children may not develop respiratory diseases during childhood in response to environmental or “paraoccupational” exposure to asbestos. The long-term retention of asbestos fibers in the lung and the long latency period for onset of asbestos-related respiratory diseases suggest that individuals exposed earlier in life may be at greater risk to the eventual development of respiratory problems than those exposed later in life, but direct evidence for this hypothesis is not available. In contrast, incidence of mesothelioma was not significantly related to age of first exposure in the study by Hansen et al. (1998).

Studies examining age-related susceptibility to airborne asbestos in animals were not located. There was no indication from the available literature that specialized respiratory defense mechanisms might be less active or underdeveloped in children relative to adults. An association has been noted between the slow N-acetyltransferase 2 (NAT2) genotype and the increased risk for developing mesothelioma or nonmalignant respiratory disease in adults exposed to high levels of asbestos (Hirvonen et al. 1995, 1996; see Section 3.10 for more details). To date, it is uncertain if that reported early developmental differences in the expression of NAT2 (Leeder and Kearns 1997) may lead to developmental differences in susceptibility to asbestos toxicity.

No information was located specifically concerning health effects in children exposed to asbestos by the oral or dermal routes. Childhood exposures are likely to result in responses similar to those reported in adults (see Sections 3.2.2 and 3.2.3).

No human studies were located regarding asbestos-related developmental toxicity by any exposure route, but one group of investigators has reported that asbestos fibers were detected more frequently and at higher mean concentrations in tissues from stillborn infants than in placental tissues from live births (Haque et al. 1991, 1992, 1996, 1998). It is unclear if the differences in asbestos tissue counts between these stillborn and liveborn groups are related to either differences in maternal environmental exposure leading to transplacental transfer of fibers, nonexposure-related differences in fetal or placental factors leading to a breach of the normal fetal/placental barrier and an accumulation of fibers in fetal and placental tissue, or sample contamination. Transplacental transfer of asbestos fibers has been demonstrated in pregnant rats and mice given single bolus intravenous injections of asbestos suspensions

(Cunningham and Pontefract 1974; Haque and Vrazel 1998), but the tissue counts in both of these experiments were highly variable. For example, the range of concentrations in 36 digests of fetal tissues sacrificed 1 hour after injection in the mouse experiment ranged from 116 to 30,342 f/g (Haque and Vrazel 1998). This variability may due to an inconsistent mass breakthrough of fibers associated with the bolus intravenous administration (Cunningham and Pontefract 1974). It is expected that the extent of transplacental transfer of fibers would be much less with inhalation, oral, or dermal exposures.

No animal developmental toxicity studies were located for inhalation or dermal routes of exposure. Results from chronic oral studies in rats and hamsters provided no indication of potential for developmental toxicity (exposure was through gestation, weaning, and adulthood), except for some slight reductions in pup birth weight (which might possibly be secondary to asbestos exposure) (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c). Likewise, no exposure-related developmentally toxic effects were found in pregnant mice exposed during gestation to asbestos in drinking water at concentrations as high as 143 μg/mL (Schneider and Maurer 1977).

3.8 BIOMARKERS OF EXPOSURE AND EFFECT

Biomarkers are broadly defined as indicators signaling events in biologic systems or samples. They have been classified as markers of exposure, markers of effect, and markers of susceptibility (NAS/NRC 1989).

Due to a nascent understanding of the use and interpretation of biomarkers, implementation of biomarkers as tools of exposure in the general population is very limited. A biomarker of exposure is a xenobiotic substance or its metabolite(s) or the product of an interaction between a xenobiotic agent and some target molecule(s) or cell(s) that is measured within a compartment of an organism (NAS/NRC 1989). The preferred biomarkers of exposure are generally the substance itself or substance-specific metabolites in readily obtainable body fluid(s), or excreta. However, several factors can confound the use and interpretation of biomarkers of exposure. The body burden of a substance may be the result of exposures from more than one source. The substance being measured may be a metabolite of another xenobiotic substance (e.g., high urinary levels of phenol can result from exposure to several different aromatic compounds). Depending on the properties of the substance (e.g., biologic half-life) and environmental conditions (e.g., duration and route of exposure), the substance and all of its metabolites may have left the body by the time samples can be taken. It may be difficult to identify individuals exposed to hazardous substances that are commonly found in body tissues and fluids (e.g., essential mineral nutrients such as copper, zinc, and selenium). Biomarkers of exposure to asbestos are discussed in Section 3.8.1.

Biomarkers of effect are defined as any measurable biochemical, physiologic, or other alteration within an organism that, depending on magnitude, can be recognized as an established or potential health impairment or disease (NAS/NRC 1989). This definition encompasses biochemical or cellular signals of tissue dysfunction (e.g., increased liver enzyme activity or pathologic changes in female genital epithelial cells), as well as physiologic signs of dysfunction such as increased blood pressure or decreased lung capacity. Note that these markers are not often substance specific. They also may not be directly adverse, but can indicate potential health impairment (e.g., DNA adducts). Biomarkers of effects caused by asbestos are discussed in Section 3.8.2.

A biomarker of susceptibility is an indicator of an inherent or acquired limitation of an organism's ability to respond to the challenge of exposure to a specific xenobiotic substance. It can be an intrinsic genetic or other characteristic or a preexisting disease that results in an increase in absorbed dose, a decrease in the biologically effective dose, or a target tissue response. If biomarkers of susceptibility exist, they are discussed in Section 3.10 “Populations That Are Unusually Susceptible”.

3.8.1 Biomarkers Used to Identify or Quantify Exposure to Asbestos

Principal biomarkers of exposure to asbestos fibers include the detection and counting of fibers or asbestos bodies in bronchoalveolar lavage fluid samples (De Vuyst et al. 1982, 1988, 1997; Dumortier et al. 1990, 1998; Roggli et al. 1994a; Sebastien et al. 1988a; Teschler et al. 1994; Tuomi et al. 1991b), sputum samples (McDonald et al. 1988, 1992; Sebastien et al. 1988b), or in autopsied or surgically resected lung tissue samples (Case 1994; Churg 1982; Churg and Warnock 1981; Churg and Wright 1994; Churg et al. 1993; de Klerk et al. 1996; Dodson et al. 1999; Dufresne et al. 1995, 1996a, 1996b; Sebastien et al. 1989). Asbestos bodies are collections of fibers (usually of length >8 µm) with a protein-iron coating (also known as ferruginous bodies) that, when observed in lung tissue sections in conjunction with fibrosis, have been proposed to be used in the diagnosis of asbestosis (Churg 1989; Craighead et al. 1982). Whereas light microscopy can be used to detect and count asbestos bodies, most uncoated fibers in tissue or fluid samples are too small to be visible (Dodson et al. 1999). Transmission or scanning electron microscopy is used to detect and count uncoated asbestos fibers in lung tissue or fluid samples, and electron diffraction or energy-dispersive x-ray analysis is used to determine asbestos type (e.g., chrysotile, anthophyllite, tremolite) (NIOSH 1994b). These biomarkers provide indicators of retained internal dose, the cumulative net result of deposition and clearance of inhaled asbestos fibers.

Analyses of bronchoalveolar lavage fluid samples or sputum samples can directly reflect alveolar concentrations of retained fibers and, although they do not reflect the proportion of deposited fibers that may move to the interstitium (Case 1994; Pinkerton et al. 1984), can provide information regarding past exposure to asbestos, especially to amphibole fibers. Obtaining sputum samples is much less invasive than obtaining bronchoalveolar lavage samples. In Libby, Montana vermiculite miners and millers exposed to fibrous tremolite, counts of asbestos bodies in sputum samples closely reflected intensity and duration of past exposure (Sebastien et al. 1988b), but asbestos body counts in sputum samples from volunteers from other cohorts of workers exposed to asbestos (predominately chrysotile or lower levels of amphibole fibers than in Libby) did not reliably reflect past levels of exposure (McDonald et al. 1988, 1992). Concentrations of asbestos bodies in bronchoalveolar lavage fluid samples have been reported to reflect past exposure to asbestos fibers in a number of studies (De Vuyst et al. 1988, 1997; Dumortier et al. 1990, 1998; Roggli et al. 1994a; Teschler et al. 1994; Tuomi et al. 1991b) and to correlate with lung tissue concentrations of asbestos bodies (De Vuyst et al. 1988; Sebastien et al. 1988a; Teschler et al. 1994), but exposure to amphibole fibers may be better reflected than exposure to chrysotile fibers. For example, Sebastien et al. (1988a) reported a statistically significant correlation ($r=0.74$, $p<0.0001$) between concentrations of asbestos bodies in bronchoalveolar fluid samples (which ranged from 0.05 to 10^4 asbestos bodies/mL) and concentrations in lung parenchyma tissue samples (which ranged from 40 to 8.9×10^6 asbestos bodies/g dried lung parenchyma) in 69 patients who had either an open lung biopsy or an autopsy. Sebastien et al. (1988a) concluded that bronchoalveolar concentrations exceeding 1 asbestos body /mL predict that the parenchymal concentration will be in excess of 1,000 asbestos bodies/g dry tissue and that the patient will have experienced "a nontrivial asbestos exposure." Dumortier et al. (1990) reported that, in brake lining and asbestos cement workers, the core fiber of the asbestos bodies was usually amphibole fibers, but chrysotile cores were found in most recently exposed brake lining workers examined. A statistically significant correlation between asbestos body concentrations in bronchoalveolar fluid samples and lung parenchyma samples was also found in 20 patients with histories of occupational exposure to mixed (chrysotile and amphibole) asbestos fibers (Teschler et al. 1994). Concentrations of uncoated amphibole fibers (fibers were counted as particles with nearly parallel long edges, lengths >1 µm, and aspect ratios >3:1) in bronchoalveolar fluid samples were correlated with concentrations of uncoated amphibole fibers in lung parenchyma, but concentrations of uncoated chrysotile fibers in fluid samples were not correlated with concentrations in lung parenchyma samples (Teschler et al. 1994). Teschler et al. (1994) concluded that concentrations of asbestos bodies and amphibole fibers in bronchoalveolar fluid samples reliably predict lung concentrations of retained amphibole fibers, but not retained chrysotile fibers, and that negative findings for asbestos bodies in bronchoalveolar fluid samples do not necessarily rule out significant exposure to asbestos fibers.

Analysis of concentrations of asbestos bodies (by light microscopy) or asbestos fibers (by electron microscopy) in lung tissue samples may represent more accurate reflections of past asbestos exposure than analysis of bronchoalveolar fluid or sputum samples, but these approaches are not without difficulties, especially for assaying exposure to chrysotile fibers, which are more rapidly cleared than amphibole fibers (Case 1994; Churg and Wright 1994). Although asbestos bodies can form on lung retained chrysotile, amphibole cores appear to be more prevalent in general populations and asbestos-exposed occupational groups, even though exposure may have primarily involved chrysotile (Case 1994; Dumortier et al. 1990). Correlations between lung concentrations of asbestos bodies and concentrations of retained uncoated asbestos fibers in numerous studies have been observed most consistently for amphibole fibers and generally not for chrysotile fibers (Albin et al. 1990b; Case et al. 1994; Karjalainen et al. 1996a, 1996b).

Comparison of lung fiber concentrations across studies and laboratories and establishment of benchmark lung fiber concentrations to indicate occupational exposure are difficult due to differences in preparative and sampling methods, types of electron microscope and magnification, and criteria for defining and counting fibers (Gylseth et al. 1985). In addition, numerous studies of measured indices of occupational asbestos exposure, such as years of exposure or cumulative exposure, and lung retained fiber concentrations generally have shown significant correlations between exposure and concentrations of retained amphibole fibers, but do not generally show a correlation between exposure and retained chrysotile fiber concentrations (see Churg and Wright 1994 for review of many of these studies). These findings are generally taken to reflect much faster clearance of the major proportion of deposited chrysotile fibers compared with amphibole fibers. However, studies (Case 1991; Case and Sebastien 1987, 1989) conducted by a single laboratory of Quebec chrysotile miners and millers, their families, residents without familial connections to the mines and mills, and referent residents who did not live close to the mines found that lung concentrations of chrysotile fibers, tremolite fibers, and asbestos bodies were related to increasing proximity of residence to the mines and increasing degree of domestic or occupational exposure. From the results of these studies, Case (1994) concluded that asbestos body concentrations over 250 asbestos bodies/g dry lung and chrysotile or tremolite fiber concentrations greater than $1x10^5$ fibers/g dry lung were “robust indicators of mining area residence”.

For the attribution of asbestos exposure in individual cases, recommendations have been made to combine all available exposure data, including work history, radiological and histological findings, and lung concentrations of asbestos bodies and fibers when appropriate (Case 1994; Karajalainen et al. 1996a, 1996b). Benchmark concentrations of 0.1–1x10^6 fibers/g dry lung have sometimes been used as indicators of occupational asbestos exposure (Case 1994; International Expert Meeting on Asbestos 1997). Their application to ascertain or validate occupational exposure in individual cases, however, especially those involving chrysotile exposure, is expected to result in both false positives and false negatives, because of the variability in the association between exposure measures and retained fiber concentrations (Becklake and Case 1994; Case 1994; Karajalainen et al. 1994a; Takahashi et al. 1994; Williams et al. 1995). Some of this variability is likely attributable to analytical variability due to contamination or loss in processing, variability in retention of fibers in different regions of the lung and variability in sampling of different lung regions, variability in exposure parameters including fiber type, length, and width, and variability in individuals' physiological parameters influencing retention.

Concentrations of retained fibers in autopsied or resected lung tissue samples also have been used as exposure variables in several case-control studies designed to characterize potential dose-response relationships for asbestos-induced mesothelioma and attribute risk to specific fiber types and size classes (McDonald et al. 1989; Rödelsperger et al. 1999; Rogers et al. 1991). Results from these studies indicated that relative risk for mesothelioma was significantly related to increasing concentrations of amphibole fibers longer than 5 µm (Rödelsperger et al. 1999), 8 µm (McDonald et al. 1989), or 10 µm (Rogers et al. 1991). Significant relationships with increasing concentrations of retained chrysotile fibers were less apparent in these studies. Rödelsperger et al. (1999) and McDonald et al. (1989) did not find statistically significant trends for increasing relative risks (odds ratios) with increasing retained chrysotile fiber concentrations. Rogers et al. (1991) found a statistically significant trend for increasing relative risks with increasing chrysotile fiber concentration (all lengths included), but this was only found in a subgroup of cases and controls with only chrysotile fibers detected in their lungs.

Asbestos fibers have also been measured in urine (see Section 7.1), and limited data indicate that above average exposures in the workplace (Finn and Hallenbeck 1984) and through drinking water (Cook and Olson 1979) can be detected by this means. However, only a tiny fraction of inhaled or ingested fibers is excreted in the urine, and the quantitative relationship between exposure and urinary fiber concentration appears quite variable. Moreover, urinary levels presumably are mainly a reflection only of recent exposures. Thus, urinary analysis for fibers has not been established or validated as a reliable means of biomonitoring for chronic asbestos exposure.

3.8.2 Biomarkers Used to Characterize Effects Caused by Asbestos

The most common means of characterizing the effects of inhalation exposure to asbestos in living persons is the chest x-ray (e.g., Amandus et al. 1987; Anton-Culver et al. 1989; Jones et al. 1988b; McDonald et al. 1986b). The International Labour Office (ILO) established a classification system for profusion of opacities in chest radiographs that includes four categories of increasing severity, each with three subcategories: 0 (0/-, 0/0, 0/1); 1 (1/0, 1/1, 1/2); 2 (2/1, 2/2, 2/3), and 3 (3/2, 3/3, 3/4) (ILO 1989). Chest radiographs are capable of detecting both pleural and parenchymal abnormalities, but sensitivity and specificity are limited (Gefter and Conant 1988). In particular, x-ray changes are rarely detectable until after some degree of physiological impairment has occurred (Aberle et al. 1988a). A more sensitive method is gallium-67 lung scanning, which often can detect asbestos-induced inflammation and other lung abnormalities prior to their detection by x-ray (Bisson et al. 1987; Hayes et al. 1989; Klaas 1993). Computerized tomography (CT) and high-resolution computed tomography (HRCT) may also be superior to conventional radiological examination in some cases (Aberle et al. 1988a, 1988b; Akira et al. 1991; Al Jarad et al. 1993; Friedman et al. 1988; Gamsu et al. 1989; Klaas 1993; Murray et al. 1995; Neri et al. 1994, 1996; Oksa et al. 1994; Sluis-Cremer et al. 1984). Magnetic resonance imaging may also be used to identify asbestos-induced lung abnormalities (Bianchi et al. 1997; Boraschi et al. 1999).

Quantitative analysis of lung function is also used for evaluating the effects of asbestos inhalation (e.g., Ernst et al. 1989; Finkelstein 1986; Kilburn et al. 1995). The specific end points of greatest value are FEV_1 and FVC, since these are most affected by fibrotic changes in the lung. Changes in biphasic lung carbon monoxide diffusing capacity may be better suited for detecting early decreases in lung function due to asbestos exposure (Dujic et al. 1992; Wang et al. 1998). Most studies find that respiratory changes parallel radiological changes (e.g., Britton 1982; Cordier et al. 1987; Di Lorenzo et al. 1996; Dujic et al. 1992; Markowitz et al. 1997; Miller et al. 1996), although several studies report measurable respiratory decrements in the absence of radiological changes (Ohlson et al. 1984; Wang et al. 1997; Weill et al. 1975).

The American Thoracic Society (1986) adopted a set of criteria for the diagnosis of asbestosis that includes a reliable history of asbestos exposure, an appropriate time interval between exposure and detection, and the following clinical criteria: (a) chest radiographic evidence of small irregular opacifications of a profusion of 1/1 or greater using the ILO classification; (b) a restrictive pattern of lung impairment with a forced vital capacity below the lower limit of normal; (c) a diffusing capacity below the lower limit of normal; and (d) bilateral late or pan inspiratory crackles at the posterior lung bases not cleared by cough. The International Expert Meeting on Asbestos (1997) similarly specified that the confident diagnosis of interstitial fibrosis of the lung as a consequence of exposure to asbestos dust (i.e., asbestosis) requires, in addition to clinical features and architectural tissue abnormalities typical of interstitial fibrosis, a history of significant exposure to asbestos dust, or the detection of asbestos fibers or bodies in lung tissue greatly in excess of that seen in the general population. This group further specified that a histological diagnosis of asbestosis requires identification of diffuse interstitial fibrosis in lung tissue remote from tumors, in addition to the presence of 2 or more asbestos bodies in 1-cm^2 areas of sectioned lung tissue or uncoated lung-retained fiber counts outside of the range for general-population counts from the same laboratory.

Examination of cells and cellular factors present in lung lavage fluid and blood serum may be used to indicate early changes associated with asbestos-induced fibrosis. A number of human studies have shown that the differential cell count (Hayes et al. 1989; Rom 1991) and levels of fibronectin (Begin et al. 1986; Rom 1991), procollagen III (Begin et al. 1986), and hyaluronic acid (Cantin et al. 1992) are elevated in the lung lavage fluid of asbestos workers as compared to nonexposed controls. A significant elevation of the amino-terminal peptide of procollagen III (PIIINP) was found in the serum of asbestos workers when compared to controls (Cavalleri et al. 1991). Also, excretion of the oxidative DNA adduct, 8-hydroxy-deoxyguanosine, has been shown to be increased in the urine of asbestos workers and therefore, might be used to indicate DNA damage (Tagesson et al. 1993).

It is important to stress that radiological, lung lavage, and respiratory tests must be evaluated in conjunction with thorough occupational and environmental history and physical examination. Other causes of lung injury (e.g., smoking, occupational exposures to other chemicals, lung infections) also must be considered when evaluating exposure to asbestos.

3.9 INTERACTIONS WITH OTHER CHEMICALS

In epidemiological studies, an interaction between two risk factors is generally defined as a departure from an additive or multiplicative model of relative risks when both risk factors are present (Steenland and Thun 1986). With respect to lung cancer, some studies indicate that the interaction between asbestos and smoking is greater than additive (DHHS 1985; Selikoff et al. 1968). The most dramatic data include an age-standardized mortality ratio of 5.17 for nonsmoking asbestos workers, 10.85 for smokers not exposed to asbestos, and 53.20 for asbestos-exposed smokers (Hammond et al. 1979). The risk from combined exposure clearly exceeds the predicted risk based on additivity (15.0), and the data suggest a multiplicative interaction. Other studies have found that smoking increases the risk of lung cancer from asbestos exposure more than predicted by additivity, but often less than predicted by a multiplicative model (Liddell et al. 1997, 1998; McDonald et al. 1980; Saracci 1987; Selikoff et al. 1980; Thomas and Whittemore 1988).

The mechanism by which smoking and asbestos interact to increase risk of lung cancer is not known, but several hypotheses (which are not mutually exclusive) have been suggested. One possible mechanism is a smoking-induced decrease in clearance of fibers from the lung, perhaps by interference with ciliary action or macrophage activity (Plowman 1982), leading in turn to increased penetration of the respiratory epithelium by fibers (Hobson et al. 1988; McFadden et al. 1986). For example, significantly higher concentrations of chrysotile and amosite fibers were found in airway mucosa of lungs from smokers, compared with nonsmokers, who had heavy occupational exposure to asbestos (Churg and Stevens 1995). In guinea pigs, clearance of short chrysotile fibers was decreased by 30% after 1 month in those coexposed to cigarette smoke compared to animals exposed to chrysotile alone (Churg et al. 1992). Exposure of explanted rat tracheobronchial epithelial cells to ozone or cigarette smoke resulted in increased retention of asbestos fibers, suggesting that a direct enhancement of fiber uptake may also be involved (Churg et al. 1996, 1998). Increased asbestos fiber retention was also noted in rats exposed to ozone *in vivo* (Pinkerton et al. 1989). Another proposal is that asbestos fibers (either in air or in the lung) may adsorb carcinogenic substances present in smoke, thereby increasing levels of these substances in the lung (Menard et al. 1986; Mossman et al. 1983b). Asbestos fibers may also catalyze the transformation of other compounds to reactive intermediates (Graceffa and Weitzman 1987). Kamp et al. (1998) speculated that iron-induced reactive oxygen species, produced following exposure to both cigarette smoke and asbestos fibers, might cause damage to DNA in pulmonary epithelium. Finally, on the assumption that cancer is a multistep process, asbestos and smoking could interact by affecting different steps in the process. An interaction of this sort between dimethylbenzanthracene and asbestos has been demonstrated in a two-stage carcinogenicity assay *in vitro* (Topping and Nettesheim 1980), with asbestos displaying effects characteristic of a promoter. Asbestos and chemical carcinogens may act synergistically to cause cell proliferation (Mossman et al. 1984; Sekhon et al. 1995) and metaplasia in cells of the lung, events proposed to be involved in tumor development (Mossman et al. 1984).

There is also good evidence that smoking increases the risk of asbestosis. For example, the death rate from asbestosis was found to be 2.8 times higher in asbestos-exposed smokers than in asbestos-exposed nonsmokers (Hammond et al. 1979; Selikoff et al. 1980). Evidence of increased frequency of clinical signs of asbestosis (rales, dyspnea, crepitations) in smoking versus nonsmoking workers has been observed (Berry et al. 1979; Lerman et al. 1986), as has a synergistic effect of smoking on the occurrence of parenchymal opacities in the lungs of asbestos workers (Blanc et al. 1988). On the other hand, several researchers have reported that the effects of asbestos and smoking on these signs are additive rather than synergistic (Begin et al. 1987a; Hnizdo and Sluis-Cremer 1988; Weiss 1984).

In contrast to the interactive effect of smoking on lung cancer and fibrosis, smoking does not appear to increase the risk of mesothelioma (Berry et al. 1985; Hammond et al. 1979; Selikoff et al. 1980).

Data are not available on interactive effects between asbestos and other substances after oral exposure of humans. In animals, chronic oral exposure to asbestos caused no convincing increase in tumors in animals that had been treated with a known intestinal carcinogen (dimethylhydrazine) compared to the incidence in animals treated with dimethylhydrazine alone (NTP 1983, 1985, 1990b). However, these studies were judged to be inconclusive, since the doses of dimethylhydrazine employed gave either too few or too many gastrointestinal tumors to allow easy detection of an effect by asbestos (NTP 1983, 1990b). Gamma radiation, in combination with asbestos fibers, has been shown to synergistically enhance the oncogenic transformation of mouse embryo fibroblasts (Hei et al. 1984).

3.10 POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE

A susceptible population will exhibit a different or enhanced response to asbestos than will most persons exposed to the same level of asbestos in the environment. Reasons may include genetic makeup, age, health and nutritional status, and exposure to other toxic substances (e.g., cigarette smoke). These parameters result in reduced detoxification or excretion of asbestos, or compromised function of organs affected by asbestos. Populations who are at greater risk due to their unusually high exposure to asbestos are discussed in Section 6.7, Populations With Potentially High Exposures.

Studies of workers who are exposed to asbestos in workplace air indicate that not all people who are exposed to equal doses of asbestos are equally affected. As discussed in Section 3.9, it is likely that one main source of this variability in susceptibility between people is smoking history or the degree of exposure to other risk factors with which asbestos interacts. As discussed in Section 3.7, another potential factor may be age at first exposure. The long-term retention of asbestos fibers in the lung and the long latency period for the onset of asbestos-related respiratory diseases suggest that individuals exposed earlier in life may be at greater risk to the eventual development of respiratory problems than those exposed later in life. A recent study of nonoccupationally exposed residents of an Australian asbestos-mining region, however, found no significant association between age of first exposure and incidence of mesothelioma (Hansen et al. 1998).

Variability in susceptibility to asbestos-induced respiratory tissue damage may be related to individual genetic differences in ability to detoxify reactive electrophilic molecules (e.g., reactive oxygen radicals and nitrogen oxide) produced during pulmonary disposition of fibers. Glutathione S-transferases have been proposed to be important Phase II enzymes that protect against electrophile-induced tissue damage by catalyzing conjugation with reduced glutathione. One class of glutathione S-transferases, GSTμ, has been hypothesized to be particularly important, as deletion of the GSTM1 gene that encodes this enzyme has been associated with increased risk for mesothelioma (Hirvonen et al. 1995), other cancers (Hirvonen 1997), and nonmalignant pulmonary disorders (Hirvonen et al. 1996; Kelsey et al. 1997) in case-control studies of asbestos-exposed people. In contrast, no significant association has been found for deficiency of the θ class of glutathione S-transferases (encoded by the GSTT1 gene) and increased risk for asbestos-related nonmalignant lung disorders (Hirvonen et al. 1996; Jakobsson et al. 1995a; Kelsey et al. 1997). The null GSTM1 and GSTT1 genotypes occur in about 50 and 15–25% of Caucasians, respectively (Hirvonen 1997).

NAT2 is another Phase II enzyme that displays genetic polymorphisms (one associated with slow acetylation and another with fast acetylation) that also may be associated with susceptibility to asbestos toxicity. Among a group of subjects exposed to high levels of asbestos, individuals who lacked the GSTM1 gene and had the slow NAT2 genotype showed a 4-fold increased risk for developing nonmalignant respiratory disorders and an 8-fold increased risk for developing mesothelioma compared with individuals with the GSTM1 gene and the fast NAT2 genotype (Hirvonen et al. 1996). In another study, no significant association was found between the NAT2 and GSTM1 genotypes and lung cancer; however, subjects in this study were exposed to relatively low levels of asbestos (Saarikoski et al. 2000). Although the mechanism of how slow acetylation may increase susceptibility to asbestos is uncertain, Hirvonen et al. (1995, 1996) have hypothesized that, compared with fast acetylators, slow NAT2 acetylators may accumulate greater amounts of polyamines (which stimulate cell proliferation) due to a slower acetylation rate in their catabolism. Related to this hypothesis is the observation that asbestos fibers induce ornithine decarboxylase in hamster cells, resulting in stimulation of polyamine synthesis and resultant cell proliferation (Marsh and Mossman 1991). Other less specific lines of evidence provide support for the hypothesis that genotype may be important in determining susceptibility to asbestos-related disease. For example, Huncharek et al. (1996) found increased incidence of cancer among parents of mesothelioma cases compared with parents of controls without mesothelioma.

As discussed in Section 3.2.1.3, results from experiments showing a larger increase in cell numbers in pulmonary lavage fluid and increased severity of pulmonary lesions in response to inhaled asbestos in immunologically deficient mice compared with immunologically normal mice of the same genetic background (Corsini et al. 1994) suggest that genetic differences in cell-mediated immunological capabilities may be another predisposing factor in the etiology of asbestos-induced lung diseases.

Recent studies have shown that a high percentage of human mesotheliomas also test positive for the presence of Simian Virus 40 (SV40). Based on this finding, it has been suggested that SV40-infected individuals who are exposed to asbestos might be at increased risk for developing mesothelioma (see summaries of Carbone 1999 and Carbone et al. 2000).

3.11 METHODS FOR REDUCING TOXIC EFFECTS

This section will describe clinical practice and research concerning methods for reducing toxic effects of exposure to asbestos. However, because some of the treatments discussed may be experimental and unproven, this section should not be used as a guide for treatment of exposures to asbestos. When specific exposures have occurred, poison control centers and medical toxicologists should be consulted for medical advice.

Standard texts of medical toxicology (e.g., Ellenhorn et al. 1997; Goldfrank et al. 1998) do not provide specific information about treatment immediately following exposure to asbestos since the major health hazards of asbestos are associated with chronic rather than acute exposure.

3.11.1 Reducing Peak Absorption Following Exposure

The most important route of asbestos exposure is inhalation, but acute effects are not of primary concern as the major health hazards that are associated with chronic exposure, and can have latencies of more than 30 years. Public health initiatives have therefore focused on reducing initial exposure rather than reducing postexposure absorption.

3.11.2 Reducing Body Burden

As discussed in Section 3.4.4 inhaled asbestos fibers that are deposited in the lung are principally removed by mucociliary transport into the alimentary canal and eventually are excreted in the feces.

Chrysotile fibers appear to be cleared more readily than amphibole fibers, and long fibers are cleared more slowly than short fibers (Coin et al. 1992; Morgan 1991).

One study suggests that subjects who stop smoking after already having been exposed to asbestos see some improvement in lung health (Waage et al. 1996), but long term data for the efficacy of cessation of smoking in large cohorts of individuals previously exposed to asbestos are not available.

To date, there is no method to remove asbestos from lungs. As discussed in Section 3.9, smoking and exposure to asbestos appear to interact synergistically to produce pulmonary fibrosis and lung cancer. This interaction may be explained, at least in part, by demonstrations that smoking impairs the ability of the lungs to remove inhaled fibers (Churg and Stevens 1995; Churg et al. 1992). These findings suggest that cessation of smoking may lead to enhanced fiber clearance in asbestos-exposed workers who are also smokers. Workers likely to be exposed to asbestos through maintenance work in buildings (e.g., carpenters, plumbers, electricians, and custodial workers) should receive education about this possible synergism and be encouraged not to smoke.

3.11.3 Interfering with the Mechanism of Action for Toxic Effects

The mechanisms by which asbestos causes toxic effects have not yet been clearly determined, and there are no proven methods of interfering with them. Methods of interference can be suggested based on the current understanding of the mechanisms of action derived from animal and human studies, but these methods will require additional research before they can be put to use.

Current research on the toxic effects of asbestos suggests that both direct binding and cell-mediated pathways may be involved (see Section 3.5). Asbestos fibers can bind to various cell macromolecules (proteins, membranes, DNA, and RNA) leading to a variety of direct cellular effects such as increases in cell permeability, conformational changes affecting protein function, and physical interference with chromosome segregation leading to chromosome deletion (Barrett et al. 1989; Chang et al. 1990; Malorni et al. 1990). Modification of the surface of asbestos fibers can decrease their *in vitro* toxic effects (Awadalla et al. 1990; Brown et al. 1990, 1991; Habashi et al. 1991), and these data suggest that direct interactions between asbestos fibers and cell molecules are partly responsible for asbestos-related toxicity.

A second proposed mechanism in asbestos toxicity involves active oxygen species. When exposed to asbestos, alveolar macrophages attempt to phagocytize the fiber and then digest it by producing reactive oxygen species. These include hydrogen peroxide and superoxide radical anion (O_2^-), which are relatively mild oxidants (Cantin et al. 1988; Case et al. 1986; Hansen and Mossman 1987). However, hydrogen peroxide and superoxide can spontaneously react with one another to produce hydroxyl radicals, which are much more potent oxidants. This reaction is enhanced by the presence of iron which can come from the fiber itself, as a contaminant associated with the asbestos, or from the exposed animal's tissues (Fontecave et al. 1990; Koerten et al. 1990a; Lund and Aust 1991a).

Both *in vivo* and *in vitro* studies have linked production of reactive oxygen species to asbestos-induced cellular effects including lipid peroxidation, cytotoxicity, cell proliferation, genotoxicity, and apoptosis (see Section 3.5). The uptake of asbestos fibers into epithelial cells is also increased by reactive oxygen species (Hobson et al. 1990; Peterson and Kirschbaum 1998).

Free radical scavengers may prove to be successful in interfering with the mechanism of action for asbestos. *In vitro* studies have shown that the effects of asbestos can be diminished by compounds that reduce the levels of reactive oxygen species, such as free radical scavengers (ascorbic acid, bemitil, mannitol, salicylate, 5,5'-dimetyl-l-proline N-oxide, rutin, vitamin E, vitamin A) and enzymes that catalyze the decomposition of reactive oxygen species (catalase, superoxide dismutase). An *in vitro* study assessing the antioxidant efficiency of the flavonoids, quercitin and rutin, and their ability to protect against asbestos-induced cell injury found that both compounds reduced both the production of oxygen radicals and the cell injury resulting from asbestos exposure (Kostyuk et al. 1996). One *in vivo* study reported a dose-dependent inhibition of lung injury, inflammation, and asbestosis in rats treated with polyethylene glycol-conjugated catalase (Mossman et al. 1990b).

Vitamin A has been widely studied in the field of cancer prevention, and studies have shown that smokers who consume more dietary vitamin A from foods have a lower risk for lung cancer (Mayne et al. 1998). Vitamin A is generally given as a dietary supplement in one of two forms, either as retinol (vitamin A) or as β-carotene, a precursor which is converted by the body to vitamin A. An investigation focusing on dietary intake of vitamin A in asbestos workers (40 subjects) reported that subjects who had developed bronchial metaplasia reported a lower intake of dietary vitamin A than those without the condition (Mayne et al. 1998).

Supplementing the diet with vitamin A (retinol or β-carotene) has been shown to increase ventilatory function (Chuwers et al. 1997). However, intervention trials with supplements of vitamin A have shown an increased risk of lung cancer, with the carotene and retinol efficiency trial, CARET, being terminated early because interim results showed that the intervention group (treated simultaneously with both retinol and β-carotene) was developing more cancer than the controls (Omenn et al. 1996a, 1996b). A study carried out on a large cohort (1,024 individuals) of occupationally exposed asbestos workers in Australia (de Klerk et al. 1998) studied the relative efficacy of the two most common forms of vitamin A, β-carotene and retinol. The authors concluded that there was no benefit from the administration of β-carotene, but that there were significantly lower rates of mesothelioma among the subjects taking retinol. Another study by the same authors (Musk et al. 1998) found that subjects (1,203 exposed asbestos workers) supplied with vitamin A (retinol) had lower rates of malignant mesothelioma and lung cancer than subjects who chose not to participate. However, the reduction was not statistically significant, although it did increase with time and may therefore reflect a long-term protective effect. In general, results from the various clinical trials of vitamin A carried out to date do not look very promising. Supplements of β-carotene had detrimental effects, while the results with retinol are borderline.

Another possible method of reducing the production of hydroxy radicals is by the chelation of iron. Iron chelators such as deferoxamine have been successful at inhibiting the *in vitro* production of hydroxyl radicals (Goodglick et al. 1989; Lund and Aust 1991b; Weitzman and Graceffa 1984). By binding to asbestos fibers, deferoxamine blocks their ability to participate in redox reactions that produce hydroxyl radicals. A study in mice demonstrated the binding of desferroxamine to crocidolite fibers *in vivo* (Weitzman et al. 1988). It should be noted that other iron chelators such as citrate, EDTA, or nitriloacetate actually lead to an increased production of hydroxyl radicals (Lund and Aust 1991b, 1992). Although these chelators are successful in binding iron, they do not prevent iron from participating in the Fenton reaction, and it is possible that by mobilizing iron from the fiber, these chelators may actually make the iron more redox-active.

Adenosine 3',5'-cyclic monophosphate (cAMP) has been shown to reduce pulmonary edema and lung toxicity caused by factors other than asbestos. An *in vitro* study by Vatche and coworkers (Israbian et al. 1994) found that cAMP diminished asbestos-induced cytotoxicity by maintaining intracellular ATP levels and inhibiting cellular replication rather than by affecting asbestos-induced oxygen radical production. This may represent another alternative strategy to free-oxygen radical scavengers for limiting asbestos-induced lung damage.

In addition to the effects described above, cells exposed to asbestos respond by the production of a large number of different factors including, leukotrines, interleukins, growth factors, chemoattractants, and nitric oxide (see Section 3.5). These factors mediate a wide range of cell responses including inflammation, macrophage recruitment, and cell proliferation. Recent research has also suggested that nuclear regulatory proteins, oncogenes, proto-oncogenes and secondary messenger proteins may play an important mechanistic role. Additional research to better understand the interaction of these responses may provide clues for the development of new therapeutic approaches.

3.12 ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA, as amended, directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of asbestos is available. Where adequate information is not available, ATSDR, in conjunction with the National Toxicology Program (NTP), is required to assure the initiation of a program of research designed to determine the health effects (and techniques for developing methods to determine such health effects) of asbestos.

The following categories of possible data needs have been identified by a joint team of scientists from ATSDR, NTP, and EPA. They are defined as substance-specific informational needs that if met would reduce the uncertainties of human health assessment. This definition should not be interpreted to mean that all data needs discussed in this section must be filled. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

3.12.1 Existing Information on Health Effects of Asbestos

The existing data on health effects of inhalation, oral, and dermal exposure of humans and animals to asbestos are summarized in Figure 3-6. The purpose of this figure is to illustrate the existing information concerning the health effects of asbestos. Each dot in the figure indicates that one or more studies provide information associated with that particular effect. The dot does not necessarily imply anything about the quality of the study or studies, nor should missing information in this figure be interpreted as a "data need". A data need, as defined in ATSDR's *Decision Guide for Identifying Substance-Specific Data Needs Related to Toxicological Profiles* (ATSDR 1989), is substance-specific information necessary to conduct comprehensive public health assessments. Generally, ATSDR defines a data gap more broadly as any substance-specific information missing from the scientific literature.

Figure 3-6. Existing Information on Health Effects of Asbestos

	Death	Systemic			Immunologic/Lymphoretic	Neurologic	Reproductive	Developmental	Genotoxic	Cancer
		Acute	Intermediate	Chronic						
Inhalation		●	●	●	●				●	●
Oral				●						●
Dermal		●								

Human

	Death	Systemic			Immunologic/Lymphoretic	Neurologic	Reproductive	Developmental	Genotoxic	Cancer
		Acute	Intermediate	Chronic						
Inhalation		●	●	●	●					●
Oral		●		●			●	●		●
Dermal										

Animal

● Existing Studies

There have been a very large number of studies, both in humans and animals, focusing on the major health effects associated with inhalation (asbestosis, lung cancer, and mesothelioma) and oral exposure (gastrointestinal cancer). There have also been a number of studies on immune system changes in humans exposed by inhalation, but this has not been investigated in people exposed orally. There are few formal studies focusing on other possible effects of asbestos. However, because so few fibers are able to penetrate from the lungs or the gastrointestinal tract into the body, there is little reason to believe that other effects are of major concern.

3.12.2 Identification of Data Needs

Acute-Duration Exposure. Only a few inhalation or oral studies have sought to determine the effects of short-term exposures to asbestos. There are no human data on noncancer effects after acute exposures, and no acute-duration MRLs have been derived. However, there is one study in animals in which a single exposure produced fibrosis of the lung (McGavran et al. 1989), and one study that suggests that a single high inhalation exposure might cause cancer (Wagner et al. 1974). This is a potentially important point, since some people might have one or two significant exposures to asbestos during their life. With current regulations and state of knowledge regarding asbestos toxicity; however, the likelihood of acute high-level exposures for most people is small and studies of health effects in humans with such exposures are unlikely to be established. Additional studies on the long-term effects of acute inhalation exposure in animals may be useful to determine if this is of concern, and if it is, to define the dose-response relationship for cancer, fibrosis, and other biologic outcomes. Although oral exposure to high levels of asbestos is unlikely, acute oral exposure to asbestos in rats and mice have been shown to cause aberrant crypt foci, putative precursor lesions of colon cancer (Corpet et al. 1993). Further studies to investigate the development of these lesions, especially after the ingestion of asbestos in drinking water, may be useful.

Dermal exposure to amosite asbestos in shipbuilding workers resulted in the development of warts or corns, predominately on the hands (Alden and Howell 1944). The corns usually developed within 10 days of an original pricking sensation and the feeling of a small splinter-like foreign body. Histological examination of such corns did reveal the presence of asbestos fibers, and the corns were generally taken to be of no pathological concern (Alden and Howell 1944; Dupre et al. 1984; Selikoff and Lee 1978). There are no indications in available data that dermal absorption of asbestos fibers may occur to any significant extent.

Intermediate-Duration Exposure. Several studies (Ehrlich et al. 1992; Jones et al. 1980a; Seidman et al. 1979, 1986; Shepherd et al. 1997) in humans suggest that workers exposed to asbestos for periods of 1–12 months may subsequently develop asbestos-associated pleural changes or lung disease. However, these studies do not provide sufficient dose-response data to derive a reliable intermediate-duration inhalation MRL. A single study in animals reported fibrosis after intermediate exposure to asbestos (Donaldson et al. 1988a). Further inhalation studies in rats to investigate the fibrogenic and carcinogenic risks from intermediate-duration exposures may be helpful in assessing the risks in humans who may only be exposed for a limited period. It should be noted, however, that the parallel development of asbestos fiber lung retention models for rats and humans will likely increase the usefulness of the rat toxicity data. Such models may increase the accuracy of extrapolating from the rat data to predict human health risks (see Sections 3.4.5 and 3.5.3. for discussion of difficulties in developing these models). Several intermediate-duration oral studies in animals have been performed, and these have not revealed any evidence of noncancer effects (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c; Schneider and Maurer 1977). In the absence of data to suggest that a significant noncancer risk exists after oral exposure, it does not seem that additional studies of this sort are critical.

Chronic-Duration Exposure and Cancer. Epidemiological studies provide descriptions of exposure-response relationships for signs of lung fibrosis and for increased rates of mortality associated with nonmalignant respiratory disease in workers with estimated chronic cumulative exposures as low as about 15–70 and 30–1,200 f-yr/mL, respectively (see Section 3.2.1.2 for references). The studies, however, do not provide information for responses at lower cumulative exposure levels, at air levels experienced by more modern workers in regulated nations (from <0.1–0.2 to 2–5 f/mL), or at air levels that may be experienced by people in relatively polluted nonoccupational exposure scenarios (up to about 0.01 f/mL). No chronic inhalation MRL was derived due to the large degree of uncertainty in extrapolating from data for high-level exposures to low levels that might be experienced by populations surrounding hazardous waste sites with asbestos. Epidemiological research approaches that may decrease this uncertainty are described below in Section 3.12.2 Epidemiological and Human Dosimetry Studies.

Studies in animals provide supporting evidence for the fibrogenicity of airborne asbestos (see Section 3.2.1.2. for references). However, the extrapolation of exposure-response relationships for asbestos-induced lung fibrosis in laboratory animals to humans is not recommended due to the long persistence of fibers in humans, the relatively short life-span of laboratory animals, and the anatomical and physiological differences between laboratory animals and humans that influence rates of lung deposition and clearance of asbestos fibers. The development of physiologically-based mathematical lung retention models for asbestos fibers in rats and humans and the application of the models to extrapolate from available rat chronic toxicity data may decrease uncertainty in predicting risks for pulmonary fibrosis (and respiratory tract cancers) in humans exposed to low levels of asbestos. This research approach is discussed further below in Section 3.12.2. More discussion of the difficulties in developing such models and extrapolating from animals to humans are discussed in Sections 3.4.5 and 3.5.3.

The carcinogenic effects of chronic inhalation exposure to asbestos (i.e., lung cancer and pleural mesothelioma) have been amply demonstrated, both in humans and animals (see Section 3.2.1.2 for references). However, a number of important issues remain to be resolved. In particular, it would be useful to know whether there are maximum and/or minimum lengths and diameters beyond which fibers lack carcinogenic effects, or whether there are continuous gradients of carcinogenicity as a function of fiber type, length, and diameter. In this regard, additional research on the mechanism of carcinogenicity may be more useful than additional epidemiological or chronic exposure animal studies. This would include studies on the molecular and cellular mechanisms by which asbestos fibers cause lung cancer and mesothelioma (and pulmonary fibrosis).

Along these same lines, further work would be helpful in defining other fiber characteristics that are important determinants of carcinogenicity. It is suspected, for example, that amphiboles, such as crocidolite and tremolite asbestos, are more likely to cause mesothelioma than chrysotile, but it is not certain if this is attributable to differences in fiber length alone or to differences in chemical properties (e.g., fiber morphometry, iron content, durability in biological fluids and tissues). Consequently, additional animal studies of the relative carcinogenic potency of airborne asbestos fibers of different types (e.g., chrysotile versus amphibole asbestos), carefully matched with regard to fiber size distribution, may be valuable.

Another area where further research may be useful is the synergistic interaction between asbestos and other risk factors for lung cancer, especially smoking. Particularly helpful may be further studies on the mechanism of such interactions, since this could help improve current means of predicting the consequences of exposures to substances such as cigarette smoke.

In view of the uncertainty regarding the risk of gastrointestinal cancer following direct or indirect ingestion of asbestos, further research in this area may be useful. Although an extensive series of lifetime feeding studies have already been performed by NTP, only two of these studies (NTP 1983, 1985) focused on the issue of fiber length in oral carcinogenicity. Further studies to investigate the role of fiber length in gastrointestinal cancer may be useful, with special emphasis on whether there is a minimum length below which carcinogenic risk is minimal. This would have considerable practical consequence in evaluating the potential risk to human health associated with ingestion of asbestos in drinking water. Additional epidemiological studies that include exposure both after occupational inhalation and community drinking water ingestion could also be helpful, especially if they were carefully designed to address the uncertainties and limitations in the evidence currently available.

Genotoxicity. The genotoxic effects of asbestos have been studied *in vivo* to a limited extent in humans (Donmez et al. 1996; Fatma et al. 1991; Hansteen et al. 1993; Lee et al. 1999; Marczynski et al. 1994a, 2000a, 2000b; Pelin-Enlund et al. 1990; Rom et al. 1983; Tammilehto et al. 1992; Tiainen et al. 1989) and animals (EPA 1988j; Fatma et al. 1992; Marczynski et al. 1994b, 1994c). These studies generally reported chromosomal aberrations with asbestos exposure. Most *in vitro* studies in eukaryotic cells indicate that asbestos is clastogenic, causing a variety of chromosomal aberrations; some studies also suggest that asbestos may be mutagenic, although the results for tests of gene mutagenesis have been mixed, both *in vitro* and *in vivo* (see Section 3.3). Further studies to determine the mechanism of clastogenicity, the dependency of clastogenicity on fiber size and type, and the relative genotoxic sensitivity of different respiratory and gastrointestinal epithelial cells may lead to the identification of cellular, biochemical, or genetic responses to asbestos that may be amenable to therapeutic intervention.

Reproductive Toxicity. There are no studies in humans on the potential reproductive effects of asbestos exposure. There is limited evidence from studies in animals that chronic ingestion of asbestos does not injure reproductive tissues, and that exposure during gestation does not reduce fertility (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c). This indicates that reproductive effects are probably not of concern, and indeed, there is little mechanistic basis for thinking that this could occur. For these reasons, further studies on this end point do not appear critical, but it should be noted that standard two-generation reproductive toxicity studies in animals exposed to ingested, inhaled, or dermally applied asbestos are not available.

Developmental Toxicity. Studies on potential developmental effects in humans exposed to asbestos are restricted to reports from one group of investigators reporting that asbestos fibers were detected in fetal and placental tissues from stillborn infants more frequently and at higher concentrations than in placental tissue from liveborn infants (Haque et al. 1991, 1992, 1996, 1998). Understanding of the toxicological significance of these observations awaits confirmation and explanation from further research in other laboratories. It is presently unclear if the noted differences in fiber concentrations between stillborn and liveborn tissue are due to differences in maternal exposures, differences in fetal or placental factors unrelated to asbestos exposure, or specimen contamination.

Studies in animals have not detected any evidence of teratogenic effects in rats and hamsters exposed for life (including during gestation and lactation) to different types of asbestos by the oral route (NTP 1983, 1985, 1988, 1990a, 1990b, 1990c). However, decreased body weights at birth and later in life were noted in some cases (NTP 1985, 1990c). It seems likely that these effects either were random or were secondary to reduced food intake by the dams. No developmentally toxic effects were found following exposure of pregnant mice to asbestos in drinking water at concentrations as high as 143 µg/mL (Schneider and Maurer 1977). Asbestos fibers have been reported to cross the placenta following bolus intravenous injections of asbestos suspensions into rats and mice (Cunningham and Pontefract 1974; Haque and Vrazel 1998). These data were quite variable, and thus could be due, at least in part, to a mass breakthrough of fibers that might be associated with the bolus intravenous exposure protocol. It is expected that transplacental transfer of fibers following environmental exposures (inhalation, oral, or dermal) to asbestos may be of a much smaller magnitude.

The available data suggest that developmental toxic effects are not a critical public health concern from asbestos exposure. Additional animal studies on fetal and postnatal development as affected by inhalation exposure may be helpful to confirm or discard this suggestion.

Immunotoxicity. There are numerous studies of the immune system in workers (active or retired) exposed to asbestos in workplace air (deShazo et al. 1988; Froom et al. 2000; Kagan et al. 1977; Pernis et al. 1965; Sprince et al. 1991, 1992; Warwick et al. 1973). These studies indicate that the immune system may be depressed in individuals who have developed clinical signs of injury, such as asbestosis or cancer. However, the cause-effect relationship between the immunological changes and the asbestos-related diseases is not certain. Also, it is not known if similar effects occur after oral exposure, or if the effects are inhalation specific. Prospective studies on this subject may be useful, both in discerning the importance of immune system injury in the etiology of asbestos-induced disease, and determining whether impaired immune function can be used as a possible early test of individual sensitivity to asbestos.

Neurotoxicity. There are no reliable indications in studies of humans or animals that exposure to asbestos leads to neurotoxicity. Even though tests have not been performed to search for possible subtle effects, there is little reason to suspect that this is an effect of concern, and detailed studies on this effect do not appear to be essential.

Epidemiological and Human Dosimetry Studies. There have been a very large number of epidemiological studies performed on workers exposed in the past to relatively high concentrations of asbestos in air. Further epidemiological studies on populations with lower exposure levels may be useful to decrease the uncertainty that asbestos-induced respiratory diseases may develop with chronic exposure to current levels of asbestos inside buildings, in the ambient environment, and/or near waste sites. Prospective cohort mortality studies of workers involved in asbestos-related occupations under currently regulated conditions or retrospective studies of workers who entered asbestos-related occupations after 1970 or 1980 when respective occupational limits of 5 and 2 f/mL were recommended in the United States (ACGIH 1998) may be particularly useful. Other groups of people that may warrant study include family members of asbestos workers, maintenance workers (such as plumbers, electricians, carpenters, and custodial workers) in buildings with asbestos-containing materials, sailors exposed aboard ships, or nonoccupationally exposed residents of communities with current or past mining or manufacturing operations involving asbestos (e.g., Libby, Montana). End points of concern would include not only cancers, but also pulmonary fibrosis, pleural changes, and respiratory and immune function.

Of special value in any ongoing or future epidemiological study, either of health effects associated with the workplace or the ambient environment, are good exposure data, including quantitative data on the intensity and duration of exposure for each member of the study group, and the type and dimensions of the fibers involved. Accurate exposure data linked to lung fiber concentration data from resected or autopsied lung tissue (that describe distributions of fiber dimensions and mineralogical types) would be useful for the development of human lung retention models, similar to those being developed for refractory ceramic fibers (Yu et al. 1997) that incorporate current understanding of factors influencing the rates of deposition and clearance of asbestos fibers (e.g., breathing patterns, airway morphometry, fiber dimensions, and fiber mineralogy). Such models may decrease uncertainty in extrapolating from data for humans exposed to high exposure levels to predict risks for malignant or nonmalignant respiratory disease in humans exposed to low levels of asbestos. If rat lung retention models are also developed, then human lung retention models may be useful in extrapolating from available rat inhalation toxicity data to provide alternative estimates of human health risks associated with low-level exposure to asbestos.

Biomarkers of Exposure and Effect.

Exposure. The most relevant parameter for quantifying exposure to asbestos is the body burden of retained fibers (Case 1994; Churg 1982; Churg and Warnock 1981; Churg and Wright 1994; Dodson et al. 1999; Dufresne et al. 1995, 1996a, 1996b; Gylseth et al. 1985; Sebastien et al. 1989; Wagner et al. 1986). However, there are no methods currently available for measuring tissue levels of fibers in living persons other than by biopsy (see Section 3.8.1 for discussion of strengths and weaknesses of using retained fiber concentrations in lung tissue as indicators of past exposure). Uses of concentrations of asbestos bodies and uncoated fibers in bronchoalveolar lavage and sputum samples as biomarkers of exposure also have been examined in several studies, but these approaches have not been fully developed as quantitative indicators of exposure (see Section 3.8.1). Fibers can also be detected in urine and feces (Cook and Olson 1979; Finn and Hallenback 1984), but these methods would likely reflect only recent exposures (within the last several days) and not the cumulative tissue burden. Efforts to develop a noninvasive method for measuring fiber levels in tissues (especially in the lung) would be particularly valuable in assessing human exposures to asbestos.

Effect. No specific and sensitive biomarkers of asbestos-induced disease are known. Chest x-rays can detect both the noncarcinogenic and carcinogenic lesions produced by asbestos in the lung and pleura, but usually not until after significant injury or change has occurred (Anton-Culver et al. 1989; Jones et al. 1988b). Similarly, spirometric tests of lung function can detect early stages of asbestos-induced disease, but only after functional decrements (Ernst et al. 1989; Finkelstein 1986). Further studies would be valuable to determine if changes such as depressed immune system function or altered levels of other biochemical parameters can be used as an indicator of risk of asbestos-induced cancer or fibrosis. Also, further efforts would be valuable to improve diagnostic methods for detecting early asbestos-related effects, such as high-resolution computed tomography to detect pleural thickening or pleural plaques (Aberle et al. 1988a, 1988b) and lung carbon monoxide diffusing tests to detect early decreases in lung function (Dujic et al. 1992; Wang et al. 1998). In general, there is a need for the development of more noninvasive asbestos-specific biomarkers of effect. Additional research on potential associations between particular genetic polymorphisms and susceptibility to asbestos-induced lung disease may lead to new biomarkers of susceptibility.

Absorption, Distribution, Metabolism, and Excretion. Because asbestos consists of insoluble fibers, it does not undergo absorption, distribution, metabolism, or excretion in a fashion similar to most other chemicals. With respect to inhalation exposure, the toxicokinetic parameters of greatest relevance are the extent and location of fiber deposition in the respiratory tract, the rate of fiber removal by mucociliary transport, and translocation of fibers within and across the lung. A number of studies are available on lung deposition and clearance of asbestos fibers in animals (e.g., Bolton et al. 1983; Coin et al. 1992; Evans et al. 1973; Morgan et al. 1975; Timbrell 1982). Use of these data to develop predictive lung retention models for animals, parallel to the development of human lung retention models, may decrease the uncertainty in estimating human health risks associated with low-level exposure to asbestos fibers. In contrast to data for laboratory animals, human data poorly describe relationships between exposure levels and lung retention of asbestos fibers. Additional research linking accurate exposure data with lung fiber burden data in humans is likely to result in the development of human lung retention models and aid both in the description of patterns of deposition and clearance of asbestos fibers in humans. Additional studies on the dissolution and breakage of asbestos fibers of various dimensions and types in human and animal respiratory tract fluids and cells may also aid in the development of these models. Additional research clarifying the biological and mineralogical parameters that influence asbestos fiber migration and penetration through the lungs into the peripheral lung and pleural membrane, possibly determinants of mesothelioma risk, is also warranted.

Available data are not sufficient to make a precise estimate of the fraction of ingested fibers that pass through the gastrointentinal wall, but there is agreement that it is a very small amount and not of significant toxicological concern (Sebestien et al. 1980b; Weinzweig and Richards 1983).

Comparative Toxicokinetics. Available data from chronic rat inhalation bioassays show similar asbestos-induced respiratory effects to those in humans associated with occupational exposure to asbestos (pulmonary fibrosis, lung cancer, and pleural mesothelioma), but the use of the rat data to predict human health risks from exposure to airborne asbestos has a number of areas of uncertainty, including those associated with interspecies differences in lifespan, airway morphometry, and breathing patterns. The development of rat and human lung retention models that incorporate species differences in anatomical and physiological parameters influencing deposition and clearance of asbestos fibers may decrease the uncertainty in making human health risk predictions from the rat data and to allow comparisons with low-level risk estimates derived from the available epidemiological data. The previous section outlined several areas of comparative toxicokinetics research that are likely to aid in the development of these models.

Methods for Reducing Toxic Effects. The most important route of exposure to asbestos is by inhalation of asbestos fibers that are deposited in the lung. The acute effects of exposure have not been much studied, as the major health hazards are believed to be associated with chronic exposure. The mechanisms by which asbestos causes toxic effects have not yet been clearly determined (IARC Expert Panel 1996), and there are no proven methods of interfering with them, nor is it currently possible to reduce toxicity by reducing body burden after exposure. Further information as to the mechanisms of asbestos toxicity is a primary data need that may eventually lead to therapeutic approaches for reducing toxic effects from asbestos.

There is some evidence that smoking and asbestos inhalation interact synergistically to produce pulmonary fibrosis and lung cancer (see Section 3.9). One study suggests that subjects who stop smoking after having already been exposed to asbestos see some improvement in lung health (Waage et al. 1996), but long term data for the efficacy of cessation of smoking in large cohorts of asbestos-exposed individuals may help to confirm or reject this suggestion.

Current research on the mechanism of asbestos toxicity suggests that a combination of direct binding and cell mediated pathways are involved (see Section 3.5). *In vitro* studies indicate that involvement of iron-catalyzed production of reactive oxygen species in the mechanism of action for asbestos (Fontecave et al. 1990; Garcia et al. 1988; Korkina et al. 1992; Shatos et al. 1987; Weitzman and Graceffa 1984), and a large number of *in vitro* studies (see Sections 3.5 and 3.11) have shown that compounds that reduce the levels of reactive oxygen species, either by scavenging them, or by catalyzing their decomposition, can reduce the cell injury resulting from asbestos exposure. Inhibition of lung injury, inflammation, and asbestosis has been reported *in vivo* in an animal inhalation model of disease using polyethylene glycol-conjugated catalase (Mossman et al. 1990b).

A number of iron chelators have also been successful *in vitro* at limiting the production of hydroxyl radicals (Goodlick et al. 1989; Lund and Aust 1991b; Weitzman and Graceffa 1984). Some iron chelators, however, actually lead to increased production of hydroxyl radicals (Lund and Aust 1991b, 1992) and, although they chelate the iron, they do not prevent it taking part in the Fenton reaction. Their use as a treatment for asbestos exposure is therefore less likely than that of compounds that directly reduce the levels of reactive oxygen species. Additional *in vivo* studies that evaluate the efficacy of such compounds may lead to the development of a method for reducing the toxic effects of asbestos.

Adenosine 3',5'-cyclic monophosphate (cAMP) has been shown to reduce pulmonary edema and lung toxicity caused by factors other than asbestos. An *in vitro* study by Vatche and coworkers (Israbian et al. 1994) found that cAMP diminished asbestos-induced cytotoxicity by maintaining intracellular ATP levels and inhibiting cellular replication rather than by affecting asbestos-induced oxygen radical production. This may represent another worthwhile alternative strategy to free-oxygen radical scavengers for limiting asbestos-induced lung damage.

Children's Susceptibility. There is a lack of reports on asbestos-related respiratory diseases in children, but childhood exposure to asbestos has been associated with the development of respiratory diseases in adulthood (Anderson et al. 1976; Andrion et al. 1994; Fraire et al. 1988; Inase et al. 1991; Lanphear and Buncher 1992; Magee et al. 1986; Voison et al. 1994; Wagner et al. 1960). The long-term retention of asbestos fibers in the lung and the long latency period for the onset of asbestos-related respiratory diseases suggest that individuals exposed earlier in life may be at greater risk to the eventual development of respiratory problems than those exposed later in life. Direct evidence in support of this hypothesis, however, is not available. In contrast, no significant association was found between incidence of mesothelioma and age of first exposure in a study of residents of an Australian mining region who had no history of occupational exposure to asbestos (Hansen et al. 1998). To date, there is no persuasive evidence that children have a greater susceptibility to asbestos toxicity than adults.

If groups of children exposed to known levels of asbestos could be identified, the lifetime studies could be designed to assess long-term effects of childhood exposure to asbestos. Respiratory effect end points could be compared to those in occupationally-exposed adults in an effort to assess susceptibility in children relative to adults. However, due to changes in the use of asbestos during the past several decades, it may be difficult to identify such groups of children.

Animal experiments could be designed to determine whether there are age-related differences in pulmonary responses to inhaled asbestos fibers (e.g., fibrosis, cell proliferation, gene expression, macrophage production of reactive chemicals). For example, adult rats have been shown to display, within 20 days, a range of dose-related changes in pulmonary inflammation indices, increases in pulmonary cell proliferation, and increases in the severity of pulmonary fibrosis in response to short-term inhalation exposure to asbestos concentrations of approximately 60 and 2,800 f/mL (Quinlan et al. 1994, 1995). Comparing the results of these studies with results from replicate studies with juvenile rats may demonstrate age-related susceptibility to asbestos toxicity that is not directly related to latency of disease development in juveniles relative to adults. However, the relevance of such models for assessment of age-related susceptibility of cancer effects in humans may be limited due to species differences in anatomy, physiology, and duration of lifetime.

Data needs related to developmental effects associated with prenatal and postnatal exposures to asbestos were discussed previously in Section 3.12.2.

Child health data needs relating to exposure are discussed in Section 5.8.1 Identification of Data Needs: Exposures of Children.

3.12.3 Ongoing Studies

Ongoing studies pertaining to Asbestos have been identified and are shown in Table 3-7.

Table 3-7. Ongoing Studies on the Health Effects of Asbestos[a]

Investigator	Affiliation	Research description	Sponsor
Aust, A E	Utah State University, Logan, UT	Role of O_2 radicals and iron in asbestos-induced cancer	NIEHS
Barrett, JC	NIEHS, NIH	Role of mutagenesis in carcinogenesis	NIEHS
Broaddus, VC	University of California San Francisco, San Francisco, CA	Protective role of apoptosis in asbestos pleural injury	NIEHS
Brody, AR	Tulane University of Louisiana, New Orleans, LA	Epithelial growth factors in environmental lung disease	NHLBI
Brody, AR	Tulane University of Louisiana, New Orleans, LA	Growth factors in asbestos-induced pulmonary fibrosis	NIEHS
Dinse, G	NIEHS, NIH	Statistical analysis of human cancer data	NIEHS, NIH
Garshick, E	Department of Veterans Affairs, Medical Center Brockton, MA	Screening for occupational and respiratory disorders	VA
Gerwin, BI	Division of Basic Sciences - NCI	In vitro studies of human mesothelial cells	NCI, NIH
Goodman, GE	Fred Hutchinson Cancer Research Center, Seattle, WA	Caret–coordinating center	NCI
Guthrie, GD	Mineralogical Society of America	Mineralogical Society of America Workshop on the health effects of mineral dusts	USDOE Energy Research
Hei, TK	Columbia University Health Sciences, New York, NY	Mechanisms of fiber carcinogenesis	NIEHS
Hei, TK	Columbia University Health Sciences, New York, NY	Mutagenicity of mineral fibers	NIEHS
Heintz, NH	University of Vermont & St Agric College, Burlington, VT	Asbestos and NO_2 in environmental lung disease	NIEHS
Ho, Y	Wayne State University, Detroit, MI	The nature of lung antioxidant defense mechanisms	NHLBI

Table 3-7. Ongoing Studies on the Health Effects of Asbestos *(continued)*

Investigator	Affiliation	Research description	Sponsor
Holian, A	University of Texas Health Science Center Houston, Houston, TX	Analysis of human macrophage function in response to fibrogenic particulates	NCRR
Hoyle, GW	Tulane University of Louisiana, New Orleans, LA	Pulmonary fibrosis in PDGF transgenic mice	NHLBI
Hunninghake, GW	University of Iowa, Iowa City, IA	Mechanisms of cytokine production in asbestosis	NCRR
Hunninghake, GW	Department of Veterans Affairs, Medical Center, Iowa City, IA	Regulation of alveolar macrophage function	VA
Kadiiska, M	NIEHS, NIH	Transition metal mediated free radical formation *in vitro* and *in vivo*	NIEHS
Kamp, DW	Department of Veterans Affairs, Medical Center, Chicago, Il	Mechanisms of asbestos-induced alveolar epithelial cell injury	VA
Kane, AB	Brown University, Providence, RI	Pathogenesis of mesenchymal tumors induced by asbestos	NIEHS
Kelsey, KT	Harvard University, Boston, MA	LOH at 3P and P53 and K-RAS mutation in lung cancer beta-carotene/retinol	NIEHS
Kriebel, D	University of Massachusetts Lowell, Lowell, MA	Lung cancer and exposure to chrysotile and amphiboles	NCI
Libbus, B	Integrated Laboratory S, Durham, NC	Fiber-induced DNA damage and carcinogenicity	HHS
Morris, GF	Tulane University of Louisiana, New Orleans, LA	P53 in asbestos induced lung disease	NIEHS
Mossman, BT	University of Vermont, Soule Medical Bldg, Alumni Building, Burlington, VT	EGFR signaling pathways by particulates in lung disease	NIEHS
Mossman, BT	University of Vermont, Soule Medical Bldg, Alumni Building, Burlington, VT	Molecular signaling by oxidant stress in lung epithelium	NHLBI

Table 3-7. Ongoing Studies on the Health Effects of Asbestos *(continued)*

Investigator	Affiliation	Research description	Sponsor
Oakes, D	University of Rochester, Rochester, NY	Statistical analysis of multiple event time data	NCI
Palmer, CJ	University of Vermont, Burlington, VT	Asbestos-induced cell proliferation via an ERK5 pathway	NIEHS
Rose, C	University of Colorado Health Sciences Center, Denver, CO	Sputum cytology and urinary bombesinlike peptide levels	NCRR
Schapira, RM	Department of Veterans Affairs, Medical Center, Milwaukee, WI	Lung arginine uptake and metabolism after particulate matter exposure	VA
Schenker, MB	University of California Davis, Davis, CA	Environmental asbestos and mesothelioma in California	NCI
Stewart, PA	NCI, NIH	Studies of occupational cancer—occupational exposure assessment	Division of Cancer Etiology
Takaro, T	University of Washington, Seattle, WA	Combined effect of radiation and asbestos in producing pulmonary fibrosis	NIOSH
Testa, JR[b]	Fox Chase Cancer Center, Philadelphia, PA	Molecular genetic alterations in malignant mesothelioma	NCI
Thorne, PS	University of Iowa, Iowa City, IA	Core–inhalation toxicology	NIEHS
Tolbert, PE	Emory University, Atlanta, GA	Environmental risk factors for lymphomas and sarcomas	NCI

[a]Information from FEDRIP (2000) unless otherwise indicated.
[b]Testa (1999)

DNA = deoxyribonucleic acid; NCI = National Cancer Institute; NCRR = National Center for Research Resources; NHLBI = National Heart, Lung, and Blood Institute; NIEHS = National Institute of Environmental Health Sciences; NIH = National Institutes of Health; NIOSH = National Institute for Occupational Safety and Health; USDA = United States Department of Agriculture; USDOE = United States Department of Energy; VA = Veterans' Administration

4. CHEMICAL AND PHYSICAL INFORMATION

4.1 CHEMICAL IDENTITY

Asbestos is a generic term for a group of six naturally-occurring, fibrous silicate minerals that have been widely used in commercial products. Asbestos minerals fall into two groups or classes, serpentine asbestos and amphibole asbestos. It should be noted that serpentine and amphibole minerals also occur in nonfibrous or nonasbestiform forms. These nonfibrous minerals, which are *not* asbestos, are much more common and widespread than the asbestiform varieties. Serpentine asbestos, which includes the mineral chrysotile, a magnesium silicate mineral, possesses relatively long and flexible crystalline fibers that are capable of being woven. Amphibole asbestos, which includes the minerals amosite, crocidolite, tremolite, anthophyllite, and actinolite, form crystalline fibers that are substantially more brittle than serpentine asbestos and is more limited in being fabricated. This group can form a variety of polymeric structures through formation of Si-O-Si bonds. For the amphibole class of asbestos (amosite, crocidolite, tremolite, anthophyllite, and actinolite), the polymeric structure consists of a linear double chain, as shown in (see Figure 4-1 [top]). These chains crystallize into long, thin, straight fibers, which are the characteristic structure of this type of asbestos. For the serpentine class (chrysotile), the polymeric form is an extended sheet (see Figure 4-1, [bottom]). This extended sheet tends to wrap around itself forming a tubular fiber structure. These fibers are usually curved ("serpentine"), in contrast to the straight morphometry of the amphiboles. Some of the asbestos minerals are solid solution series, since they show a range of chemical formulas as a result of ion or ionic group substitutions. Tremolite and actinolite form such a series with iron replacing magnesium as one goes from tremolite to actinolite. The definition of how much iron must be present before tremolite becomes actinolite is not universally recognized and has changed over time (Wylie and Verkouteren 2000). Wylie and Verkouteren also cited the sodic-calcic amphiboles, winchite and richterite, which form a solid solution series and are not regulated under Federal Regulations (EPA 1987d; OSHA 1998a, 1998b). Asbestiform varieties of these amphiboles were found in vermiculite ore in Libby Montana (Wylie and Verkouteren 2000). Table 4-1 lists common synonyms and other pertinent identification information for asbestos (generic) and the six individual asbestos minerals.

The geological or commercial meaning of the word asbestos is broadly applied to fibrous forms of the silicaceous serpentine and amphibole minerals mentioned above. Asbestos minerals form under special physical conditions that promote the growth of fibers that are loosely bonded in a parallel array (fiber bundles) or matted masses. The individual fibrils, which are readily separated from the bundles of fibers, are finely acicular, rodlike crystals. Deposits of fibrous minerals are generally found in veins, in which

Table 4-1. Chemical Identity of Asbestos

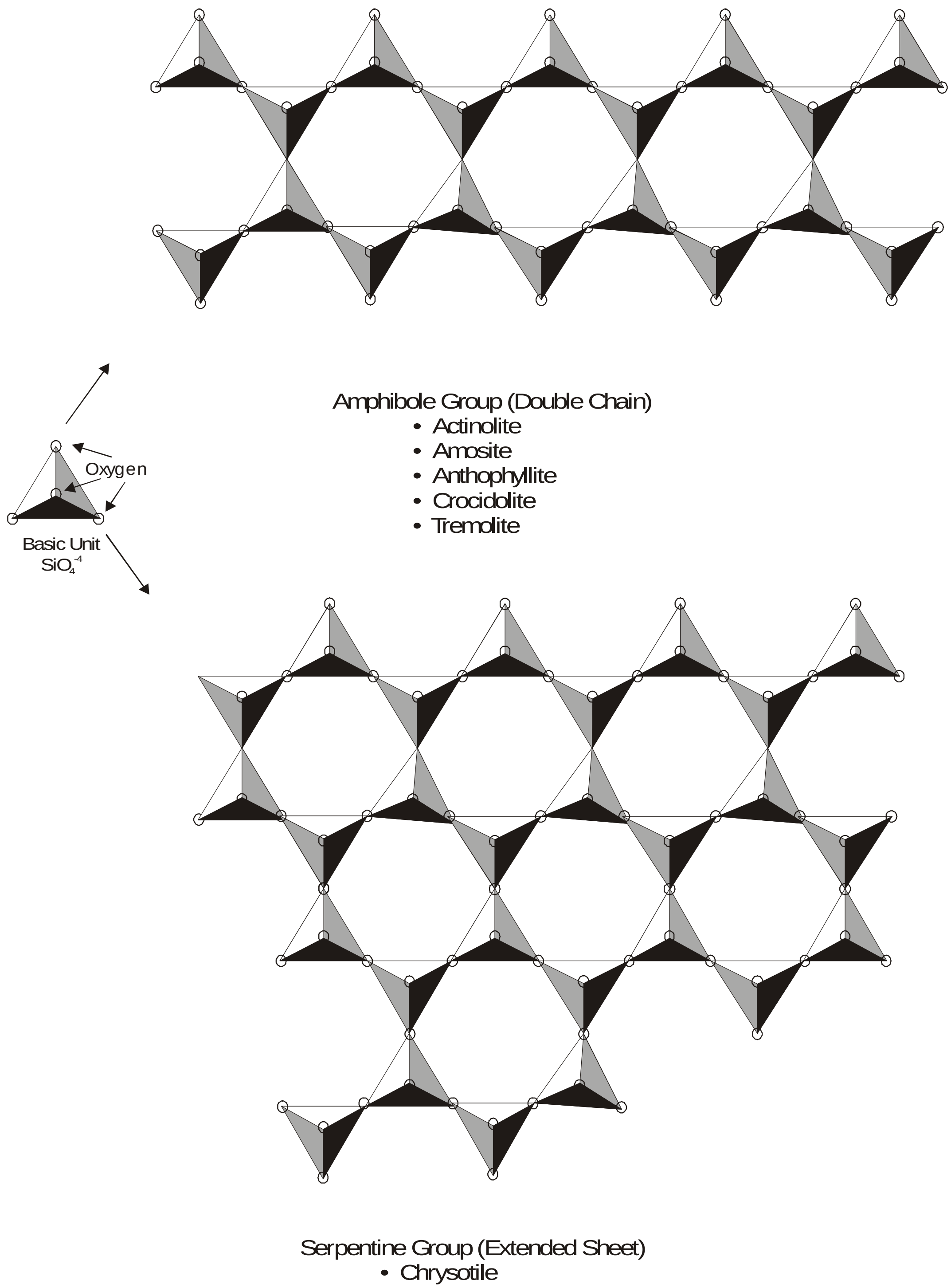
Characteristic	Asbestos	Amosite	Chrysotile	Tremolite[a]	Actinolite[a]	Anthophyllite	Crocidolite
Synonyms	No data	Mysorite, brown asbestos; fibrous cummingtonite/ grunerite	Serpentine asbestos; white asbestos	Silicic acid; calcium magnesium salt (8:4)	No data	Ferroantho-phyllite; azbolen asbestos	Blue asbestos
Trade name	No data	No data	Avibest; Cassiar AK; Calidria RG 144; Calidria RG 600	No data	No data	No data	No data
Chemical formula	No data	$[(Mg,Fe)_7Si_8 O_{22}(OH)_2]_n$	$Mg_3Si_2O_5(OH)_4$	$[Ca_2Mg_5Si_8 O_{22} (OH)_2]_n$	$[Ca_2(Mg,Fe)_5 Si_8O_{22}(OH)_2]_n$	$[(Mg,Fe)_7Si_8O_{22} (OH)_2]_n$	$[NaFe_3^{2+}Fe_2^{3+}Si_8 O_{22}(OH)_2]_n$
Chemical structure				See Figure 4-1			
Identification numbers:							
CAS registry	1332-21-4	12172-73-5	12001-29-5	14567-73-8	13768-00-8	17068-78-9	12001-28-4
NIOSH RTECS	CI6475000	BT6825000	GC2625000	XX2095000	AUO550000	CA8400000	GP8225000
EPA hazardous waste	No data	No data	No data	No data	No data	No data	No data
OHM/TADS	7217043	No data	No data	No data	No data	No data	No data
DOT/UN/NA/ IMCO shipping	IMCO 9.0 UN2212 UN2212	No data	IMCO 9.3 UN2590	No data	No data	No data	No data
HSDB	511	2957	2966	4212	No data	No data	No data
NCI	CO8991	No data	C61223A	CO8991	No data	No data	CO9007

[a]Tremolite and actinolite form a continuous mineral series in which Mg and Fe(II) can freely substitute with each other while retaining the same three-dimensional crystal structure. Tremolite has little or no iron while actinolite contains iron (Jolicoeur et al. 1992; Ross 1981; Skinner et al. 1988).

Sources: EPA 1985b; HSDB 2001a, 2001b, 2001c, 2001d; IARC 1977

CAS = Chemical Abstracts Service; DOT/UN/NA/IMCO = Department of Transportation/United Nations/North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil and Hazardous Materials/Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substances

Figure 4-1. Basic Polysilicate Structures of Asbestos*



* Adapted from Hurlbut and Klein 1977

the fibers are at right angles to the walls of the vein. In the general mineralogical definition, fiber size is not specified. Health regulatory agencies use a more limited definition of asbestos fibers, and therefore, only a subset of asbestos fibers are subject to regulations and used in reporting fiber concentrations. U.S. workplace air regulations apply to chrysotile, crocidolite, amosite, and the asbestiform varieties of anthophyllite, tremolite, and actinolite (OSHA 1992). Prior to 1992, these regulations referred to chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite. Since nonasbestiform and asbestiform varieties of the last three minerals have the same name, new legislation was needed to specifically exclude the nonasbestiform varieties of these minerals. The word asbestos is often added after the mineral (e.g., tremolite asbestos) to signify that the asbestiform variety of the mineral is being referred to. This is not necessary for chrysotile, crocidolite, or amosite because the nonasbestiform varieties have different names (i.e., serpentine, riebeckite, and cummintonite-grunerite). OSHA defended the change in definition by noting that there was a lack of substantial evidence that exposed employees would be at significant risk because the nonasbestiform tremolite, anthophyllite, and actinolite were not regulated in the asbestos standard. OSHA (1992) noted that nonasbestiform amphibole airborne particles are regulated by a separate standard for "not otherwise specified" particulate dusts to protect against "the significant risks of respiratory effects which all particulates create at higher levels of exposure." OSHA defines an asbestos fiber for counting purposes as a particle with a length >5 µm and a length:width ratio (aspect ratio) >3:1. It should be noted that other agencies use different definitions of asbestos fibers for counting purposes. For example, EPA defines a fiber as any particle with aspect ratio >5:1 when analyzing bulk samples for fiber content.

Most amphibole and serpentine minerals in the earth's crust are of nonfibrous forms and are therefore not asbestiform. Fibrous forms may occur together with nonfibrous forms in the same deposits. Nonasbestiform amphiboles may occur in many diverse forms, including flattened prismatic and elongated crystals and cleavage fragments. These crystals exhibit prismatic cleavage with an angle of about 55E between cleavage planes. When large pieces of nonfibrous amphibole minerals are crushed, as may occur in mining and milling of ores containing the minerals, microscopic fragments may be formed that have the appearance of fibers but are generally shorter and have smaller length:width ratios (i.e., particle length >5 µm and a length:width ratio >3:1) than particles traditionally defined as fibers by health regulatory agencies (American Thoracic Society 1990; Case 1991; Ross 1981; Skinner et al. 1988). However, some cleavage fragments may fall within the dimensional definition of a fiber and be counted as an asbestos fiber in air samples or biological samples, unless evidence is provided that the particles are nonasbestiform.

4.2 PHYSICAL AND CHEMICAL PROPERTIES

Asbestos fibers are basically chemically inert, or nearly so. They do not evaporate, dissolve, burn, or undergo significant reactions with most chemicals. In acid and neutral aqueous media, magnesium is lost from the outer brucite layer of chrysotile. Amphibole fibers are more resistant to acid attack and all varieties of asbestos are resistant to attack by alkalis (Chissick 1985; WHO 1998). Table 4-2 summarizes the physical and chemical properties of the six asbestos minerals.

Table 4-2. Physical and Chemical Properties of Asbestos

Property	Amosite	Chrysotile	Tremolite	Actinolite	Anthophyllite	Crocidolite
Molecular weight[a]	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Color	Brown, gray, greenish	White, gray, green, yellowish	White to pale green[b]	Green[b]	Gray, white, brown-gray, green	Lavender, blue, green
Physical state	Solid	Solid	Solid	Solid	Solid	Solid
Flexibility	Fair	Good	Brittle	Fair to brittle	Fair to brittle	Good
Melting point/ decomposition temperature	600–900 EC	800–850 EC	1,040 EC	No data	950 EC	800 EC
Specific gravity	3.43	2.55	2.9–3.2	3.0–3.2	2.85–3.1	3.37
Solubility:						
Water	Insoluble	Insoluble	Insoluble	Insoluble	Insoluble	Insoluble
Organic solvents	Insoluble	Insoluble	Insoluble	Insoluble	Insoluble	Insoluble
Acids[c]	12.00	56.00	No data	No data	2.13	3.14
Bases[c]	6.82	1.03	No data	No data	1.77	1.20
Isoelectric point	5.2–6.0	11.8	No data	No data	No data	No data
Electrical charge at neutral pH	Negative	Positive	No data	No data	Negative	Negative
Length distribution in UICC reference samples						
% >1 µm	46	36–44	No data	No data	46	36
% >5 µm	6	3–6	No data	No data	5	3
% >10 µm	1	1–3	No data	No data	1	0.7

Table 4-2. Physical and Chemical Properties of Asbestos *(continued)*

Property	Amosite	Chrysotile	Tremolite	Actinolite	Anthophyllite	Crocidolite
Flammability limits	Nonflammable	Nonflammable	Nonflammable	Nonflammable	Nonflammable	Nonflammable
Conversion factors[d]						

Sources: Chissick 1985; EPA 1980a, 1985b; HSDB 2001a, 2001b, 2001c, 2001d; IARC 1977; Jolicoeur et al. 1992; Kayser et al. 1982; NAS 1977; Ross 1981; Skinner et al. 1988; SRI 1982.

[a]All forms of asbestos are indefinite polymers.
[b]Tremolite and actinolite form a continuous mineral series in which Mg and Fe(II) can freely substitute with each other. With increasing iron content, the color of tremolite, typically creamy white, takes on a greenish cast.
[c]Percent loss in weight due to loss of counter-ions; silicate structure remains intact.
[d]See text, Section 3.2

UICC = Union Internationale Centre le Cancer

5. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

5.1 PRODUCTION

The production volume of asbestos mines in the United States has decreased substantially from a peak of over 299 million pounds (136,000 metric tons) in the late 1960s and early 1970s (SRI 1982) to 112 million pounds (51,000 metric tons) in 1987, 37 million pounds (17,000 metric tons) in 1989, and 14,000 metric tons in 1993 (U.S. Bureau of Mines 1994; USGS 1998). Production dwindled to 15.4 million pounds (7,000 metric tons) in 1997, 13.2 million pounds (6,000 metric tons) in 1998, and was estimated to remain at 13.2 million pounds (6,000 metric tons) in 1999 (USGS 2000).

While the production and use of asbestos in the United States and Western Europe has declined in recent years as a result of health concerns and bans on many of its uses, there continues to be extensive sales and use of asbestos in South and Central America, Asia, and Africa. World production was estimated as 1.9 million metric tons in 1996. The leading producers in order of declining production volumes were Russia, Canada, China, Brazil, Zimbabwe, and Kazakhstan (Anonymous 2000; Karnak Corporation 1998; Nicholson and Landrigan 1996; USGS 1999b). Nearly all of the asbestos produced worldwide is chrysotile; over 99% of asbestos used in the U.S. has been chrysotile (USGS 2000).

In the past, asbestos was produced by companies in California, Arizona, North Carolina, and Vermont, but many of these companies suspended asbestos mining operations in the 1970s. In 1985, three U.S. companies produced asbestos fibers: Calaveras Asbestos, Ltd., Calaveras County, California; KCAC, Inc., San Benito County, California; and Vermont Asbestos Group, Orleans County, Vermont. By 1997, only one company was mining asbestos in the United States, KCAC Inc., San Benito County, California (USGS 1997, 1999b). The company mines a highly sheared serpentinite composed of matted short fiber chrysotile and unfractured serpentinite (also called a mass fiber deposit). The U.S. resources of serpentinite asbestos, while large, are mostly composed of short fibers. The chrysotile with the longest fibers comes from Zimbabwe.

In the United States, asbestos was mainly mined in open pits in which ore was blasted or drilled from the pit, crushed, dried, and stored until milling. The milling process removes asbestos fibers from the ore by a series of crushing, fiberizing, screening, aspirating, and grading operations. More recently, an alternative method of mining was developed in order to reduce fiber air emission. This method uses bulldozers and scrapers (rather than blasting) to remove the ore from the pit. The ore is watered down to prevent air dispersion of the fibers, and is crushed, sized, and screened while wet. After being dewatered, the fibers are pelletized, dried, and prepared for shipment either as pellets or further processed to yield open fibers (EPA 1988i).

Table 5-1 lists the number of facilities in each state that reported producing, processing, or using asbestos (friable), the intended use, and the range of maximum quantity of asbestos that is stored on site. The data listed in Table 5-1 are derived from the Toxics Release Inventory (TRI99 2001). Only ‘friable’ asbestos is required to be reported. Starting in 1998, seven new industrial sectors were required to report their releases to the TRI. One of these new industrial sectors, Resource Conservation and Recovery Act (RCRA) hazardous waste treatment and disposal facilities, often has large amounts of asbestos on site. The TRI data should be used with caution since only certain types of facilities are required to report (EPA 1999b). Therefore, this is not an exhaustive list.

5.2 IMPORT/EXPORT

Most of the asbestos used in the United States is imported; domestic production is mostly exported. Imports from 1950 to 1974 varied from about 1,287 million pounds to 1,580 million pounds (585,000–718,000 metric tons) per year. During the late 1970s, imports began decreasing, with a sharp drop after 1980. By 1984, imports declined to 462 million pounds (210,000 metric tons) and in 1997 and 1998 they had dipped to 46.2 million pounds (21,000 metric tons) and 35.2 million pounds (16,000 metric tons), respectively. Imports for 1999 are estimated to be 33 million pounds (15,000 metric tons) (USGS 2000). Between 1995 and 1998, 99% of imports came from Canada. In 1999, Canada supplied 91% of imports (USGS 1999b). The United States also imported approximately 60,100 metric tons of asbestos- and cellulose-fiber cement products in 1999. These products were in the form of flat sheets and panels (93%), corrugated sheets (4%), and pipes (1%).

Exports of asbestos were low until the mid-1960s when a significant increase in exports occurred. In recent years, export volumes have generally decreased from 132 million pounds (60,000 metric tons) in 1987 to 48 million pounds (22,000 metric tons) in 1991and 39.6 million pounds (18,000 metric tons) in 1994. In 1999, exports of unmanufactured asbestos were approximately 47.7 million pounds (21,700 metric tons), of which approximately 15.4 million pounds (7,000 metric tons) were of domestic origin. These exports included asbestos crudes, fiber, stucco sand, and refuse. Re-exports of Canadian fiber probably accounted for the bulk of the remaining exports. Exports and re-exports of friction products—brake linings, disk pads, and mounted disk linings accounted for 81% of the values of all

Table 5-1. Facilities that Produce, Process, or Use Asbestos

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AL	1	100	999	13
AZ	1	100,000	999,999	2, 3, 8
CA	7	1,000	9,999,999	2, 3, 8, 13
FL	2	10,000	99,999	2, 3, 8, 9
IL	2	10,000	99,999	2, 3, 8, 13
IN	2	10,000	999,999	2, 3, 8
KS	1	10,000	99,999	2, 3, 12
KY	3	1,000	99,999	1, 5, 9, 13
LA	8	1,000	999,999	1, 2, 3, 5, 8, 9, 10, 11, 12, 13
MD	1	10,000	99,999	9
MI	1	1,000	9,999	13
NC	1	10,000	99,999	13
NJ	2	10,000	999,999	8, 9
NV	2	10,000	99,999	12, 13
NY	3	10,000	999,999	2, 3, 8, 9, 13
OH	3	1,000	999,999	1, 2, 3, 4, 5, 8
OK	1	1,000	9,999	13
OR	2	10,000	999,999	2, 3, 8, 13
PA	3	10,000	999,999	2, 3, 8, 13
SC	2	10,000	99,999	1, 2, 3, 5, 8
TN	2	10,000	999,999	8, 9
TX	7	100	999,999	1, 2, 3, 5, 8, 9, 12, 13
UT	3	1,000	9,999,999	1, 5, 13
VA	2	10,000	99,999	1, 2, 3, 5, 9
WA	1	10,000	99,999	12
WV	1	10,000	99,999	11
WY	1	10,000	99,999	1, 5, 10

Source: TRI99 2001

[a]Post office state abbreviations used
[b]Amounts on site reported by facilities in each state
[c]Activities/Uses:

1. Produce
2. Import
3. Onsite use/processing
4. Sale/Distribution
5. Byproduct
6. Impurity
7. Reactant
8. Formulation Component
9. Article Component
10. Repackaging
11. Chemical Processing Aid
12. Manufacturing Aid
13. Ancillary/Other Uses

manufactured asbestos products. The quantity of these exports and whether they were produced in the United States was not reported (SRI 1982; U.S. Bureau of Mines 1992, 1994; USGS 1997, 1999a, 1999b).

5.3 USE

Asbestos has been used in a broad variety of industrial applications which draw upon its low cost and desirable properties such as heat and fire resistance, wear and friction characteristics, tensile strength, heat, electrical and sound insulation, adsorption capacity, and resistence to chemical and biological attack. At the peak of its demand, about 3,000 applications or types of products were listed for asbestos. In most of its applications, asbestos is bonded with other materials such as Portland cement, plastics, and resins. In other applications, asbestos is used as a loose fibrous mixture or woven as a textile.

Consumption of asbestos in the United States has been declining for two decades. Reported consumption of asbestos in the United States was 790 million pounds (359,000 metric tons) in 1980, 497 million pounds (226,000 metric tons) in 1984, 185 million pounds (84,000 metric tons) in 1987, 81 million pounds (35,000 metric tons) in 1991, 73 million pounds (33,000 metric tons) in 1994, and 46 million pounds (21,000 metric tons) in 1997. By 1998 and 1999, U.S. consumption of asbestos had declined to 34.8 million pounds (15,800 metric tons) per year. The 1999 domestic consumption pattern was 61% for roofing products, 19% for gaskets, and 13% for friction products (automobile clutch, brake, and transmission components). Roofing products, gaskets, and friction products will continue to be the only significant domestic markets for asbestos in the foreseeable future. Only chrysotile is presently used for manufacturing in the United States (USGS 1999b). Ninety-four percent of chrysotile consumed was grade 7, a short (3 μm) fiber. Only 0.4% of the asbestos used were long fibers (6–9.5 μm); these were mostly used in plastics (Chissick 1985; Jolicoeur et al. 1992; SRI 1982; USGS 1997, 1999b; U.S. Bureau of Mines 1992, 1994).

In 1973, EPA prohibited the spraying of asbestos-containing material on buildings and structures for fireproofing and insulation purposed. The ban on the use of spraying was later expanded to include applications for decorative purposes. The Consumer Product Safety Commission banned other uses including its inclusion in patching compounds and asbestos heat shields in hair dryers. In October 1991, a United States federal court overturned an EPA regulation (1989f) know as the ‘Asbestos Ban and Phase Out Rule’ that would have prohibited the manufacture, importation, processing, and distribution in commerce of asbestos and most asbestos-containing products by 1997 under the Toxic Substances

Control Act (TSCA) (U.S. Bureau of Mines 1992; Vu 1993). At present, only asbestos-containing products that were not being manufactured, imported, or processed on July 12, 1989 remain subject to the prohibition requirements of the EPA regulation (EPA 1992a). Specific products which remain subject to the rule will be documented by EPA.

Substitutes for asbestos are constantly being developed (EPA 1989f). Nonasbestos friction materials are currently being used in disc brake pads, and substitutes have been developed for drum brake linings. Substitutes include fibers made of carbon, steel, cellulose, ceramics, glass, and wollastonite and organic fibers made from aramid, polyethylene, polypropylene, and polytetrafluoroethylene (USGS 2000). No single substitute was as versatile and as cost effective as asbestos.

5.4 DISPOSAL

Currently, friable asbestos-containing wastes may only be deposited in landfills that are approved and regulated by the federal government. Regulations include wetting or using dust suppression agents, covering with at least 15 cm (6 inches) of nonasbestos-containing material, and deterring public access with a fence or natural barrier (EPA 1990a). These regulations are intended to ensure that asbestos at these sites is not dispersed into the environment. No data were located on amounts of friable asbestos in such sites. Nonfriable asbestos waste is considered to be a nonhazardous waste and can be disposed of in any landfill. There is no significant recycling of asbestos (USGS 2000). However, Cassiar Mines and Metals, Inc., a Canadian company that owns a mine in British Columbia, is currently producing chrysotile from its stockpiles and mine tailings (USGS 1999b). It is also developing a magnesium plant using stockpiled chrysotile and serpentinite as a source material.

According to the TRI, in 1996, an estimated 750 pounds of asbestos (friable) were released to publicly owned-treatment works (POTWs) by facilities producing, processing, or using asbestos, and an estimated 3.3 million pounds were transferred off-site (TRI96 1999). In 1999, 4.8 million pounds of friable asbestos was transferred off-site, presumably for disposal (TRI99 2001). Starting in 1998, seven new industrial sectors were required to report their releases to the TRI. Asbestos was transferred off-site from only one of these industrial sectors, RCRA hazardous waste treatment and disposal facilities; the amount transferred was 2.4 million pounds.

6. POTENTIAL FOR HUMAN EXPOSURE

6.1 OVERVIEW

Asbestos has been identified in at least 83 of the 1,585 hazardous waste sites that have been proposed for inclusion on the EPA National Priorities List (NPL) (HazDat 2001). However, the number of sites evaluated for asbestos is not known. The frequency of these sites can be seen in Figure 6-1. All of these sites are located in the United States.

Although asbestos is neither volatile nor soluble, small fibers or clumps of fibers may occur in suspension in both air and water. These fibers are very stable and do not undergo significant degradation in the environment. Large fibers are removed from air and water by gravitational settling at a rate dependent upon their size, but small fibers may remain suspended for long periods of time.

The general population is exposed to low levels of asbestos primarily by inhalation. Small quantities of asbestos fibers are ubiquitous in air. They may arise from natural sources (e.g., weathering of asbestos-containing minerals), from windblown soil from hazardous waste sites where asbestos is not properly stored, and from deterioration of automobile clutches and brakes or breakdown of asbestos-containing (mainly chrysotile) materials, such as insulation. Tremolite asbestos is a contaminant in some vermiculite and talc. These sources would also contribute to asbestos levels in air. Higher levels of airborne asbestos occur near asbestos mines and may occur near industries that produced asbestos-containing products (Case 1991; Case and Sebastien 1987, 1989; WHO 1998). While the use of asbestos in most products has been phased out, higher asbestos levels may be present in soil near these industries. Higher exposure levels may result when asbestos is released from asbestos-containing building materials such as insulation, ceiling tiles, and floor tiles that are in poor condition or disturbed. In general, levels of asbestos in air inside and outside buildings with undisturbed asbestos-containing materials are low, but indoor levels may be somewhat higher than outside levels. In most cases, the exposure of the general population to asbestos has been found to be very low. The concentrations of asbestos fibers in outdoor air are highly variable, ranging from below 0.1 ng/m^3 (equivalent to $3x10^{-6}$ f/mL measured by phase contrast microscopy [PCM]) in rural areas to over 100 ng/m^3 ($3x10^{-3}$ PCM f/mL) near specific industrial sources such as asbestos mines. Typical concentrations are $1x10^{-5}$ PCM f/mL in rural areas and up to an order of magnitude higher in urban areas. In the vicinity of an asbestos mine or factory, levels may reach 0.01 f/mL or higher. The concentration of fibers in indoor air is also highly variable, depending on the amount and condition of asbestos-containing materials in the building. Typical concentrations range from

Figure 6-1. Frequency of NPL Sites with Asbestos Contamination

1 to 200 ng/m^3 (3x10^{-5} to 6x10^{-3} PCM f/mL) (Nicholson 1987). For a human exposed for a lifetime (70 years), this range of exposures corresponds to cumulative doses of approximately 0.002–0.4 PCM f-yr/mL. Children may be exposed to asbestos in the same ways that adults are exposed outside the workplace—from asbestos in air, especially near emission sources or in buildings with deteriorating asbestos-containing material. Since children are more apt to play in dirt, they may be exposed to higher levels of asbestos if the dirt they are playing in contains asbestos and they inhale the dust.

Fibers in water arise mainly by erosion of natural deposits of asbestos or by corrosion of fibers from pipes made with asbestos-containing cement. Asbestos concentrations in most water supplies are less than 1 million fibers per liter (MFL), but may exceed 100 MFL in some cases. For a human consuming 2 L/day, this would yield a dose of about 2–200 million fibers per day.

Occupational exposure occurs primarily through inhalation of asbestos-containing air in the workplace. Workers involved in the mining and processing of asbestos ores or in the production of asbestos-containing products may be exposed to asbestos fibers in air. The presence of asbestiform minerals has been detected in certain mining areas, and people employed in mining and processing of other ores may therefore be exposed to asbestos. In particular, tremolite asbestos can be found in certain sources of vermiculite or talc. It is also a contaminant in the chrysotile mined in Quebec, Canada (Case et al. 2000; Frank et al. 1998; Sebastien et al. 1989; Srebro and Roggli 1994). Asbestos-containing material had been commonly used in buildings in insulation, fireproofing, dry wall, ceiling and floor tile, and other materials, and disturbing this material might release asbestos fibers into the air. Therefore, workers involved in demolition work or asbestos abatement, as well as in building maintenance and repair, are potentially exposed to higher levels of asbestos.

According to the Toxics Release Inventory (TRI), in 1999, total releases of asbestos (friable) to the environment (including air, water, and soil) from 87 facilities that reported producing, processing, or using asbestos were 13.6 million pounds (TRI99 2001). Table 6-1 lists amounts released from these facilities grouped by state.

Table 6-1. Releases to the Environment from Facilities that Produce, Process, or Use Asbestos

		Reported amounts released in pounds per year[a]						
State[b]	Number of facilities	Air[c]	Water	Underground injection	Land	Total on-site release[d]	Total off-site release[e]	Total on and off-site release
AL	3	0	No data	No data	49,048	49,048	No data	49,048
AR	1	23	No data	No data	No data	23	2	25
AZ	1	0	No data	No data	No data	0	336	336
CA	9	255	No data	No data	3,242,237	3,242,492	103,699	3,346,191
DE	1	No data	No data	No data	No data	No data	No data	No data
FL	3	103	No data	No data	No data	103	5,726	5,829
IL	4	250	No data	No data	No data	250	1,500	1,750
IN	2	0	No data	No data	No data	0	264	264
KS	1	19	No data	No data	No data	19	2,800	2,819
KY	3	250	No data	No data	59,160	59,410	880,084	939,494
LA	12	19	0	No data	636,000	636,019	268,890	904,909
MD	1	No data	No data	No data	No data	No data	22,908	22,908
MI	1	0	No data	No data	No data	0	No data	0
NC	2	No data	No data	No data	No data	No data	24,000	24,000
NJ	2	175	No data	No data	186	361	3,080	3,441
NV	2	1	No data	No data	76,000	76,001	No data	76,001
NY	5	17	0	No data	770,000	770,017	78,829	848,846
OH	3	1,371	0	No data	No data	1,371	178,000	179,371
OK	1	18	No data	No data	100,579	100,597	No data	100,597
OR	3	0	No data	No data	8,157,587	8,157,587	170	8,157,757

Table 6-1. Releases to the Environment from Facilities that Produce, Process, or Use Asbestos

		Reported amounts released in pounds per year[a]						
State[b]	Number of facilities	Air[c]	Water	Underground injection	Land	Total on-site release[d]	Total off-site release[e]	Total on and off-site release
PA	4	252	0	No data	0	252	433,414	433,666
SC	2	2	No data	No data	No data	2	160	162
TN	2	107	No data	No data	No data	107	145,100	145,207
TX	10	253	0	No data	3,560	3,813	200,532	204,345
UT	3	20	No data	No data	450,426	450,446	42,003	492,449
VA	2	296	No data	No data	No data	296	2,451,886	2,452,182
WA	1	1	No data	No data	No data	1	No data	1
WV	1	No data	No data	No data	0	0	No data	0
WY	2	No data	No data	No data	29,000	29,000	No data	29,000
Total	87	3,432	0	No data	13,573,783	13,577,215	4,843,383	18,420,598

Source: TRI99 2001

[a]Data in TRI are maximum amounts released by each facility.
[b]Post office state abbreviations are used.
[c]The sum of fugitive and stack releases are included in releases to air by a given facility.
[d]The sum of all releases of the chemical to air, land, water, and underground injection wells.
[e]Total amount of chemical transferred off-site, including to publicly owned treatment works (POTW).

6.2 RELEASES TO THE ENVIRONMENT

According to the TRI, in 1999, total releases of asbestos (friable) to the environment (including air, water, and soil) from 87 facilities that reported producing, processing, or using asbestos were 13.6 million pounds (TRI99 2001). Table 6-1 lists amounts released from these facilities grouped by state. The TRI data should be used with caution because only certain types of facilities are required to report. This is not an exhaustive list.

6.2.1 Air

Although asbestos is not volatile, small fibers and clumps of fibers may be released to air as dust. Asbestos originating from the weathering of natural deposits of asbestos-bearing rocks is found in air and has been deposited in ice cores dating back to 1750. No estimates of the amounts of asbestos released to the air from natural sources is available. Asbestos is much more likely to be released to the atmosphere when asbestos deposits are disturbed—as in mining operations. In Canada, over 95% of asbestos is mined in open-mining operations that involve drilling and blasting, and this contributes more air emissions than underground mining operations (Sebastien et al. 1984). Other anthropogenic sources of asbestos emissions besides mining are the crushing, screening, and milling of the ore, the processing of asbestos into products, the use of asbestos-containing materials, and the transport and disposal of asbestos-containing wastes.

In 1992, the EPA estimated that emissions from asbestos processing, including milling, manufacturing, and fabrication were about 2,240 pounds per year (EPA 1992b). This estimate assumed full compliance with the current National Emission Standards for Hazardous Air Pollutants (NESHAP) (EPA 1990a) applicable to asbestos. Based on new data, EPA later determined that asbestos emissions from processing facilities were much lower than the original estimates used to list these facilities as source categories under the 1990 Clean Air Act Amendments of 1992 (OSHA 1994).

Another potential source of asbestos release to air is from clutches and brakes on cars and trucks; a wide range of air concentrations of asbestos fibers (0.004–16.0 f/mL) has been reported in numerous air sampling studies of workplaces during maintenance and replacement of vehicle brakes (WHO 1998). Release of asbestos from insulation or other building materials is discussed in Section 6.4.1, below. Estimated asbestos emissions from waste disposal from all sources were about 499,000 pounds

(22.7 metric tons) per year (EPA 1990a). If all sources were in full compliance with the NESHAP for asbestos, waste disposal emissions would be reduced to 1,320 pounds (600 kg) per year (EPA 1990a).

According to TRI, in 1999, the estimated release of asbestos (friable) was 3,432 pounds to the air from 87 facilities that reported producing, processing, or using asbestos. This accounted for about 0.02% of total environmental releases (TRI99 2001). Table 6-1 lists amounts of asbestos released from these facilities to air.

Asbestos has been identified in air at 17 of the 1,585 current or former NPL hazardous waste sites where it was detected in some environmental media (HazDat 2001).

6.2.2 Water

Asbestos is released to water from a number of sources, including erosion of natural deposits and waste piles, corrosion from asbestos-cement pipes, and disintegration of asbestos roofing materials with subsequent transport via rainwater into cisterns, sewers, etc. (Millette et al. 1980). Waste water from asbestos-related industries may also carry significant burdens of asbestos fibers (EPA 1976). The total amount of asbestos released to water has been estimated to be 110,000–220,000 pounds (50–100 metric tons) per year (NRC 1984).

According to TRI, in 1999, no asbestos (friable) was released to water from 87 facilities that reported producing, processing, or using asbestos (TRI99 2001). Table 6-1 lists the amount of asbestos released from these facilities.

Asbestos has been identified in groundwater and surface water samples respectively collected from 11 and 9 of the 1,585 current or former NPL hazardous waste sites, where it was detected in some environmental media (HazDat 2001).

6.2.3 Soil

Soil may be contaminated with asbestos by the weathering of natural asbestos deposits, or by land-based disposal of waste asbestos materials. While disposal of waste asbestos to landfills was a common practice in the past, current regulations restrict this practice (see Chapters 5 and 8).

In 1999, the disposal of 13,573,783 pounds of asbestos (friable) on land was reported by 87 U.S. facilities that produced, processed, or used asbestos (TRI99 2001). An additional 4,843,383 pounds of asbestos were transferred to other locations, including publically owned treatment works (POTWs), in 1999, and it is likely that most of this was ultimately released on land. No asbestos was injected underground in 1999. Table 6-1 lists the amounts of asbestos released from these facilities by state.

Asbestos has been identified in soil and sediment samples respectively collected from 27 and 7 of the 1,585 current or former NPL hazardous waste sites, where it was detected in some environmental media (HazDat 2001).

6.3 ENVIRONMENTAL FATE

6.3.1 Transport and Partitioning

Asbestos fibers are nonvolatile and insoluble, so their natural tendency is to settle out of air and water, and deposit in soil or sediment (EPA 1977, 1979c). However, some fibers are sufficiently small that they can remain in suspension in both air and water and be transported long distances. For example, fibers with aerodynamic diameters of 0.1–1 µm can be carried thousands of kilometers in air (Jaenicke 1980), and transport of fibers over 75 miles has been reported in the water of Lake Superior (EPA 1979c). Adsorptive interactions between the fibers and natural organic contaminants may favor coagulation and precipitation of the fibers (EPA 1979c).

6.3.2 Transformation and Degradation

6.3.2.1 Air

Asbestos fibers in air are not known to undergo any significant transformation or degradation (EPA 1979c).

6.3.2.2 Water

Chrysotile asbestos may undergo some dissolution in the aquatic environment, especially at low pH. Magnesium hydroxide leaches from the outer brucite layer, but the basic silicate structure of the fiber remains intact. Amphibole asbestos is much more resistant to attack in acidic media (Chissick 1985; Choi and Smith 1972; Morgan and Holmes 1986; WHO 1998).

Asbestos degrades in the environment very slowly (NRC 1984). Although the estimated half-life of asbestos in aquatic systems is not known, it is expected to be quite long (NRC 1984), and asbestos may persist in the environment virtually unchanged for very long periods of time following its release (EPA 1989f).

6.3.2.3 Sediment and Soil

Asbestos fibers are not known to undergo significant transformation or degradation in soil.

6.4 LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT

Numerous measurements have been performed to determine the concentration of asbestos fibers in environmental media, primarily air. These studies have reported their results in a variety of units, including ng/m^3 (measured by midget impinger counting analysis), TEM f/mL (fibers measured by transmission electron microscopy), and PCM f/mL (fibers measured by phase contrast microscopy). The most accurate and sensitive method for measuring asbestos fiber content in air is electron microscopy, and preferably transmission electron microscopy (TEM) must be used. Phase contrast microscopy cannot distinguish between asbestos and nonasbestos fibers or between different types of asbestos. However, in certain occupational settings where the predominant fiber is asbestos, PCM should give an adequate measure of asbestos concentration. In nonoccupational environments where a large fraction of the fibers are not asbestos (e.g., wool, cotton, glass), PCM may greatly overestimate the asbestos levels in air. Regulations regarding asbestos determine what fibers are counted in the analysis. Established methods define fiber material having a length $5 μm and a length to diameter ratio of $3:1. In the same air sample, the fibers counted by TEM can be 50–70 times higher than those counted by PCM. This relates to the fact that PCM cannot detect fibers less than about 0.20–0.30 μm in diameter while TEM is capable of detecting fibers with diameters as small as 0.01 μm. Therefore, PCM may miss thin fibers as well as include nonasbestos fibrous material. The conversion factors between fibers counted by PCM and those counted by TEM are highly variable, depending on the size and length distribution of the fibers. No single set of factors will be accurate for all samples, although a conversion factor can be established for specific fiber types and occupational settings. A comparison was made between fiber counts by PCM and TEM using samples from a chrysotile mine, crusher, mill and tailings site, a brake manufacturing industry, and a taping products industry (Verma and Clark 1995). It was anticipated that such a study would allow extrapolations to be made from occupational exposures to low-level nonoccupational exposures. Fibers from 65 filters were counted using PCM and TEM, and ratio of the fiber counts by the two methods determined for various operations and locations. In addition, the fiber determinations by TEM were made to include different groups of fibers. The fiber concentration ratios determined were TEM to PCM for all TEM fibers, for all TEM asbestos fibers, for TEM asbestos fibers with length >5 µm and diameter <3 µm, and for TEM asbestos fibers with length >5 µm and diameters >0.3 µm and <3 µm. The results for 'all TEM fibers' and 'all TEM asbestos fibers' showed that for the operations studied, the airborne fibers were 93–100% asbestos. The fiber concentration ratios of TEM to PCM for 'all asbestos fibers' were highly variable for the different samples, ranging between 19 and 76. The high of 76 was for milling where a predominance of small fibers resulted from more efficient dust collection. The fiber concentration ratios of TEM to PCM for 'TEM fibers of length >5 µm and diameter >0.3 µm and <3 µm' was fairly consistent, varying between 1.2 and 10.4 but mostly <4.4 or between 1.4 and 3.2 when data were grouped by operation rather than by individual occupations or locations. This indicates that this method of counting and sizing the fibers was consistent. The TEM fibers of length >5 µm and diameter >0.3 µm and <3 µm was 4–18% of the total TEM fibers. The proportion of long, thin fibers increased as the asbestos operation moved from the primary sector (mining) to end use (manufacturing).

In 1984, the NRC (1984) recommended that a conversion be used to measure asbestos fibers. It was suggested that crude approximations could be achieved by assuming that 1 PCM f/mL is equal to 60 TEM f/mL. Both 1 PCM f/mL and 60 TEM f/mL are approximately equal to a mass concentration of 30 $\mu g/m^3$. Since the health effects data regarding inhalation exposure to asbestos are usually expressed in terms of PCM f/mL, ambient air data reported in units of ng/m^3 or TEM f/mL are converted to units of PCM f/mL using the factors suggested by NRC (1984).

6.4.1 Air

Ambient outdoor air, remote from any special sources, is generally found to contain 0.001–0.1 ng/m^3 of asbestos ($3x10^{-8}$–$3x10^{-6}$ PCM f/mL) (NRC 1984). Another source reports the average concentration of asbestos fibers in rural outdoor air as $1x10^{-5}$ PCM f/mL (HEI 1991). In urban areas, most ambient air concentrations range from 0.1 to 10 ng/m^3 (3x10^{-6}–3x10^{-4} PCM f/mL), but may range up to 100 ng/m^3 (3x10^{-3} PCM f/mL) as a result of local sources (Corn 1994; EPA 1991b; IARC 1977; Nicholson and Pundsack 1973; Selikoff et al. 1972). The median concentration in U.S. cities has been estimated to be 2.3 ng/m^3 (7x10^{-5} PCM f/mL) (NRC 1984). Two other investigations of asbestos in outdoor air in the United States reported levels of asbestos from not detected (ND) to 8x10^{-3} PCM f/mL, with a median of 3x10^{-4} PCM f/mL and a mean of 5x10^{-5} PCM f/mL (WHO 1998). These levels are sufficiently low that they are not likely to be of significant health concern to most people. Near industrial operations involving asbestos, levels may be as high as 50–5,000 ng/m^3 (10.0015–15 PCM f/mL) (IARC 1977). A recent analysis of monitoring data for asbestos in ambient air worldwide estimated rural and urban levels at about 1x10^{-5} TEM f/mL (2x10^{-7} PCM f/mL) and 1x10^{-4} TEM f/mL (2x10^{-6} PCM f/mL), respectively (HEI 1991). Higher levels were measured near source-dominated locations.

Average asbestos fiber concentrations (>5 Fm) in chrysotile mining towns in Quebec that had been 0.08 f/mL in 1973 and 1974 declined to 0.007 by 1982 and have remained below 0.01 f/mL between 1982 and 1994 (WHO 1998). A comprehensive study of asbestos air levels around various asbestos-related industries was conducted in Taiwan (Chang et al. 1999). Samples (n=246) were obtained as a function of distance around 41 factories producing cement, friction products, textiles, tile, insulation, and refractory materials. Samples around 14 of these plants, randomly chosen to include all types of plants, were analyzed by TEM; the remainder of the samples were analyzed by PCM. The results of this study appears in Table 6-2. In general, the asbestos concentrations around asbestos-related industries were low and inversely related to distance from the factory. The large geometric standard deviation reflects unevenly distributed levels for the same type of plant. Asbestos levels around refractory plants were low indicating a low release during the wet, clay-like material in the manufacturing process. In contrast, higher levels of asbestos fibers were found around textile plants where the manufacturing process is dry and open. Asbestos concentrations obtained by PCM were much higher than those obtained by TEM. This overestimation of fiber concentrations by PCM is much greater when the levels of nonasbestos fibers are high. For the same factory, levels of TEM asbestos substances were generally lower than nonasbestos substances and in some samples combined concentration of asbestos and nonasbestos substances were similar to results obtained by PCM.

McDonald et al. (1986b) reported that TEM and chemical analysis of samples of airborne fibers from various locations of the Libby, Montana, vermiculite mine and mill showed several morphologies (straight with uniform diameter, needle shape, and curved), chemical content compatible with the

Table 6-2. Asbestos Levels in Ambient Air Around Taiwanese Factories

Factory type	Number of factories	Method	GM (GSD) asbestos concentrations (f/mL) Distance from factory		
			200 m	400 m	600 m
Cement	5	TEM	0.006 (1.230)	0.007 (1.487)	0.006 (1.301)
		PCM	0.01 (3.49)	0.01 (2.91)	<0.01
Friction	3	TEM	0.008 (2.441)	0.008 (1.978)	0.002 (2.221)
		PCM	0.01 (322)	0.02 (2.88)	<0.01
Textile	2	TEM	0.012 (2.221)	0.020 (1.432)	0.006 (1.765)
		PCM	0.02 (3.21)	0.02 (3.33)	<0.01
Ground tile	2	TEM	0.033 (1.412)	0.021 (1.421)	0.025 (2.321)
		PCM	0.4 (3.21)	<0.01	0.01 (2.21)
Insulation	1	TEM	0.012 (2.321)	0.020 (2.210)	0.006 (2.773)
		PCM	<0.01	<0.01	<0.01
Refractory	1	TEM	<0.0001	<0.0001	<0.0001
		PCM	<0.01	<0.01	<0.01
Overall	14	TEM	0.0015 (1.943)	0.0011 (2.022)	0.007 (2.221)
		PCM	0.06 (3.29)	0.01 (3.21)	0.01 (2.21)

Source: Chang et al. 1999

GM = geometric mean; GSD geometric standard deviation; PCM = phase contrast microscopy; TEM = transmission electron microscopy tremolite-actinolite series with some evidence of sodium content; ranges for diameter, length, and length:width ratio of 0.1–2, 1–70, and 3–100 µm, respectively. Greater than 60% of fibers were reported to be longer than 5 µm (McDonald et al. 1986b). Tremolite asbestos is a contaminant in some vermiculite.

Asbestos fibers may be released to indoor air due to the possible disturbance of asbestos-containing building materials such as insulation, fireproofing material, dry wall, and ceiling and floor tile (EPA 1991b; HEI 1991; Spengler et al. 1989). Measured indoor air values range widely, depending on the amount, type, and condition (friability) of asbestos-containing materials used in the building. For example, asbestos in floor tile is less friable than that in insulation or sprayed coatings. The release of asbestos fibers from asbestos-containing materials (ACM) is sporadic and episodic. Human activity and traffic may facilitate release of asbestos fibers and stir up asbestos-containing dust. Therefore, monitoring performed at night or on weekends may underestimate human exposure to asbestos in buildings. In addition, asbestos levels are apt to be higher in some areas of a building (e.g., boiler room) than in others and these areas may not be accessible to most people using the building. In a review of indoor air monitoring data from a variety of locations, Nicholson (1987) reported that arithmetic mean concentrations ranged from 1 to 200 ng/m^3 ($3x10^{-5}$ to $6x10^{-3}$ PCM f/mL). In a survey performed by EPA (1988c), levels of asbestos in 94 public buildings that contained asbestos ranged from not detected (ND) to 0.2 TEM f/mL (ND–$3x10^{-3}$ PCM f/mL), with an arithmetic mean concentration of 0.006 TEM f/mL (10^{-4} PCM f/mL) (Spengler et al. 1989). Analysis of data based on air samples from 198 buildings with ACM indicated mean asbestos levels ranging from $4x10^{-5}$ to $2.43x10^{-3}$ TEM f/mL ($7x10^{-7}$–$4x10^{-5}$ PCM f/mL) (HEI 1991). Asbestos concentrations in 41 schools that contained asbestos ranged from ND to 0.1 TEM f/mL (ND–$2x10^{-3}$ PCM f/mL), with an arithmetic mean of 0.03 TEM f/mL ($5x10^{-4}$ PCM f/mL) (EPA 1988c; Spengler et al. 1989). Another study reported average concentrations of airborne asbestos fibers $5 µm in length of $8.0x10^{-5}$ and $2.2x10^{-5}$ TEM f/mL in 43 nonschool buildings and 73 school buildings, respectively (Chesson et al. 1990; HEI 1992; Spengler et al. 1989). The average outdoor level in these studies were comparable to those measured indoors (Spengler et al. 1989). Building survey and air sampling, both inside and outside the building was conducted on 315 buildings nationwide over a 5-year period. The study was undertaken by consultants for defendants for litigation from buildings in which asbestos removal was alleged to be necessary because of risk to occupants from exposure to asbestos-containing materials (Lee et al. 1992). In the study a total of 2,892 air samples were obtained and analyzed by TEM. Public, commercial, residential, school and university buildings were included in the study, all of which were occupied. The airborne asbestos concentrations from this study (see Table 6-3) include all chrysotile and amphibole particles having a length:width ratio $3, concentrations of fibers $5 µm long, and the

Table 6-3. Exposure to Airborne Asbestos in U.S. Buildings[a]

			Asbestos structure and fiber concentrations						
			Asbestos structures[b] (f/mL)			Fibers[c] (f/mL)		Optical equivalents (f/mL)[d]	
Building type	Number of buildings	Number of Samples	Mean	Median	90th percentile	Mean[e]	90th percentile	Mean[e]	90th percentile
School	177	921	0.04015	0.01017	0.08134	0.00018	0.00071	0.00011	0.00056
University	78	426	0.00865	0.00165	0.02543	0.00008	0.00000	0.00007	0.00000
Commercial	28	213	0.00162	0.00101	0.00476	0.00003	0.00000	0.00002	0.00000
Public	32	123	0.00538	0.00335	0.01551	0.00016	0.00054	0.00007	0.00015
Residential	1	10	0.00486			0.00000		0.00000	
Outdoor		759	0.00188	0.00000	0.00437	0.00005	0.00000	0.00002	0.00000
Personal		106	0.00866	0.00316	0.02368	0.00012	0.00000	0.00009	0.00000
Indoor[f]	315		0.02485			0.00013		0.00008	

Source: Lee et al. 1992

[a]All analyses performed by TEM.
[b]All asbestos particles having a length:width ratio $3.
[c]Asbestos fibers $5 µm long.
[d]Optically equivalent asbestos fibers (i.e., fibers $5 Fm long and $0.25 Fm in width).
[e]Median concentrations for all categories are 0.00000 f/mL.
[f]Indoor air samples include schools, universities, public, commercial, and residential buildings.

GM = geometric mean; GSD = geometric standard deviation; TEM = transmission electron microscopy concentration of structures with lengths of \$5 µm and widths of at least 0.25 µm. The latter category is referred to as “optically equivalent” structures and represent those structures that would have been identified by PCM. The average concentration of all asbestos structures was 0.025 f/mL. The average concentration of asbestos fibers \$5 µm was $1.3x10^{-4}$ f/mL, while for those that could be detected by optical methods, it was $8.0x10^{-5}$ f/mL. In 48% of indoor samples and 75% of outdoor samples, no asbestos fibers \$5 µm were found. There are significant differences in the concentration of total asbestos structures among building types, but not for fibers \$5 µm. Additionally, there was no difference in the indoor and outdoor levels of asbestos fibers \$5 µm for commercial, public, or university buildings, although a higher level indoors was found for school buildings. Outdoor levels were consistently lower than indoor levels when all asbestos structures were considered. Most of the chrysotile fibers were very thin (97% less than 0.2 µm in diameter [and would have been missed by PCM]) and short (85% less than 1 µm long). Only 2% of the fibers were amphiboles and these fibers were generally longer and thicker than the chrysotile fibers.

In studies from a Health Effects Institute-Asbestos Research Study, mean concentrations of fibers \$5 µm ranged from 0 to $2.5x10^{-4}$ f/mL in public and commercial buildings and from $1.0x10^{-5}$ to $1.11x10^{-3}$ f/mL in schools and universities (Lee et al. 1992). Average concentrations in the United States are 10–100 times less than those found in Britain, Germany, and Canada. The structures found in buildings are much smaller and coarser than those found in occupational settings. Corn (1994) reported the mean, 90th percentile, and maximum asbestos levels in 231 buildings, including schools, universities, and public, commercial, and residential buildings as $1.0x10^{-4}$, $5.1x10^{-4}$, and $2.06x10^{-3}$ PCM f/mL, respectively; outdoor levels were $6.0x10^{-5}$ f/mL.

A study of 49 buildings in the United States reported mean asbestos fiber levels of $9.9x10^{-4}$ PCM f/mL in buildings with no ACM, $5.9x10^{-4}$ PCM f/mL in buildings with ACM in good condition, and $7.3x10^{-4}$ PCM f/mL in buildings with damaged ACM (WHO 1998). In general, direct comparison of levels inside and outside ACM buildings indicates that typical (nondisturbed) indoor levels are usually low, but may be higher than outside levels (Chesson et al. 1990). Buffing asbestos-containing floor tile in a commercial building led to a small increase in asbestos bodies <5 µm long, but no increase in those >5 µm in length (Demyanek et al. 1994).

Asbestos may also be released to indoor air from the use of asbestos-contaminated household water (Hardy et al. 1992; Webber et al. 1988). Limited studies indicate that both amphibole and chrysotile fibers can be aerosolized by portable home humidifiers (Hardy et al. 1992). The airborne asbestos concentrations in the home were directly proportional to the asbestos concentrations in the water used in the humidifiers.

6.4.2 Water

The concentration of asbestos fibers in water (expressed as million TEM fibers per liter, MFL) varies widely. Concentrations in most areas are <1 MFL (EPA 1979b), but values of 1–100 MFL and occasionally higher have been detected in areas contaminated by erosion from natural asbestos deposits (EPA 1976; Kanarek et al. 1980) or from mining operations (Sigurdson et al. 1981).

Sources of asbestos in drinking water may be a result of natural deposits from releases due to the use of asbestos-cement pipes in water distribution systems. The amount of asbestos contributed from asbestos-cement pipe is negligible in some locations (Hallenbeck et al. 1978), but may result in concentrations of 1–300 MFL at other locations (Craun et al. 1977; Howe et al. 1989; Kanarek et al. 1981). In one reported incident, grossly deteriorated asbestos-cement pipe in the water distribution system resulted in water concentrations of asbestos up to 1,850 MFL (Webber et al. 1989). The variability in the amount of fibers coming from asbestos-cement pipe appears to depend on a number of parameters, but is mostly related to characteristics of the water such as low pH and low hardness, which influence the rate at which the water can corrode the pipe (NAS 1982). In a recent Austrian study, the asbestos content of drinking water that was contaminated by natural asbestos deposits or the use of asbestos cement pipe was compared with that in control areas (Neuberger et al. 1996). In 10 areas with asbestos deposits and 14 areas that had asbestos-cement pipes, the asbestos concentration in drinking water was low (median 32,000 total asbestos fibers per liter) and was not significantly different from 6 control areas. The highest concentration, 190,000 f/L, was found in an area with natural asbestos deposits at the source of the supply. In areas without natural deposits, the increased asbestos concentration was not significant and was unrelated to aggressiveness of the water supply or to age or length of the pipe. It should be noted that asbestos-cement pipes in areas with aggressive water are coated in Austria. Elevated asbestos concentrations of asbestos were found in water in an uncoated asbestos-cement cistern. In a similar study involving 59 aqueducts in Tuscany, Italy, 76% of the samples were below the detection limit of 0.002 MFL (Cherubini et al. 1998). Asbestos fibers in the other samples were present at concentrations lower than 0.04 MFL. Samples of aggressive water taken from asbestos-cement pipes were too few to determine whether a significant correlation existed between water quality and asbestos release from the pipes. The majority of all fibers found in these studies was chrysotile, and most fibers were less than 5 µm in length (Hallenbeck et al. 1978; Millette et al. 1980; Neuberger et al. 1996; Pitt 1988).

6.4.3 Sediment and Soil

The serpentine and amphibole mineral groups occur over a wide a range of geological environments. The preponderance of these minerals are of a nonfibrous form. Fibrous forms of these mineral groups are minor constituents of many rocks and can be found in soils. For example, tremolite asbestos is found as an impurity in some commercially mined deposits of talc, vermiculite, and chrysotile (Amandus et al. 1987; Boutin et al. 1989; Case 1991; Davis et al. 1985; Lockey et al. 1984; McDonald et al. 1986a; Ross 1981; Skinner et al. 1988). Ross (1981) has reviewed the occurrence of different forms of asbestos minerals and the history of their exploitation. The occurrence of asbestiform minerals is a function of the chemical composition of the underlying rock and the temperatures and pressures that were instrumental in forming these rocks. Commercially exploitable deposits of asbestos minerals are associated with certain types of rocks and for some asbestos minerals, these deposits are rare.

No studies were located regarding the concentration of asbestos fibers that occur in soil. Asbestos was found in about 80% of a number of samples of street dirt at concentrations ranging from 100 million to 1 billion fibers per gram (f/g) (Pitt 1988). These were primarily chrysotile fibers, but most were <2 µm in length and therefore, were not comparable with fiber concentrations that are $5 µm. The concentration of fibers $5 µm in length was not reported. It is likely that the main source of this asbestos was release from automobile brakes.

6.4.4 Other Environmental Media

Tremolite-actinolite is present in or around some deposits of chrysotile asbestos. However, levels of amphibole asbestos in commercial chrysotile were not reported. Tremolite is a contaminant in talc from New York and California, but the extent and fibrosity of the tremolite is unclear (DOL 1980; Wagner et al. 1982c; American Thoracic Society 1990). The tremolite in some talc from California has been described as flake-like and that from New York as having fine fibers (Wagner et al. 1982a). Some tremolite in the chrysotile from Quebec has been described as having coarse fibers. A British survey of talc powders used for various purposes identified 3 out of 24 samples as containing tremolite. Ten of 20 samples of cosmetic talc purchased in New York City between 1971 and 1975 contained 1–14% (w/w) of fibrous tremolite and anthophyllite (Paoletti et al. 1984). Paoletti et al. (1984) conducted a survey of asbestos fibers in talc powders from Italian and international markets using electron microscopy, electron diffraction, and x-ray microanalysis. The fiber criteria used was that accepted by the Council of European Communities (i.e., those having a length:width ratio $3 and a width <3 μm). Three of 14 samples of talc provided by European Pharmacopoeia from the international market contained tremolite asbestos; in 2 of the samples, the percent of asbestos fibers was about 20% by weight. In the 15 samples of Italian industrial, pharmaceutical, and cosmetic talc, 7 contained fibers of tremolite, ranging from 0.2 to 1.6% by weight. Interestingly, about three-quarters of the asbestos fibers observed in each sample had diameters less than about 0.4 μm and therefore, were probably below the resolving power of phase contrast microscopy.

Raw vermiculite (vermiculite concentrate) is a mica-like mineral that rapidly expands upon heating to produce a lightweight, bulky material, vermiculite, that is used in fireproofing, insulation, packaging, and in horticultural/agricultural products, as a soil conditioner, fertilizer carrier, etc. One of the largest vermiculite deposits in the United States is in Libby, Montana, where raw vermiculite was mined and milled from 1923 until 1990. Vermiculite from the mine was marketed under the trade name Zonolite. Atkinson et al. (1982) found fibrous tremolite-actinolite, nonfibrous tremolite-actinolite, and nonfibrous anthophyllite in raw ore and vermiculite concentrate samples from the vermiculite mine and mill in Libby, Montana: fibrous tremolite-actinolite accounted for ~21–26% of the weight of raw ore and 2–6% of the weight of vermiculite concentrate (as cited in Amandus et al. 1987). In a 1984 study of samples from Libby, Montana conducted by W.R. Grace, fiber percentage by weight varied from 3.5 to 6.4% in raw ore and from 0.4 to 1.0% in the concentrate (cited in Amandus et al. 1987). Amandus et al. (1987) noted that among 599 fibers counted in eight airborne membrane filter samples from Libby, 96 and 16% had length:width ratios >10 and >50, respectively. Percentages of fibers with lengths >10, >20, and >40 μm were 73, 36, and 10%, respectively. Moatamed et al. (1986) analyzed samples of vermiculite ores from Libby, Montana; Louisa County, Virginia; and South Africa for the presence of amphibole fiber (asbestos) contamination. Two samples of Montana unexpanded vermiculite ore were determined to have 0.08 and 2.0% amphibole content by weight; two samples of expanded Montana vermiculite both showed 0.6% amphibole content. The South African unexpanded and expanded samples showed 0.4 and 0.0% amphibole content, respectively. The unexpanded and expanded Virginia samples were both determined to be 1.3% amphibole by weight. The number of fibers detected by microscopy in the Virginia samples were reported to be “extremely low” in comparison to the Montana samples, and the South African vermiculite samples showed a “near absence of fibers” or “rare, short fibrous structures.” Based on energy-dispersive x-ray analysis of random fibers in the samples, the fibers in the Montana and Virginia samples were classified predominantly as actinolite, whereas the fibers in the South African samples were predominantly anthophyllite. The size of fibers in the Montana and South African samples indicate that these amphiboles were asbestiform, while the actinolite present in the Virginia samples may have been predominantly nonasbestiform cleavage fragments (Moatamed et al. 1986).

Recently, EPA conducted a survey of vermiculite products, primarily those used in gardening, to determine whether products currently on the market contain asbestos and if so, whether consumers are at risk from using these products (EPA 2000d). Five of the 16 products purchased in garden stores in the Seattle area contained asbestos, 3 of which contained enough asbestos to be quantified reliably. These samples contained between 0.1 and 2.8% tremolite-actinolite asbestos. Samples taken from the same bag of material were variable in fiber concentration with higher levels of fibers found in the fine particles taken from the bottom of a bag. The use of these products were then simulated to see whether the fibers became airborne. Fibers were detected in air samples at (0.16–0.95 f/mL) from the Zonolite Chemical Packaging. Asbestos was detected in 17 of an additional 38 vermiculite products purchased around the country, of which only 5 contained quantifiable levels. The study concluded that consumers face only minimal health risks by using vermiculite products and these can be minimized by keeping the product moist to avoid creating dust and using the product in well ventilated areas. Fibrous and nonfibrous tremolite has been detected in vermiculite from both Montana and South Carolina, but the levels in South Carolina vermiculite may be lower (American Thoracic Society 1990). Actinolite was found in Virginia samples, but at lower levels than in Montana vermiculite and mostly as cleavage fragments (Moatamed et al. 1986).

In the past, filters made from asbestos were employed in the preparation of wines, beers, and other items consumed by humans, and asbestos concentrations in these materials ranged from 1 to 10 MFL (Cunningham and Pontefract 1973). Analysis of 47 brands of sake purchased in Japan from 1983 to 1985 indicated that asbestos concentrations in sake ranged from less than the detection limit (7.8×10^{-3} MFL) to 196 MFL (Ogino et al. 1988).

The use of asbestos filters in food or pharmaceutical preparation has been discontinued in the United States, and intake of asbestos through foods or drugs is now unlikely.

Asbestos fibers may be incorporated in sewage sludge as a result of their presence in waste water. Asbestos has been reported in municipal sewage sludges and sewage sludge composts from large and small cities in the United States (Manos et al. 1991, 1993; Patel-Mandlik et al. 1988). Asbestos was detected in 34 of 51 sludge ash samples at levels ranging from 1 to 10% by volume (Manos et al. 1991).

In a 1993 study of the prevalence of asbestos in sludge from 16 sewage plants in large American cities, asbestos was detected in 13 of the sludges at up to 7% by volume (Patel-Mandlik et al. 1994). The sludge disposal methods of the participating treatment plants were land application, 44%; land filling, 37%; and incineration, 19%.

6.5 GENERAL POPULATION AND OCCUPATIONAL EXPOSURE

As noted above, the concentrations of asbestos found in indoor air, outdoor air, and drinking water vary widely, and it is not possible to calculate human exposure levels accurately except on a site-by-site basis. With this limitation in mind, Table 6-4 presents some rough estimates of exposure levels for a general population living in an urban or suburban area and for asbestos workers. The exposure levels used for the general public are intended to represent the central portion of the typical range of exposures; thus, some persons could be exposed to higher levels, while others could be exposed to less. The workplace air concentration used to estimate worker exposure (0.1 f/mL) is the same as the current U.S. workplace exposure limit (OSHA 1998a, 1998b, 1998c). Actual workplace exposures could be higher or lower. It has been estimated that about 568,000 workers in production and services industries and 114,000 in construction industries may be exposed to asbestos in the workplace (OSHA 1990). Rough estimates of dose of fibers transferred to the gastrointestinal tract after inhalation exposure were calculated using the same assumptions (e.g., 30% of inhaled fibers are transferred to the gastrointestinal tract) as employed in similar calculations by NAS (1983).

The exposure of the general population (nonoccupational exposure) to asbestos in both indoor and outdoor air is extremely low. Older buildings may contain ACM, which had been used for insulation, surface treatment (e.g., fireproofing), floor and ceiling tiles, insulating boards, and spackling, patching, and plastering compounds and asbestos levels are generally higher in indoor air than outdoors (HEI 1991; Spengler et al. 1989). However, exposure appears to be low regardless of whether the buildings do not contain ACM, contain ACM in good condition, or contain damaged ACM (Spengler et al. 1989). As mentioned in Section 6.4.4, the release of asbestos fibers from ACM is sporadic and episodic, and human activity and traffic in occupied buildings would result in higher air concentration of asbestos fibers than in unoccupied buildings. Unfortunately, many investigators fail to report the time when monitoring was performed and whether the building was occupied at the time. One recent investigation found mean asbestos levels in indoor air of occupied buildings having ACM to be 8.0×10^{-5} f/mL, while outdoor air levels were 2.0×10^{-5} f/mL; in both cases, median levels were below detection limits (Lee et al. 1992). Exposure of custodial and maintenance personnel would be higher as they are more likely to be in areas

Table 6-4. Summary of Typical General Population and Occupational Exposures

Exposed population	Exposure medium	Typical concentration	Assumed exposure	Cumulative exposure level (f-yr/mL)	Estimated dose to gastrointestinal tract[a] (MF/day)
General population	Ambient (outdoor) air	$2x10^{-6}$ PCM f/mL	20 m^3/day, 70 years (10% of time outdoors)[e]	0.000014[b]	0.0000012[c]
	Indoor air[e]	$3x10^{-6}$ PCM f/mL	20 m^3/day, 70 years (90% of time indoors)[b]	0.00019[f]	0.000016[g]
	Drinking water	0.017 MFL[e]	2 L/day	–	0.034
Asbestos worker	Workplace air	0.1 PCM f/mL[h]	40 years, 8 m^3/day, 5 days/week, 49 weeks/year[i]	1.1[j]	0.16[k]

[a]Assumes 30% of inhaled fibers are transferred to stomach (NAS 1983)
[b]Approximate value based on EPA 1989e
[c]Cumulative exposure level (values in []): Typical concentration [$2x10^{-6}$ f/mL] x Life span [70 years] x Fraction of time outdoors [0.1]
[d]Dose to gastrointestinal tract:(values in []): Typical concentration [$2x10^{-6}$ f/mL] x Volume inhaled/day [20 m^3] x Fraction of time outdoors [0.1] x Fraction of inhaled fibers transferred to gastrointestinal tract [0.3] x 10^6 mL/m^3 x 10^{-6} MF/f
[e]Millette et al. 1980; concentration converted from TEM basis to PCM basis using 1 TEM f=1/60 PCM f (NRC 1984).
[f]Cumulative exposure level (values in []): Typical concentration [$3x10^{-6}$ f/mL] x Life span [70 years] x Fraction of time indoors [0.9]
[g]Dose to gastrointestinal tract:(values in []): Typical concentration [$3x10^{-6}$ f/mL] x Volume inhaled/day [20 m^3] x Fraction of time indoors [0.9] x Fraction of inhaled fibers transferred to gastrointestinal tract [0.3]x10^6 mL/m^3 x 10^{-6} MF/f
[h]Time-weighted average (TWA) Permissible Exposure Limit (PEL) (OSHA 1998c)
[i]NAS 1983
[j]Cumulative exposure level (values in []): Typical concentration [0.1 f/mL] x Working life span [40 years] x Fraction of air breathed in workplace [8 m^3/day/20 m^3/day x 5 days/7 days x 49 weeks/52 weeks]
[k]Dose to gastrointestinal tract:(values in []): Typical concentration [0.1 f/mL] x Volume inhaled/workday [8 m^3 x 5 days/7 days x 49 weeks/52 weeks] x Fraction of time outdoors [0.1] x Fraction of inhaled fibers transferred to gastrointestinal tract [0.3]x10^6 mL/m^3 x 10^{-6} MF/f

f/mL = fibers per milliliter; MF = million fibers; MFL = million fibers per liter; PCM = phase contrast microscopy; TEM = transmission electron microscopy of a building that may contain asbestos (e.g., boiler room) and may come into contact or disturb ACM, thereby increasing air levels during the course of their activities.

People living in the vicinity of asbestos mines and asbestos-related industries may be exposed to higher levels of asbestos (Case 1991; Case and Sebastien 1987, 1989; Churg 1986b; Churg and DePaoli 1988). The magnitude of such exposures tend to be overestimated when researchers use PCM in situations where the concentrations of nonasbestos fibers are high (e.g., around textile and friction product factories) or if the actual concentration of asbestos is very low (e.g., around refractory plants). In their investigation of exposure levels around asbestos-related industries in Taiwan, Chang et al. (1999) found differences in asbestos fiber levels around different types of plants; those using dry and more mechanical operations (e.g., textiles) tended to have higher levels than other plants. Also, asbestos levels were inversely related to distance from the plant. In a study of the contribution of airborne asbestos fibers to the work environment from the operation of an overhead crane having asbestos brake pads, the 8-hour time-weighted-average (TWA) asbestos fiber concentration ranged from <0.005 to 0.011 f/mL (PCM) and from <0.0026 to 0.0094 f/mL (TEM) (Spencer et al. 1999). No asbestos fibers were detected by TEM during the operation of the cranes.

Workers involved in mining of asbestos or minerals contaminated with asbestos or manufacturing or using asbestos-containing products may be occupationally exposed to elevated levels of asbestos. Average asbestos fiber concentrations (>5 Fm) in the Quebec chrysotile mining industry declined markedly from 16 f/mL in 1973 to 2 f/mL in 1978 and has remained below 2 f/mL between 1978 and 1994 (WHO 1998). The highest asbestos concentration in 1973 was 52 f/mL.

A simulation of bandsawing sheet asbestos gasket material was performed in order to retrospectively evaluate worker exposure from this operation (Fowler 2000). The work was performed on 1/8-inch chrysotile asbestos (80%)/neoprene sheet (purchased in 1996) using a conventional 16-inch woodworking bandsaw. Personal samples and area samples at the breathing zone were assessed using PCM, TEM (total), and TEM (>5 µm). Personal air concentrations of fibers >5 µm during bandsawing were between 2.2 and 4.9 f/mL by PCM. The personal air concentrations by TEM were higher; 22.2–49.3 f/mL for all asbestos fibers and 8.2–17.6 f/mL for fibers >5 µm. Area results were somewhat lower with PCM results between 0.75 and 2.3 f/mL and TEM results in the ranges of 14.3–22.7 f/mL (total) and 5.7–7.6 f/mL (>5 µm). These results show that airborne fiber levels were well above the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) of 0.1 and 1.0 f/mL for PEL (TWA) and PEL (ceiling), respectively.

A similar simulation was performed by Esmen and Corn (1998) to estimate the exposure of workers in the historically important process of splitting open bags of asbestos and transferring the contents to a container. In splitting open a bag of powdery material, there is generally an immediate but short duration release of material. Exposure depends on the number of bags opened and the air exchange rate. The 8-hour TWA exposure levels were determined for various scenarios and air exchange rates using PCM (fibers >3 μm). In the case where one 4.5 kg bag of chrysotile asbestos was opened and boxed every 15 minutes for 8 hours, air asbestos levels ranged from 21 f/mL at 0.5 air exchanges per hour (ACH) to 0.45 f/mL at 30 ACH. Peak exposure levels reached 80 f/mL.

In 1985, a comprehensive study of Japanese plants producing asbestos-containing products was conducted to assess exposure levels to asbestos fibers using phase-contrast microscopy. Personal exposures ranges were 0.07–0.66, 0.25–0.41, and 0.06–0.78 f/mL for disintegrating (feeding), mixing, and cutting/grinding/drilling processes, respectively (Higashi et al. 1994). Exposure levels were <0.3 f/mL in 70% of the workplaces in 1985 and 98% of workplaces in 1992. Concentrations in a new, well-controlled plant were <0.1 f/mL. Bulgarian workers engaged in the production of asbestos gaskets and filter materials at two plants were exposed to 0.04–0.38 and 0.04–0.43 f/mL of asbestos (Strokova et al. 1998).

As part of an international epidemiological study of cancer incidence and mortality among workers in the pulp and paper industry, the International Agency for Research on Cancer (IARC) coordinated a study involving researchers in 15 countries in gathering exposure measurements taken between 1956 and 1993 for nonproduction departments in the industry from previously unpublished studies (Teschke et al. 1999). The results are shown in Table 6-5. Exposure to asbestos was found in three areas: maintenance, construction, cleaning; storage, yard, loading, shipping; and steam and power generation with 16, 50, and 0% of exposures in these departments exceeding 0.2 f/mL.

Building materials used in older buildings such as insulation, dry wall, roofing, and flooring often contain asbestos. Occupational exposure to asbestos during asbestos abatement work is an area of concern. Lange and Thomulka (2000a, 2000b, 2000c) and Lange et al. (1996) collected both area and personal samples during various abatement projects and their results suggest that occupational levels were low with no value exceeding the OSHA PEL (see Table 6-6). In general, abatement of boiler and pipe insulation produced the highest airborne fiber levels and abatement of floor tile and mastic produced the lowest. Personal samples, which had higher concentration levels than area samples, are suggested to be

Table 6-5. Exposure to Airborne Asbestos in Nonproduction Departments of the Pulp and Paper Industry[a]

Department	Number of mills	Number of samples	Mean (f/cc)	Median (f/cc)	Maximum (f/cc)	Type	Percent less than LOD	LOD (f/cc)	Percent greater than TLV[a]
Maintenance, construction, cleaning	12	31	0.081	0.004	0.5	TWA	42	0.001	16
Storage, loading, shipping	4	26	7.2	0.18	28	TWA	19	0.010	50
Steam and power generation	6	16	0.013	0	0.1	TWA	56	0.005	0

Source: Teschke et al. 1999

[a]TLV (1995-6) = 0.2 f/cc

LOD = limit of detection; TLV = threshold limit value; TWA = time-weighted average

Table 6-6. Exposure to Airborne Asbestos During Asbestos Abatement[a]

Material abated	Number of samples	Concentration range (f/mL)	Arithmetic mean (SD) (f/mL)	Geometric mean (GSD) (f/mL)	Type[b]	Reference
Roofing material (wet method)	12[c]	0.0047–0.0752	0.015 (0.014)	0.011 (2.53)	Personal (non-TWA)	Lange and Thomulka 2000b
	17	<0.0006–0.0162	0.006 (0.006)	0.004 (2.82)	Area (non-TWA)	
Floor tile and mastic	10[c]	<0.008–0.094	0.022 (0.017)	0.015 (2.54)	Personal (non-TWA)	Lange and Thomulka 2000a
	13[c]	<0.002–0.067	0.010 (0.008)	0.006 (2.73)	Area (non-TWA)	
Dry wall[d]	25[c]	0.12–3.16	0.76 (0.57)	0.59.(1.94)	Personal (TWA)	Lange and Thomulka 2000c
Floor tile and mastic	23	0.01–0.08	0.04 (0.04)	0.03 (1.71)	Personal (TWA)	Lange and Thomulka 2000c
Pipe/boiler in a crawl space	102	0.005–1.542	0.202	0.149 (2.33)	Area	Lange et al. 1996
Pipe/boiler in a crawl space[e]	42	0.005–0.998	0.192	0.097 (3.17)	Area	
Pipe/boiler in a crawl space[e]	42	0.005–0.957	0.187	0.089 (2.75)	Personal	
Ceiling tile removal in mini-containment	11	0.005–0.331	0.043	0.019 (2.09)	Area	
Ceiling tile removal in mini-containment	9	0.005–0.154	0.022	0.007 (3.38)	Personal	
Transite removal	41	0.005–0.278	0.077	0.048 (3.50)	Personal	

Table 6-6. Exposure to Airborne Asbestos During Asbestos Abatement[a] *(continued)*

Material abated	Number of samples	Concentration range (f/mL)	Arithmetic mean (SD) (f/mL)	Geometric mean (GSD) (f/mL)	Type[b]	Reference
Floor tile and mastic (solvent method) removal	14	0.005–0.010	0.005	0.005	Area	
Mastic removal (blast method)	4	0.005–0.005	0.005	0.005	Area	

[a]Analysis by TEM.
[b]8-Hour TWA concentrations assume exposure only during sample periods. TWA levels refer to mean concentrations.
[c]One outlier excluded from calculation of means and standard deviations.
[d]Respirators are required for dry wall abatement.

GSD = geometric standard deviation; SD = standard deviation; TEM = transmission electron microscopy; TWA = time-weighted average the best measure of occupational exposure. Higher exposure levels occur during dry wall abatement, but respirators are required for this type of abatement work.

Workers involved in custodial and maintenance and repair work in asbestos-containing buildings may be exposed to elevated asbestos levels in the workplace. The results of some recent studies in this area appear in Table 6-7. In all cases, the 8-hour TWA exposures for personal sampling were below the OSHA PEL of 0.1 f/mL for fibers above 5 µm. Mlynarek et al. (1996) found that the highest 8-hour TWA exposure occurred during ceiling tile replacement followed by high efficiency particulate air (HEPA) vacuuming or wet wiping of dust and debris. In their study of asbestos exposure of maintenance personnel in five buildings who worked above the ceiling in proximity to spray-applied fireproofing, Corn et al. (1994) found that less than a maximum of 5% of a worker's total working time was spent in such activity. Exposures were below the OSHA PEL with only simple protective measures employed such as HEPA vacuuming and wetting down of surfaces. Exposure would have been reduced substantially more by the use of respirators for the relatively short period of time maintenance personnel spent above the ceiling. Routine floor tile maintenance procedures such as spray-buffing, wet-stripping, and ultra high speed burnishing can result in elevated levels of airborne asbestos. TEM analysis showed that over 98% of the asbestos structures were below 5 µm in length and would not be detected or counted by PCM (Kominsky et al. 1998a, 1998b). Only in the case of ultra high speed burnishing was the OSHA PEL exceeded. However, this was due to the generation of nonasbestos particles during the burnishing process and therefore do not reflect actual asbestos exposure. This example underscores the limitations of PCM in interpreting workplace exposure.

The geometric mean asbestos body and crocidolite fiber content in 90 former workers in the Wittenoon crocodiolite industry in Western Australia were 17.5 asbestos bodies/g wet tissue and 183 TEM f/µg dry tissue, respectively (de Klerk et al. 1996). The geometric mean intensity of exposure, duration of exposure, and cumulative exposure were 20 f/mL, 395 days, and 20.9 f-yr/mL, respectively. The fiber concentration in the lung was correlated to the intensity and duration of exposure.

6.6 EXPOSURES OF CHILDREN

This section focuses on exposures from conception to maturity at 18 years in humans. Differences from adults in susceptibility to hazardous substances are discussed in 3.7 Children's Susceptibility.

Table 6-7. Exposure to Airborne Asbestos During Building Maintenance or Repair[a]

Material abated	Number of samples	Concentration range[b] (f/mL)	Arithmetic mean (SD) (f/mL)	TWA mean (Max) (f/mL)	Type[b]	Reference
Ceiling removal/installation	6	0.000–0.035	0.0149		Personal	Corn 1994; Corn et al. 1994
Ceiling removal/installation	18	0.001–0.044	0.0112		Area	
Electrical/plumbing	10	0.002–0.216	0.0619		Personal	
Electrical/plumbing	4	0.004–0.054	0.0308		Area	
HVAC work	8	0.000–0.077	0.0202		Personal	
HVAC work	23	0.001–0.024	0.0068		Area	
Miscellaneous work	4	0.000–0.031	0.0082		Personal	
Miscellaneous work	9	0.000–0.083	0.0108		Area	
Removal/encapsulation	4	0.015–0.115	0.0614		Personal	
Removal/encapsulation	10	0.003–0.019	0.0109		Area	
Run cable	33	0.001–0.228	0.0167		Personal	
Run cable	33	0.000–0.086	0.0080		Area	
ACM debris cleanup	9	0.012–0.36	0.074	0.0077 (0.028)	Personal	Mlynarek et al. 1996
Bulk sample collection	31	0.0030–0.17	0.034	0.0042 (0.024)	Personal	
Cable pull	37	0.011-0.20	0.048	0.013 (0.037)	Personal	
Ceiling tile replacement	67	0.030-3.5	0.35	0.030 (0.21)	Personal	
Ceiling tile replacement	18	0.0020–0.056	0.011	0.0027 (0.0088)	Area	

Table 6-7. Exposure to Airborne Asbestos During Building Maintenance or Repair[a] *(continued)*

Material abated	Number of samples	Concentration range[b] (f/mL)	Arithmetic mean (SD) (f/mL)	TWA mean (Max) (f/mL)	Type[b]	Reference
Electrical installation	14	0.010–0.11	0.037	0.011 (0.026)	Personal	
Electrical repair	24	0.003–0.052	0.020	0.0091 (0.027)	Personal	
Fluorescent lamp replacement	78	0.0054–0.065	0.025	0.0059 (0.018)	Personal	
Fluorescent lamp replacement	55	0.0039–0.0067	0.0067	0.0006 (0.0014)	Area	
HEPA vacuum/wet wiping dust/debris	17	0.029–0.304	0.098	0.026 (0.073)	Personal	
HEPA vacuum/wet wiping dust/debris	19	0.0023–0.027	0.0068	0.0031 (0.0074)	Area	
Wet wipe cleaning	25	0.018–0.048	0.031	0.0092 (0.024)	Personal	
Office environment	10	0.0016–0.057	0.0091	0.0032 (0.025)	Area	
TOTAL (range)	302	0.0030–3.5	0.020–0.35	0.0042–0.030 (0.018–0.21)	Personal	
TOTAL (range)	102	0.0016–0.062	0.0067–0.027	0.0006–0.0032 (0.0014–0.025)	Area	
Spay-buffing tile (poor)	5	0.008–0.015	0.012		Personal	Kominsky et al 1998a
Spay-buffing tile (medium)	5	0.003–0.008	0.006		Personal	
Spay-buffing tile (good)	5	0.015–0.030	0.019		Personal	
Wet-stripping tile (medium)	5	0.006–0.016	0.010		Personal	
Wet-stripping tile (good)	5	0.004–0.010	0.006		Personal	

Table 6-7. Exposure to Airborne Asbestos During Building Maintenance or Repair[a] *(continued)*

Material abated	Number of samples	Concentration range[b] (f/mL)	Arithmetic mean (SD) (f/mL)	TWA mean (Max) (f/mL)	Type[b]	Reference
Spay-buffing tile (poor)	5	0.046–0.081[c]	0.059[c]		Personal	
Spay-buffing tile (medium)	5	0.001–0.032[c]	0.014[c]		Personal	
Spay-buffing tile (good)	5	0.004–0.046[c]	0.024[c]		Personal	
Wet-stripping tile (medium)	5	0.055–2.58[c]	0.978[c]		Personal	
Wet-stripping tile (good)	5	0.010–0.128[c]	0.041[c]		Personal	
UHS burnishing tile (poor)	5	0.046–0.081[c]	0.024[c]		Personal	Kominsky et al 1998b
UHS burnishing tile (good)	5	0.004–0.046[c]	0.017[c]		Personal	
Wet-stripping tile (poor)	5	0.055–2.58[c]	0.019[c]		Personal	
Wet-stripping tile (good)	5	0.010–0.128[c]	0.015[c]		Personal	
UHS burnishing tile (poor)	5	0.872–1.692		0.133–0.275[d]	Personal	
UHS burnishing tile (good)	4	0.670–1.016		0.113–0.145[d]	Personal	
Wet-stripping tile (poor)	8	0.004–0.018		0.001–0.004[d]	Personal	
Wet-stripping tile (good)	8	0.006–0.014		0.001–0.003[d]	Personal	

[a]Analysis by PCM, NIOSH method 7400, unless otherwise indicated.
[b]8-Hour TWA concentrations assume exposure only during sample periods. TWA levels refer to mean concentrations.
[c]Analysis by TEM.
[d]Range of individual measurements, exceedance of OSHA PEL (0.1 f/mL) due to nonasbestos-containing powder generated during the burnishing operation.

ACM = asbestos-containing material; HEPA = high efficiency particulate air; HVAC = Heating, Ventilation and Air Conditioning; NIOSH = National Institute of Occupational Safety and Health; OSHA = Occupational Safety and Health Administration; PCM = phase contrast microscopy; PEL = permissible exposure limit; SD = standard deviation; TEM = transmission electron microscopy; TWA = time-weighted average

Children are not small adults. A child's exposure may differ from an adult's exposure in many ways. Children drink more fluids, eat more food, breathe more air per kilogram of body weight, and have a larger skin surface in proportion to their body volume. A child's diet often differs from that of adults. The developing human's source of nutrition changes with age: from placental nourishment to breast milk or formula to the diet of older children who eat more of certain types of foods than adults. A child's behavior and lifestyle also influence exposure. Children crawl on the floor, put things in their mouths, sometimes eat inappropriate things (such as dirt or paint chips), and spend more time outdoors. Children also are closer to the ground, and they do not use the judgment of adults to avoid hazards (NRC 1993).

Children may be exposed to asbestos in the same ways that adults are exposed outside the workplace–from asbestos in air especially near emission sources or in buildings with deteriorating asbestos-containing material. Differences in breathing patterns, airflow velocity, and airway geometry between adults and children can result in age-related differences in deposition of inhaled particles in the respiratory tract (Phalen et al. 1985). Deposition of particles in various regions of the respiratory tract in children may be higher or lower than in adults depending on particle size, but for particles with diameters <1 μm, fractional deposition in the alveolar, tracheobronchial, and nasopharyngeal regions in 2-year-old children has been estimated to be about 1.5 times higher than in adults (Xu and Yu 1986). This information may be relevant to inhalation exposure to asbestos fibers, but direct information regarding age-related differences in deposition of inhaled fibers was not located. Studies that have been conducted on asbestos levels in schools have stressed the low fiber counts in the air even when the buildings contained asbestos-containing material (Mossman et al. 1990a). As mentioned in Section 6.4.4, the release of asbestos fibers from ACM is sporadic and episodic, and human activity and traffic may facilitate release of asbestos fibers and stir up asbestos-containing dust. Monitoring of buildings are frequently performed at night or on weekends may therefore underestimate human exposure to asbestos in the buildings. Historically, children have been exposed to asbestos while playing near mining or processing facilities using materials containing asbestos, or from contact with asbestos-laden clothing of family members employed in asbestos-related industries. Although studies quantifying this type of exposure of children were not located, its existence is known based on reports of the development of asbestos-related respiratory diseases in adults who were "paraoccupationally " exposed as children, but had no occupational exposure to asbestos during adulthood (Anderson et al. 1976; Inase et al. 1991; Magee et al. 1986; Voisin et al. 1994; Wagner et al. 1960). Children may also be exposed from drinking water containing asbestos fibers or from ingesting asbestos-containing dust or soil. Asbestos fibers are not expected to undergo significant transformation in soil, and it is well documented that young children ingest more soil than adults. Studies that examined levels of childhood exposure to asbestos through soil ingestion, however, were not located.

A few small studies have assessed the lung asbestos fiber content of children. In one, a small number of asbestos fibers were found in 10 of 41 infants aged 1–27 months (Haque and Kanz 1988). In another (Case et al. 1988), asbestos fiber levels in 10 of 15 children under the age of 19 were as high those seen in older, presumably more exposed, age groups; however, all but 2 of the children were over the age of 15 and could have been exposed in jobs. A survey of the lung fiber content of 60 American children aged 8–15 years who died between 1983 and 1987 was conducted by TEM to assess fiber burdens and exposure in children (Case et al. 1994). The preliminary results indicate that asbestos bodies and lung fiber concentrations were one to two orders of magnitude lower than found by the same laboratory in a study of a sample of general population adults. Asbestos bodies were absent in 57 of the children and below 100 asbestos bodies/g in 2 more, both of whom were rural residents. Thirty-eight percent of the subjects had 1 or more long (>5 μm) asbestos fibers. Thirty-three percent of the subjects had long chrysotile fibers and 5% or less contained long amphibole fibers. Short chrysotile fibers were present in twice as many subjects as the long fibers (63 vs. 33%). Short tremolite fibers were observed in 37 subjects. The geometric mean asbestos fiber concentration for the 60 subjects was 0.10×10^6 f/g dry lung tissue.

6.7 POPULATIONS WITH POTENTIALLY HIGH EXPOSURES

The people most likely to have high exposure to asbestos are workers who come into contact with asbestos while on the job. This includes people involved in the mining of asbestos and asbestos-containing minerals and manufacture of asbestos-containing products, and also people who install, service, remove, or use these products. The presence of asbestiform minerals is widespread in mining areas, and people employed in the mining and processing of other ores may therefore be exposed to asbestos (Rogers et al. 1997). Workers engaged in the demolition of buildings with asbestos-containing materials are also potentially exposed. Although recent regulations have resulted in a marked decrease in airborne exposure levels in the workplace, the currently acceptable upper limit in workplace air (0.1 f/mL) is still considerably higher than levels found outside the workplace (usually <0.001 f/mL). In the past, workers may have carried asbestos home on their clothing or in their hair, resulting in exposure of family members (Anderson et al. 1979; Case and Sebastien 1989). However, this is not likely to be of concern at the present.

People who live near an asbestos-related industry or near an asbestos-containing waste site may encounter elevated levels of asbestos in air and accumulate it in their lungs (Case 1991; Case and Sebastien 1987, 1989). People may also be exposed to asbestos from a variety of asbestos-containing products, from poorly performed asbestos removal, or from living or working in a building with deteriorating asbestos insulation. Working in a building with asbestos-containing material that is in good condition has not been shown to result in significantly elevated levels of asbestos in air (HEI 1991).

Some people may also be exposed to elevated levels of asbestos in drinking water, particularly where there are widespread natural deposits of asbestos (e.g., San Francisco Bay area), disposal of asbestos-containing ore tailings (e.g., Duluth, Minnesota), or the use of asbestos-containing cement pipes in drinking water distribution systems with low pH and low hardness (Craun et al. 1977; Kanarek et al. 1981; Webber et al. 1989).

6.8 ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA, as amended, directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of asbestos is available. Where adequate information is not available, ATSDR, in conjunction with the National Toxicology Program (NTP), is required to assure the initiation of a program of research designed to determine the health effects (and techniques for developing methods to determine such health effects) of asbestos.

The following categories of possible data needs have been identified by a joint team of scientists from ATSDR, NTP, and EPA. They are defined as substance-specific informational needs that if met would reduce the uncertainties of human health assessment. This definition should not be interpreted to mean that all data needs discussed in this section must be filled. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

6.8.1 Identification of Data Needs

Physical and Chemical Properties. The physical and chemical properties of asbestos are well characterized (see Chapter 4), and there does not appear to be a need for further research in this area.

Production, Import/Export, Use, Release, and Disposal. Asbestos is widely used by humans in a variety of products, and exposures are likely from a number of sources. Extensive data are available on current production, import, and use of asbestos (U.S. Bureau of Mines 1992). Releases to the environment may occur either to air or to soil and water, with releases to air being of greatest health concern. Waste friable asbestos is regulated as a hazardous substance, so disposal is permitted only in authorized waste sites. Methods of handling friable asbestos are prescribed to minimize dust release. However, data are lacking on the amount of asbestos disposed in waste sites, and on the location and status of these sites.

According to the Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. Section 11023, industries are required to submit substance release and off-site transfer information to the EPA. TRI, which contains this information for 1999, became available in 2001. This database is updated yearly and provides a list of industrial facilities producing, processing, and using friable asbestos and their emissions.

Environmental Fate. Asbestos fibers are fundamentally rather inert and are not considered to undergo transport or degradative processes in the environment analogous to organic pollutants. Additional studies on the behavior of fibers in water (processes such as change in metal ion and hydroxyl ion composition, adsorption to organic materials, flocculation and precipitation, etc.) would be helpful in evaluating water-based transport of fibers, as well as in improving methods for removal of fibers from water. Transport of fibers in air is governed by processes and forces which apply to all particulate matter (EPA 1977, 1979c), and these processes are reasonably well understood.

Bioavailability from Environmental Media. Asbestos fibers are insoluble and are not absorbed in the usual sense after inhalation, oral, or dermal exposure. Most exposures occur either to fibers in air or water, so the effect of matrices such as soil or food are largely unknown. It is possible that adsorption of fibers onto other dust particles could influence the location of deposition in the lung, and might even influence the cellular response to the fibers. Research to determine if this occurs and is of biological significance would be helpful.

Food Chain Bioaccumulation. No data were located on asbestos levels in the tissues of edible organisms. However, it is not expected that either aquatic or terrestrial organisms will accumulate a significant number of fibers in their flesh. Consequently, food chain bioaccumulation or biomagnification does not appear to be of concern.

Exposure Levels in Environmental Media. There have been extensive surveys of asbestos levels in water and air (both outside air and inside air) (Chesson et al. 1990; EPA 1979b, 1991b, 1992c; HEI 1991, 1992; Howe et al. 1989; IARC 1977; Kanarek et al. 1980, 1981; NRC 1984; Spengler et al. 1989). These studies have revealed that wide ranges of asbestos levels may be encountered, indicating that human exposures can only be estimated on a site-specific basis. By converting exposures levels from TEM f/mL to PCM f/mL using a global conversion factor, the benefit of increased sensitivity of TEM and its ability to identify fiber type is diminished. However, further studies on the sources of the fibers and key determinants of exposure level would be valuable. It is especially important that further studies of asbestos levels in environmental media investigate and report on the size distribution of the fibers, because this is important in evaluating the resultant risk. Few data exist on asbestos levels in soil, especially near waste sites. Reliable and recent monitoring data for the levels of asbestos in contaminated media at hazardous waste sites and in soil at mining and other sites with naturally elevated levels of asbestos are needed so that the information obtained on levels of asbestos in the environment can be used in combination with the known body burdens to assess the potential risk of adverse health effects in populations living in these areas. Also, techniques for estimating air levels of asbestos from soil concentrations and activity scenarios would enable screening level estimations of asbestos exposure in advance of activities or disturbances occurring at contaminated sites, without extensive air monitoring.

Several key factors have been recently identified by the European Respiratory Society Working Group regarding the analysis of mineral fibers in biological samples (De Vuyst et al. 1998). These include adequate sampling, comparable analytical procedures and expression of results, and the use of well-defined reference populations. It is important to obtain agreement on guidelines for these types of studies and work to get them adopted by investigators.

Exposure Levels in Humans. The best available methods to measure human exposure levels involve measuring retained fibers in lung tissue (Case 1994; Churg 1982; Churg and Warnock 1981; Churg and Wright 1994; Dufrense et al. 1995, 1996a, 1996b; Dodson et al. 1999; Gylseth et al. 1985; Sebastien et al. 1989; Wagner et al. 1986). Uses of concentrations of asbestos bodies and uncoated fibers in bronchoalveolar lavage and sputum samples as biomarkers of exposure also have been examined in several studies, but these approaches have not been fully developed as quantitative indicators of exposure (see Section 3.8.1). Fibers can also be detected in urine and feces (Cook and Olson 1979; Finn and Hallenback 1984), but these methods would likely reflect only recent exposures (within the last several days) and not the cumulative tissue burden. As discussed in Section 3.12, efforts to develop a noninvasive method for measuring fiber levels in tissue (especially in the lung) would be particularly valuable in assessing human exposure to asbestos. Future studies of asbestos fiber concentrations in samples of biopsied or autopsied lung tissue from residents living near waste sites or other sites known to contain elevated levels of asbestos also would be helpful in estimating the magnitude of nonoccupational exposure associated with these sites.

Exposures of Children. Only a few small studies have assessed the lung asbestos fiber content of children (Case et al. 1988, 1994). Preliminary results from the most comprehensive of these studies indicate that asbestos bodies and lung fiber concentrations in children are one to two orders of magnitude lower than those found in adults. More data are needed on the levels of asbestos in children, and attempts should be made when these data are acquired to link the body burden with possible sources of exposure (e.g., residing in places with naturally elevated soil concentrations, in areas with mining or hazardous waste sites, or in housing with crumbling asbestos).

Children may be exposed to asbestos in the same ways that adults are exposed outside the workplace, from asbestos in the air especially near emission sources or in buildings with deteriorating asbestos-containing material. Children may also be exposed from drinking water containing asbestos fibers or from ingesting asbestos-containing dust or soil. However, there are factors, such as breathing rate and lung physiology, that may affect the deposition of fibers in lung tissue of children, and these factors need to be explored. These factors would be age-related, and may affect where and to what extent fibers are deposited. Just as children are exposed to asbestos in the same way as nonoccupationally-exposed adults, there are no childhood-specific means to decrease exposure.

Child health data needs relating to susceptibility are discussed in Section 3.12.2 Identification of Data Needs: Children’s Susceptibility.

Exposure Registries. No exposure registries for asbestos were located. This substance is not currently one of the compounds for which a subregistry has been established in the National Exposure Registry. The substance will be considered in the future when chemical selection is made for subregistries to be established. The information that is amassed in the National Exposure Registry facilitates the epidemiological research needed to assess adverse health outcomes that may be related to exposure to this substance.

Many industries and researchers interested in studying the health effects of asbestos in exposed workers maintain registries of individuals who were exposed to asbestos on the job.

6.8.2 Ongoing Studies

The Federal Research in Progress (FEDRIP 2001) database provides additional information obtainable from a few ongoing studies that may fill in some of the data needs identified in Section 6.8.1.

No information was located regarding ongoing studies on the stability and migration of asbestos in the environment. The EPA and many state and local agencies are continuing to make measurements of asbestos levels in air and in water, in order to identify locations where significant health concerns may be warranted.

M.B. Schenker of Institute of Toxicology, University of California Davis; in Davis, California is leading a multidisciplinary study supported by National Cancer Institute (NCI). This study will examine whether environmental asbestos deposits in California are associated with increased rates of mesothelioma. The study will address geological occurrence of asbestos and potential human exposure based on population patterns and known occupational exposure, and epidemiological characteristics of the disease in the state. The project will plan a case-control study to rigorously test the hypothesis that mesothelioma in California is independently associated with environmental asbestos exposure.

7. ANALYTICAL METHODS

The purpose of this chapter is to describe the analytical methods that are available for detecting, measuring, and/or monitoring asbestos, its metabolites, and other biomarkers of exposure and effect to asbestos. The intent is not to provide an exhaustive list of analytical methods. Rather, the intention is to identify well-established methods that are used as the standard methods of analysis. Many of the analytical methods used for environmental samples are the methods approved by federal agencies and organizations such as EPA and the National Institute for Occupational Safety and Health (NIOSH). Other methods presented in this chapter are those that are approved by groups such as the Association of Official Analytical Chemists (AOAC) and the American Public Health Association (APHA). Additionally, analytical methods are included that modify previously used methods to obtain lower detection limits and/or to improve accuracy and precision.

As discussed in Chapter 4, asbestos is not a single chemical entity, but is the name for a group of six hydrated fibrous polysilicates. Because the toxicity of asbestos appears to be related primarily to fiber size, modern analytical methods focus on providing information on these parameters, as well as on total number of fibers and mineral type. At present, the number and size distribution of fibers in a sample can only be determined by direct microscopic examination. This may be performed using either light or electron microscopy, as discussed below. It should be noted that OSHA regulations on asbestos refer to the six asbestiform minerals and a fiber is defined as having a minimum length, 5 µm, as aspect ratio of 3:1 (OSHA 1992). NIOSH methods for determining fiber concentrations are geared to counting fibers of these dimensions. In addition, these methods give detailed rules as to how to count different objects (e.g., objects with split ends or attached particles) (NIOSH 1989a, 1989b).

Light Microscopic Method. Phase contrast microscopy (PCM) accurately assesses fiber exposure levels for fibers $5 µm in length and >0.25 µm in diameter. Furthermore, PCM cannot differentiate between asbestos and nonasbestos fibers. Currently, the standard method for the determination of airborne asbestos particles in the workplace is NIOSH Method 7400, Asbestos by Phase Contrast Microscopy (NIOSH 1994a). OSHA considers that sampling and analytical procedures contained in OSHA Method ID-160 and NIOSH Method 7400 are essential for obtaining adequate employee exposure monitoring. Therefore, all employers who are required to conduct monitoring are required to use these or equivalent methods to collect and analyze samples (OSHA 1994). In NIOSH Method 7400, asbestos is collected on a 25 mm cellulose ester filter (cassette-equipped with a 50 mm electrically-conductive cowl). The filter is treated to make it transparent and then is analyzed by microscopy at 400–450x magnification, with phase-contrast illumination, using a Walton-Beckett graticule. A fiber is defined as any particle with a length >5 µm and a length-to-diameter ratio of $3:1. Although the PCM method is relatively fast and inexpensive, it does not distinguish between asbestos and nonasbestos fibers, and it cannot detect fibers thinner than 0.25 µm. Consequently, this method is most useful for the analysis of samples that are composed mainly of asbestos, but only where a significant fraction of the fibers are large enough to be counted. If samples are grossly contaminated by nonasbestiform fibers, then transmission electron microscopy (NIOSH Method 7402) should be used for positive identification. For fibers greater than 1 µm in diameter, then polarized light microscopy (NIOSH Method 7403) may be useful in identifying polymorphs (NIOSH 1987). Concentrations are reported as fibers/mL or fibers/cm^3. Recent improvements in filter preparation procedures now allow for viewing at higher magnification (1250x), resulting in a several-fold improvement in sensitivity for these fibers (Pang et al. 1989). Polarized light microscopy is frequently used for determining the asbestos content of bulk samples of insulation or other building materials (see, for example, NIOSH Method 9002 [NIOSH 1989c] and OSHA method ID-191 [OSHA 1994]); however, this approach is not used for measuring asbestos in environmental media. Method 9002 also enables one to qualitatively identify asbestos types using fiber morphology, color, and refractive index.

In summary, PCM is a useful tool in assessing occupational exposure to workers engaged in activities that generate airborne asbestos fibers. However, in nonoccupational settings where large proportions of other fibers (e.g., wool, cotton, glass) are present, PCM will overestimate the asbestos fiber concentration. In addition, the sensitivity of PCM is approximately 0.01 f/mL, an asbestos level higher than that generally found in nonoccupational environments.

Electron Microscopic Methods. Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) methods can detect smaller fibers than PCM and also fiber type, but fiber counting accuracy is unacceptably poor. This is a result of the small area that can be scanned at high magnification. Accuracy is more limited with long (>5 µm) fibers. NIOSH Method 7402, Asbestos by TEM, is used to determine asbestos fibers in the optically visible range and is intended to complement NIOSH Method 7400. Examination of a fiber sample by either TEM or SEM allows the detection of much smaller fibers than light microscopy, and so more thorough data can be collected on fiber length and diameter distribution. Of these two methods, TEM has greater sensitivity for small fibers, and is the most common method for measuring asbestos in ambient air or inside schools or other buildings. SEM analysis usually images fibers that are more than 0.2 µm in diameter because of contrast limitations, while TEM can visualize fibers of all sizes. In addition, most modern transmission electron microscopes are equipped with instrumentation that allows examination of individual fibers by electron diffraction or energy-dispersive x-ray analysis. This permits determination of the crystalline and elemental composition of the fiber. Thus, reliable distinctions can be made not only between asbestos and nonasbestos fibers, but also between different asbestos mineral classes (NIOSH 1994b). SEM may also incorporate energy-dispersive x-ray analysis devices. Although TEM clearly provides the most information about a fiber sample, TEM methods are relatively slow and costly compared to PCM methods.

Two different procedures are used for preparation of samples for TEM analysis (HEI 1991). Direct transfer methods retain particles in the same relative position during analysis as they were on the original filter with a minimum of change to the airborne particles. Indirect methods involve dispersing the particulate matter from the original filter into a liquid and capturing the suspended particles particulates onto intermediate filters that are used to prepare the TEM specimens. By varying the proportion of liquid, one is able to concentrate or dilute the sample analyzed. In addition, one is able to remove organic and other unwanted particulate matter by ashing or dissolution, thereby selectively concentrating the asbestos. In dispersing the particles in water the sample may be gently sonicated. In the process, fiber bundles may be separated into individual fibrils or fibers broken.

Application of either PCM or TEM methods to the determination of asbestos fibers in biological or environmental media (air or water) requires that the fibers be separated from interfering material and collected on appropriate supports. Methods for preparing biological and environmental samples for microscopy are described below.

7.1 BIOLOGICAL SAMPLES

Asbestos fibers are particularly resistant to chemical and thermal degradation, and this property is used to the advantage in the analysis of biological materials for asbestos. In most cases, the bulk of the biological material is solubilized by digesting the tissue in strong base (e.g., KOH) or a powerful oxidant (e.g., hypochlorite). The insoluble residue (including the asbestos fibers) is collected by ultracentrifugation or filtration, and may be further cleared of biological material by ashing. In some cases, biological material may be removed by ashing without prior digestion. Residual material is then dispersed and transferred to a suitable support for microscopy. Sample handling during sample preparation and dispersal onto a support for microscopy can break fibers or result in the breakup of fiber aggregates. If fiber breakage results in fibers shorter than 5 µm, a lower fiber count would result.

Conversely, if aggregates are separated, a higher fiber count could result. Tissue samples are often embedded in paraffin for sectioning and to preserve the sample for retrospective analysis.

In collecting and preparing samples for fiber analysis by electron microscopy, care must be taken to avoid contamination. Asbestos contamination of laboratory materials, including paraffin (Lee et al 1995), grids (Case 1994; Rogers 1984), and especially cross-contamination by tissues themselves (Case 1994) must be accounted for. While good laboratory practice required that all reagents and materials used in asbestos analysis be tested for the presence of asbestos, paraffin used to embed tissue has generally avoided scrutiny, being viewed by the laboratory as part of the tissue sample, rather than a reagent. Lee et al. (1995) observed that paraffin used to embed tissue of a mesothelioma victim was contaminated with asbestos. Both the surface and portions cut from the washed paraffin blocks contained chrysotile and amphibole fibers. These finding led to an investigation of asbestos structures in raw paraffin and paraffin from tissue blocks from several sources in different parts of the country. Asbestos was present in 24 of 27 cases; of these 24 cases, 11 had levels that could be considered above background and 4 were severely contaminated. While asbestos was observed in some samples of raw paraffin, the highest levels were seen in prepared blocks. Therefore, it is not clear whether contamination was present in the wax or introduced in the reagents used or during the embedding process. These results raises questions about the validity of tissue analyses by electron microscopy for asbestos unless blank control blocks were part of the procedure.

A recent report (Rogers et al. 1999) has demonstrated that *in situ* confocal laser scanning microscopy (CLSM) can provide three dimensional views of fibers retained, undisturbed, in lung tissue tens or hundreds of microns below the surface of the specimen. This allows the three-dimensional location of fibers relative to cells and surrounding tissue to be studied and understood. Tissue samples prepared for asbestos by analysis by TEM are generally digested and ashed. While TEM has been used to image fibers within lung tissue, the process of obtaining 60–70 nm thick tissue sections would be expected to cut apart asbestos fibers and introduce artifacts. While SEM permits intact fibers to be studied, images show primarily the surface of fibers and tissue closest to the observer. There are no standard methods for the analysis of asbestos in biological materials. Table 7-1 summarizes several methods that have been applied for analyzing asbestos fibers in a variety of biological materials.

Table 7-1. Analytical Methods for Determining Asbestos in Biological Samples

Sample matrix	Preparation method	Analytical method	Sample detection limit	Percent recovery	Reference
Bronchoalveolar fluid	Mix with sodium hypochlorite; membrane filter; dry	PCM	1 AB/mL	No data	Spurny 1994
Urine	Mix with hydrogen peroxide; digest for 20 hours; collect residue on filter	TEM	0.1-0.3x10^{-6} f/L	No data	Boatman et al. 1983
Urine	Filter through polycarbonate filter; ash filter; wash; collect residue on second filter	TEM	5x0^{3} f/mL	No data	Finn and Hallenbeck 1984
Feces	Dry, ash, dissolve residue in hydrochloric acid; filter; ash filter; transfer residue to grid	TEM	0.15x10^{6} f/g	85.5	Cunningham et al. 1976
Lung tissue	Dry to constant weight;digest with sodium hyroxide (90 EC); ash residue; collect on nucleopore filter	TEM	0.1x10^{6} f/g	No data	Wagner et al. 1982a
Lung tissue	Digest wet tissue in potassium hydroxide; wash residue with water; transfer residue to slide	PCM	5,000 f/g	No data	Whitwell et al. 1977
Tissue sections	Ash on slide; transfer	TEM	No data	No data	Pooley 1976
Tissue specimens	Predigest in 10% potassium hydroxide; collect residue by ultra-centrifugation; ash residue; transfer to carbon grids	TEM	0.2x10^{5} f/g	13–70	Carter and Taylor 1980

f/g = fibers per gram; f/L = fibers per liter; f/mL = fibers per milliliter; PCM = phase contrast microscopy; TEM = transmission electron microscopy

7.2 ENVIRONMENTAL SAMPLES

For the analysis of asbestos fibers in air, a sample of air is drawn through a filter by a vacuum pump (usually at a flow-rate of around 1–2 L/minute), and the fibers retained on the filters are examined microscopically. The sensitivity of the methods depends on the volume of air drawn through the filter and the microscopic method employed. In the workplace, where PCM is the standard method, the theoretical detection limit for a short-term sample (15 minutes) is around 0.04 PCM f/mL, but may be reduced to 0.001 f/mL using an 8-hour sample (NIOSH 1976). In practice, such low detection limits are not readily achievable, and measured values below 0.1 PCM f/mL should not usually be considered reliable (ASTM 1988). Sensitivity of TEM methods for ambient or indoor air are usually around 0.1–1 ng/m^3.

A similar approach is used for measuring asbestos in water. A known volume (generally, at least 1 L) is drawn through a filter, and the filter is then prepared for examination, usually by TEM. Table 7-2 summarizes several representative methods for the analysis of asbestos in air and water. No methods were located for the analysis of asbestos in soil.

7.3 ADEQUACY OF THE DATABASE

Section 104(i)(5) of CERCLA, as amended, directs the Administrator of ATSDR (in consultation with the Administrator of EPA and agencies and programs of the Public Health Service) to assess whether adequate information on the health effects of asbestos is available. Where adequate information is not available, ATSDR, in conjunction with the National Toxicology Program (NTP), is required to assure the initiation of a program of research designed to determine the health effects (and techniques for developing methods to determine such health effects) of asbestos.

The following categories of possible data needs have been identified by a joint team of scientists from ATSDR, NTP, and EPA. They are defined as substance-specific informational needs that if met would reduce the uncertainties of human health assessment. This definition should not be interpreted to mean that all data needs discussed in this section must be filled. In the future, the identified data needs will be evaluated and prioritized, and a substance-specific research agenda will be proposed.

Table 7-2. Analytical Methods for Determining Asbestos in Environmental Samples

Sample matrix	Preparation method	Analytical method	Sample detection limit	Percent recovery	Reference
Air	Pump air through filter membrane; convert to optically transparent gel	PCM	<0.5 f/mL	±35	ASTM 1988
Air	Filter	NIOSH 7400; PCM	<0.01 f/mL	No data	NIOSH 1994a
Air	Filter; mount on	NIOSH 7402; TEM	<0.01 f/mL	No data	NIOSH 1994b
Air	Measured volume of air collected on 25 mm diameter, 0.45 Fm MCE filter, Both direct and indirect specimen preparation	Superfund Method. TEM at 20,000X, EXDA, Separate examination of structures of all sizes ($0.5 Fm) and those with a length $5 Fm. Structures have mean aspect ratios $5:1.	Sensitivity >0.5 s/L and $0.02 s/L for all structures and those	No Data	EPA 1990c, 1990d
Water (drinking)	Filter, carbon coat and wash	APHA Method 2570-B; TEM	No data	No data	EMMIWIN 1997
Water	Filter; mount on carbon	TEM at 20,000X	0.01 MFL	100±35	Anderson and Long 1980
Water	Extract into isooctane from water containing anionic surfactant	Microscope or color spot test	0.1 MFL	No data	Melton et al. 1978

Water	Filter; mount on carbon film	TEM	No data	No data	WHO 1986

Table 7-2. Analytical Methods for Determining Asbestos in Environmental Samples *(continued)*

Sample matrix	Preparation method	Analytical method	Sample detection limit	Percent recovery	Reference
Water	Place in ultrasonic bath (15 minutes); filter; dry and collapse filter; plasma etch; mount on carbon film	TEM	No data	No data	Brackett et al. 1992

f/mL = fibers per milliliter; MCE=mixed cellulose ester; MFL = million fibers per liter; PCM = phase contrast microscopy; TEM = transmission electron microscopy; EXDA=energy dispersive x-ray analysis

7.3.1 Identification of Data Needs

Methods for Determining Biomarkers of Exposure and Effect.

Exposure. Reliable methods exist for measuring asbestos fibers in biological tissues and fluids (Boatman et al. 1983; Carter and Taylor 1980; Wagner et al. 1982b). These methods (based on microscopic examination of fibers remaining after ashing and digestion) are sufficiently sensitive to quantify fiber burden in samples from both control (background) and exposed populations. However, there is considerable variability in the details of sample preparation, and this makes inter-study comparisons difficult. For this reason, it would be helpful to develop a standardized method or group of methods for analysis of asbestos in biological materials, similar to the standardized methods for asbestos in air and water. A major limitation to current methods is that lung retained fibers can only be measured by examining excised lung tissue (see Section 3.8.1). Concentrations of fibers or asbestos bodies in broncho-alveolar lavage or sputum samples may provide indications of exposure to asbestos fibers. Consequently, it is not possible to estimate retained fiber in lung tissue of living persons except by fiber analysis of these samples that are, to various degrees, invasively obtained. Development of some noninvasive method that would permit accurate estimation of asbestos content *in vivo* would be especially valuable.

Effect. There are no chemical analytical methods recognized for measuring asbestos-induced health effects in humans. Clinical methods (x-ray, spirometry) for evaluating effects are discussed in Chapter 3. Development of sensitive and specific chemical or biochemical tests for asbestos-induced effects would be very valuable, especially if preclinical changes could be detected.

Methods for Determining Parent Compounds and Degradation Products in Environmental Media. Standardized methods have been established in the United States for measurement of asbestos in air by PCM and TEM, the media most likely to lead to human exposure (NIOSH 1989a, 1989b), Standard TEM methods are also available for measuring asbestos in water (WHO 1986). These methods are sufficiently sensitive to quantify asbestos both at background levels and at levels of health concern. There are variations in both sampling conditions and counting rules in PCM methods used in other countries that lead to significant differences in results (Dion and Perrault 1994). Improved comparability would be achieved if an international consensus could be reached to resolve these differences. However, the electron microscopic techniques that give the greatest amount of useful data are also the slowest and most costly. TEM equipment allows fiber type to be identified and finer fibers to be counted. Fiber size, shape, and mineralogy are important factors for assessing risk. Improved analytical methods for screening samples and determining the chemical structure of asbestos fibers would be useful. Further efforts to reduce the time and cost per analysis would also be helpful.

7.3.2 Ongoing Studies

Given the need and financial incentives for improved, faster asbestos analysis, studies are ongoing to improve these areas. Intense activity is underway in the areas of automation and computerization, especially with TEM and analytical electron microscopy. Another area of investigation is to identify the fiber types and sizes most closely identified with risk of lung cancer and mesothelioma and develop methodology that will give results that are most closely correlated with risk (Berman et al. 1995).

A major area of concern is the possibility that asbestos fibers adsorb carcinogens in smoke, such as benzidine, N,N-dimethylanaline, and benzo(a)pyrene, and carry them to cells. Investigations are being carried out to detect such chemical impurities on asbestos fiber surfaces by a technique known as laser microprobe mass analysis (Warner 1988).

Reliability of asbestos analysis should be improved by new regulations requiring accreditation of asbestos-testing laboratories. The National Institute of Science and Technology (formerly the National Bureau of Standards) is conducting programs for accreditation of polarized light microscopy and TEM laboratories.

8. REGULATIONS AND ADVISORIES

Because of its potential to cause adverse health effects in exposed people, numerous regulations and advisories have been established for asbestos by various international, national, and state agencies. Such regulations and advisories control asbestos in various media, such as air and water, and also how it is contained, handled, disposed, etc.

Major regulations and advisories pertaining to asbestos are summarized in Table 8-1. Most states have adopted and enforce the regulations and guidelines set by national agencies. For example, with regard to emissions standards, most states follow the National Emission Standards for Hazardous Air Pollutants established by EPA (in Volume 40, Part 61 of the Code of Federal Regulations) for asbestos emissions. States may establish their own standards, but they are comparable to or more stringent than the ones set forth by EPA, OSHA, etc. (CELDS 1994). In addition, states may establish regulations for asbestos when federal regulations do not exist for a particular scenario (Kaplan 1993).

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a]

Agency	Description	Information	References
<u>INTERNATIONAL</u>			
Guidelines:			
IARC	Carcinogenic classification	Group 1[b]	IARC 2001
<u>NATIONAL</u>			
Regulations and guidelines			
a. Air			
ACGIH	TLV–TWA	0.1 f/mL	ACGIH 2000
EPA	Carcinogenic inhalation unit risk	2.3×10^{-1} $(f/mL)^{-1}$	IRIS 2001
	Carcinogenic classification	Group A[c]	
	NESHAP—HAP		EPA 2000c 40CFR61.01(a)
NIOSH	REL (100-minute TWA in a 400 L sample); f>5 µm in length	0.1 f/mL	NIOSH 2001
OSHA	PEL (8-hour TWA)	0.1 f/mL	OSHA 2001a 29CFR1910.1001
	PEL (8-hour TWA) for construction	0.1 f/mL	OSHA 2001b 29CFR1926.1101
	PEL (excursion limit) averaged over a 30-minute sampling period for construction	1.0 f/mL	OSHA 2001b 29CFR1926.1101
	PEL (8-hour TWA) for shipyard	0.1 f/mL	OSHA 2001c 29CFR1915.1001
	PEL (excursion limit) averaged over a 30-minute sampling period for shipyard	1.0 f/mL	OSHA 2001c 29CFR1915.1001
USC	HAP		USC 2001c 42USC7412
b. Water			
EPA	Concentration at cancer risk of 10^{-4} for drinking water	700 MFL	EPA 2000a
	Human health for consumption of: Water and organism	 7 MFL	EPA 1999a

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a] *(continued)*

Agency	Description	Information	References
NATIONAL *(cont.)*			
EPA	MCL (f>10 µm in length) MCLG (f>10 µm in length)	7 MFL 7 MFL	EPA 2001a
USC	Clean Water Act—National Standards of Performance		USC 2001a 33USC1316
c. Food			
FDA	Indirect food additives: Adhesives and components of coatings		FDA 2000a 21CFR175.105 (c)(5)
	Indirect food additives: Polymers		FDA 2000b 21CFR177.2420 (b)
	Indirect food additives: Polymers —phenolic resins in molded articles		FDA 2000c 21CFR177.2410 (b)
d. Other			
ACGIH	Carcinogenic classification	A1[d]	ACGIH 2000
CPSC	Test results on crayons—manufacturers will reformulate crayons using substitute ingredients to eliminate fibers within one year		CPSC 2001a
	Testing finds no asbestos fibers in children's chalk		CPSC 2001b
EPA	Asbestos—containing materials in schools; Asbestos abatement project		EPA 2000b 40CFR763
	CERCLA—reportable quantity	1 pound	EPA 1999b 40CFR302.4
	Toxic chemical release reporting; Community Right-to-Know—effective date	01/01/87	EPA 2001c 40CFR372.65(a)
USC	Congressional findings and purpose—implementation of appropriate response actions with respect to asbestos-containing material in the Nation's schools		USC 2001b 15USC2641

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a] *(continued)*

Agency	Description	Information	References
DHHS	Carcinogen classification	Known to be a human carcinogen	NTP 2001
<u>STATE</u>			
Regulations and Guidelines			
a. Air			
Alabama	HAP		BNA 2001
Arizona	Research HAPs List		ADEQ 2001
California	Toxic air contaminant		Environmental Defense 2001
Colorado	HAP		BNA 2001
Hawaii	HAP		BNA 2001
Illinois	Toxic air contaminant		BNA 2001
Kansas	HAP		BNA 2001
Kentucky	HAP		BNA 2001
Louisiana	Toxic air pollutant		BNA 2001
	Minimum emission rate	25.0 pounds/year	
Maryland	Toxic air pollutant		BNA 2001
Minnesota	HAP threshold		BNA 2001
	De minimis level (tons/year)	Zero	
Missouri	Air contaminant		BNA 2001
	De minimis emission level	0.007 tons/year	
Nebraska	HAP		BNA 2001
New York	HAP		BNA 2001
Rhode Island	HAP		BNA 2001
Vermont	Hazardous air contaminant		BNA 2001
	Hazardous ambient air standards		BNA 2001
	Annual average	1.2×10^{-4} µg/m^3	
	Action level	1×10^{-5} pounds/ 8 hours	
Washington	HAP—threshold level	4×10^{-5} f/mL	BNA 2001
Wyoming	HAP		BNA 2001

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a] *(continued)*

Agency	Description	Information	References
STATE *(cont.)*			
b. Water			
Alabama	Primary drinking water standard		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Alaska	Drinking water standard		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Arizona	Safe drinking water		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
California	Primary MCL	7 MFL	California DHS 1999
Colorado	Groundwater standard	7 MFL	BNA 2001
	Primary drinking water regulation		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Connecticut	Public drinking water standard		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Florida	Drinking water standard		BNA 2001
	MCL	7 MFL	
Georgia	Safe drinking water		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Hawaii	MCL (f>10 µm in length)	7 MFL	CDC 1999
Illinois	Primary drinking water standard		BNA 2001
	MCL	7 MFL	
Indiana	MCL	7 MFL	IDEM 2001a
Kansas	Surface water quality criteria		BNA 2001
	Domestic water supply	7 MFL	
Kentucky	Surface water standards		BNA 2001
	Domestic water supply use	7 MFL	
Maryland	Drinking water		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Massachusetts	Water quality standard (f>10 µm in length)	7 MFL	FSTRAC 1999
Michigan	Drinking water standard		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
	Effective date	07/30/92	

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a] *(continued)*

Agency	Description	Information	References
STATE *(cont.)*			
Montana	Public water supply requirement		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Nebraska	Drinking water standard		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Nebraska	Water quality standard		BNA 2001
	Water supply (f>10 µm in length)	7 MFL	
New Hampshire	Drinking water rule		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
	MCLG (f>10 µm in length)	7 MFL	
	Surface water quality regulation		BNA 2001
	Water and fish ingestion	7 MFL	
New Mexico	Drinking water		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
New York	Drinking water supplies		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
North Dakota	Public water supply systems		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Rhode Island	Groundwater quality standard	7 MFL	BNA 2001
	Preventive action limit	3.5 MFL	
South Carolina	Drinking water		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
	Water quality criteria		BNA 2001
	Organism consumption	7 MFL	
South Dakota	Surface water quality standard		BNA 2001
	Human health value concentration	7 MFL	
Tennessee	Groundwater quality criteria	7 MFL	BNA 2001
	Public water systems		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Utah	Primary drinking water standard		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Vermont	Drinking water quality requirement		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
	MCLG (f>10 µm in length)	7 MFL	

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a] *(continued)*

Agency	Description	Information	References
STATE *(cont.)*			
Vermont	Groundwater quality standard		BNA 2001
	Enforcement standard	7 MFL	
	Preventive action limit	3.5 MFL	
Washington	Public water supplies		BNA 2001
	MCL (f>10 µm in length)	7 MFL	
Wisconsin	Groundwater quality standard		BNA 2001
	Enforcement standard	7 MFL	
	Preventive action limit	0.7 MFL	
c. Food		No data	
d. Other			
California	Chemical known to cause cancer or reproductive toxicity		BNA 2001
	Effective date	02/27/87	
	Hazardous substance		BNA 2001
	Identification and listing of hazardous waste —characteristics of toxicity		BNA 2001
	TTLC (wet-weight mg/kg)	1.0 (as a percent)	
Florida	Toxic substances in the workplace		BNA 2001
Indiana	Regulations for asbestos hazards to the atmosphere and disposal of asbestos-containing waste; licenses asbestos personnel		IDEM 2001b
Maine	Emissions standard	200 pounds	BNA 2001
Massachusetts	Oil and hazardous material		BNA 2001
	Toxic substance		BNA 2001
New Jersey	Hazardous substance		BNA 2001
New York	Occupation lung disease		BNA 2001
	Hazardous substance—reportable quantity		BNA 2001
	Air	1 pound	
	Land and water	1 pound	
Ohio	Toxic chemical list		Ohio EPA 2001
Oregon	Toxic substance		BNA 2001

Table 8-1. Regulations and Guidelines Applicable to Asbestos[a] *(continued)*

Agency	Description	Information	References
STATE *(cont.)*			
Pennsylvania	Hazardous substance		BNA 2001
South Carolina	Toxic pollutant		BNA 2001

[a]Includes: Actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite.
[b]Group 1: Carcinogenic to humans
[c]Group A: Human carcinogen
[d]A1: Confirmed human carcinogen

ACGIH = American Conference of Governmental Industrial Hygienists; ADEQ = Arizona Department of Environmental Quality; BNA = Bureau of National Affairs; CDC = Center for Disease Control; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CFR = Code of Federal Regulations; CPSC = Consumer Product Safety Commission; DHS = Department of Health Services; DHHS = Department of Health and Human Services; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; FSTRAC = Federal–State Toxicology Risk Analysis Committee; HAP = Hazardous Air Pollutant; IARC = International Agency for Research on Cancer; IDEM = Indiana Department of Environmental Management; IRIS = Integrated Risk Information System; MCL = maximum contaminant level; MCLG = maximum contaminant level goal; MFL = million fibers per liter; NESHAP = National Emission Standards for Hazardous Air Pollutants; NIOSH = National Institute of Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; REL = recommended exposure limit; TLV = threshold limit value; TTLC = total threshold limit concentration; TWA = time-weighted average; USC = United States Code

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10. GLOSSARY

Absorption—The taking up of liquids by solids, or of gases by solids or liquids.

Actinolite— A mineral in the amphibole group, a calcium magnesium (iron) silicate with the chemical formula: $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$. The mineral occurs as a series in which magnesium and iron can freely substitute for each other. Actinolite is the intermediate member; when iron is predominant the mineral is ferro-actinolite and when magnesium is predominant, the mineral is tremolite. The iron produces a green color that darkens as the iron content increases. Actinolite may occur in fibrous form (an asbestos). It is not used commercially, but is a common impurity in chrysotile asbestos.

Acute Exposure—Exposure to a chemical for a duration of 14 days or less, as specified in the Toxicological Profiles.

Adsorption—The adhesion in an extremely thin layer of molecules (as of gases, solutes, or liquids) to the surfaces of solid bodies or liquids with which they are in contact.

Adsorption Coefficient (K_{oc})—The ratio of the amount of a chemical adsorbed per unit weight of organic carbon in the soil or sediment to the concentration of the chemical in solution at equilibrium.

Adsorption Ratio (Kd)—The amount of a chemical adsorbed by a sediment or soil (i.e., the solid phase) divided by the amount of chemical in the solution phase, which is in equilibrium with the solid phase, at a fixed solid/solution ratio. It is generally expressed in micrograms of chemical sorbed per gram of soil or sediment.

Amosite—A type of asbestos in the amphibole group; it is also known as brown asbestos.

Amphibole—The group name for a family of naturally-occurring ferromagnesium silicate minerals, characterized by a double chain of silicate ions (silicon-oxygen tetrahedra). This group includes amosite, actinolite, crocidolite, and tremolite forms of asbestos. However, the amphibole group includes a much broader and larger variety of minerals than the asbestiform ones. Amphibole asbestos particles are generally brittle and often have a rod- or needle-like shape

Anthophyllite—A type of asbestos in the amphibole group; it is also known as azbolen asbestos.

Asbestiform—Possessing the properties of asbestos. Minerals of specific chemical compositions can have asbestiform varieties that are fibrous in nature (e.g., crocidolite and amosite are the asbestiform varieties of the amphibole minerals, reibeckite and grunerite; tremolite and actinolite may be either asbestiform or nonasbestiform)

Asbestos—A general term applied to certain polysilicate fibrous minerals displaying similar physical characteristics although differing in composition. The most common asbestos mineral (over 95% of U.S. production) is chrysotile, a variety of serpentine, a metamorphic mineral.

Benchmark Dose (BMD)—Usually defined as the lower confidence limit on the dose that produces a specified magnitude of changes in a specified adverse response. For example, a BMD_{10} would be the dose at the 95% lower confidence limit on a 10% response, and the benchmark response (BMR) would be 10%. The BMD is determined by modeling the dose response curve in the region of the dose response relationship where biologically observable data are feasible.

Benchmark Dose Model—A statistical dose-response model applied to either experimental toxicological or epidemiological data to calculate a BMD.

Bioconcentration Factor (BCF)—The quotient of the concentration of a chemical in aquatic organisms at a specific time or during a discrete time period of exposure divided by the concentration in the surrounding water at the same time or during the same period.

Biomarkers—Broadly defined as indicators signaling events in biologic systems or samples. They have been classified as markers of exposure, markers of effect, and markers of susceptibility.

Bulk Sample—A sample of suspected asbestos-containing material that is obtained from a building to be analyzed microscopically for asbestos content. Bulk sample analysis can be part of a process to assess the hazard from asbestos in a building.

Cancer Effect Level (CEL)—The lowest dose of chemical in a study, or group of studies, that produces significant increases in the incidence of cancer (or tumors) between the exposed population and its appropriate control.

Carcinogen—A chemical capable of inducing cancer.

Case-Control Study—A type of epidemiological study which examines the relationship between a particular outcome (disease or condition) and a variety of potential causative agents (such as toxic chemicals). In a case-control study, a group of people with a specified and well-defined outcome is identified and compared to a similar group of people without outcome.

Case Report—Describes a single individual with a particular disease or exposure. These may suggest some potential topics for scientific research but are not actual research studies.

Case Series—Describes the experience of a small number of individuals with the same disease or exposure. These may suggest potential topics for scientific research but are not actual research studies.

Ceiling Value—A concentration of a substance in workplace air that should not be exceeded, even instantaneously.

Chronic Exposure—Exposure to a chemical for 365 days or more, as specified in the Toxicological Profiles.

Chrysotile Asbestos—A fibrous member of the serpentine group of minerals. Chrysotile asbestos fibers are flexible and have a curved morphology. It is the most common form of asbestos used commercially, also referred to as white asbestos.

Cleavage Fragments—Term used to characterize the form of some nonasbestiform amphiboles. These are microscopic fragments that have the appearance of fibers but are considerably shorter and have smaller length:width ratios (i.e., length >5 µm and a length:width ratio greater than 3:1) than is used by health regulatory agencies to define asbestiform fibers. Cleavage fragments may be formed when nonfibrous amphibole minerals are crushed, as may occur in mining and milling.

Cleavage Plane—Preferred direction along smooth plane surfaces in which a mineral tends to split or cleave. Planes of cleavage are governed by atomic structure and represent direction in which atomic bonds are relatively weak. Amphiboles exhibit prismatic cleavage with an angle of about 55E between cleavage planes.

Cohort Study—A type of epidemiological study of a specific group or groups of people who have had a common insult (e.g., exposure to an agent suspected of causing disease or a common disease) and are followed forward from exposure to outcome. At least one exposed group is compared to one unexposed group.

Crocidolite—A type of asbestos in the amphibole group; it is also known as blue asbestos.

Cross-sectional Study—A type of epidemiological study of a group or groups which examines, at one point in time, the relationship between exposure to a chemical or to chemicals and outcome.

Data Needs—Substance-specific informational needs that if met would reduce the uncertainties of human health assessment.

Developmental Toxicity—The occurrence of adverse effects on the developing organism that may result from exposure to a chemical prior to conception (either parent), during prenatal development, or postnatally to the time of sexual maturation. Adverse developmental effects may be detected at any point in the life span of the organism.

Dose-Response Relationship—The quantitative relationship between the amount of exposure to a toxicant and the incidence of the adverse effects.

Embryotoxicity and Fetotoxicity—Any toxic effect on the conceptus as a result of prenatal exposure to a chemical; the distinguishing feature between the two terms is the stage of development during which the insult occurs. The terms, as used here, include malformations and variations, altered growth, and *in utero* death.

Environmental Protection Agency (EPA) Health Advisory—An estimate of acceptable drinking water levels for a chemical substance based on health effects information. A health advisory is not a legally enforceable federal standard, but serves as technical guidance to assist federal, state, and local officials.

Epidemiology—Refers to the investigation of factors that determine the frequency and distribution of disease or other health-related conditions within a defined human population during a specified period.

$FEFR_{25-75}$—Forced expiratory flowrate between 25 and 75%.

$FEV_{1.0}$—Forced expiratory volume in 1.0 second.

Fibrogenic—Causing or contributing to the fibrotic response mechanism in tissues; commonly refers to substances that contribute to fibrosis of the lungs or liver.

FVC—Forced vital capacity.

Genotoxicity—A specific adverse effect on the genome of living cells that, upon the duplication of affected cells, can be expressed as a mutagenic, clastogenic or carcinogenic event because of specific alteration of the molecular structure of the genome.

Half-life—A measure of rate for the time required to eliminate one half of a quantity of a chemical from the body or environmental media.

Horticultural Vermiculite —Grade of vermiculite sold for horticultural applications. Such grades of vermiculite have smaller particle size resulting in improved water retention, particle strength, and wettability than coarser grades of vermiculite.

Immediately Dangerous to Life or Health (IDLH)—The maximum environmental concentration of a contaminant from which one could escape within 30 minutes without any escape-impairing symptoms or irreversible health effects.

Incidence—The ratio of individuals in a population who develop a specified condition to the total number of individuals in that population who could have developed that condition in a specified time period.

Intermediate Exposure—Exposure to a chemical for a duration of 15-364 days, as specified in the Toxicological Profiles.

Immunological Effects—Functional changes in the immune response.

Immunologic Toxicity—The occurrence of adverse effects on the immune system that may result from exposure to environmental agents such as chemicals.

In Vitro—Isolated from the living organism and artificially maintained, as in a test tube.

In Vivo—Occurring within the living organism.

Lethal Concentration$_{(LO)}$ (LC_{LO})—The lowest concentration of a chemical in air which has been reported to have caused death in humans or animals.

Lethal Concentration$_{(50)}$ (LC_{50})—A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

Lethal Dose$_{(LO)}$ (LD_{LO})—The lowest dose of a chemical introduced by a route other than inhalation that has been reported to have caused death in humans or animals.

Lethal Dose$_{(50)}$ (LD_{50})—The dose of a chemical which has been calculated to cause death in 50% of a defined experimental animal population.

Lethal Time$_{(50)}$ (LT_{50})—A calculated period of time within which a specific concentration of a chemical is expected to cause death in 50% of a defined experimental animal population.

Lowest-Observed-Adverse-Effect Level (LOAEL)—The lowest exposure level of chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control.

Lymphoreticular Effects—Represent morphological effects involving lymphatic tissues such as the lymph nodes, spleen, and thymus.

Malformations—Permanent structural changes that may adversely affect survival, development, or function.

Minimal Risk Level (MRL)—An estimate of daily human exposure to a hazardous substance that is likely to be without an appreciable risk of adverse noncancer health effects over a specified route and duration of exposure.

Modifying Factor (MF)—A value (greater than zero) that is applied to the derivation of a minimal risk level (MRL) to reflect additional concerns about the database that are not covered by the uncertainty factors. The default value for a MF is 1.

Morbidity—State of being diseased; morbidity rate is the incidence or prevalence of disease in a specific population.

Mortality—Death; mortality rate is a measure of the number of deaths in a population during a specified interval of time.

Mutagen—A substance that causes mutations. A mutation is a change in the DNA sequence of a cell's DNA. Mutations can lead to birth defects, miscarriages, or cancer.

Necropsy—The gross examination of the organs and tissues of a dead body to determine the cause of death or pathological conditions.

Neurotoxicity—The occurrence of adverse effects on the nervous system following exposure to a chemical.

No-Observed-Adverse-Effect Level (NOAEL)—A level of exposure to a chemical at which there were no statistically or biologically significant increases in frequency or severity of adverse effects seen between the exposed population and its appropriate control. Effects may be produced at this level, but they are not considered to be adverse.

Octanol-Water Partition Coefficient (K_{ow})—The equilibrium ratio of the concentrations of a chemical in *n*-octanol and water, in dilute solution.

Odds Ratio (OR)—A means of measuring the association between an exposure (such as toxic substances and a disease or condition) which represents the best estimate of relative risk (risk as a ratio of the incidence among subjects exposed to a particular risk factor divided by the incidence among subjects who were not exposed to the risk factor). An odds ratio of greater than 1 is considered to indicate greater risk of disease in the exposed group compared to the unexposed.

Organophosphate or Organophosphorus Compound—A phosphorus containing organic compound and especially a pesticide that acts by inhibiting cholinesterase.

Permissible Exposure Limit (PEL)—An Occupational Safety and Health Administration (OSHA) allowable exposure level in workplace air averaged over an 8-hour shift of a 40 hour workweek.

Pesticide—General classification of chemicals specifically developed and produced for use in the control of agricultural and public health pests.

Pharmacokinetics—The science of quantitatively predicting the fate (disposition) of an exogenous substance in an organism. Utilizing computational techniques, it provides the means of studying the absorption, distribution, metabolism and excretion of chemicals by the body.

Pharmacokinetic Model—A set of equations that can be used to describe the time course of a parent chemical or metabolite in an animal system. There are two types of pharmacokinetic models: data-based and physiologically-based. A data-based model divides the animal system into a series of compartments which, in general, do not represent real, identifiable anatomic regions of the body whereby the physiologically-based model compartments represent real anatomic regions of the body.

Physiologically Based Pharmacodynamic (PBPD) Model—A type of physiologically-based dose-response model which quantitatively describes the relationship between target tissue dose and toxic end points. These models advance the importance of physiologically based models in that they clearly describe the biological effect (response) produced by the system following exposure to an exogenous substance.

Physiologically Based Pharmacokinetic (PBPK) Model—Comprised of a series of compartments representing organs or tissue groups with realistic weights and blood flows. These models require a variety of physiological information: tissue volumes, blood flow rates to tissues, cardiac output, alveolar ventilation rates and, possibly membrane permeabilities. The models also utilize biochemical information such as air/blood partition coefficients, and metabolic parameters. PBPK models are also called biologically based tissue dosimetry models.

ppbv—Parts per billion by volume.

ppmv—Parts per million by volume.

Prevalence—The number of cases of a disease or condition in a population at one point in time.

Proportionate Mortality Ratio (PMR)—The ratio of a cause-specific mortality proportion in an exposed group to the mortality proportion in an unexposed group; mortality proportions may be adjusted for confounding variables such as age. Cause-specific mortality proportions can be calculated when the cohort (the population at risk) cannot be defined due to inadequate records, but the number of deaths and the causes of deaths are known.

Prospective Study—A type of cohort study in which the pertinent observations are made on events occurring after the start of the study. A group is followed over time.

q_1*—The upper-bound estimate of the low-dose slope of the dose-response curve as determined by the multistage procedure. The q_1* can be used to calculate an estimate of carcinogenic potency, the incremental excess cancer risk per unit of exposure (usually μg/L for water, mg/kg/day for food, and $\mu g/m^3$ for air).

Recommended Exposure Limit (REL)—A National Institute for Occupational Safety and Health (NIOSH) time-weighted average (TWA) concentrations for up to a 10-hour workday during a 40-hour workweek.

Reference Concentration (RfC)—An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious noncancer health effects during a lifetime. The inhalation reference concentration is for continuous inhalation exposures and is appropriately expressed in units of mg/m^3 or ppm.

Reference Dose (RfD)—An estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure of the human population to a potential hazard that is likely to be without risk of deleterious effects during a lifetime. The RfD is operationally derived from the No-Observed-Adverse-Effect Level (NOAEL- from animal and human studies) by a consistent application of uncertainty factors that reflect various types of data used to estimate RfDs and an additional modifying factor, which is based on a professional judgment of the entire database on the chemical. The RfDs are not applicable to nonthreshold effects such as cancer.

Relative Risk (RR)—The risk expressed as a ratio of the incidence of diseased subjects exposed to a particular risk factor to the incidence of diseased subjects in a non-exposed referent group.

Reportable Quantity (RQ)—The quantity of a hazardous substance that is considered reportable under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Reportable quantities are (1) 1 pound or greater or (2) for selected substances, an amount established by regulation either under CERCLA or under Section 311 of the Clean Water Act. Quantities are measured over a 24-hour period.

Reproductive Toxicity—The occurrence of adverse effects on the reproductive system that may result from exposure to a chemical. The toxicity may be directed to the reproductive organs and/or the related endocrine system. The manifestation of such toxicity may be noted as alterations in sexual behavior, fertility, pregnancy outcomes, or modifications in other functions that are dependent on the integrity of this system.

Retrospective Study—A type of cohort study based on a group of persons known to have been exposed at some time in the past. Data are collected from routinely recorded events, up to the time the study is undertaken. Retrospective studies are limited to causal factors that can be ascertained from existing records and/or examining survivors of the cohort.

Risk—The possibility or chance that some adverse effect will result from a given exposure to a chemical.

Risk Factor—An aspect of personal behavior or lifestyle, an environmental exposure, or an inborn or inherited characteristic, that is associated with an increased occurrence of disease or other health-related event or condition.

Risk Ratio—The ratio of the risk among persons with specific risk factors compared to the risk among persons without risk factors. A risk ratio greater than 1 indicates greater risk of disease in the exposed group compared to the unexposed.

Serpentine—A name given to several members of a polymorphic group of magnesium silicate minerals—those having essentially the same chemistry but different structures or forms. Serpentine’s structure consists of layers of silicate tetrahedrons linked into sheets with the sheets being separated by layers of $Mg(OH)_2$ called brucite layers. In the asbestos varieties, the brucite and silicate layers bend into tubers that produce the fibers. Chrysotile asbestos is a fibrous member of the serpentine group. "Serpentine" comes from mottled shades of green on massive varieties, suggestive of snake markings.

Short-Term Exposure Limit (STEL)—The American Conference of Governmental Industrial Hygienists (ACGIH) maximum concentration to which workers can be exposed for up to 15 minutes continually. No more than four such exposures are allowed per day, and there must be at least 60 minutes between exposure periods. The daily Threshold Limit Value - Time Weighted Average (TLV-TWA) may not be exceeded.

Standardized Mortality Ratio (SMR)—The ratio of a cause-specific mortality rate in an exposed cohort during a given period to the mortality rate of an unexposed cohort; mortality rates are often adjusted for age or other confounding variables.

Standardized Proportionate Incidence Ratio (SPIR)—Similar to a Proportionate Mortality Ratio (PMR) in that it is a ratio of a proportion of a specific disease in an exposed group compared with the proportion in an unexposed group.

Talc—A common, extremely soft, basic magnesium silicate mineral; in compact aggregates, it is known as soapstone (steatite) in reference to their soapy feel. It is frequently associated with tremolite.

Target Organ Toxicity—This term covers a broad range of adverse effects on target organs or physiological systems (e.g., renal, cardiovascular) extending from those arising through a single limited exposure to those assumed over a lifetime of exposure to a chemical.

Teratogen—A chemical that causes structural defects that affect the development of an organism.

Threshold Limit Value (TLV)—An American Conference of Governmental Industrial Hygienists (ACGIH) concentration of a substance to which most workers can be exposed without adverse effect. The TLV may be expressed as a Time Weighted Average (TWA), as a Short-Term Exposure Limit (STEL), or as a ceiling limit (CL).

Time-Weighted Average (TWA)—An allowable exposure concentration averaged over a normal 8-hour workday or 40-hour workweek.

Toxic Dose$_{(50)}$ (TD_{50})—A calculated dose of a chemical, introduced by a route other than inhalation, which is expected to cause a specific toxic effect in 50% of a defined experimental animal population.

Toxicokinetic—The study of the absorption, distribution and elimination of toxic compounds in the living organism.

Tremolite—A mineral in the amphibole group, a calcium magnesium (iron) silicate with the chemical formula: $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$. The mineral occurs as a series in which magnesium and iron can freely substitute for each other. Tremolite is the mineral when magnesium is predominant; otherwise, the mineral is actinolite. Tremolite is sometimes found in forms that are free of iron in which it has a creamy white color; small amounts of iron produces a greenish color. Tremolite may occur in fibrous form (an asbestos). It is not used commercially in the United States, but is a common impurity in chrysotile asbestos and vermiculite mined from deposits in Libby, Montana.

Uncertainty Factor (UF)—A factor used in operationally deriving the Minimal Risk Level (MRL) or Reference Dose (RfD) or Reference Concentration (RfC) from experimental data. UFs are intended to account for (1) the variation in sensitivity among the members of the human population, (2) the uncertainty in extrapolating animal data to the case of human, (3) the uncertainty in extrapolating from data obtained in a study that is of less than lifetime exposure, and (4) the uncertainty in using Lowest-Observed-Adverse-Effect Level (LOAEL) data rather than No-Observed-Adverse-Effect Level (NOAEL) data. A default for each individual UF is 10; if complete certainty in data exists, a value of one can be used; however a reduced UF of three may be used on a case-by-case basis, three being the approximate logarithmic average of 10 and 1.

Vermiculite—A chemically inert, lightweight, fire resistant, and odorless magnesium silicate material that is generally used for its thermal and sound insulation in construction and for its absorbent properties in horticultural applications. It is made by a process called exfoliation in which flakes of raw vermiculite concentrate are rapidly heated to a temperature above 870 EC. The mica-like flakes of vermiculite concentrate, which contain interlayers of water, then expand into accordion-like particles (originally described as resembling small worms) as the water is converted into steam. Properly speaking, the term vermiculite should be used to apply to the mined, unexfoliated, commercial product (see Vermiculite concentrate). However, the common usage of the term vermiculite as the exfoliated or expanded material is so entrenched in the minds of contractors, retailers, and the general public that it is less confusing to retain the common usage and use descriptors to refer to the raw material. Vermiculite mined from Libby, Montana has been demonstrated to contain various amounts of asbestiform tremolite-like amphibole minerals.

Vermiculite Concentrate (also raw or unexfoliated vermiculite)—The mineralogical name given to hydrated laminar magnesium-aluminum-iron silicate $(Mg,Ca,K,Fe(II)_3(Si,Al,Fe(III)_4O_{10}(OH)_2O_4H_2O)$ minerals, which resemble mica in appearance. This mineral has the unusual property of exfoliating or expanding to a low density, bulky material when heated (see Vermiculite).

Xenobiotic—Any chemical that is foreign to the biological system.

APPENDIX A

ATSDR MINIMAL RISK LEVELS AND WORKSHEETS

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [42 U.S.C. 9601 et seq.], as amended by the Superfund Amendments and Reauthorization Act (SARA) [Pub. L. 99–499], requires that the Agency for Toxic Substances and Disease Registry (ATSDR) develop jointly with the U.S. Environmental Protection Agency (EPA), in order of priority, a list of hazardous substances most commonly found at facilities on the CERCLA National Priorities List (NPL); prepare toxicological profiles for each substance included on the priority list of hazardous substances; and assure the initiation of a research program to fill identified data needs associated with the substances.

The toxicological profiles include an examination, summary, and interpretation of available toxicological information and epidemiologic evaluations of a hazardous substance. During the development of toxicological profiles, Minimal Risk Levels (MRLs) are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration for a given route of exposure. An MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. MRLs are based on noncancer health effects only and are not based on a consideration of cancer effects. These substance-specific estimates, which are intended to serve as screening levels, are used by ATSDR health assessors to identify contaminants and potential health effects that may be of concern at hazardous waste sites. It is important to note that MRLs are not intended to define clean-up or action levels.

MRLs are derived for hazardous substances using the no-observed-adverse-effect level/uncertainty factor approach. They are below levels that might cause adverse health effects in the people most sensitive to such chemical-induced effects. MRLs are derived for acute (1–14 days), intermediate (15–364 days), and chronic (365 days and longer) durations and for the oral and inhalation routes of exposure. Currently, MRLs for the dermal route of exposure are not derived because ATSDR has not yet identified a method suitable for this route of exposure. MRLs are generally based on the most sensitive chemical-induced end point considered to be of relevance to humans. Serious health effects (such as irreparable damage to the liver or kidneys, or birth defects) are not used as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur.

MRLs are intended only to serve as a screening tool to help public health professionals decide where to look more closely. They may also be viewed as a mechanism to identify those hazardous waste sites that are not expected to cause adverse health effects. Most MRLs contain a degree of uncertainty because of the lack of precise toxicological information on the people who might be most sensitive (e.g., infants, elderly, nutritionally or immunologically compromised) to the effects of hazardous substances. ATSDR uses a conservative (i.e., protective) approach to address this uncertainty consistent with the public health principle of prevention. Although human data are preferred, MRLs often must be based on animal studies because relevant human studies are lacking. In the absence of evidence to the contrary, ATSDR assumes that humans are more sensitive to the effects of hazardous substance than animals and that certain persons may be particularly sensitive. Thus, the resulting MRL may be as much as a hundredfold below levels that have been shown to be nontoxic in laboratory animals.

Proposed MRLs undergo a rigorous review process: Health Effects/MRL Workgroup reviews within the Division of Toxicology, expert panel peer reviews, and agency wide MRL Workgroup reviews, with participation from other federal agencies and comments from the public. They are subject to change as new information becomes available concomitant with updating the toxicological profiles. Thus, MRLs in the most recent toxicological profiles supersede previously published levels. For additional information regarding MRLs, please contact the Division of Toxicology, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road, Mailstop E-29, Atlanta, Georgia 30333.

APPENDIX B

USER'S GUIDE

Chapter 1

Public Health Statement

This chapter of the profile is a health effects summary written in non-technical language. Its intended audience is the general public especially people living in the vicinity of a hazardous waste site or chemical release. If the Public Health Statement were removed from the rest of the document, it would still communicate to the lay public essential information about the chemical.

The major headings in the Public Health Statement are useful to find specific topics of concern. The topics are written in a question and answer format. The answer to each question includes a sentence that will direct the reader to chapters in the profile that will provide more information on the given topic.

Chapter 2

Relevance to Public Health

This chapter provides a health effects summary based on evaluations of existing toxicologic, epidemiologic, and toxicokinetic information. This summary is designed to present interpretive, weight-of-evidence discussions for human health end points by addressing the following questions.

1. What effects are known to occur in humans?

2. What effects observed in animals are likely to be of concern to humans?

3. What exposure conditions are likely to be of concern to humans, especially around hazardous waste sites?

The chapter covers end points in the same order they appear within the Discussion of Health Effects by Route of Exposure section, by route (inhalation, oral, dermal) and within route by effect. Human data are presented first, then animal data. Both are organized by duration (acute, intermediate, chronic). *In vitro* data and data from parenteral routes (intramuscular, intravenous, subcutaneous, etc.) are also considered in this chapter. If data are located in the scientific literature, a table of genotoxicity information is included.

The carcinogenic potential of the profiled substance is qualitatively evaluated, when appropriate, using existing toxicokinetic, genotoxic, and carcinogenic data. ATSDR does not currently assess cancer potency or perform cancer risk assessments. Minimal risk levels (MRLs) for noncancer end points (if derived) and the end points from which they were derived are indicated and discussed.

Limitations to existing scientific literature that prevent a satisfactory evaluation of the relevance to public health are identified in the Chapter 3 Data Needs section.

Interpretation of Minimal Risk Levels

Where sufficient toxicologic information is available, we have derived minimal risk levels (MRLs) for inhalation and oral routes of entry at each duration of exposure (acute, intermediate, and chronic). These MRLs are not meant to support regulatory action; but to acquaint health professionals with exposure levels at which adverse health effects are not expected to occur in humans. They should help physicians and public health officials determine the safety of a community living near a chemical emission, given the concentration of a contaminant in air or the estimated daily dose in water. MRLs are based largely on toxicological studies in animals and on reports of human occupational exposure.

MRL users should be familiar with the toxicologic information on which the number is based. Chapter 2, "Relevance to Public Health," contains basic information known about the substance. Other sections such as Chapter 3 Section 3.9, "Interactions with Other Substances," and Section 3.10, "Populations that are Unusually Susceptible" provide important supplemental information.

MRL users should also understand the MRL derivation methodology. MRLs are derived using a modified version of the risk assessment methodology the Environmental Protection Agency (EPA) provides (Barnes and Dourson 1988) to determine reference doses for lifetime exposure (RfDs).

To derive an MRL, ATSDR generally selects the most sensitive end point which, in its best judgement, represents the most sensitive human health effect for a given exposure route and duration. ATSDR cannot make this judgement or derive an MRL unless information (quantitative or qualitative) is available for all potential systemic, neurological, and developmental effects. If this information and reliable quantitative data on the chosen end point are available, ATSDR derives an MRL using the most sensitive species (when information from multiple species is available) with the highest NOAEL that does not exceed any adverse effect levels. When a NOAEL is not available, a lowest-observed-adverse-effect level (LOAEL) can be used to derive an MRL, and an uncertainty factor (UF) of 10 must be employed. Additional uncertainty factors of 10 must be used both for human variability to protect sensitive subpopulations (people who are most susceptible to the health effects caused by the substance) and for interspecies variability (extrapolation from animals to humans). In deriving an MRL, these individual uncertainty factors are multiplied together. The product is then divided into the inhalation concentration or oral dosage selected from the study. Uncertainty factors used in developing a substance-specific MRL are provided in the footnotes of the LSE Tables.

Chapter 3

Health Effects

Tables and Figures for Levels of Significant Exposure (LSE)

Tables (3-1, 3-2, and 3-3) and figures (3-1 and 3-2) are used to summarize health effects and illustrate graphically levels of exposure associated with those effects. These levels cover health effects observed at increasing dose concentrations and durations, differences in response by species, minimal risk levels (MRLs) to humans for noncancer end points, and EPA's estimated range associated with an upper- bound individual lifetime cancer risk of 1 in 10,000 to 1 in 10,000,000. Use the LSE tables and figures for a quick review of the health effects and to locate data for a specific exposure scenario. The LSE tables and figures should always be used in conjunction with the text. All entries in these tables and figures represent studies that provide reliable, quantitative estimates of No-Observed-Adverse-Effect Levels (NOAELs), Lowest-Observed-Adverse-Effect Levels (LOAELs), or Cancer Effect Levels (CELs).

The legends presented below demonstrate the application of these tables and figures. Representative examples of LSE Table 3-1 and Figure 3-1 are shown. The numbers in the left column of the legends correspond to the numbers in the example table and figure.

LEGEND

See LSE Table 3-1

(1) Route of Exposure One of the first considerations when reviewing the toxicity of a substance using these tables and figures should be the relevant and appropriate route of exposure. When sufficient data exists, three LSE tables and two LSE figures are presented in the document. The three LSE tables present data on the three principal routes of exposure, i.e., inhalation, oral, and dermal (LSE Table 3-1, 3-2, and 3-3, respectively). LSE figures are limited to the inhalation (LSE Figure 3-1) and oral (LSE Figure 3-2) routes. Not all substances will have data on each route of exposure and will not therefore have all five of the tables and figures.

(2) Exposure Period Three exposure periods - acute (less than 15 days), intermediate (15–364 days), and chronic (365 days or more) are presented within each relevant route of exposure. In this example, an inhalation study of intermediate exposure duration is reported. For quick reference to health effects occurring from a known length of exposure, locate the applicable exposure period within the LSE table and figure.

(3) Health Effect The major categories of health effects included in LSE tables and figures are death, systemic, immunological, neurological, developmental, reproductive, and cancer. NOAELs and LOAELs can be reported in the tables and figures for all effects but cancer. Systemic effects are further defined in the "System" column of the LSE table (see key number 18).

(4) Key to Figure Each key number in the LSE table links study information to one or more data points using the same key number in the corresponding LSE figure. In this example, the study represented by key number 18 has been used to derive a NOAEL and a Less Serious LOAEL (also see the 2 "18r" data points in Figure 3-1).

(5) Species The test species, whether animal or human, are identified in this column. Chapter 2, "Relevance to Public Health," covers the relevance of animal data to human toxicity and Section 3.4, "Toxicokinetics," contains any available information on comparative toxicokinetics. Although NOAELs and LOAELs are species specific, the levels are extrapolated to equivalent human doses to derive an MRL.

(6) Exposure Frequency/Duration The duration of the study and the weekly and daily exposure regimen are provided in this column. This permits comparison of NOAELs and LOAELs from different studies. In this case (key number 18), rats were exposed to 1,1,2,2-tetrachloroethane via inhalation for 6 hours per day, 5 days per week, for 3 weeks. For a more complete review of the dosing regimen refer to the appropriate sections of the text or the original reference paper, i.e., Nitschke et al. 1981.

(7) System This column further defines the systemic effects. These systems include: respiratory, cardiovascular, gastrointestinal, hematological, musculoskeletal, hepatic, renal, and dermal/ocular. "Other" refers to any systemic effect (e.g., a decrease in body weight) not covered in these systems. In the example of key number 18, 1 systemic effect (respiratory) was investigated.

(8) NOAEL A No-Observed-Adverse-Effect Level (NOAEL) is the highest exposure level at which no harmful effects were seen in the organ system studied. Key number 18 reports a NOAEL of 3 ppm for the respiratory system which was used to derive an intermediate exposure, inhalation MRL of 0.005 ppm (see footnote "b").

(9) LOAEL A Lowest-Observed-Adverse-Effect Level (LOAEL) is the lowest dose used in the study that caused a harmful health effect. LOAELs have been classified into "Less Serious" and "Serious" effects. These distinctions help readers identify the levels of exposure at which adverse health effects first appear and the gradation of effects with increasing dose. A brief description of the specific end point used to quantify the adverse effect accompanies the LOAEL. The respiratory effect reported in key number 18 (hyperplasia) is a Less serious LOAEL of 10 ppm. MRLs are not derived from Serious LOAELs.

(10) Reference The complete reference citation is given in Chapter 9 of the profile.

(11) CEL A Cancer Effect Level (CEL) is the lowest exposure level associated with the onset of carcinogenesis in experimental or epidemiologic studies. CELs are always considered serious effects. The LSE tables and figures do not contain NOAELs for cancer, but the text may report doses not causing measurable cancer increases.

(12) Footnotes Explanations of abbreviations or reference notes for data in the LSE tables are found in the footnotes. Footnote "b" indicates the NOAEL of 3 ppm in key number 18 was used to derive an MRL of 0.005 ppm.

LEGEND

See Figure 3-1

LSE figures graphically illustrate the data presented in the corresponding LSE tables. Figures help the reader quickly compare health effects according to exposure concentrations for particular exposure periods.

(13) Exposure Period The same exposure periods appear as in the LSE table. In this example, health effects observed within the intermediate and chronic exposure periods are illustrated.

(14) Health Effect These are the categories of health effects for which reliable quantitative data exists. The same health effects appear in the LSE table.

(15) Levels of Exposure concentrations or doses for each health effect in the LSE tables are graphically displayed in the LSE figures. Exposure concentration or dose is measured on the log scale "y" axis. Inhalation exposure is reported in mg/m^3 or ppm and oral exposure is reported in mg/kg/day.

(16) NOAEL In this example, 18r NOAEL is the critical end point for which an intermediate inhalation exposure MRL is based. As you can see from the LSE figure key, the open-circle symbol indicates to a NOAEL for the test species-rat. The key number 18 corresponds to the entry in the LSE table. The dashed descending arrow indicates the extrapolation from the exposure level of 3 ppm (see entry 18 in the Table) to the MRL of 0.005 ppm (see footnote "b" in the LSE table).

(17) CEL Key number 38r is 1 of 3 studies for which Cancer Effect Levels were derived. The diamond symbol refers to a Cancer Effect Level for the test species-mouse. The number 38 corresponds to the entry in the LSE table.

(18) Estimated Upper-Bound Human Cancer Risk Levels This is the range associated with the upper-bound for lifetime cancer risk of 1 in 10,000 to 1 in 10,000,000. These risk levels are derived from the EPA's Human Health Assessment Group's upper-bound estimates of the slope of the cancer dose response curve at low dose levels (q_1*).

(19) Key to LSE Figure The Key explains the abbreviations and symbols used in the figure.

SAMPLE

1 6

Table 3-1. Levels of Significant Exposure to [Chemical x] – Inhalation

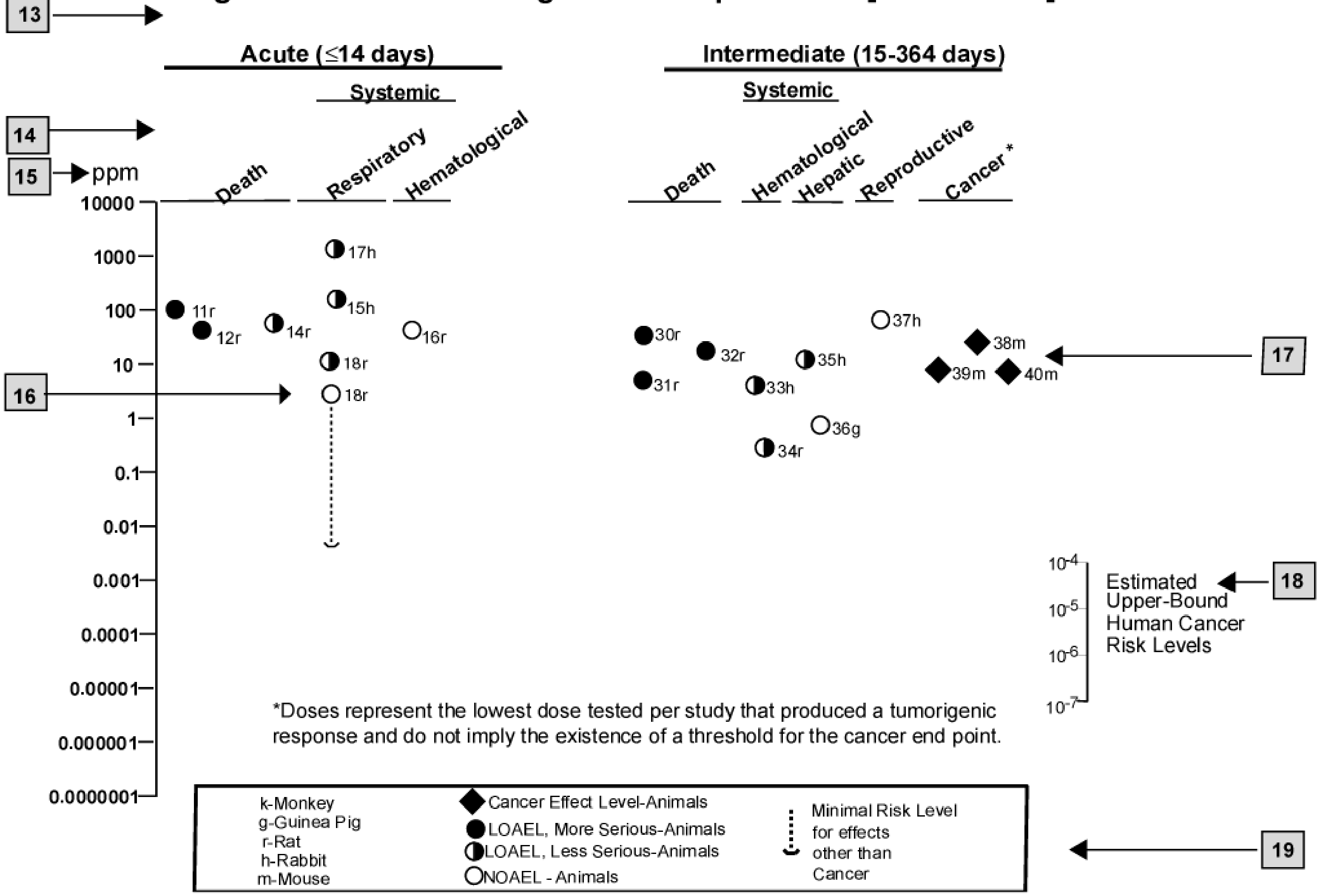
	Key to figure[a]	Species	Exposure frequency/ duration	System	NOAEL (ppm)	LOAEL (effect) Less serious (ppm)	LOAEL (effect) Serious (ppm)	Reference
2 6	INTERMEDIATE EXPOSURE							
		5	6	7	8	9		10
3 6	Systemic	9	9	9	9	9		9
4 6	18	Rat	13 wk 5 d/wk 6 hr/d	Resp	3[b]	10 (hyperplasia)		Nitschke et al. 1981
	CHRONIC EXPOSURE							
							11	
	Cancer						9	
	38	Rat	18 mo 5 d/wk 7 hr/d				20 (CEL, multiple organs)	Wong et al. 1982
	39	Rat	89–104 wk 5 d/wk 6 hr/d				10 (CEL, lung tumors, nasal tumors)	NTP 1982
	40	Mouse	79–103 wk 5 d/wk 6 hr/d				10 (CEL, lung tumors, hemangiosarcomas)	NTP 1982

[a] The number corresponds to entries in Figure 3-1.

12 6 [b] Used to derive an intermediate inhalation Minimal Risk Level (MRL) of 5 x 10^{-3} ppm; dose adjusted for intermittent exposure and divided by an uncertainty factor of 100 (10 for extrapolation from animal to humans, 10 for human variability).

SAMPLE

Figure 3-1. Levels of Significant Exposure to [Chemical X] - Inhalation



APPENDIX C

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AB	Asbestos body
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos-containing material
ADI	Acceptable Daily Intake
ADME	Absorption, Distribution, Metabolism, and Excretion
AFID	alkali flame ionization detector
AFOSH	Air Force Office of Safety and Health
AML	acute myeloid leukemia
AOAC	Association of Official Analytical Chemists
atm	atmosphere
APHA	American Public Health Association
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BAT	Best Available Technology
BCF	bioconcentration factor
BEI	Biological Exposure Index
BSC	Board of Scientific Counselors
C	Centigrade
CAA	Clean Air Act
CAG	Cancer Assessment Group of the U.S. Environmental Protection Agency
CAS	Chemical Abstract Services
CDC	Centers for Disease Control and Prevention
CEL	Cancer Effect Level
CELDS	Computer-Environmental Legislative Data System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	curie
CL	ceiling limit value
CLP	Contract Laboratory Program
cm	centimeter
CML	chronic myeloid leukemia
CNS	central nervous system
CPSC	Consumer Products Safety Commission
CWA	Clean Water Act
d	day
Derm	dermal
DHEW	Department of Health, Education, and Welfare
DHHS	Department of Health and Human Services
DNA	deoxyribonucleic acid
DOD	Department of Defense
DOE	Department of Energy
DOL	Department of Labor
DOT	Department of Transportation
DOT/UN/ NA/IMCO	Department of Transportation/United Nations/ North America/International Maritime Dangerous Goods Code
DWEL	Drinking Water Exposure Level

ECD	electron capture detection
ECG/EKG	electrocardiogram
EEG	electroencephalogram
EEGL	Emergency Exposure Guidance Level
EPA	Environmental Protection Agency
F	Fahrenheit
f	fibers
F_1	first-filial generation
FAO	Food and Agricultural Organization of the United Nations
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
f/m^3	fibers per cubic meter
f/mL	fibers per milliliter
FPD	flame photometric detection
fpm	feet per minute
ft	foot
FR	*Federal Register*
g	gram
GC	gas chromatography
Gd	gestational day
gen	generation
GLC	gas liquid chromatography
GPC	gel permeation chromatography
HPLC	high-performance liquid chromatography
hr	hour
HRGC	high resolution gas chromatography
HSDB	Hazardous Substance Data Bank
IDLH	Immediately Dangerous to Life and Health
IARC	International Agency for Research on Cancer
ILO	International Labor Organization
in	inch
IRIS	Integrated Risk Information System
Kd	adsorption ratio
kg	kilogram
kkg	metric ton
K_{oc}	organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
L	liter
LC	liquid chromatography
LC_{Lo}	lethal concentration, low
LC_{50}	lethal concentration, 50% kill
LD_{Lo}	lethal dose, low
LD_{50}	lethal dose, 50% kill
LT_{50}	lethal time, 50% kill
LOAEL	lowest-observed-adverse-effect level
LSE	Levels of Significant Exposure
m	meter
MA	*trans,trans*-muconic acid
MAL	Maximum Allowable Level
mCi	millicurie

MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MF	million fibers
MFL	million fibers per liter
mg	milligram
min	minute
mL	milliliter
mm	millimeter
mm Hg	millimeters of mercury
mmol	millimole
mo	month
mppcf	millions of particles per cubic foot
MRL	Minimal Risk Level
MS	mass spectrometry
NAAQS	National Ambient Air Quality Standard
NAS	National Academy of Science
NATICH	National Air Toxics Information Clearinghouse
NATO	North Atlantic Treaty Organization
NCE	normochromatic erythrocytes
NCI	National Cancer Institute
NIEHS	National Institute of Environmental Health Sciences
NIOSH	National Institute for Occupational Safety and Health
NIOSHTIC	NIOSH's Computerized Information Retrieval System
NFPA	National Fire Protection Association
ng	nanogram
NLM	National Library of Medicine
nm	nanometer
NHANES	National Health and Nutrition Examination Survey
nmol	nanomole
NOAEL	no-observed-adverse-effect level
NOES	National Occupational Exposure Survey
NOHS	National Occupational Hazard Survey
NPD	nitrogen phosphorus detection
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NR	not reported
NRC	National Research Council
NS	not specified
NSPS	New Source Performance Standards
NTIS	National Technical Information Service
NTP	National Toxicology Program
ODW	Office of Drinking Water, EPA
OERR	Office of Emergency and Remedial Response, EPA
OHM/TADS	Oil and Hazardous Materials/Technical Assistance Data System
OPP	Office of Pesticide Programs, EPA
OPPTS	Office of Prevention, Pesticides and Toxic Substances, EPA
OPPT	Office of Pollution Prevention and Toxics, EPA
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste, EPA
OTS	Office of Toxic Substances
OW	Office of Water

OWRS	Office of Water Regulations and Standards, EPA
PAH	Polycyclic Aromatic Hydrocarbon
PBPD	Physiologically Based Pharmacodynamic
PBPK	Physiologically Based Pharmacokinetic
PCE	polychromatic erythrocytes
PCM	phase contrast microscopy
PEL	permissible exposure limit
PID	photoionization detector
pg	picogram
pmol	picomole
PHS	Public Health Service
PMR	proportionate mortality ratio
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PSNS	Pretreatment Standards for New Sources
REL	recommended exposure level/limit
RfC	Reference Concentration
RfD	Reference Dose
RNA	ribonucleic acid
RTECS	Registry of Toxic Effects of Chemical Substances
RQ	Reportable Quantity
SARA	Superfund Amendments and Reauthorization Act
SCE	sister chromatid exchange
sec	second
SEM	scanning electron microscopy
SIC	Standard Industrial Classification
SIM	selected ion monitoring
SMCL	Secondary Maximum Contaminant Level
SMR	standard mortality ratio
SNARL	Suggested No Adverse Response Level
SPEGL	Short-Term Public Emergency Guidance Level
STEL	short term exposure limit
STORET	Storage and Retrieval
TD_{50}	toxic dose, 50% specific toxic effect
TEM	transmission electron microscopy
TLV	threshold limit value
TOC	Total Organic Compound
TPQ	Threshold Planning Quantity
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	time-weighted average
U.S.	United States
UF	uncertainty factor
VOC	Volatile Organic Compound
yr	year
WHO	World Health Organization
wk	week
>	greater than
$\geq$	greater than or equal to

=	equal to
<	less than
≤	less than or equal to
%	percent
α	alpha
β	beta
δ	delta
γ	gamma
μg	microgram
μm	micrometer
q_1^*	cancer slope factor
–	negative
+	positive
(+)	weakly positive result
(–)	weakly negative result

APPENDIX D

RISK ASSESSMENT SUMMARY

1.0 LUNG CANCER

Most studies of the risk of asbestos-related lung cancer in occupationally exposed workers indicate that the dose-response relationship is best described by a relative risk model, given by the equation:

$$\text{Relative Risk} = 1.00 + K_L \cdot (\text{cumulative dose})$$

Using this equation, EPA (1986a) calculated the value of K_L (the fractional increase in relative risk of lung cancer per f-yr/mL) for 14 sets of lung cancer mortality data from studies of workers in textile production, friction products manufacture, asbestos mining and milling, insulation products manufacture, and asbestos cement manufacture. The resulting values varied widely, ranging from 0.0006 $(\text{f-yr/mL})^{-1}$ (McDonald et al. 1980) to 0.067 $(\text{f-yr/mL})^{-1}$ (Finkelstein 1983). The geometric mean of all of the studies was 0.065 $(\text{f-yr/mL})^{-1}$. When studies involving mining and milling were excluded (these were judged to be less typical of the risks likely to be encountered in the environment), the resulting geometric mean value was 0.010 $(\text{f-yr/mL})^{-1}$. It is important to stress that this relates to fibers measured by PCM, and not to the total number of fibers measured by TEM.

Since this is a relative risk model, the absolute risk of lung cancer due to asbestos exposure depends not only on cumulative asbestos dose, but also on the underlying risk of lung cancer due to other causes:

$$\text{Absolute Risk} = \text{Relative Risk} \times \text{Underlying Risk}$$

Based on national average lung cancer risk data for male and female smokers and nonsmokers, EPA (1986a) calculated that lifetime exposure to 0.0001 f/mL corresponded to the excess lung cancer risks tabulated in Table D-1.

For the purposes of preparing a simplified graphical display of cancer risk levels for presentation in Figure 3-1, risks from males and females were averaged, both for smokers and nonsmokers, and the cumulative doses corresponding to a lifetime lung cancer risk of $1\text{x}10^{-4}$ were calculated and shown in Table D-1.

2.0 MESOTHELIOMA

Several studies (e.g., Newhouse and Berry 1976; Nicholson et al. 1982; Peto et al. 1982) indicate that the risk of mesothelioma from a given level of exposure to asbestos depends primarily upon the time elapsed since exposure (latency), with risk increasing exponentially with time after a lag period of about 10 years. Based on this, EPA (1986a) fit exposure-incidence data from four studies (Finkelstein 1983; Peto 1980; Peto et al. 1982; Seidman 1984) to the following equation:

Table D-1. Risk Assessment for Asbestos-associated Lung Cancer

	Smokers			Nonsmokers		
Parameter	Male[a]	Female[a]	Average[b]	Male[a]	Female[a]	Average[b]
Lung cancer risk from lifetime exposure to 0.0001 f/mL	$2.4\text{x}10^{-5}$	$1.5\text{x}10^{-5}$	$2.0\text{x}10^{-5}$	$0.2\text{x}10^{-5}$	$0.2\text{x}10^{-5}$	$0.2\text{x}10^{-5}$
Concentration (f/mL) corresponding to lifetime excess risk level of 10^{-4}			0.0005			0.005
Cumulative dose (f·yr/mL) for a 70-year exposure corresponding to 10^{-4} risk level			0.035			0.35

[a]Source: EPA 1986a
[b]Average of males and females

$$\text{Incidence} = K_M \cdot f \cdot [(T\text{-}10)^3\text{-}(T\text{-}10\text{-}d)^3]$$

where:

K_M = empirical constant
f = intensity of exposure (f/mL)
T = latency (years since first exposure)
d = duration of exposure (years)

The resulting values of K_M ranged from $1\text{x}10^{-8}$ to $3\text{x}10^{-8}$ for three of the studies, with one study (Finkelstein 1983) giving a higher value ($12\text{x}10^{-8}$). Based on an analysis of the relative risk of mesothelioma compared to lung cancer in other studies, a value of $1\text{x}10^{-8}$ was identified as the most reasonable estimate for K_M (EPA 1986a). Although this value has considerable uncertainty (about a factor of 10), it can be used to make rough predictions of mesothelioma incidence at low exposure levels, similar to those likely to be encountered in the environment. Assuming lifetime continuous exposure to air containing 0.0001 f/mL, the expected incidence is 2 to 3 mesothelioma deaths per 100,000 persons (EPA 1986a), as shown in Table D-2.

For the purposes of preparing a simple graphical presentation of these risk estimates for inclusion in Figure 3-1, the data from all four groups were combined (since there is little difference between males and females or between smokers and nonsmokers), to yield an average 10^{-4} risk level of $3.1\text{x}10^{-2}$ f-yr/mL.

3.0 COMBINED RISK OF LUNG CANCER AND MESOTHELIOMA

The combined risk of lung cancer and mesothelioma has been estimated by EPA (IRIS 2001), based on the risk calculations presented in EPA (1986a). The average unit risk value was calculated as a composite value for males and females. The epidemiological data show that cigarette smoking and asbestos exposure interact synergistically for production of lung cancer and do not interact with regard to mesothelioma. The unit risk value is based on risks calculated using U.S. general population cancer rates and mortality patterns without consideration of smoking habits. The risks associated with occupational exposure were adjusted to continuous exposure by applying a factor of 140/50, based on the assumption of 20 m^3/day (140 m^3/week) for total ventilation and 10 m^3/8-hour workday (40 m^3/week) in the occupational setting. The results of these calculations indicate that a concentration of 4×10^{-4} f/mL corresponds to a lifetime excess risk level of 10^{-4}. This combined risk estimate was not presented in Figure 3-1, since both the text and the Figure deal with lung cancer and mesothelioma separately.

The Health Effect Institute estimates lifetime cancer risks from lung cancer and mesothelioma combined based on levels of asbestos detected in 198 ACM-containing buildings (HEI 1991). These estimates, presented in Table D-3, should be interpreted with caution because of uncertainty associated with the estimation of average exposure levels and with the risk assessment model. The "high" levels represented in the table are approximately equal to the upper 95th percentile of the exposure levels detected. It should be noted that if the single highest public building sample was excluded from the calculation of the average exposure level, then the average value would be reduced from 0.0002 to 0.00008 TEM f/mL and risk would be similarly reduced by one half. The occupational exposure level of 0.1 f/mL is equivalent to the PEL proposed by OSHA. Actual worker exposures are expected to be lower.

Table D-2. Risk Assessment for Asbestos-related Mesothelioma

	Smokers		Nonsmokers		
Parameter	Male[a]	Female[a]	Male[a]	Female[a]	Average[b]
Risk of mesothelioma from lifetime exposure to 0.0001 f/mL	1.8×10^{-5}	2.5×10^{-5}	2.2×10^{-5}	2.7×10^{-5}	2.2×10^{-5}
Concentration (f/mL) corresponding to lifetime excess risk level of 10^{-4}					0.00045
Cumulative dose (f·yr/mL) for a 70-year exposure corresponding to 10^{-4} risk level					0.031

[a]Source: EPA 1986a
[b]Average of all four groups

Table D-3. Estimated Lifetime Risks of Lung Cancer and Mesothelioma Combined for Different Scenarios of Exposure to Airborne Asbestos Fibers

Conditions	Premature cancer deaths (lifetime risks) per million exposed persons (male and female)
Lifetime, continuous outdoor exposure	
• 0.00001 TEM f/mL ($2x10^{-7}$ PCM f/mL from birth rural	4
• 0.0001 TEM f/mL ($2x10^{-6}$ PCM f/mL) from birth (high urban)	40
Exposure in a school containing ACM, from age 5 to 18 years (180 days/year, 5 hours/day)	
• 0.0005 TEM f/mL ($8x10^{-6}$ PCM f/mL) (average)	6
• 0.005 TEM f/mL ($8x10^{-5}$ PCM f/mL) (high)	60
Exposure in a public building containing ACM age 25 to 45 years (240 days/year, 8 hours/day)	
• 0.0002 TEM f/mL ($3x10^{-6}$ PCM f/mL) (average)	4
• 0.002 TEM f/mL ($3x10^{-5}$ PCM f/mL) (high)	40
Occupational exposure from age 25 to 45	
• 0.1 PCM f/mL (current occupational levels)	2,000
• 10 PCM f/mL (historical industrial exposures)	200,000

Source: HEI 1991

4.0 GASTROINTESTINAL CANCER

4.1 Risk Estimate Based on Animal Data

In a lifetime feeding study in rats, exposure to intermediate length chrysotile fibers led to an increased incidence of intestinal polyps (NTP 1985). Based on these data, EPA (1985b) calculated that the 10^{-4} risk level corresponded to an asbestos concentration of $7.1x10^{8}$ f/L in drinking water.

In order to present this risk estimate in Figure 3-4, the concentration of $7.1x10^{8}$ f/L was converted to a dose of $2.0x10^{7}$ f/kg/day (assuming ingestion of 2 L/day by a 70-kg adult), and this was converted to a dose of 0.16 mg/kg/day by dividing by $0.129x10^{9}$ f/mg (reported in NTP 1985).

4.2 Risk Estimate Based on Human Inhalation Data

Since there are no human studies in which ingestion of a known amount of asbestos can be associated with a clear increase in gastrointestinal cancer risk, NAS (1983) extrapolated data on gastrointestinal risk from epidemiological studies of workers exposed to asbestos by inhalation. These calculations indicated that lifetime ingestion of $1.1x10^{6}$ TEM fibers/liter of water corresponded to an excess gastrointestinal cancer risk of 10^{-4} (NAS 1983).

In order to present this risk estimate in Figure 3-4, the concentration of 1.1×10^6 f/L was converted to a dose of 3.1×10^4 f/kg/day (assuming ingestion of 2 L/day by a 70-kg adult), and this was converted to a dose of 1.6×10^{-5} mg/kg/day by multiplying by a factor of 5.0×10^{-10} mg/TEM fiber (NRC 1984).

APPENDIX E

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APPENDIX F

CHEMICAL-SPECIFIC HEALTH CONSULTATION: TREMOLITE ASBESTOS AND OTHER RELATED TYPES OF ASBESTOS

CHEMICAL-SPECIFIC HEALTH CONSULTATION: TREMOLITE ASBESTOS AND OTHER RELATED TYPES OF ASBESTOS

September, 2001

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APPENDIX F

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APPENDIX F

EXECUTIVE SUMMARY

The U.S. Department of Health and Human Services (DHHS) is addressing public health concerns regarding a fibrous amphibole that occurs in vermiculite ore in the Libby, Montana, area. Scientists agree that exposure to this mineral increased the risk of nonmalignant respiratory and pleural disorders, lung cancer, and mesothelioma in groups of people who worked in the now closed Libby vermiculite mine and mill. These health problems are similar to those experienced by workers exposed to other types of asbestos before modern workplace air regulations were established. The Agency for Toxic Substances and Disease Registry (ATSDR) has prepared this chemical-specific health consultation to provide support for public health decisions regarding individuals exposed to fibrous amphibole from Libby vermiculite or other related asbestos-containing materials. Key technical terms used in discussing asbestos-related health problems are defined after the Introduction.

Physical and Chemical Properties, Occurrence, and Detection: Tremolite Asbestos

Asbestos is the name of a group of highly fibrous minerals with separable, long, and thin fibers. Separated asbestos fibers are strong enough and flexible enough to be spun and woven, are heat resistant, and are chemically inert. Minerals with these asbestos characteristics are said to have an asbestiform habit.

Regulatory agencies such as the U.S. Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) recognize six asbestos minerals: chrysotile, a serpentine mineral; and five amphibole minerals, actinolite asbestos, tremolite asbestos, anthophyllite asbestos, crocidolite asbestos, and amosite asbestos. Nonasbestiform amphibole minerals are not included in U.S. health regulations regarding asbestos because there is insufficient evidence that they will produce adverse health effects of the same type and severity produced by chronic exposure to asbestos.

Samples of the fibrous amphibole in the Libby vermiculite ore, popularly referred to as tremolite asbestos, were recently analyzed by U.S. Geological Survey scientists. On the basis of variable chemical composition, several different mineral names were assigned to the samples: winchite, richterite, tremolite, actinolite, ferro-edenite, and magnesio-arfvedsonite. All of these are classified as amphibole minerals. Most of the samples showed both asbestiform and nonasbestiform habits. Since it is known that this mix of fibrous amphibole increased the risk of typical asbestos-related diseases in groups of people who worked in the Libby, Montana, mine and mill, proposals have been made to consider changing U.S. asbestos regulations to include other asbestiform amphiboles in addition to the five mentioned previously.

Nonasbestiform tremolite is the predominant form of tremolite in the earth's crust, but there are many reports of tremolite asbestos occurring around the world in specific locations (including some locations in Maryland and California) and natural materials. Tremolite asbestos has only rarely been found in commercially mined deposits. It has never been a nationally important commercial source of asbestos in the United States. Two minerals of commercial importance that have been reported to contain tremolite asbestos or other amphibole asbestos are vermiculite and talc.

Before 1990, the now closed mine in Libby, Montana, was a significant source of vermiculite in the United States. In 1998, vermiculite was mined in the United States predominantly in South Carolina and Virginia and was also imported from South Africa and China. A 1984 study reported that the percentage of tremolite asbestos fiber by weight varied from 3.5% to 6.4% in raw vermiculite ore from Libby, Montana. In contrast, several studies of vermiculite mined elsewhere (South Carolina, Virginia, and South Africa) reported that levels of amphibole asbestos were either not detectable or only present at much lower levels than those found in the Libby vermiculite.

Talc ores can also contain a range of other minerals. In the United States, commercial talc is categorized into cosmetic grade, which is free of asbestos, and industrial grade, which may contain other asbestiform or nonasbestiform minerals, depending on intended use. For example, one important U.S. source of industrial-grade talc is a mixture referred to as tremolitic talc. Analysis by OSHA scientists shows that the tremolite in this talc is nonasbestiform.

The combined use of light microscopy, electron microscopy, and energy dispersive x-ray analysis offer the most accurate approach to identify asbestos and estimate concentrations in air samples or bulk samples that may become airborne upon disturbance. For the purposes of counting asbestos fibers in these samples, regulatory agencies commonly count as fibers those particles of asbestos minerals that have lengths $ 5 µm and length:width ratios $ 3:1. For other purposes, such as detecting fibers in bulk building materials, asbestos particles with length:width ratios $5:1 are counted. Typical air concentrations of asbestos fibers in ambient air are 0.00001 to 0.0001 fibers per milliliter (fiber/mL). Recent exposure limits for U.S. workplaces are 0.1 to 0.2 fiber/mL.

Exposure Potential: Tremolite Asbestos

Occupational exposure to tremolite asbestos may occur in workers involved in mining, milling, and handling of other ores and rocks that may contain tremolite asbestos (e.g., vermiculite or talc). Residents who live close to mining, milling, or manufacturing sites that involve tremolite asbestos-containing material may be potentially exposed to higher levels of airborne asbestos than levels in general ambient air. EPA, ATSDR, and other agencies currently are investigating past and current exposure to fibrous amphibole found in Libby, Montana, vermiculite. In addition, ATSDR is currently conducting medical testing of individuals who lived close to or worked in the Libby vermiculite mine and mill.

Asbestos can be found in a variety of building materials such as insulation, ceiling or floor tiles, and cement pipes. Amphibole asbestos has been found in some vermiculite sources that have been used as home and building insulation. Workers or homeowners involved in demolition work, maintenance, repair, or remodeling of buildings containing these products can be exposed to higher airborne fibrous amphibole levels than levels in general ambient air. Exposure can occur only when building materials containing asbestos are disturbed in some way to release particles and fibers into the air. When asbestos-containing materials are solidly embedded or contained, exposure will be minimal.

Recently, small amounts of amphibole asbestos have been found in some samples of vermiculite-containing consumer garden products by EPA and in some talc-containing crayons by the U.S. Consumer Product Safety Commission (CPSC). EPA recommended that consumers can reduce possible exposure by limiting the production of dusts when using the garden products. CPSC concluded that the risk is extremely low that children might be exposed to asbestos fibers through inhalation or ingestion of crayons containing asbestos and transitional fibers. The U.S. manufacturers of these crayons, however, have agreed to eliminate talc from their products in the near future.

Health Effects from Asbestos or Tremolite Asbestos

It is known that exposure to any asbestos type (i.e., serpentine or amphibole) will increase the likelihood of lung cancer, mesothelioma (a tumor of the pleura or peritoneum that is rare in the general population), and nonmalignant lung and pleural disorders including interstitial pulmonary fibrosis (asbestosis), pleural plaques, pleural thickening, and pleural effusions. This conclusion is based on observations of these diseases in groups of workers with cumulative exposures ranging from about 5 to 1,200 fiber-year/mL.

Such exposures would result from 40 years of occupational exposure to air concentrations of 0.125 to 30 fiber/mL. The conclusion is supported by results from animal and mechanistic studies.

Based on an analysis of the epidemiologic data, EPA calculated that lifetime continuous exposure to asbestos air concentrations of 0.0001 fiber/mL could result in up to 2-4 cancer deaths (lung cancer or mesothelioma) per 100,000 people. This air concentration is within reported ranges of ambient air levels (0.00001 to 0.0001 fiber/mL). The EPA analysis has been extensively discussed and reviewed in the scientific literature. EPA is in the process of reviewing and possibly updating their cancer risk estimates for asbestos.

Important determinants of asbestos toxicity include exposure concentration, duration, and frequency, and fiber dimensions and durability. Long and thin fibers are expected to reach the lower airways and alveolar regions of the lung, to be retained in the lung longer, and to be more toxic than short and wide fibers or particles. Wide particles are expected to be deposited in the upper respiratory tract and not to reach the lung and pleura, the sites of asbestos-induced toxicity. Short, thin fibers, however, may also play a role in asbestos pathogenesis. Fibers of amphibole asbestos such as tremolite asbestos, actinolite asbestos, and crocidolite asbestos are retained longer in the lower respiratory tract than chrysotile fibers of similar dimension.

Diseases from asbestos exposure take a long time to develop. Most cases of lung cancer or asbestosis in asbestos workers occur 15 or more years after initial exposure to asbestos. Asbestos-exposed tobacco smokers have greater than additive risks for lung cancer than do asbestos-exposed nonsmokers (i.e., the risk is greater than the individual risks from asbestos and smoking added together). The time between diagnosis of mesothelioma and the time of initial occupational exposure to asbestos commonly has been 30 years or more. Cases of mesotheliomas have been reported after household exposure of family members of asbestos workers and in individuals without occupational exposure who live close to asbestos mines.

As with other forms of asbestos, chronic exposure to airborne tremolite asbestos is expected to increase risks of lung cancer, mesothelioma, and nonmalignant lung and pleural disorders. Evidence in humans comes from epidemiologic studies of tremolite asbestos-exposed groups of vermiculite miners and millers from Libby, Montana. This evidence is supported by reports of increased incidences of nonmalignant respiratory diseases, lung cancer, and mesothelioma in villages in various regions of the world that have traditionally used tremolite-asbestos whitewashes in homes or have high surface deposits of tremolite asbestos and by results from animal studies.

Clinical Diagnosis for Asbestos-Related Diseases

The chest x-ray is the most common and important tool to detect lung and pleural disease caused by chronic exposure to tremolite asbestos or other types of asbestos. Results from pulmonary function tests and high resolution computerized tomography can also be used in the diagnosis.

Biopsy to detect asbestos fibers in pieces of lung tissue, although not needed to make a clinical diagnosis, is the most reliable test to determine asbestos exposure. Less invasive tests can be conducted to detect asbestos fibers or asbestos bodies in bronchoalveolar lavage fluid or in sputum. These tests, however, do not reliably indicate how much asbestos a person may have been exposed to, or predict whether disease will develop.

Treatment Options for Asbestos-Related Diseases

Treatment options for patients diagnosed with nonmalignant lung or pleural disease from chronic exposure to asbestos are few. Preventing of further exposure and ceasing any tobacco smoking activities are the most important steps individuals can take to minimize development of health problems. Once established, these diseases may remain stable or progress in severity in the absence of further exposure. The diseases rarely regress. Treatment options for patients diagnosed with asbestos-related cancer of the lung or pleura are restricted to resection and/or chemotherapy.

Pleural effusions are early manifestations of inhalation exposure to high concentrations of asbestos; the fluid contains varying amounts of red blood cells, macrophages, lymphocytes, and mesothelial cells. Pleural effusions may be an early indication of mesothelioma and warrant further evaluation. Early identification of mesothelioma and intervention may increase chances of survival.

Additional research may help to develop therapeutic methods to interfere with the development of asbestos-induced lung and pleural disorders and to cause the disorders to regress once they are established.

Recommendations

Prevention of exposure and cessation of any tobacco smoking activities are the most important steps that individuals can take to prevent or minimize the development of asbestos-related health problems.

People who were exposed to asbestos and who smoke are expected to be unusually susceptible to asbestos-related lung cancer and asbestosis and are encouraged to cease smoking. Studies of asbestos workers indicate that asbestos-exposed smokers have greater than additive risks for lung cancer and asbestosis than asbestos-exposed nonsmokers.

Individuals residing or working in buildings with insulation or other building materials that may potentially contain asbestiform minerals (for example, vermiculite from the Libby, Montana, mine) are encouraged to ensure that the insulation material is solidly contained and not able to be disturbed and become airborne. If the material is to be removed, special procedures must be followed that minimize the generation of dust and specify appropriate locations for disposal. Individuals can obtain information about asbestos removal and disposal procedures from the 10 regional offices of the EPA.

Further evaluation of the progression of disease associated with exposure to Libby, Montana vermiculite contaminated with asbestos is warranted. EPA, ATSDR, and other agencies currently are investigating exposure levels that Libby, Montana, residents (including children) who were not employed in the vermiculite mines and mills may have and are experiencing. In addition, ATSDR is currently conducting medical testing of individuals potentially exposed to fibrous amphibole associated with vermiculite in Libby, Montana.

APPENDIX F

Introduction

The U.S. Department of Health and Human Services (DHHS) is addressing public health concerns regarding a fibrous amphibole that occurs in vermiculite ore in the Libby, Montana, area. Vermiculite was mined and milled in Libby from 1923 until 1990. In 1963 the mine was acquired from the Zonolite Company by W.R. Grace Company, which marketed the vermiculite as Zonolite®.

The Libby amphibole mineral, popularly known as tremolite asbestos, has been assigned a number of different names by scientists over the years (Meeker et al. 2001; Wylie and Verkouteren 2000); however, scientists agree that exposure to the mineral increased the risk of nonmalignant respiratory and pleural disorders, lung cancer, and mesothelioma in groups of people who worked in the now closed Libby mine and mill.[1] These health problems are similar to those experienced by workers exposed to other types of asbestos before modern workplace air regulations were established.

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this chemical-specific health consultation to provide support for public health decisions regarding Libby, Montana, and other locations where tremolite asbestos and related asbestos can be found. This document :

- defines terms used to discuss health effects from asbestiform minerals;
- discusses the chemistry of amphibole minerals;
- discusses the occurrence of tremolite asbestos in the earth's crust;
- discusses common methods to detect asbestos in air samples;
- discusses the potential for human exposure to asbestos;
- presents overviews of health effects from asbestos, deposition and clearance of asbestos in the lung, and mechanisms of asbestos toxicity;
- evaluates the weight of evidence that tremolite asbestos can cause mesothelioma, lung cancer, and nonmalignant disorders of the lung and pleura;
- discusses clinical diagnosis for asbestos-related diseases; and
- recommends actions to protect the public from possible health problems from tremolite asbestos and other forms of asbestos.

Evidence that nonasbestiform amphiboles may cause the same effects as amphibole asbestos is outside of the scope of this health consultation. The reader is referred to earlier reports (American Thoracic Society

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[1] Epidemiologic studies of Libby, Montana, miners and millers are discussed later in this document.

1990; OSHA 1992) that discuss this issue and to epidemiological studies of workers exposed to mixtures of nonasbestiform amphibole minerals and other nonasbestos minerals including silica, taconite, and talc. For regulatory purposes, the Occupational Safety and Health Administration (OSHA 1992) concluded that there was insufficient evidence that nonasbestiform forms of tremolite, actinolite, and anthophyllite will produce adverse health effects of the same type and severity produced by chronic exposure to amphibole asbestos (OSHA 1992; Vu 1993). Nevertheless, the reader should be aware that repeated exposure to excessive amounts of insoluble dusts of any type can cause adverse health effects including interstitial pulmonary fibrosis (ACGIH 1996; OSHA 1992).

Definitions of Terms Used To Discuss Health Effects from Asbestiform Minerals

Definitions of key technical terms are provided because there has been variable use of some of them in the scientific literature and popular press.

Amphibole: A large group of silicate minerals with more than 40-50 members (Leake 1978; Leake et al. 1997). The molecular structure of all amphiboles consists of two chains of SiO_4 molecules that are linked together at the oxygen atoms. In the earth's crust, amphibole minerals are mostly nonasbestiform; asbestiform amphiboles are relatively rare (Veblen and Wylie 1993; Zoltai 1979, 1981). See definitions of asbestiform, mineral, and mineral habit. Also see the *Chemistry of Amphibole Minerals* section.

Asbestiform: A habit of crystal aggregates displaying the characteristics of asbestos: groups of separable, long, thin, strong, and flexible fibers often arranged in parallel in a column or in matted masses (Veblen and Wylie 1993; Zoltai 1979, 1981). See definitions of mineral and mineral habit. Figure 1 shows a scanning electron micrograph of an asbestiform amphibole mineral showing a parallel arrangement of long fibers. Mineralogists call asbestiform amphibole minerals by their mineral name followed by "asbestos" (Leake 1978). Thus, asbestiform tremolite is called tremolite asbestos.

Asbestos: A group of highly fibrous minerals with separable, long, thin fibers often arranged in parallel in a column or in matted masses (Veblen and Wylie 1993; Zoltai 1979, 1981). Separated asbestos fibers

Figure 1. Scanning electron micrograph of asbestiform amphibole from a former vermiculite mining site near Libby, Montana. Source: U.S. Geological Survey and U.S. Environmental Protection Agency, Region 8, Denver, Colorado.

are generally strong enough and flexible enough to be spun and woven, are heat resistant, and are chemically inert (Veblen and Wylie 1993). See definitions of fibrous and mineral.

Currently, U.S. regulatory agencies, such as the Environmental Protection Agency (EPA) and OSHA, recognize six asbestos minerals: the serpentine mineral, chrysotile; and five asbestiform amphibole minerals, actinolite asbestos, tremolite asbestos, anthophyllite asbestos, amosite asbestos (also known as asbestiform cummingtonite-grunerite), and crocidolite asbestos(also known as asbestiform riebeckite) (ATSDR 2001a; OSHA 1992; Vu 1993). Proposals have been made to update asbestos regulations to include other asbestiform amphibole minerals such as winchite asbestos and richterite asbestos (Meeker et al. 2001; Wylie and Verkouteren 2000). See the *Chemistry of Amphibole Minerals* section.

Asbestosis: Interstitial fibrosis of the pulmonary parenchymal tissue in which asbestos bodies (fibers coated with protein and iron) or uncoated fibers can be detected (American Thoracic Society 1986). Pulmonary fibrosis refers to a scar-like tissue in the lung which does not expand and contract like normal tissue. This makes breathing difficult. Blood flow to the lung may also be decreased, and this causes the heart to enlarge. People with asbestosis have shortness of breath, often accompanied by a persistent cough. Asbestosis is a slow-developing disease that can eventually lead to disability or death in people who have been exposed to high amounts of asbestos over a long period. Asbestosis is not usually of concern to people exposed to low levels of asbestos. For more information, see the *Health Effects from Asbestos: Overview* section.

Cleavage fragment: Microscopic particles formed when large pieces of nonasbestiform amphiboles are crushed, as may occur in mining and milling of ores. Within a population of nonasbestiform amphibole cleavage fragments, a fraction of the particles may fit the definition of a fiber adopted for counting purposes. Populations of asbestos fibers can be readily distinguished from populations of nonasbestiform cleavage fragments, but sometimes it can be difficult to distinguish an isolated nonasbestiform cleavage fragment from an isolated asbestos fiber (Crane 2000; OSHA 1992). See definitions of asbestiform, fiber, fibrous, and mineral habit.

Fiber: Any slender, elongated mineral structure or particle. For the purposes of counting asbestos fibers in air samples, regulatory agencies commonly count particles that have lengths $ 5 µm and length:width ratios $ 3:1 as fibers. For detecting asbestos fibers in bulk building materials, particles with length:width ratios $5:1 are counted as fibers. See the *Detection and Analysis of Asbestos in Air Samples* section for more details.

Fiber-year/mL: Epidemiologic studies of groups of asbestos-exposed workers commonly express exposure in cumulative exposure units of fiber-year/mL. This exposure measure is calculated by multiplying a worker's duration of exposure (measured in years) by the average air concentration during the period of exposure (measured in number of fibers/mL of air).

Fibrous: A mineral habit with crystals that look like fibers (Zoltai 1981). A mineral with a fibrous habit is not asbestiform if the fibers are not separable and are not long, thin, strong, and flexible (Veblen and Wylie 1993; Zoltai 1979; 1981).

Interstitial: A term used as an adjective relating to spaces within a tissue or organ. *Pulmonary interstitial fibrosis* refers to fibrosis (scarring) occurring within lung tissue.

Mesothelioma: Cancer of the thin lining surrounding the lung (the pleura) or the abdominal cavity (the peritoneum). Mesotheliomas are rare cancers in general populations. Mesotheliomas annually accounted for an average of 1.75 deaths per million in the U.S. general population for the period 1987-1996 (NIOSH 1999). For U.S. white males (the U.S. group with the highest mortality rate), the rates were 3.61 per million in 1987 and 2.87 per million in 1996 (NIOSH 1999). See the *Health Effects from Asbestos: Overview* section for more information..

Mineral: Any naturally occurring, inorganic substance with a crystal structure. Naturally occurring, inorganic substances without a crystal structure (such as amorphous silica) are called mineraloids (Veblen and Wylie 1993).

Mineral Habit: The shape or morphology that single crystals or crystal aggregates take during crystal formation (Veblen and Wylie 1993). Mineral habit is influenced by the environment during crystal formation. Habits of single crystals include prismatic, acicular, platy, and fiber. Habits of crystal aggregates include asbestiform, fibrous, lamellar, and columnar.

Parenchyma: The functional cells or tissue of a gland or organ; for example, the lung parenchyma. The major lung parenchymal abnormality associated with exposure to asbestos is the development of scar-like tissue referred to as pulmonary interstitial fibrosis or asbestosis.

Pleura: A thin lining or membrane around the lungs or chest cavity. This lining can become thickened or calcified in asbestos-related disease.

Pleural: Having to do with or involving the pleura.

Pleural abnormalities: Abnormal or diseased changes occurring in the pleura. Pleural abnormalities associated with exposure to asbestos include pleural plaques, pleural thickening or calcifications, and pleural effusion.

Pleural calcification: As a result of chronic inflammation and scarring, pleura becomes thickened and can calcify. White calcified areas can be seen on the pleura by X-ray.

Pleural cavity: The cavity, defined by a thin membrane (the pleural membrane or pleura), which contains the lungs.

Pleural effusion: Cells (fluid) can ooze or weep from the lung tissue into the space between the lungs and the chest cavity (pleural space) causing a pleural effusion. The effusion fluid may be clear or bloody. Pleural effusions may be an early sign of asbestos exposure or mesothelioma and should be evaluated.

Pleural plaques: Localized or diffuse areas of thickening of the pleura (lining of the lungs or chest cavity. Pleural plaques are detected by chest x-ray, and appear as opaque, shiny, and rounded lesions.

Pleural thickening: Thickening or scarring of the pleura may be associated with asbestos exposure. In severe cases, the normally thin pleura can become thickened like an orange peel and restrict breathing.

Pulmonary interstitial fibrosis: Scar-like tissue that develops in the lung parenchymal tissue in response to inhalation of dusts of certain types of substances such as asbestos.

Serpentinite: Igneous or metamorphic rock chiefly composed of serpentine minerals such as chrysotile or lizardite (Jackson 1997). Chrysotile, when found, can occur in localities with serpentinite rock (Churchill et al. 2001).

Tremolite asbestos: A special form of the amphibole mineral, tremolite, that displays separable, long, thin fibers often arranged in parallel in a column or in matted masses. The fibers are generally strong enough and flexible enough to be spun and woven, are heat resistant, and are chemically inert.

Ultramafic rock: Igneous rock composed chiefly of dark-colored ferromagnesian silicate minerals (Jackson 1997). Asbestiform amphiboles, when found, can occur in localities with ultramafic rock (Churchill et al. 2001).

Vermiculite: A mineral belonging to the mica group of silicate minerals (Ross et al. 1993). Vermiculite has water molecules located between the silicate layers in the crystal structure. When heated, vermiculite expands to form a light-weight material that has been used for home and building insulation, as a soil amendment, and as a packing material. The process of heating and expanding vermiculite is called exfoliation or "popping". Raw vermiculite ore is processed to produce vermiculite concentrate, which is shipped to exfoliating plants to produce the finished vermiculite product.

The photograph in Figure 2 shows a sample of raw vermiculite ore from Libby, Montana, with asbestiform amphibole fibers mixed in with the vermiculite. Figure 3 shows processed vermiculite concentrate (before expansion) and exfoliated vermiculite (after expansion).

Chemistry of Amphibole Minerals

The molecular structure of all amphiboles consists of two chains of SiO_4 molecules that are linked together at the oxygen atoms (Jolicoeur et al. 1992; Skinner et al. 1988; Veblen and Wylie 1993). The chains are bonded together by cations (e.g. Ca, Mg, Fe) and hydroxyl molecules and stacked together to form crystals. The internal crystal structure of all amphiboles is the same, but there is a wide range of chemical variability within the amphibole group. Four subgroups of amphiboles are currently recognized: the magnesium-iron-manganese-lithium subgroup; the calcic subgroup; the sodic-calcic subgroup; and the sodic subgroup (Leake et al. 1997). Amphibole mineral names are based on ideal chemical compositions. The chemical composition of a specific mineral sample is likely to be close to, but not exactly the same as, the ideal chemical composition of its mineral name, because of natural chemical variability in minerals.

Tremolite ($Ca_2Mg_5Si_8O_{22}[OH]_2$) and ferro-actinolite ($Ca_2Fe_5Si_8O_{22}[OH]_2$) are mineral names currently applied to end members of a series[2] within the calcic amphibole subgroup in which the magnesium and iron content can vary widely (Leake et al. 1997;Verkouteren and Wylie 2000; Wylie and Verkouteren 2000). The ideal chemical composition of tremolite has no iron, ferro-actinolite contains no magnesium, and actinolite contains intermediate amounts of magnesium and iron (Leake et al. 1997). Figure 4 shows two other series within the amphibole group: 1) the tremolite-richterite series in which the calcium and sodium content can vary, and 2) the tremolite-winchite series in which the magnesium, calcium, and iron content vary. Some samples of the Libby amphibole show a chemical composition that is somewhere in the middle of the plane defined by the tremolite, richterite, and winchite corners of the cube in Figure 4.

From a chemical analysis of 30 amphibole samples from Libby mining and milling sites, the U.S. Geological Survey (USGS) assigned several different amphibole names to the samples: winchite, richterite, tremolite, actinolite, ferro-edenite, and magnesio-arfvedsonite (Meeker et al. 2001). These investigators noted that most of the amphibole samples displayed both asbestiform habits and nonasbestiform habits (from which cleavage fragments could be formed).

Occurrence of Tremolite Asbestos

Nonasbestiform tremolite is the predominant form of tremolite that exists in the earth's crust (Veblen and Wylie 1993). There are many reports, however, of tremolite asbestos occurring in specific locations around the world.

Tremolite asbestos has only rarely been found in commercially mined deposits. Some tremolite asbestos has been mined in South Africa, India, Maryland, and South Korea, but it has never been a nationally important commercial source of asbestos in the United States. (Ross 1981). The extent of tremolite asbestos mining was small in Powhatan and Pylesville, Maryland, where it occurs with anthophyllite asbestos in ultramafic rocks (Ross 1981). In South Africa, tremolite asbestos was mined in the early twentieth century, but most amphibole asbestos recently mined in South Africa is amosite or crocidolite (Ross 1981). In contrast, as late as 1996, deposits of anthophyllite and tremolite asbestos were being commercially mined for use in asbestos cement in the South Rajasthan region of India (Mansinghka and Ranawat 1996).

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[2] Called a solid state solution series by mineralogists.

Figure 2. Photograph of a sample of Libby, Montana, vermiculite ore. Fiber-like structures can be seen along the left edge of the piece of ore on the left. Source: U.S. Geological Survey and U.S. Environmental Protection Agency, Region 8, Denver, Colorado.

Figure 3. Photograph of vermiculite concentrate (on the right) and exfoliated vermiculite (on the left). Source: U.S. Geological Survey and U.S. Environmental Protection Agency, Region 8, Denver, Colorado.

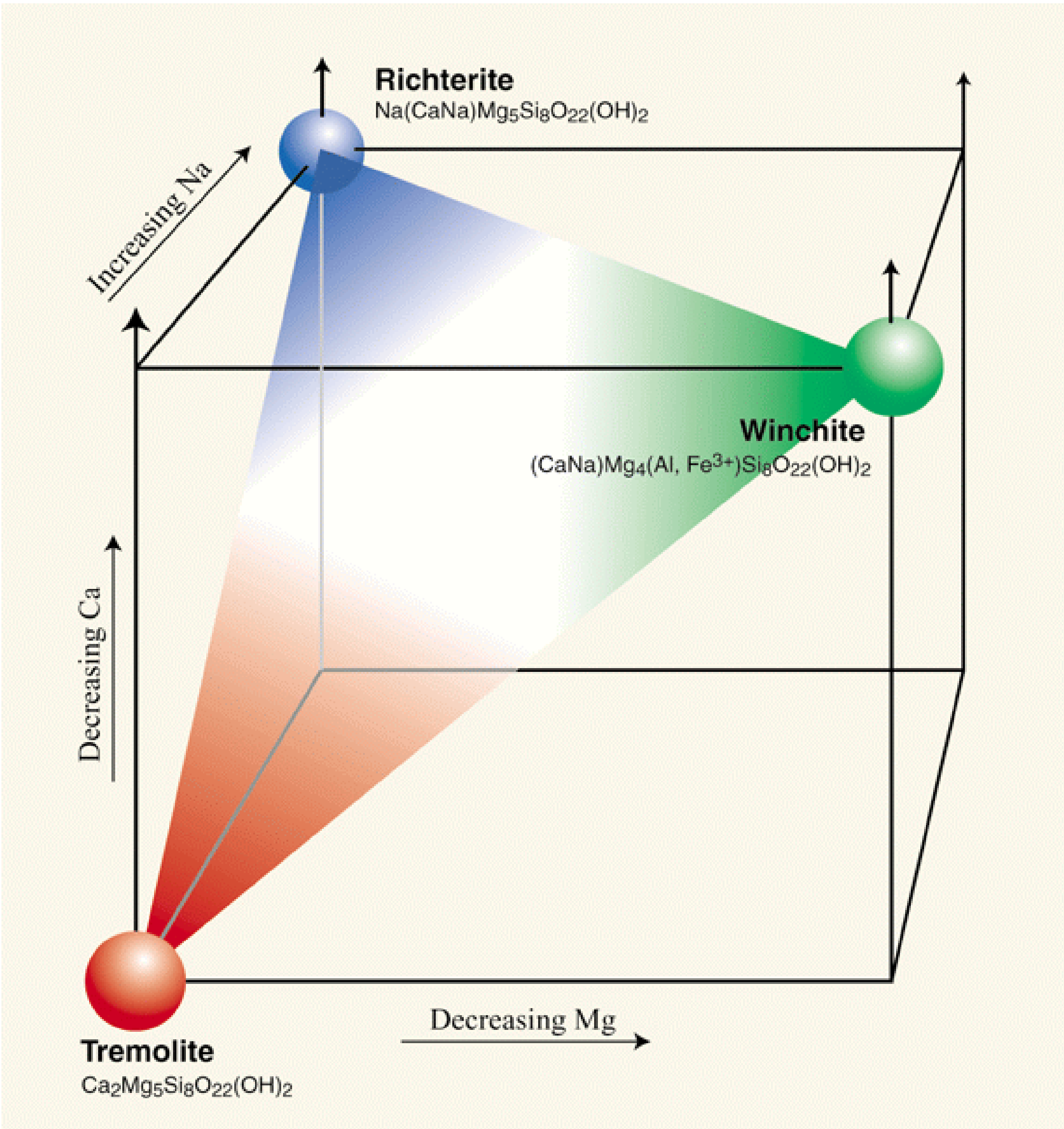

Figure 4. Relationships between magnesium, calcium, and sodium content and three amphibole mineral names: tremolite, winchite, and richterite. All three names have been assigned to various amphibole samples from former vermiculite mining and milling sites near Libby, Montana. Source: U.S. Geological Survey and U.S. Environmental Protection Agency, Region 8, Denver Colorado.

In certain Mediterranean regions, central and eastern Turkey, and New Caledonia in the South Pacific, soil containing tremolite asbestos has been used as stucco and for whitewashing of interior or exterior walls in certain villages (Baris et al. 1988a, 1988b; Bazas 1987; Bazas et al. 1985; Boutin et al. 1989; Constantopoulos et al. 1987a, 1992; Coplu et al. 1996; De Vuyst et al. 1994; Dumortier et al. 1998; Langer et al. 1987; Luce et al. 1994, 2001; McConnochie et al. 1987; Metintas et al. 1999; Sakellariou et al. 1996; Yazicioglu et al. 1980). This practice has declined as the health effects of inhalation exposure to tremolite asbestos have become better known.

Tremolite asbestos and chrysotile occur naturally in California, most commonly in areas of ultramafic rock and serpentinite (Churchill et al. 2001; Renner 2000). The Division of Mines and Geology of the California Department of Conservation has prepared a map identifying areas of ultramafic rock and serpentinite where tremolite asbestos and chrysotile may occur in El Dorado County, California (Churchill et al. 2001).

Occurrence in Vermiculite Before 1990, the now closed mine in Libby, Montana, was a significant source of vermiculite concentrate in the United States. According to a 1998 USGS report, vermiculite concentrate was produced in U.S. mines at Enoree and Woodruff, South Carolina, and in Louisa County, Virginia (USGS 1998b). U.S. imports of vermiculite in 1998 were supplied by South Africa and China (USGS 1998b). Twenty vermiculite exfoliating plants operated in 11 states in 1998.

In an early EPA-supported study, ~21% to 26% of the weight of raw ore samples and 0.3% to 7% of the weight of vermiculite concentrate samples from Libby were accounted for by asbestiform amphibole identified as tremolite-actinolite (Atkinson et al. 1982). In a 1984 study of samples from Libby, Montana, conducted by W.R. Grace, asbestiform amphibole percentage by weight varied from 3.5% to 6.4% in raw ore and from 0.4% to 1.0% in the concentrate (cited in Amandus et al. 1987a).

Amandus et al. (1987a) noted that among 599 fibers counted in eight airborne membrane filter samples from the Libby mine and mill, 96% and 16% had length:width ratios >10 and >50, respectively. Percentages of fibers with lengths >10, >20, and >40 μm were 73%, 36%, and 10%, respectively. McDonald et al. (1986b) reported that fibers in Libby air samples showed ranges for diameter, length, and length:width ratio of 0.1–2 μm, 1–70 μm, and 3–100, respectively. Greater than 60% of fibers were reported to be longer than 5 μm (McDonald et al. 1986b). These data are consistent with the asbestiform habit of the Libby amphibole.

When amphibole asbestos has been detected in vermiculite from other localities, the reported amounts have been lower than those in Libby vermiculite.

Moatamed et al. (1986) analyzed samples of vermiculite ores from Libby, Montana; Louisa County, Virginia; and South Africa for the presence of amphibole. Two samples of Montana unexpanded vermiculite ore were determined to have 0.08% and 2.0% amphibole by weight; two samples of expanded Montana vermiculite both showed 0.6% amphibole content. The South African unexpanded and expanded samples showed 0.4% and 0.0% amphibole content, respectively. The unexpanded and expanded Virginia samples were both determined to be 1.3% amphibole by weight.

The Virginia amphibole (identified as actinolite) and the South African amphibole (identified as anthophyllite) were predominately nonasbestiform, whereas the Montana amphibole (identified as actinolite) was predominately asbestiform (Moatamed et al. 1986). Numbers of fibrous amphibole particles in the Virginia samples were reported to be “extremely low” in comparison to the Montana samples. The infrequent, short fibrous structures were “most likely cleavage fragments.” The South African vermiculite samples showed a “near absence of fibers” or “rare, short fibrous structures.”

In another investigation, total asbestiform fibers (classified as tremolite-actinolite) represented less than 1% of the weight of samples of raw ore and vermiculite concentrate from Enoree and Patterson, South Carolina, compared with ~21% to 26% and 0.3% to 7% of the weight of raw ore and vermiculite concentrate samples, from Libby, Montana respectively (Atkinson et al. 1982). Concentrations of particles with length > 5 μm in exfoliated vermiculite samples from South Carolina ranged from 0.7 to 11.7 x 10^6 fibers per g, whereas concentrations were higher in exfoliated Libby samples, ranging from 23 to 160 x 10^6 fibers per g (Atkinson et al. 1982). Transmission electron micrographs of nonasbestiform amphibole cleavage fragments from samples of Enoree vermiculite showed dramatic morphological differences from amphibole fibers from Libby vermiculite ore (Ross et al. 1993).

Amphibole (reported as tremolite) was detected in 26 of 57 samples of vermiculite with concentrations ranging from 0.01% to 6.4% in the samples with tremolite (Addison and Davies 1990). It was reported that “most of the amphibole in these samples was non-asbestiform.” Further information was not provided in the report concerning where these samples came from and which ones may have contained asbestiform amphibole.

EPA (2000) investigated the occurrence of asbestos in vermiculite-containing garden products purchased in stores in several regions of the United States. These products ranged from products marketed as vermiculite to mixtures of vermiculite with other materials (e.g., soil or other minerals). In an initial investigation, asbestos was detected in 5 of 16 of the products tested, but only three products had sufficient levels that could be quantified. Reported weight concentrations of asbestos (identified as actinolite) were 0.30% and 0.33% for one product, 0.10% to 2.79% for another product, and 0.45% for the third (only one sample concentration was reported for this product). The second investigation detected asbestos in 17 of 36 garden products, but asbestos concentrations (identified predominantly as actinolite) were above 0.1% in only 5 of these products, ranging from 0.13 to 0.7% in an initial sampling. Further sampling showed that the concentrations in these "positive" products varied considerably, but no concentrations higher than the upper end of the initial ranges were reported.

To understand how much asbestos consumers may inhale when using vermiculite-containing garden products, EPA (2000) simulated exposure scenarios in enclosed conditions and in outside open air. From these simulations, EPA (2000) concluded that consumers "face only a minimal health risk from occasionally using vermiculite products at home or in their gardens." To further reduce the low health risk associated with occasional domestic use, EPA (2000) recommended 1) using vermiculite outdoors or in well-ventilated areas; 2) avoiding vermiculite dust by keeping vermiculite damp during use; and 3) avoiding bringing vermiculite dust into the home on clothing.

Occurrence in Chrysotile Amphibole asbestos, identified as tremolite asbestos or actinolite asbestos, has been reported to be a minor contaminant in some deposits of chrysotile in Quebec. Part of the evidence that tremolite asbestos exists in certain chrysotile deposits mined in Quebec comes from observations of higher concentrations of tremolite asbestos fibers than chrysotile fibers in autopsied lung tissues of certain miners and millers who were chronically exposed to chrysotile ores (see Case 1994 for review). Inhaled tremolite asbestos fibers are more persistent in lungs than inhaled chrysotile fibers.

The amount of tremolite asbestos or actinolite asbestos in chrysotile deposits, if present, is expected to vary from region to region and site to site. Tremolite was detected in 3 of 8 samples of commercial chrysotile using a method with detection limits of 0.01% to 0.05% that involved chrysotile digestion and energy-dispersive x-ray analysis (Addison and Davies 1990). Tremolite fibers in these samples were described as generally fine, straight, and needle-like with diameters around 0.2 μm. Weight percentages accounted for by tremolite in the 3 "positive" samples were 0.02%, 0.08%, and 0.20%. The authors concluded, based on a combined analysis of results from this method, electron microscopy, and infrared spectrophotometry, that the tremolite in only one of the positive samples was asbestiform. In a wider survey of chrysotile samples using the same technique, tremolite was detected in 28 of 81 chrysotile samples; tremolite accounted for weight percentages in positive samples ranging from 0.01% to 0.6% (Addison and Davies 1990). The report did not indicate the extent to which the tremolite samples in the wider survey were asbestiform or nonasbestiform.

Occurrence in Talc Talc occurs in mines along the Appalachian Mountains and in California and Texas; Germany; Florence, Italy; Tyrol, Austria; Transvaal, South Africa; and Shetland, Scotland (Amethyst Galleries 1999). In the United States in 1998, there were 15 talc-producing mines in 7 states. Companies in Montana, New York, Texas, and Vermont accounted for 98% of domestic production (USGS 1999). Industrial use of talc shows the following pattern: ceramics, 37%; paints, 19%; paper, 10%; roofing, 10%; plastics, 7%; cosmetics, 5%; rubber, 3%; and other uses, 9% (NTP 1993). The geological formation of talc may lead to the formation of other mineral phases including amphiboles and serpentines, including some in asbestiform habits. In the United States, commercial talc is categorized into cosmetic grade, which is free of asbestos, and industrial grade, which may contain other asbestiform or nonasbestiform minerals (NTP, 1993; Zazenski et al. 1995). Zazenski et al. (1995) noted that the Cosmetic, Toiletry, and Fragrance Association, the United States Pharmacopeia, and the Food Chemical Codex have established talc quality assurance specifications followed by U.S. cosmetic, pharmaceutical, and food companies that use talc to ensure the purity of their products.

Results of a survey of asbestos fibers in consumer cosmetic talc powders from Italian and international markets using electron microscopy, electron diffraction, and energy dispersive x-ray analysis showed that asbestos was detected in 6 of 14 talc samples from the European Pharmacopeia (Paoletti et al. 1984). Chrysotile was identified in 3 samples, 2 samples contained tremolite asbestos and anthophyllite asbestos, and 1 sample contained chrysotile and tremolite asbestos. The authors noted that, in all talc powders analyzed, fibrous talc particles frequently were present that were morphologically similar to amphibole asbestos fibers. Counting fibers as particles with aspect ratio >3:1 and width < 3 µm, the percentages of particles that were asbestos fibers ranged from <0.03% to 0.13% for 4 samples, and were 18% to 22% for the other 2 samples. Paoletti et al. (1984) noted that the European Pharmacopeia, at that time, had not established analytical quality control of asbestos contamination.

Industrial talc currently mined in New York is called tremolitic talc because it contains significant quantities of nonasbestiform tremolite. Historical references in the scientific literature indicate that these talc deposits and their industrial products may contain asbestos (American Thoracic Society 1990; DOL

1980; NTP 1993; Wagner et al. 1982). In 1992, OSHA noted that the debate over the mineralogical content of the New York tremolitic talc ore was unresolved, but that the presence of asbestiform talc in the ore may have led to the identification of asbestiform tremolite and anthophyllite. More recently, a report from OSHA's Salt Lake Technical Center (Crane 2000) suggests that, in some cases, cleavage fragments of nonasbestiform tremolite and anthophyllite in the talc ore and products may have been inappropriately identified as asbestos. Crane (2000) described the New York talc ore as having nonasbestiform tremolite, mostly nonasbestiform anthophyllite, talc in both massive and asbestiform habits, and minor amounts of other minerals and mineraloids.

Talc has been used in the manufacture of crayons for many years. Recently, it was reported in the U.S. press that tremolite asbestos, anthophyllite asbestos, and chrysotile were detected in some crayons at concentrations ranging from 0.03% to 2.86% (CPSC 2000). In response, the Consumer Product Safety Commission (CPSC 2000) examined crayons from several U.S. manufacturers to determine whether asbestos was present. Trace amounts of anthophyllite asbestos were found in some of the crayons. The CPSC (2000) concluded that the risk that children would be exposed to fibers through inhalation or ingestion of talc-containing crayons is "extremely low," but recommended that, as a precaution, crayons should not contain these fibers. The manufacturers have agreed to reformulate their crayons using substitute materials (CPSC 2000).

Detection and Analysis of Asbestos in Air Samples

The detection and analysis of asbestos in air samples (and in bulk materials that may become airborne) involve both fiber quantification and mineral identification. The distribution of numbers of particles of differing sizes in a sample is determined by microscopic examination, performed using either light or electron microscopy. For counting purposes, a fiber is defined as any particle with a length $5 µm and a length:width ratio $3:1. Concentrations in air are reported as fiber/mL or fiber/cc. For the purposes of determining asbestos content in bulk building material, EPA (2000) uses an operational definition of fiber as any particle with a length:width ratio $ 5:1. Electron diffraction and energy-dispersive x-ray analysis give information on the chemical content and mineral identity of the particles. The combined use of light microscopy, electron microscopy (transmission and scanning), electron diffraction, and energy-dispersive x-ray methods in analyzing air and/or bulk material samples offers the most accurate approach to estimating airborne asbestos concentrations.

Light Microscopic Methods The current standard method for determining airborne asbestos particles in the U.S. workplace is the National Institute for Occupational Safety and Health (NIOSH) Method 7400 which uses phase contrast light microscopy (PCM) (NIOSH 1994a, 1994b). Fibers are collected on a filter and counted with 400–450x magnification. The method does not accurately distinguish between asbestos and nonasbestos fibers, and cannot detect fibers thinner than about 0.25 μm. Recent improvements in filter preparation allow for viewing at higher magnification (1250x) resulting in a several-fold improvement in sensitivity (Pang et al. 1989).

Phase contrast microscopy methods are widely used to assess occupational exposure to workers engaged in activities known to generate airborne asbestos fibers. However, in settings where large proportions of other particles or fibers (e.g., wool, cotton, glass) are present, the phase contrast microscopy will overestimate the asbestos fiber concentration without additional information.

Polarized light microscopy is frequently used for determining the asbestos content of bulk samples of insulation or other building materials (see, for example, NIOSH Method 9002 [NIOSH 1989] and OSHA method ID-191 [OSHA 1994]). This method also enables qualitative identification of asbestos types using morphology, color, and refractive index.

Electron Microscopic Methods Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) methods can detect smaller fibers than PCM and can be used to determine mineral habit in bulk materials that may become airborne. NIOSH Method 7402, Asbestos by TEM, is used to determine asbestos fibers in the optically visible range and is intended to complement PCM (NIOSH Method 7400). Examination of a sample by either TEM or SEM allows the detection of much smaller fibers than light microscopy, and so more thorough data can be collected on fiber length and diameter distribution. Of these two methods, TEM has greater sensitivity for small fibers, and is the most common method for measuring asbestos in ambient air or inside schools or other buildings. SEM analysis usually images fibers that are more than 0.2 μm in diameter because of contrast limitations, while TEM can visualize fibers of all sizes.

Electron Diffraction and Energy-Dispersive X-ray Methods These methods determine crystal structure and elemental composition and are used to identify the mineral group to which a fiber or particle belongs. Modern transmission electron microscopes are equipped with instrumentation that examines individual particles by both of these methods, but scanning electron microscopy does not measure electron diffraction patterns. To distinguish between a nonasbestiform amphibole cleavage fragment and an asbestiform amphibole fiber of the same mineral type, information about mineral habit (which comes from light and electron microscopy) is needed.

Conversion Factors Conversion factors are used to compare results from epidemiologic studies that used different methods to measure airborne asbestos levels. Early studies often measured air concentrations in units of mass per volume of air or number of particles per volume of air, whereas more recent studies measure air concentrations in units of number of fibers (particles with lengths \$ 5 µm and aspect ratio \$ 3:1, determined by PCM or electron microscopy) per volume of air.

Older studies of health effects and occupational exposure measured dust exposure in units of million particles per cubic foot (mppcf). This method did not distinguish fibrous from nonfibrous particles and used relatively low magnification, so only the largest fibers were detected. The British Occupational Hygiene Society (BOHS 1968) suggested that an asbestos air concentration of 1 mppcf is roughly equal to 3 fiber/mL (detected by PCM).

To convert from PCM-measured to TEM-measured air concentrations, the National Research Council (NRC 1984) recommended that 1 PCM fiber/mL is roughly equal to 60 TEM fiber/mL, and that 1 PCM fiber/mL and 60 TEM fiber/mL are roughly equal to a mass concentration of 0.03 mg asbestos dust/m^3 (i.e., 1 mg/m^3 is roughly equal to 33 PCM fiber/mL or 2000 TEM fiber/mL). The NRC acknowledged that these conversion factors provide only rough estimates because converting from phase contrast microscopy counts to TEM counts can vary with different sizes of fibers, and converting from mass-per-volume units to fibers-per-volume units can vary with different mineral types and different sizes of fibers.

Epidemiologic studies of groups of asbestos-exposed workers commonly express exposure in cumulative exposure units (fiber-year/mL). This exposure measure is calculated by multiplying a worker's duration of exposure (measured in years) by the average air concentration during the period of exposure (measured in fiber/mL).

Potential for Human Exposure to Asbestos

Occupational exposure to asbestos may occur and has occurred in workers involved in mining, milling, and handling of chrysotile (and other forms of asbestos) and vermiculite ores, in exfoliating vermiculite, and in mining, milling, and handling of other ores and rocks that may contain tremolite asbestos or other amphibole asbestos. Unless efforts are made to limit dust generation and release, and limit transport of dust on clothes to home environments, there is a probability of exposure to other workers, family members, and area residents.

Residents who live close to mining, milling, or manufacturing sites that involve asbestos-containing material may be potentially exposed to higher levels of airborne tremolite asbestos than levels in general ambient air. EPA, ATSDR, and other agencies currently are investigating levels of amphibole asbestos exposure that residents (including children) who were not employed in the vermiculite mines and mills may have and are experiencing. In addition, ATSDR is conducting medical testing of individuals potentially exposed to asbestiform minerals associated with vermiculite in Libby, Montana (ATSDR 2001b).

Asbestos fibers may be released to indoor or outdoor air by the disturbance of asbestos-containing building materials such as insulation, fire-proofing material, dry wall, and ceiling and floor tile, although the use of asbestos-containing building materials has declined sharply in recent years (HEI 1991). Amphibole asbestos has been found in some vermiculite sources that have been used as home and building insulation. Workers or homeowners involved in demolition work or asbestos removal, or in building or home maintenance, repair, and remodeling, potentially can be exposed to higher levels of airborne asbestos than levels in general ambient air. In general, exposure may occur only when the asbestos-containing material is disturbed in some way to release particles and fibers into the air. Exposure will be greatest when dry, friable (i.e., easily released) material is disturbed. When asbestos-containing materials are solidly embedded or contained, exposure will be negligible (USGS 1998b, 1999).

Typical concentrations of asbestos fibers (with lengths $ 5 µm) in urban and rural ambient air may be about 0.0001 or 0.00001 fiber/mL, respectively (ATSDR 2001a). In workplace air, recent U.S. regulations have limited asbestos air concentrations to 0.1 to 0.2 fiber/mL to protect against the development of pulmonary fibrosis and cancer (OSHA 1992, 1994). A study of indoor air of homes, schools, and other buildings that contain asbestos materials measured an average asbestos concentration of about 0.0001 fiber/mL (Lee et al. 1992). Most of the fibers in this study were identified as chrysotile; 2% of the fibers were identified as amphibole fibers. Indoor air concentrations are highly variable, however, and depend on the friability of the asbestos-containing material and on activities in which people are engaged.

As discussed in the *Occurrence of Tremolite Asbestos* section, small amounts of amphibole asbestos fibers have been identified in some samples of vermiculite-containing consumer garden products from the United States (EPA 2000). EPA (2000) concluded that consumers may face only a minimal health risk from occasionally using vermiculite products at home, and can reduce any risk by limiting the production of dusts when using the products.

Health Effects from Asbestos: Overview

It is known that exposure to airborne asbestos fibers can increase the risk of lung cancer, malignant mesothelioma, and nonmalignant respiratory effects including pulmonary interstitial fibrosis (asbestosis), pleural plaques, pleural calcification, and pleural thickening. Epidemiologic studies have shown increasing risks for malignant or nonmalignant respiratory disease significantly associated with increasing measures of exposure intensity and duration among groups of occupationally exposed individuals. Results from studies of animals exposed by various routes of exposure and from mechanistic studies are consistent with these findings. Reviews of this evidence include those by the Agency for Toxic Substances and Disease Registry (ATSDR 2001a), the American Conference of Governmental Industrial Hygienists (ACGIH 1998), the American Thoracic Society (1990), Case (1991), Churg and Wright (1994), the Environmental Protection Agency (EPA 1986), the International Agency for Research on Cancer (IARC 1987a), Kamp and Weitzman (1997, 1999), Langer and Nolan (1998), Lippmann (1994), McDonald and McDonald (1997), Mossman and Churg (1998), Mossman et al. (1983, 1990), the National Toxicology Program (NTP 2001), the Occupational Safety and Health Administration (OSHA 1986, 1992), Stayner et al. (1996, 1997), Wylie et al. (1993), and the World Health Organization (WHO 1998).

Consensus Issues and Conclusions

There is general agreement among scientists and health agencies on the following issues and conclusions regarding health effects from asbestos.

(1) *Exposure to any asbestos type (i.e., serpentine or amphibole) can increase the likelihood of lung cancer, mesothelioma, and nonmalignant lung and pleural disorders.*

(2) *Important determinants of toxicity include exposure concentration, exposure duration and frequency, and fiber dimensions and durability.*

(3) *Fibers of amphibole asbestos such as tremolite asbestos, actinolite asbestos, and crocidolite are retained longer in the lower respiratory tract than chrysotile fibers of similar dimension.*

(4) *Pulmonary interstitial fibrosis associated with deposition of collagen, progressive lung stiffening and impaired gas exchange, disability, and death occurred in many asbestos workers.*

(5) *Most cases of asbestosis or lung cancer in asbestos workers occurred 15 or more years after their initial exposure to asbestos.*

(6) *Asbestos-exposed tobacco smokers have greater than additive risks for lung cancer than do asbestos-exposed nonsmokers.*

(7) *The time between diagnosis of mesothelioma and the time of initial occupational exposure to asbestos commonly has been 30 years or more.*

(8) *Cases of mesotheliomas have been reported after household exposure of family members of asbestos workers and in individuals without occupational exposure who live close to asbestos mines.*

Unresolved Issues and Discussions

(1) *Does exposure to asbestos increase the risk for gastrointestinal cancer?*
Results in support of a positive answer to this question include small increases in death rates from gastrointestinal cancer in some groups of asbestos-exposed workers and in some populations with high levels of asbestos fibers in drinking water, and a small but statistically significantly increased incidence of benign intestinal tumors in one National Toxicology Program (NTP) study of male rats exposed to chrysotile in their food for life (see ATSDR 2001a for citation of these studies). However, the increased gastrointestinal mortalities noted in workers and in populations exposed through drinking water were usually quite small, and consistent results were not found across studies. In addition, it is difficult to determine whether the increases were due to asbestos or to other factors (e.g., exposure to other chemicals, misdiagnosis, dietary factors, alcohol intake). The weight of the finding of intestinal tumors in chrysotile-exposed rats is counterbalanced by the facts that the tumors were both infrequent and benign, and that no significant increases in tumors occurred in five other NTP lifetime cancer bioassays of rats exposed to different forms of asbestos in their diet.

The available data do not support a definitive conclusion about whether the increased risk for gastrointestinal cancer observed in some of the epidemiologic studies is real or not. Some scientists believe the available evidence is substantial, others believe the evidence is inadequate to reach a firm conclusion, and still others believe the increased risks are probably due to other factors. ATSDR (2001a) and NTP (2001) concur, however, that it seems only prudent to consider increased risk of gastrointestinal cancer an effect of concern from exposure to asbestos.

(2) *Are chrysotile fibers (or amphibole asbestos fibers) primarily responsible for mesotheliomas in certain groups of workers predominantly exposed to chrysotile?*

Some investigators have proposed that chrysotile fibers may not be the primary cause of mesothelioma in humans exposed predominantly to chrysotile, whereas others have proposed that amphibole fibers are more potent than chrysotile in this regard (see Berman et al. 1995; Case 1991; Churg 1988; Churg and Wright 1994; Frank et al. 1998; Langer and Nolan 1998; Lippmann 1994; McDonald and McDonald 1997; Stayner et al. 1996). Tremolite asbestos fibers have often been detected at higher concentrations than chrysotile fibers in autopsied lung tissues of certain miners and millers who were chronically exposed to chrysotile ores that contained only very small amounts of tremolite asbestos (see Case 1994 for review). Part of the difficulty in ascribing primary responsibility in these mesothelioma cases is that chrysotile fibers are removed from the lung much more quickly than amphibole asbestos fibers, and data on fiber content in pleural or peritoneal tissue in human cases are few.

(3) *Are amphibole asbestos types more potent than chrysotile in inducing asbestosis and lung cancer?*

Some investigators have proposed that amphibole asbestos fibers, such as tremolite asbestos, are more potent than chrysotile fibers in inducing fibrotic lung disease and lung cancer (McDonald 1998; McDonald and McDonald 1997; McDonald et al. 1999; Mossman et al. 1990). Others propose that differences in the potency of chrysotile and amphibole-asbestos fibers in inducing lung cancer cannot be reliably discerned from available data (Berman et al. 1995; Stayner et al. 1996).

Despite the dispute in the scientific literature concerning issues (2) and (3), U.S. and international agencies concur that exposure to any type of asbestos (including chrysotile) can increase the risk for asbestosis, mesothelioma, and lung cancer in humans (e.g., ATSDR 2001a; EPA 1986; IARC 1987a; NTP 2001; WHO 1998).

(4) *Should the U.S. regulatory definition of an asbestos fiber (length $5 µm with aspect ratio $ 3:1), established for purposes of quantifying exposure levels, be changed?*

This issue has received continued debate since the establishment of the definition (see American Thoracic Society 1990; OSHA 1992, 1994; Wylie et al. 1993, 1997). At least part of the debate has involved uncertainties associated with the relative importance of long and short inhaled fibers in asbestos pathogenicity.

In support of the importance of longer fibers, animal carcinogenic responses to asbestos have been variously reported to be best correlated with the concentration of fibers with lengths $8 µm and diameters # 0.25 µm (Stanton et al. 1981) and with the concentration of fibers with lengths $20 µm (Berman et al. 1995). Case-control analyses of fiber concentrations in autopsied lungs of mesothelioma subjects and subjects who died of other causes showed that increased risks for mesothelioma were significantly related to longer fibers. Fibers longer than 5 µm (Rodelsperger et al. 1999), 8 µm (McDonald et al. 1989), or 10 µm (Rogers et al. 1991) were implicated in different studies.

In contrast, analyses of autopsied human lung tissue of asbestos-exposed and nonexposed patients often show greater numbers of short (< 5 µm) than long (> 5 µm) retained fibers (Dodson et al. 1997, 1999), and short chrysotile fibers have been reported to be the most prevalent type of fibers found in parietal pleura tissue from asbestos-exposed autopsy cases (Sebastien et al. 1980). Also, significant inverse relationships have been observed between degree of fibrosis and retained amphibole fiber length in autopsy studies of chrysotile miners and millers (Churg and Wright 1989) and amosite-exposed shipyard and insulation workers (Churg et al. 1990). Significant correlations have also been observed in animal studies between carcinogenic response and concentrations of fibers with lengths shorter than 8 µm (Berman et al. 1995; Stanton et al. 1981). In addition, exceptions to the principle that long and thin structures are required for a carcinogenic response to asbestos or other fibers have been reported in animal studies (Davis et al. 1991; Stanton et al. 1981). For example, carcinogenic responses in rats to two tremolite asbestos samples were markedly higher than the predicted response from Stanton's regression curve relating probability of tumor to the number of particles with lengths $8 µm and diameters # 0.25 µm (Stanton et al. 1981). In addition, one of seven talcs tested had high numbers of particles with lengths $8 µm and diameters # 0.25 µm, but did not produce tumors (Stanton et al. 1981).

(5) *What are the molecular events involved in the development of asbestos-induced respiratory and pleural effects and how are they influenced by fiber dimensions and mineral type?*

Identification of the molecular and cellular events of asbestos-induced disease has been the subject of extensive research within the past two decades (see *Mechanisms of Asbestos Toxicity: Overview* section). However, much remains unknown, and the precise steps in pathogenic pathways are not fully established.

(6) *What are the actual risks for malignant or nonmalignant respiratory disease that may exist at exposure levels below air concentrations (0.1–0.2 fiber/mL) established as recent occupational exposure limits?*

Asbestosis: Based on its review of available data, a task group convened by the World Health Organization (WHO 1998) concluded that "asbestotic changes are common following prolonged exposure of 5 to 20 fiber/mL" and that "the risk at lower exposure levels is not known."

Alternatively, based on an analysis that extrapolated from data for asbestosis mortalities in a group of asbestos textile workers, Stayner et al. (1997) concluded that there was an excess risk of 2/1,000 for asbestosis mortality for men exposed for 45 years to an airborne asbestos concentration of 0.1 fiber/mL. Other scientists have criticized the applicability of the Stayner analysis to general population environmental exposures, noting that this group of asbestos textile workers displayed higher mortality rates than other groups of asbestos workers (Case et al. 2000; Hodgson and Darnton 2000).

Lung Cancer and Mesothelioma: Based on an analysis of data from epidemiologic studies of workers who were exposed to asbestos before modern occupational exposure limits were established, EPA (1986) calculated by extrapolation that lifetime exposure to asbestos air concentrations of 0.0001 fiber/mL could result in up to 2 to 4 excess cancer deaths (lung cancer or mesothelioma) per 100,000 people. This air concentration is within reported ranges of ambient air levels (0.00001 to 0.0001 fiber/mL). The EPA analysis has been extensively discussed and reviewed in the scientific literature (Camus et al. 1998; Hodgson and Darnton 2000; Hughes 1994; Landrigan 1998; Lash et al. 1997). EPA is in the process of reviewing and possibly updating their cancer risk estimates for asbestos.

(7) *Can lung cancer be attributed to asbestos exposure (regardless of fiber type) in the absence of pulmonary fibrosis*?

Some scientists have supported the hypothesis that asbestosis is a necessary prerequisite for asbestos-induced lung cancer, but there is also evidence that an increased risk for lung cancer occurs in asbestos workers without obvious asbestosis (see Henderson et al. 1997; Hillerdal and Henderson 1997; Hughes and Weill 1991; Jones et al. 1996; Wilkinson et al. 1995). Hillerdal and Henderson (1997) concluded from their review of the data that "there was an increasing body of evidence that, at low exposure levels, asbestos produces a slight increase in the relative risk of lung cancer even in the absence of asbestosis." In contrast, Jones et al. (1996) concluded from their review that, "While the issue of whether asbestosis is a necessary precursor to asbestos-attributable lung cancer cannot at this time be considered settled, the weight of the available evidence strongly supports this proposition."

Deposition and Clearance of Inhaled Asbestos Fibers: Overview

Human and animal studies indicate that when asbestos fibers are inhaled, thick fibers (diameters greater than 2–5 μm) are deposited in the upper airways, whereas thinner fibers are carried deeper into the alveolar regions of the lung (ATSDR 2001a; Lippman 1994; Wylie et al. 1993). Absorption by epithelial cells and penetration through the epithelial layers of the respiratory tract are thought to be minimal, but some transport of inhaled fibers from the lung to the pleural cavity occurs (ATSDR 2001a; Wylie et al. 1993). Fiber width is a key determinant of access of fibers to the lung and pleural cavity, and thus of fiber toxicity. Wylie et al. (1993) reviewed available evidence from human epidemiology studies, human lung burden studies, and studies of animals implanted or injected with asbestos indicating that fibers with widths greater than 1 μm are unlikely to cause lung cancer or mesothelioma.

Fibers deposited in the respiratory tract are principally removed by mucociliary transport and swallowing, followed by elimination from the gastrointestinal tract via feces. Small numbers of fibers may reach the lymph system or be transported to the pleura and peritoneum. Dissolution of fibers by alveolar macrophages is also thought to play a role in eliminating asbestos fibers from the lung, especially for chrysotile fibers; interstitial macrophages, intravascular macrophages, and pleural macrophages also interact with deposited asbestos fibers (see Oberdorster 1994). In addition, some fibers are not cleared from the lung, leading to a gradual accumulation.

There is evidence in animals that long fibers are retained in the lungs for longer periods than short fibers (e.g., Coin et al. 1992; Davis 1989). This relationship may be associated with the inability of macrophages to engulf and remove fibers that are significantly larger than themselves (Bignon and Jaurand 1983), but analysis of autopsied human lung or parietal tissue for retained fibers often shows higher numbers of short (< 5 μm) fibers than long (> 5 μm) fibers (Dodson et al. 1997, 1999; Sebastien et al. 1980).

There is also evidence that amphibole fibers are retained for longer periods than chrysotile fibers (Albin et al. 1994; Churg 1994; Churg et al. 1993; Davis 1989; Wagner et al. 1974). For example, amphibole retention in lungs of rats repeatedly exposed to airborne amphibole fibers for 24 months showed a continuous increase throughout exposure, whereas chrysotile lung retention reached a much lower maximum level within about 3 months in rats similarly exposed to chrysotile fibers (Wagner et al. 1974). Tremolite fibers in autopsied lung tissue from workers exposed to airborne chrysotile fibers contaminated with small amounts of tremolite (<1%) accounted for disproportionately large percentages (47–67%), and chrysotile fibers accounted for disproportionately small percentages (19–53%), of the total fibers detected (Churg and Wright 1994). The apparent longer retention of amphibole fibers in lung tissue has been proposed as a partial explanation of why amphibole asbestos appears to be more potent in producing mesothelioma than chrysotile (American Thoracic Society 1990; Mossman et al. 1990).

Mechanisms of Asbestos Fiber Toxicity: Overview

Identification of the molecular and cellular responses leading to the progressive development of asbestos-induced lung cancer, mesothelioma, pulmonary fibrosis, and pleural thickening and effusion has been the subject of extensive research within the past two decades. Published reviews of this work include those by Begin et al. (1992), Kamp and Weitzman (1997, 1999), Kamp et al. (1992), Luster and Simeonova (1998), Mossman and Churg (1998), Mossman et al. (1983, 1996), Rom et al. (1991), and Tanaka et al. (1998). In general, it is recognized that there are multiple cellular and molecular responses to asbestos fibers, that no single mechanism is likely to account for all asbestos-related diseases, that the precise steps in pathogenic pathways leading to asbestos-related disease are not fully established, and that fiber structural and chemical properties (e.g., length, width, iron content, durability, surface areas) are important variables that play a role in the development of lung and pleural injury.

A central working hypothesis proposes that the presence of asbestos fibers in the lung activates alveolar macrophages, pulmonary neutrophils, pulmonary epithelial cells, and pleural mesothelial cells to produce reactive oxygen species (such as hydrogen peroxide, the superoxide anion, and the hydroxyl radical) and/or reactive nitrogen species (such as nitric oxide and peroxynitrite) that can damage cellular macromolecules (e.g., deoxyribonucleic acid [DNA], ribonucleic acid [RNA], signal transduction proteins, and membrane lipids) and lead to cellular dysfunction, cytotoxicity, cellular transformation (to malignancy), and cellular proliferation (see the reviews cited in the previous paragraph for evidence in support of this hypothesis). In addition, iron cations associated with asbestos fibers may augment the production of hydroxyl radicals. The pathogenesis of asbestos-induced lung injury is also thought to involve altered expression of genes involved in oxidation protection (e.g., catalase and superoxide dismutase), other stress responses (e.g., heat shock proteins and ferritin), cellular proliferation (e.g., cytokines, cytokine binding proteins, and growth factors), and apoptosis in alveolar macrophages, pulmonary epithelial cells, and/or pleural mesothelial cells. Further understanding of how persistent production of reactive oxygen or nitrogen species and persistent inflammatory cellular responses precisely interact may be useful for developing better approaches to the diagnosis, prevention, and treatment of asbestos-related disease.

Health Effects from Tremolite Asbestos

As with other forms of asbestos, health effects of concern from exposure to inhaled tremolite asbestos are lung cancer, mesothelioma, and nonmalignant lung and pleural disorders. Evidence in humans comes from epidemiologic studies of tremolite asbestos-exposed groups of vermiculite miners and millers from Libby, Montana. This evidence is supported by reports of increased incidences of nonmalignant respiratory diseases, lung cancer, and mesothelioma in villages in various regions of the world that have traditionally used tremolite-asbestos whitewashes or have high surface deposits of tremolite asbestos and by results from animal studies.

Nonmalignant Respiratory Effects: Pulmonary Fibrosis and Pleural Changes. Studies of Libby, Montana vermiculite workers chronically exposed to airborne tremolite asbestos provide evidence that exposure to tremolite asbestos increases the risk of interstitial pulmonary fibrosis, pleural calcification, and pleural wall thickening and the risk of death from these nonmalignant diseases. Supporting evidence comes from observations of 1) high prevalences of pleural calcification among residents of villages where whitewashes containing tremolite asbestos were used or where there are abundant surface deposits of tremolite asbestos and 2) pulmonary fibrogenic reactions in lungs of rats and mice after exposure to tremolite asbestos by inhalation or intratracheal instillation.

In response to a report of 12 cases of pleural effusion within a 12-year period in an Ohio fertilizer plant that processed Libby, Montana vermiculite, 501 workers were surveyed for symptoms of respiratory distress, examined by chest radiography, and tested for pulmonary function (Lockey et al. 1984). Chest radiographs showed 479/501 (95.6%) workers with no significant radiographic changes, 1/501 (0.2%) workers with small irregular parenchymal opacities indicative of pulmonary fibrosis, 10/501 (2.0%) workers with significant pleural changes described as thickening, plaques, and/or calcification, and 11/501(2.2%) workers with costophrenic angle blunting only. Cumulative fiber exposures for the 11 employees with parenchymal or pleural changes ranged from 0.01 to 39.9 fiber-year/mL (mean = 12 fiber-year/mL). Cumulative fiber exposures for the 11 employees with costophrenic angle blunting ranged from 0.2 to 27.5 fiber-year/mL (mean = 5.4 fiber-year/mL). Increased prevalences of radiographic pleural changes, self-reported pleuritic chest pain, and self-reported shortness of breath were significantly associated with cumulative fiber exposure indices, but exposure-related changes in pulmonary function (spirometric variables and carbon dioxide diffusing capacity) were not found.

Chest radiographs of 184 men employed at the Libby, Montana vermiculite mine and mill for at least 5 years during 1975–1982 were evaluated for parenchymal abnormalities indicative of pulmonary fibrosis (presence of small irregular parenchymal opacities with a profusion $ International Labor Organization [ILO] category 1/0[3]) and pleural abnormalities including calcification and thickening on the wall (Amandus et al. 1987b). Prevalences for small parenchymal opacities $ ILO category 1/0, any pleural change, pleural calcification, and pleural wall thickening were 10, 15, 4, and 13%, respectively. Vermiculite workers who were smokers, were of age 45 or greater, and had cumulative fiber exposure indices >100 fiber-year/mL (but not those with exposures <100 fiber-year/mL) showed a significantly higher prevalence of small irregular parenchymal opacities (4/13, 30.8%) than several reference groups of workers of similar age and smoking habits without known fiber exposure (e.g., nonasbestos cement workers). Amandus et al. (1987b) suggested that the finding of higher prevalence of parenchymal changes in the Libby, Montana vermiculite workers compared with the Ohio fertilizer plant workers (Lockey et al. 1984) may be explained by a higher average cumulative exposure index for the Montana workers.

Another study examined possible relationships between cumulative fiber exposure and chest radiographic findings for 173 workers employed in the Libby, Montana, mine and mill in July 1983, 80 of 110 former male employees who resided within 200 miles of Libby, and 47 local men without known exposure to dust (McDonald et al. 1986a). Age-standardized percentages of subjects with parenchymal opacities (small irregular opacities with $ILO category 1/0) and pleural thickening of chest wall increased with increasing cumulative fiber exposure categories. For example, age-standardized percentages for small opacities were 10.6%, 18.4%, 15.4%, 31.3%, and 27.9% for subjects with mean cumulative exposures of 4.1, 17.5, 53.9, 144.4, and 495.8 fiber-year/mL, respectively. Logistic regression analysis indicated that the prevalence of small opacities (with profusion $ILO category 1/0) was significantly affected by age, smoking, and cumulative exposure; prevalence for pleural thickening was significantly affected by age and cumulative exposure. The logistic regression analysis predicted that for current smokers at age 65,

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[3]The ILO classification system (ILO 1989) for profusion of opacities in chest radiographs establishes four categories of profusion of increasing severity, each with three subcategories noted in parentheses: 0 (0/-, 0/0, 0/1); 1 (1/0, 1/1, 1/2); 2 (2/1, 2/2, 2/3); 3 (3/2, 3/3, 3/4).

the risk for developing small parenchymal opacities $ILO category 1/0 would increase by about 5–10% with each cumulative exposure increment of 100 fiber-year/mL. McDonald et al. (1986a) also concluded that at 0.1 fiber/mL, no detectable excess of radiological change should be detectable after a working life of 40 years. However, in a later discussion of their Libby, Montana, regression analysis, McDonald et al. (1988) noted that the increased risk of small radiographic opacities ($ILO category 1/0) was between 0.05 and 0.1% per fiber-year/mL.

There are two cohort mortality studies of tremolite-asbestos-exposed workers employed for at least 1 year at the Libby, Montana, vermiculite mine and mill. Causes of death were evaluated among 161 deaths that occurred by 1981 in 575 men who were hired before 1970 (Amandus and Wheeler 1987) and among 165 deaths that occurred by 1983 in 406 men who were hired before 1963 (McDonald et al. 1986b). Both studies assigned cumulative fiber exposure indices (fiber/year-cc = fiber-year/mL) to each subject based on individual work histories and estimated fiber concentrations in air at various job locations (fiber/mL). Workplace air concentrations were estimated from microscopic examination of membrane filter samples collected after 1968 and from dust concentrations from midget impinger samples collected before 1968 in the dry mill area (Amandus et al. 1987a; McDonald et al. 1986b). Fiber concentrations in periods before 1968 were adjusted to reflect higher fiber concentrations expected to have existed in these earlier periods at several job locations due to changes in production methods.

Elevated standardized mortality ratios (SMRs) for nonmalignant respiratory disease, using mortality rates for U.S. males as reference, were calculated for both cohorts. Amandus and Wheeler (1987) reported an SMR of 2.43 (95% confidence interval [CI] = 1.48, 3.75; 20 observed deaths versus 8.2 expected), and McDonald et al. (1986b) reported an SMR of 2.55 (95% CI was not reported; 20 observed deaths, expected deaths not reported). For workers with cumulative exposure indices >399 fiber-year/mL, Amandus and Wheeler (1987) reported a statistically significantly elevated SMR of 4.00 (7 observed versus 1.8 expected). Deaths from nonmalignant respiratory disease expected to be directly related to tremolite fiber exposure (pulmonary fibrosis or pneumoconiosis) represented 50% (10/20; Amandus and Wheeler 1987) and 40% (8/20; McDonald et al. 1986b) of deaths from nonmalignant respiratory disease. Neither study was able to demonstrate consistent, statistically significant relationships between increasing exposure index and increasing risk for death from nonmalignant respiratory disease, but the statistical power was limited in both studies because of the small numbers of workers evaluated. Other limitations of the studies include the limited follow-up periods (only 28% and 40% of the cohorts had died when the studies were conducted) and the lack of information about individual smoking histories. Nevertheless, the results from these studies add considerable weight to the evidence that exposure to airborne asbestos, including tremolite asbestos, can lead to the development of nonmalignant respiratory disease and death.

Two studies of other groups of miners and millers at other vermiculite mines in South Africa and South Carolina did not find evidence for increased prevalence of diseases associated with asbestos exposure (Hessel and Sluis-Cremer 1989; McDonald et al. 1988). The vermiculite in these studies was reported to contain much lower levels of tremolite asbestos or other amphibole asbestos fibers than the Libby, Montana, vermiculite (Atkinson et al. 1982; Moatamed et al. 1986; McDonald et al. 1988). It is plausible that the lack of increased prevalences of diseases associated with asbestos exposure in these workers is primarily due to the very low levels of asbestiform amphibole minerals in these vermiculite deposits (Atkinson et al. 1982; Moatamed et al. 1986; Ross et al. 1993). In addition, such factors as lower levels of airborne fiber concentrations at the worksites, small numbers of subjects in the studies, and limitations in study design and exposure data may have contributed to this lack of evidence.

In a cross-sectional study by Hessel and Sluis-Cremer (1989), no increased prevalence of parenchymal or pleural abnormalities on chest radiographs, no excess of self-reported respiratory symptoms, and no lung function performance deficits were found in a group of 172 South African vermiculite workers (average duration of employment was 15.3 years) compared with a group of workers involved in mining and refining copper. Samples of unexpanded and expanded vermiculite from this mine showed 0.4% and 0.0% amphibole content (Moatamed et al. 1986). The amphibole was nonasbestiform with “rare, short fibrous structures” that were predominantly anthophyllite. From this analysis, Moatamed et al. (1986) concluded that the South Africa vermiculite samples were “essentially fiber free.”

McDonald et al. (1988) evaluated causes of 51 deaths that occurred by the end of 1985 in 194 men who were employed for at least 6 months before the end of 1970 in the mining and milling of vermiculite from Enoree, South Carolina. Only 3 deaths were attributed to nonmalignant respiratory disease compared with 2.45 expected (not statistically significant); no deaths were attributed to pneumoconiosis. Chest radiographs of 83 current employees with expected dust exposure revealed no elevated percentage of subjects with parenchymal or pleural abnormalities compared with a group of 25 workers in another division of the company without exposure to dust. The vermiculite from South Carolina contains, at most, only trace amounts of tremolite asbestos (see *Occurrence of Tremolite Asbestos* section). Atkinson et al. (1982) reported that in samples of vermiculite from Patterson and Enoree, South Carolina, less than 1% of the weight was accounted for by asbestiform particles. Estimates of workplace air concentrations of particles with length $5 µm and aspect ratio > 3:1 were low, ranging from 0.4 fiber/mL in 1970 samples to 0.0 fiber/mL in 1985 in "wet zone" work areas and from 0.84 fiber/mL in 1970 to 0.02 fiber/mL in 1985 in "dry zone" areas (McDonald et al. 1988). Transmission electron microscopy and energy dispersive x-ray analysis of settled dust samples from dry zone locations showed four types of elongated particles: tremolite-actinolite (37.9%), vermiculite fragments (28.0%), talc/anthophyllite (15.9%), and iron-rich fibers (4.6%); 14% of the particles were not identified. McDonald et al. (1988) noted that the lack of observed respiratory effects in these vermiculite workers may have been due to a combination of the small number of subjects in the study (i.e., decreased detection power) and low airborne fiber concentrations. The mean cumulative fiber exposure of the Libby, Montana mortality cohort studied by McDonald et al. (1986b) was 144.6 fiber-year/mL, whereas the mean of the South Carolina cohort was estimated at 0.75 fiber-year/mL.

High prevalences of pleural calcification have been noted in inhabitants of northwestern Greece villages who had no known occupational exposure to asbestos fibers. In a 1980 study of 408 subjects who represented 15% of the population of three villages (Metsovo, Anilio, and Milea) over the age of 10, chest radiographs showed very few small opacities indicative of pulmonary fibrosis, but an overall prevalence of pleural calcification in 34.7% of men and 21.5% of women examined (Bazas 1987; Bazas et al. 1985). Constantopoulos et al. (1985, 1987a) reported that radiographic screening detected pleural calcifications in up to 323/688 (46.9%) inhabitants of the same villages and another village (Votonossi) in this area (called Metsovo). The frequency of pleural calcification increased with age; about 70% of inhabitants of age >70 years had pleural calcification (Constantopoulos et al. 1985, 1987a). Constantopoulos et al. (1991) also found pleural calcifications in 24 of 101 (23.7%) examined inhabitants of another Greek village (Distrato) outside the Metsovo region.

Constantopoulos et al. (1985, 1987a, 1991) attributed the pleural calcifications to the domestic production and use of a tremolite-asbestos-containing whitewash ("luto") made from a local soil. Analysis of samples of the whitewash material by light microscopy, transmission electron microscopy, and x-ray dispersion analysis indicated that it contained predominantly asbestiform tremolite (Langer et al. 1987). The finding of tremolite fibers in transbronchial lung biopsy specimens from individuals diagnosed with pleural calcification supported the attribution of the effect to the use of tremolite-asbestos-containing whitewash; the amphibole fibers in the tissue were described as "tremolitic and asbestiform" (Constantopoulos et al. 1985). Furthermore, pleural calcifications were not observed in nearby villagers who did not use "luto" for whitewashing; these villagers used limestone (calcium oxide) (Constantopoulos et al. 1987a). Sakellariou et al. (1996) reported that domestic use of "luto" whitewash in the Metsovo area decreased from about 92% in 1950 to 71% in 1960, to 38% in 1970, and to 18% in

1980. Mineralogic analysis of Distrato whitewash also revealed chrysotile and tremolite asbestos fibers, but details of this analysis were not reported (Constantopoulos et al. 1991).

High incidences of pleural calcifications have also been reported for inhabitants of several rural regions of Turkey where tremolite-asbestos-containing whitewash has been used to cover interior walls (Baris et al. 1988a; Coplu et al. 1996; Dumortier et al. 1998; Metintas et al. 1999; Yazicioglu et al. 1980). For example, chest radiographs of 167 inhabitants (20 years or more of age) of the village of Caparkayi showed that 63 (37.7%) had radiological abnormalities. Interlobar fissure thickening (thickening in the regions between lobes of the lung), diffuse interstitial fibrosis, calcified pleural plaques, and pleural thickening were observed in 16.8%, 15.6%, 14.4%, and 7.8% of the 167 inhabitants, respectively (Baris et al. 1988a). The whitewash material used in this village was shown to be rich in tremolite asbestos fibers, both fine and coarse (Baris et al. 1988a). In a survey of 124 inhabitants of the village of Kureysler, 14% showed calcified pleural plaques and 4% showed noncalcified pleural plaques (Coplu et al. 1996). Tremolite asbestos fibers were abundant in the whitewash material and in soil from the roads of Kureysler. Indoor air fiber concentrations in samples from a Kureysler house were 0.14 and 0.94 fiber/mL, before and after the floor was swept, respectively (Coplu et al. 1996). Tremolite fibers represented the predominant fiber type in bronchoalveolar lavage fluid samples from 64 Turkish subjects with expected environmental exposure to asbestos fibers; concentrations of fibers in the samples were similar to concentrations in samples from subjects with known occupational exposure to asbestos (Dumortier et al. 1998).

Northeastern Corsica is another region where environmental exposure to tremolite asbestos fibers has been associated with radiographic pleural abnormalities (Boutin et al. 1989; Rey et al. 1993, 1994). A retrospective survey of 1,721 chest radiographs of subjects from northern Corsica found prevalences of pleural plaques in 3.7% and 1.1% of subjects from northeastern and northwestern Corsica, respectively (Boutin et al. 1989). Northeastern Corsica, unlike the northwest, contains surface deposits of chrysotile and tremolite asbestos. Rey et al. (1993, 1994) reported that the incidence of bilateral pleural plaques was 41% in nonoccupationally exposed inhabitants of a village in northeastern Corsica where tremolite fiber concentrations in air samples ranged from 6 to 72 ng/m^3. In contrast, the incidence was 7.5% in inhabitants of a village with airborne tremolite concentrations <1 ng/m^3. Rey et al. (1993) suggested that the presence of pleural plaques is an indicator of exposure to fibers, but is not a precancerous lesion. It was noted that concomitant pleural plaques were found in only 43% of 14 Corsican cases of mesothelioma attributed to environmental exposure to tremolite asbestos fibers.

Results from a study of rats exposed repeatedly to high concentrations of tremolite asbestos confirm the capability of airborne tremolite to cause progressive pulmonary fibrosis (Davis et al. 1985a). Groups of 48 SPF male Wistar rats (AF/HAN strain) were exposed to a nominal concentration of 10 mg/m^3 tremolite asbestos, 7 hours/day, 5 days/week for 12 months starting at 10 weeks of age. The test material from Korea was determined to be about 95% tremolite asbestos (termed " 95% pure fibrous tremolite" by the authors) as confirmed by scanning electron microscopy and x-ray diffraction analysis with only minor amounts of iron and minor contamination with other silicate materials. Phase contrast microscopy of air samples determined the average fiber concentration (with lengths $5 μm) at about 1,600 fiber/mL. At 12 and 18 months after the start of exposure, 3 and 4 rats, respectively, were sacrificed and lungs were examined histologically for nonmalignant and malignant lesions (other tissues were also examined for tumors). Other rats were allowed to live until spontaneous death. At 12 months, average percentages of areas with nonmalignant lesions were 23% for peribronchiolar fibrosis, 35.2% for irregular alveolar wall thickening, and 0% for interstitial fibrosis. At 18 months, percentages of areas affected by these lesions were 13.4%, 27.7%, and 3%, respectively. None of the 12 rats dying between 27 and 29 months showed peribronchiolar fibrosis or irregular alveolar wall thickening, but 14.5% of lung area showed interstitial fibrosis. The fibrogenic activity of tremolite was also demonstrated in mice given single intratracheal instillations of suspensions of 5 mg Indian tremolite asbestos in saline (250 mg/kg body weight) (Sahu et al. 1975). Examination of lung tissue from mice sacrificed at 1, 2, 7, 15, 30, 60, 90, 120, and 150 days after instillation showed signs of a progressive fibrogenic reaction consisting of moderate proliferation of alveolar macrophages starting at 30 days, phagocytosis at 60 days, and moderate reticulinosis by 90 days. The fibrosis was classified as "grade I," compared with a more severe "grade II" fibrosis from similar exposure to amosite fiber suspensions. The results show that exposure of rats and mice to tremolite asbestos leads to a progressive development of pulmonary interstitial fibrosis after exposure has ceased. They are consistent with results from human studies indicating a long latency of development of pulmonary fibrosis from exposure to high concentrations of asbestos fibers. Animal studies designed to characterize exposure-response relationships for pulmonary fibrosis and varying concentrations of airborne tremolite asbestos were not located; neither were studies examining nonmalignant pleural changes in animals and exposure to airborne tremolite asbestos.

Lung Cancer. Elevated incidences of lung cancer and respiratory cancers have been observed in Libby, Montana, vermiculite workers exposed to tremolite asbestos. Results from studies of animals exposed to tremolite asbestos by inhalation and intratracheal instillation confirm that tremolite asbestos can induce lung cancer.

Mortality studies of Libby, Montana, vermiculite workers exposed to tremolite asbestos found excess mortalities from lung cancer (SMR=2.23; 95% CI=1.36, 3.45; 20 observed versus 9.0 expected; Amandus and Wheeler 1987) and respiratory cancer (SMR=2.45; 95% CI not reported; 23 observed deaths; expected deaths not reported; McDonald et al. 1986b). The respiratory cancer category included malignant neoplasms of the larynx, trachea, bronchus, lung, pleura, and mediastinum. Both studies found statistically significant relationships between increased risk for lung or respiratory cancer and increasing cumulative exposure. A precise tobacco smoking adjustment of the data could not be made, and some portion of the excess lung cancer occurrence may be reasonably attributed to smoking (Amandus and Wheeler 1987). Tobacco smoking, a potential confounding factor, was not addressed in the study by McDonald et al. (1986b). Comparative analysis of exposure-response relationships with other studies of asbestos-exposed workers indicated that the slope of the exposure-response regression was steeper in the Libby workers than in other workers exposed predominantly to chrysotile or to chrysotile, amosite, and crocidolite, but was less steep than the slope for workers exposed in asbestos textile plants (Amandus and Wheeler 1987).

In a mortality study of South Carolina vermiculite workers (McDonald et al. 1988), no increased risk for lung cancer was found. McDonald et al. (1988) attributed the apparent absence of cancer effect in these vermiculite miners and millers to the small number of subjects in the study and the low levels of airborne fibers at the South Carolina workplace relative to the Libby, Montana, mine and mill. As discussed earlier, this source of vermiculite does not appear to contain significant quantities of amphibole asbestos (Atkinson et al. 1982).

Lung tumors were found in 18/39 SPF male Wistar rats (AF/HAN strain) exposed to 10 mg/m^3 Korean tremolite asbestos for 12 months and allowed to live until spontaneous death occurred (Davis et al. 1985a). Rats with tumors included 2 with benign and 16 with malignant tumors. No lung tumors were found in a concomitant control group of 36 nonexposed rats (Davis et al. 1985a). Primary benign or malignant lung tumors were found in 1/38 (adenoma) and 3/37 (1 adenoma, 1 adenocarcinoma, and 1 squamous cell carcinoma) female Wistar rats given 10 or 20 twice weekly intratracheal instillations of suspensions of 0.5 mg “fibrous” tremolite in saline (7×10^7 or 30×10^7 total fibers with length >5 µm, diameter <2 µm, and length:width ratio >5:1) (Pott et al. 1994). The test material in this study was not further characterized with respect to asbestiform or nonasbestiform habit. After treatment, the rats were allowed to live until spontaneous death. No lung tumors were found in 79 control rats instilled with saline. Pott et al. (1994) speculated that the lack of a marked lung carcinogenic response in their study was due to insufficient numbers of tremolite fibers instilled.

Mesothelioma. Elevated incidences of mesotheliomas have been observed in Libby, Montana, vermiculite workers exposed to tremolite asbestos and in inhabitants of rural villages in Greece, Corsica, and Turkey where tremolite-asbestos-rich surface deposits exist or where tremolite-asbestos-containing whitewashes were domestically produced and used to paint interior walls. Results from studies of animals exposed to tremolite asbestos by intrapleural implantation, intraperitoneal injection, and inhalation confirm that tremolite asbestos can induce mesothelioma.

In the cohort mortality studies of Libby, Montana, vermiculite workers exposed to tremolite asbestos, mesotheliomas were noted in 4 of the 165 deaths (proportionate mortality ratio [PMR] = 2.4%) studied by McDonald et al. (1986b) and 2 of the 161 deaths (PMR = 1.2%) studied by Amandus and Wheeler (1987). No mesotheliomas were identified among the 51 deaths in the cohort mortality study of vermiculite workers in a South Carolina mine and mill where airborne fiber concentrations were estimated to be much lower than in the Libby, Montana, workplaces (McDonald et al. 1988). Cohort mortality studies of other groups of vermiculite miners and millers were not located.

Cases of mesotheliomas have been reported among inhabitants of villages in the Metsovo region of Greece where whitewash containing tremolite asbestos was domestically produced and used to paint interior walls (Constantopoulos et al. 1987b, 1991; Langer et al. 1987; Sakellariou et al. 1996). Six pleural mesotheliomas were reported among 600 deaths (about 1%) that occurred in four of these villages between 1981 and 1985 (Constantopoulos et al. 1987b; Langer et al. 1987). Constantopoulos et al. (1987b) noted that the incidence of mesothelioma deaths in the Metsovo region between 1981 and 1985 was about 300 times greater than expected in a non-asbestos-exposed population. Sakellariou et al. (1996) later reported that eight cases were recorded in the Metsovo region between 1980 and 1984 and that six cases were recorded for the 1985–1994 period. Sakellariou et al. (1996) proposed that the incidence of pleural mesothelioma may be decreasing as the use of the tremolite–asbestos whitewash is diminishing.

Other regions in which cases of mesothelioma have been attributed to environmental exposure to tremolite asbestos (not occupational exposure) include northeastern Corsica, a region with abundant surface deposits rich in tremolite fibers (Magee et al. 1986; Rey et al. 1993), the island of Cyprus (McConnochie et al. 1987), regions of New Caledonia (Luce et al. 1994, 2001), and regions of rural Turkey where tremolite-asbestos-containing whitewashes have been used domestically (Baris et al. 1988a, 1988b; Erzen et al. 1991; Metintas et al. 1999; Schneider et al. 1998; Yazicioglu et al. 1980).

Increased incidences of pleural tumors resembling human mesotheliomas have been observed in rats (Stanton et al. 1981; Wagner et al. 1982) and hamsters (Smith et al. 1979) exposed to tremolite asbestos by intrapleural implantation, in rats exposed to tremolite asbestos or actinolite asbestos samples by intraperitoneal injection (Davis et al. 1991; Pott et al. 1989; Roller et al. 1996, 1997), and in rats exposed to airborne tremolite asbestos (Davis et al. 1985a). Increases in most of these studies were statistically significant.

For example, pleural fibrosarcomas resembling human mesotheliomas developed in 22/28 (78.6%) and 21/28 (75%) female Osborne-Mendel rats within 2 years of intrapleurally implanting 40 mg of 2 tremolite asbestos samples in gelatin, compared with 17/598 (2.8%) control rats implanted with gelatin (Stanton et al. 1981)[4]. Percentages of fibers in the 2 tremolite asbestos samples with lengths >4 µm were 34% and 31% and diameters <2.5 µm were 100% and 94%. In another study, mesotheliomas were found in 36/36, 35/36, 32/33, and 24/36 rats given single 10-mg intraperitoneal doses of four samples of tremolite asbestos and allowed to live until spontaneous death (Davis et al. 1991). Respective median survival time for these groups of AF/HAN rats were 301, 365, 428, and 755 days, indicating some variance in tumor-development period. Numbers of fibers ($x10^5$) with length $8 µm and diameter <0.25 µm in 1 mg of these samples were 121, 8, 48, and 1, respectively. Mesotheliomas developed in only 4/33 and 2/36 rats given similar injections of two samples of tremolite that did not have as distinct an asbestiform morphology (no fibers with length $8 µm and diameter <0.25 µm were detected, although some fibers were detected with length $8 µm and diameter >0.25 µm) (Davis et al. 1991). Mesotheliomas also were found in 2/39 SPF male Wistar (AF/HAN strain) rats exposed by inhalation to 10 mg/m^3 Korean tremolite asbestos for 12 months, but none were found in 36 control rats (Davis et al. 1985a).

Overall Health Effects Weight of Evidence Studies of workers exposed to airborne dusts of Libby, Montana, vermiculite containing tremolite asbestos provide strong evidence that exposure to high levels of airborne tremolite asbestos can lead to increased risk of structural changes in the lung and pleura including pulmonary fibrosis, pleural calcification, and pleural wall thickening (Amandus et al. 1987b; Lockey et al. 1984; McDonald et al. 1986a) and of death from nonmalignant respiratory disease (Amandus and Wheeler 1987; McDonald et al. 1986b). Additional observations adding to the evidence

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[4] In the Stanton et al. (1981) experiments, seven samples of refined talc from different sources were tested. No malignancies were found in 6 of the talc-exposed groups of rats, including one group exposed to talc containing significant concentrations of particles with structures having lengths > 8 µm and diameters #0.25 µm. The incidence of rats with pleural sarcomas in the other talc-exposed group (1/26) was not significantly elevated compared with the incidence in a combined control group that included untreated rats and rats implanted with noncarcinogenic material.

that long-term exposure to airborne tremolite fibers can lead to the development of nonmalignant changes in the lung and pleura include:

- high prevalences of pleural calcification among residents of villages in Greece (Bazas 1987; Bazas et al. 1985; Constantopoulos et al. 1985, 1987a, 1991), Turkey (Baris et al. 1988a; Coplu et al. 1996; Dumortier et al. 1998; Metintas et al. 1999; Yazicioglu et al. 1980), and Corsica (Boutin et al. 1989; Rey et al. 1993, 1994) where whitewashes containing tremolite asbestos have been used domestically or where there are abundant surface deposits rich in tremolite asbestos, and
- progressive pulmonary fibrogenic reactions in the lungs of rats and mice after exposure to tremolite asbestos by inhalation or intratracheal instillation (Davis et al. 1985a; Sahu et al. 1975).

Evidence that repeated exposure to airborne tremolite asbestos can lead to increased risk for the development of lung cancer includes observations of statistically significantly increased rates of mortality from lung cancer in groups of Libby Montana vermiculite workers compared with rates for the general population (Amandus and Wheeler 1987; McDonald et al. 1986b), statistically significant relationships between cumulative fiber exposure measures and prevalence of lung or respiratory cancer among Libby vermiculite workers (Amandus and Wheeler 1987; McDonald et al. 1986b), and increased incidences of lung tumors in rats exposed to tremolite asbestos by inhalation (Davis et al. 1985a) or intratracheal instillation (Pott et al. 1994). The weight of the human evidence for tremolite asbestos-induced lung cancer is limited by the inability to adjust for likely confounding factors from smoking in the Libby vermiculite workers.

There is a causal relationship between long-term exposure to airborne tremolite asbestos and mesothelioma, which is a rare fatal cancer accounting for 2.87 deaths per million within the U.S. white male general population in 1996 (NIOSH 1999). The evidence includes elevated prevalences of mesothelioma deaths (of about 1/100 to 2/100) among groups of Libby, Montana, vermiculite workers (Amandus and Wheeler 1987; McDonald et al. 1986b), among residents of Greek (Constantopoulos et al. 1987b, 1991; Langer et al. 1987; Sakellariou et al. 1996), Turkish (Baris et al. 1988a, 1988b; Erzen et al. 1991; Metintas et al. 1999; Schneider et al. 1998; Yazicioglu et al. 1980), and New Caledonia (Luce et al. 1994, 2001) villages that used tremolite-asbestos whitewashes on interior walls, and in regions of northeastern Corsica and Cyprus that have abundant surface deposits of tremolite asbestos (Magee et al. 1986; McConnochie et al. 1987; Rey et al. 1993). Strong supporting evidence comes from animal studies showing increased incidences of pleural tumors resembling human mesotheliomas in rats (Stanton et al. 1981; Wagner et al. 1982) and hamsters (Smith et al. 1979) exposed to tremolite asbestos by intrapleural implantation, in rats exposed to tremolite asbestos or actinolite asbestos samples by intraperitoneal injection (Davis et al. 1991; Pott et al. 1989; Roller et al. 1996, 1997), and in rats exposed to airborne tremolite asbestos (Davis et al. 1985a).

Clinical Aspects of Diseases Associated with Exposure to Asbestos

Exposure to tremolite asbestos or other forms of asbestos can increase risks for developing pleural plaques, pleural thickening (i.e. pleural fibrosis), pleural effusions, interstitial lung fibrosis, lung cancer, and mesothelioma.

Asbestos-related pleural abnormalities have been commonly associated with asbestos-related lung parenchyma lesions, but the American Thoracic Society (1986) noted that they should be diagnosed separately because “there are differences between pleural and parenchymal fibrosis in epidemiology, clinical features, and prognosis.” Asbestos-related pleural plaques have been described as “fibrohyaline nodular lesions, most often on the parietal pleura, but also on the diaphragmatic pleura and less frequently on the pericardium” (Mossman and Gee 1989).

Unlike people with pleural plaques alone, who do not have impaired pulmonary functions or symptoms such as chest pain, persons with asbestos-related pleural thickening commonly experience symptoms and have impaired pulmonary function (American Thoracic Society 1986). Studies of groups of modern asbestos workers, who likely were exposed to lower airborne concentrations of asbestos fibers than workers in the first half of the twentieth century, found that the prevalence of pleural abnormalities (most often plaques) is often as high as 10 times higher than the prevalence of parenchymal abnormalities (Becklake 1994; Mossman and Gee 1989; Orlowski et al. 1994). Pleural effusions are early manifestations of inhalation exposure to high concentrations of asbestos; the fluid contains varying amounts of red blood cells, macrophages, lymphocytes, and mesothelial cells (American Thoracic Society 1986; Mossman and Gee 1989). Pleural effusions may be an early indication of mesothelioma and warrant further evaluation. Early identification of mesothelioma and intervention may increase chances of survival (ATSDR 2000).

The American Thoracic Society (1986) defines asbestosis as interstitial fibrosis of the lung parenchyma from exposure to asbestos. Studies of occupationally exposed patients who develop asbestosis have shown that latency periods of at least 15 years are common between the time of initial exposure to asbestos fibers and the onset of respiratory symptoms (American Thoracic Society 1986; Kamp and

Weitzman 1997; Mossman and Gee 1989). These symptoms include shortness of breath during physical exertion (i.e., exertional dyspnea), pleuritic chest pain, phlegm production, wheezing, and end-inspiratory crackles. Lung functions that can be decreased are lung volumes, pulmonary compliance, and diffusing capacity for carbon monoxide (DLCO) (Becklake 1994; Kamp and Weitzman 1997).

Clinical diagnosis of asbestosis is accomplished by a reliable exposure history; a latency period of at least 15–20 years since first exposure; chest radiographic evidence of parenchymal abnormalities (small, irregular opacifications of a profusion of 1/1 or greater); a restrictive pattern of lung impairment with a reduced forced vital capacity; reduced diffusing capacity; and bilateral late or pan inspiratory crackles (American Thoracic Society 1986). Chest radiography is the most important clinical tool for the diagnosis of asbestosis. Supplemental use of high resolution computerized tomography improves the sensitivity and accuracy of detecting parenchymal and pleural changes that can account for symptoms of respiratory distress and lung function deficits in patients (Aberle et al. 1988a, 1988b; Becklake 1994; Begin et al. 1992; Harkin et al. 1996; Klaas 1993). When clinically indicated, detection of asbestos bodies (fibers surrounded by a coat of iron and protein) in surgically removed lung parenchymal tissue with diffuse interstitial fibrosis confirms the diagnosis of asbestosis (American Thoracic Society 1986).

People who repeatedly inhale dusts with tremolite asbestos also are expected to have increased risk for lung cancer and malignant mesothelioma. Several studies of asbestos workers have found that smoking increases the risk of lung cancer in a greater than additive manner, but does not appear to increase the risk for mesothelioma (Berry et al. 1985; Hammond et al. 1979; McDonald et al. 1980; Selikoff et al. 1980).

Eighty to ninety percent of patients diagnosed with mesothelioma report a history of occupational or environmental exposure to some form of asbestos (Attanoos and Gibbs 1997; Bianchi et al. 1997; Colt 1997; Roggli et al. 1997). Malignant mesothelioma is an aggressive and fatal cancer that is most often located in the pleura (90%) and sometimes in the peritoneum (6%–10%) (Attanoos and Gibbs 1997; Kelley 1998). In a review of 1,690 cases of mesothelioma associated with occupational exposure to asbestos, the authors reported that the median period of latency between initial exposure and detection was 32 years; 99% and 96% of the cases had latency periods of more than 15 and 20 years, respectively (Lanphear and Buncher 1992).

Treatment options are few for patients diagnosed with asbestos-related nonmalignant lung or pleural disease. Preventing further exposure and ceasing any tobacco smoking activities are the most important steps individuals can take to minimize development of health problems. Once developed, these diseases may remain stable or progress in severity in the absence of further exposure (Becklake 1994). The diseases rarely regress. Treatment options for patients diagnosed with asbestos-related cancer of the lung or pleura are restricted to resection and/or chemotherapy. One study suggests that subjects who stop smoking after already having been exposed to asbestos show some improvement in lung health (Waage et al. 1996), but long-term data for the effectiveness of cessation of smoking in large cohorts of asbestos-exposed individuals are not available.

Conclusions

- Tremolite is an amphibole mineral that most commonly exists in the earth's crust in forms that are nonasbestiform. Tremolite asbestos has only rarely been found in amounts sufficient for commercial use, but has been reported to occur at various sites throughout the world.

- Vermiculite deposits in the region of Libby, Montana, contain fibrous amphibole that is popularly called tremolite asbestos. Although scientists have called this mineral by various names, there is agreement that exposure to the mineral increased the risk of nonmalignant respiratory and pleural disorders, lung cancer, and mesothelioma in Libby mine and mill workers. The mine has been closed since 1990, and access to the sites is restricted.

- Exposure to all types of asbestos can increase the risk of developing lung cancer, malignant mesothelioma, and nonmalignant respiratory and pleural effects, including pulmonary interstitial fibrosis (asbestosis), pleural plaques, pleural calcification, and pleural thickening. Asbestos-exposed smokers have greater than additive risks for lung cancer and asbestosis than do asbestos-exposed nonsmokers.

- Important determinations of asbestos toxicity include exposure concentration, duration, fiber dimensions, and fiber durability. There is animal and human evidence that long fibers are retained in the lungs for longer periods than short fibers and that amphibole fibers, such as tremolite asbestos, are retained longer than chrysotile fibers. Short and long fibers may contribute to the pathogenesis of inflammation, fibrosis, and cancer in humans, but their relative importance is uncertain.

- Latency periods for the development of asbestos-related nonmalignant respiratory effects are usually 15–40 years from the time of initial exposure to asbestos.

- The latency periods are generally 20 years or more for lung cancer and 30 years or more for mesothelioma due to asbestos exposure.

- Occupational exposure to asbestos may occur in workers involved in mining, milling, and handling of certain sources of chrysotile and vermiculite ores; in exfoliating vermiculite that contains tremolite asbestos; and in mining, milling, and handling of other ores and rocks that may contain tremolite asbestos. Residents who live close to mining, milling, or manufacturing sites that involve tremolite asbestos-containing-material may be potentially exposed to higher levels of airborne tremolite asbestos than levels in general ambient air.

- Asbestos may be released to indoor or outdoor air as a result of the disturbance of asbestos-containing building materials such as insulation, fire-proofing material, dry wall, and ceiling and floor tile. Amphibole asbestos has been found in some sources of vermiculite that has been used as home and building insulation. Workers or homeowners involved in demolition work or asbestos removal, or in building or home maintenance, repair, and remodeling, potentially can be exposed to higher levels of airborne asbestos than levels in general ambient air. In general, exposure may occur only when the asbestos-containing material is disturbed in some way to release asbestos fibers into the air. When asbestos-containing materials are solidly embedded or contained, exposure will be negligible.

- Recently, small amounts of amphibole asbestos have been found in some samples of vermiculite-containing consumer garden products and in some talc-containing crayons. Consumers can reduce possible exposure by limiting the production of dusts when using the garden products. The risk that children might be exposed to asbestos fibers through inhalation or ingestion of crayons containing asbestos and transitional fibers is extremely low. The U.S. manufacturers of these crayons, however, have agreed to eliminate talc from their products in the near future.

- The combined use of light microscopy, electron microscopy (transmission and scanning), and x-ray dispersive methods in analyzing air and/or bulk material samples offers the most accurate approach to estimating airborne asbestos concentrations.

- Clinical diagnostic methods for determining exposure and effects of asbestos include chest radiography, pulmonary function tests, and high resolution computerized tomography.

Microscopic detection of asbestos bodies in autopsied or biopsied lung tissue can be used to confirm exposure when tissue is available.

- Pleural effusions are early manifestations of inhalation exposure to high concentrations of asbestos. Pleural effusions may be an early indication of mesothelioma and warrant further evaluation. Early identification of mesothelioma and intervention may increase chances of survival.

- Additional research may help to develop therapeutic methods to interfere with the development of nonmalignant lung and pleural disorders, and to cause the disorders to regress once they are established. Such research may include studies on the mechanism of asbestos-related disease to provide further understanding of how persistent production of reactive oxygen or nitrogen species and persistent inflammatory cellular responses precisely interact.

Recommendations

Prevention of exposure and cessation of any tobacco smoking activities are the most important steps that individuals can take to prevent or minimize the development of asbestos-related health problems.

People who were exposed to asbestos and who smoke are expected to be unusually susceptible to asbestos-related lung cancer and asbestosis and are encouraged to cease smoking. Studies of asbestos workers indicate that asbestos-exposed smokers have greater than additive risks for lung cancer and asbestosis than asbestos-exposed nonsmokers. Although the mechanism of this interaction is poorly understood, one possible mechanism that has received some support from research is that smoking can decrease the clearance of asbestos fibers from the lung by impairing mucociliary action and macrophage activity (see ATSDR 2001a for review).

Individuals residing or working in buildings with insulation or other building materials that may potentially contain asbestiform minerals (for example, vermiculite from the Libby Montana mine) are encouraged to ensure that the insulation material is solidly contained and not able to be disturbed and become airborne. If the material is to be removed, special procedures must be followed that minimize the generation of dust and specify appropriate locations for disposal. Individuals can obtain information about asbestos removal and disposal procedures from the 10 regional offices of the EPA.

Further evaluation of the progression of disease associated with exposure to Libby, Montana vermiculite contaminated with asbestos is warranted. EPA, ATSDR, and other agencies currently are investigating exposure levels that Libby, Montana, residents (including children) who were not employed in the vermiculite mines and mills may have and are experiencing. In addition, ATSDR is currently conducting medical testing of individuals potentially exposed to fibrous amphibole associated with vermiculite in Libby, Montana.

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APPENDIX F

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APPENDIX F

INDEX

Attachment #18

COMMUNITY DEVELOPMENT AGENCY
DEVELOPMENT SERVICES DIVISION

http://www.edcgov.us/DevServices/

PLACERVILLE OFFICE:
2850 Fairlane Court, Placerville, CA 95667
BUILDING
(530) 621-5315 / (530) 622-1708 Fax
bldgdept@edcgov.us
PLANNING
(530) 621-5355 / (530) 642-0508 Fax
planning@edcgov.us

LAKE TAHOE OFFICE:
3368 Lake Tahoe Blvd., Suite 302
South Lake Tahoe, CA 96150
(530) 573-3330
(530) 542-9082 Fax
tahoebuild@edcgov.us

TO: Planning Commission — Agenda of: September 11, 2014

FROM: Mel Pabalinas

DATE: September 4, 2014

RE: A14-0001/Z14-0001/SP86-0002-R/PD94-0004-R-2/El Dorado Hills Apartments; Additional Information

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The following additional information for the above project is being provided for your review and consideration.

1) Tally of Public Comments

Exhibit A details the tally of all comments received for the project through September 4, 2014. The tally provides a breakdown of the quantity and source of comments sorted by support and non-support of the project. Of the 108 total comments, 39 are in support of the project, 13 are non-support, and 56 comments posed concerns but did not specifically express non-support or state opposition to the project. All comments received for the project have been forwarded to the Commission.

2) Trip Generation Comparison

Exhibit B is a memo from Natalie Porter, Traffic Engineer, from Long Range Planning Division. As a supplement to the traffic analysis for the project, the memo details a comparison of the trip generation between the underlying commercial use (based on the approved El Dorado Hills Town Center East Planned Development) and the proposed multifamily use. The memo concludes that there are 37 fewer PM peak hour trips under the proposed multifamily use without internal trip adjustment.

3) Project Comments from El Dorado County Sheriff's Office

Exhibit C is a memo from the El Dorado County Sheriff's Office discussing the department's concern on the project as it relates to design and its potential effects to their current and future law enforcement service in the El Dorado Hills area. The memo concludes that two full-time

Deputies would be needed to provide service coverage in this area based on growth and increased service requests. Staff is not recommending any changes to the project or Conditions of Approval at this time. Staff will be having a discussion with the Sheriff's Office and CAO regarding the potential for funding law enforcement.

Attachments to Staff Memo

Exhibit A	Summary of Written and Oral Comments (May 27, 2014 – September 4, 2014)
Exhibit B	Community Development Agency, Long Range Planning Division, Memo on Trip Generation Comparison; August 29, 2014
Exhibit C	El Dorado County Sheriff's Office Areas of Concern-New Development; El Dorado Hills Apartments; August 21, 2014

\\dsfs0\DS-Shared\DISCRETIONARY\A\2014\A14-000,SP86-0002R, Z14-0001,PD94-0004R2 (El Dorado Hills Apartments)\Planning Commission #3\091114\Staff Memo 09-04-14.docx

El Dorado Hills Town Center East Apartments
Summary of Written and Oral Comments (May 27, 2014 – September 4, 2014)

Written Comments

Individuals 58 letters/emails			***Commercial*** 10 letters/emails		***Other (agencies and organizations)*** 7 letters/emails[c]		
Support	Non-Support	Concerns but did not specifically express non-support or state opposition to project	Support	Non-Support	Support	Non-Support	Concerns but did not specifically express non-support or state opposition to project
3	7	48	9[a]	1[b]	-	2[d]	2

Oral Comments at 6/26/14 Planning Commission

Individuals (Public) 9 speakers			***Commercial*** 0 speakers		***Other (agencies and organizations)*** 0 speakers		
Support	Non-Support	Concerns but did not specifically express non-support or state opposition to project	Support	Non-Support	Support	Non-Support	Concerns but did not specifically express non-support or state opposition to project
1	2	6	n/a	n/a	n/a	n/a	n/a

Comments Subsequent to 6/26/14 Planning Commission

Individuals (Public) 3 letter/email			***Commercial*** 24 letters/email		***Other (agencies and organizations)*** 0 letters/email		
Support	Non-Support	Concerns but did not specifically express non-support or state opposition to project	Support	Non-Support	Support	Non-Support	Concerns but did not specifically express non-support or state opposition to project
2	1	n/a	24[e]	n/a	n/a	n/a	n/a

Notes:

a CBRE Land Investments, CBRE Retail Services, CBRE Industrial Properties, El Dorado Hills Chamber of Commerce, Foothills Partners, PC Stelmakia LP, Town Center East LP, Roebblen, Youngdahl

b The Marketplace at Town Center East

c Three letters from agencies (CVRWQCB, Caltrans, EID) and four letters from organizations (APAC, Four Seasons Civic League, Measure Y Committee, Save Our County)

d APAC, Four Seasons Civic League

e Includes El Dorado Hills Business Park Owners Association, O1 Communications, and businesses in Montano Commercial Development

- No letters specifically expressing support

n/a not applicable

EXHIBIT A

COMMUNITY DEVELOPMENT AGENCY
LONG RANGE PLANNING DIVISION

INTEROFFICE MEMORANDUM

Date: August 29, 2014

To: Rommel Pabalinas, Senior Planner

From: NKP Natalie K. Porter, P.E., T.E.
Traffic Engineer

Subject: Trip Generation Comparison for the El Dorado Hills Town Center Apartment Project (A14-0001/Z14-0001/SP86-0002-R/PD94-0004-R-2)

BACKGROUND

The El Dorado Hills Town Center Apartment Project is being proposed for development on a current vacant parcel within Town Center East. This proposed change requires a General Plan Amendment, a Specific Plan Amendment, Rezone and a revision to the approved Development Plan.

One of the Planning Commissioners requested an easy to follow summation of the potential number of trips that could be generated by the current approved land uses (commercial) versus the alternative proposed land use (residential - apartments).

The following is a summation of the trip generation discussion and tables from the *El Dorado Hills Town Center Apartments Transportation Impact Analysis (TIA)*, May 2014, prepared by Fehr & Peers. In addition to the peak hour information, the daily trip generation is also included in the discussion below.

EL DORADO HILLS TOWN CENTER APARTMENTS TRIP GENERATION

The trip generation, which is a prediction of the number of person trip ends that are generated by and attracted to a particular land use, was calculated using rates from the Institute of Transportation Engineers (ITE) *Trip Generation Manual, 9th Edition*, which provides industry accepted guidelines.

Current Approved Land Use

Based on the Declaration of Use Restrictions and Agreement to Grant Easements for El Dorado Hills Town Center East, the current approved land use for Parcels 1-3 (see pages 49 – 50 of the *El Dorado Hills Town Center Apartments TIA*, May 2014) can include the following land uses:

- Parcel 1: General Commercial/Retail use with a maximum of 20,000 square feet of gross rental area.
- Parcel 2: Full-service hotel and conference center that will include, at a minimum (i) 100 hotel rooms, (ii) a table service lunch and dinner restaurant containing not less than 4,000 square feet and not more than 4,500 square feet of gross rentable area, (iii) a conference facility sufficient to accommodate at least 250 persons, and (iv) retail space with frontage on Town Center Boulevard containing no less than 3,000 square feet of gross rentable area.

EXHIBIT B

- Parcel 3: General Commercial/Retail use, with a minimum of 10,000 square feet of rentable retail shop space with frontage on Town Center Boulevard.

These uses have the following trip generation rates:

Parcel 1:

General Commercial/Retail, using ITE code 820 (Shopping Center). Shopping centers are groups of integrated commercial establishments. As integrated developments, many trips will occur between different establishments without traveling outside the shopping center, due to the convenience of having complementary land uses near each other. This trip internalization increases with larger shopping centers. To account for trip internalization of the approved commercial land use, the average trip rate for ITE code 820 was applied, since it results in lower trip generation compared to using the fitted curve equation. The fitted curve equation is a more project-specific application that usually results in a higher rate. Therefore, using the average trip rate is a conservative assumption, since it results in lower trip generation for the approved land uses.

For 20,000 sq. ft. of General Commercial/Retail

Daily rate: 42.70 trips per 1,000 sq. ft. leasable area = 854 daily trips

AM peak hour rate: 0.96 = 12 in, 7 out = 19 total AM peak hour trips
PM peak hour rate: 3.71 = 36 in, 38 out = 74 total PM peak hour trips

Parcel 2:

Full-service hotel, using ITE code 310 (Hotel) plus 3,000 square feet of retail, using ITE code 820 (Shopping Center). The full-service hotel land use in ITE includes restaurant uses common to hotels. Therefore, the restaurant described in the Use Restriction was assumed part of the hotel, a conservative assumption (i.e., on the low side), since a stand-alone restaurant would generate more trips.

1. For 100 rooms in a Full-service hotel :

Daily rate: 8.92 trips per occupied room = 892 daily trips

AM peak hour rate: 0.67 = 39 in, 28 out = 67 total AM peak hour trips
PM peak hour rate: 0.70 = 34 in, 36 out = 70 total PM peak hour trips

2. For the 3,000 sq. ft. of retail:

Daily rate: 42.70 trips per 1,000 sq. ft. leasable area = 128 daily trips

AM peak hour rate: 0.96 = 2 in, 1 out = 3 total AM peak hour trips
PM peak hour rate: 3.71 = 5 in, 6 out = 11 total PM peak hour trips

Parcel 3:

General Commercial /Retail, using ITE code 820.

For 10,000 sq. ft. of General Commercial/Retail:

Daily rate: 42.70 trips per 1,000 sq. ft. leasable area = 427 daily trips

AM peak hour rate: 0.96 = 6 in, 4 out = 10 total AM peak hour trips
PM peak hour rate: 3.71 = 18 in, 19 out = 37 total PM peak hour trips

Total Trip Generation for the Current Approved Land Use:

Daily: 854 + 892 + 128 + 427 = 2,301 total daily trips

AM peak hour: 19 + 67 + 3 + 10 = 99 total AM peak hour trips
PM peak hour: 74 + 70 + 11 + 37 = 192 total PM peak hour trips

Proposed Project Land Use:

Multi-Family Housing (see pages 27 – 29 of the *El Dorado Hills Town Center Apartments TIA*, May 2014), ITE code 220 (Apartment), replacing the current approved land use for Parcels 1, 2 and 3.

For 250 apartment units:

Daily rate: 6.65 trips per dwelling unit = 1,663 total daily trips

AM peak hour rate: 0.51 = 26 in, 102 out = 128 total AM peak hour trips
PM peak hour rate: 0.62 = 101 in, 54 out = 155 total PM peak hour trips

By matching trip ends within the Town Center East, an internal reduction for PM peak hour rate was calculated: 18 in, 10 out = 28 total internal trips for PM peak hour trips. Examples of internal trips include an apartment resident going to one of the restaurants in Town Center, to the movie theatre, or to any of the shopping opportunities within Town Center instead of generating a trip to any of the commercial uses in Town Center from anywhere outside the boundaries of Town Center East. As a conservative estimate, no internal reduction was assumed for the AM peak hour, although it is reasonable to expect residents of the proposed project going to Starbucks or getting gas on their way to work in the morning. Both these trips would represent internal trips relative to Town Center East.

Net PM peak hour trips: 101 in - 18 in = 83 in
54 out – 10 out = 44 out
(Total: 155 – 28 = 127 total PM peak hour trips)

CONCLUSION

Trip Generation difference between Current Approved Land Use and Proposed Project Land Use:

Daily = 2,301 – 1,663 = 638 fewer trips under Proposed Land Use
AM peak hour: 99 – 128 = -29 AM peak hour trips (29 more under Proposed Land Use)
PM peak hour: 192 – 127 = 65 fewer PM peak hour trips under Proposed Land Use
(37 fewer PM peak hour trips under Proposed Land Use without internal trip adjustment)

EL DORADO COUNTY SHERIFF'S OFFICE AREAS OF CONCERN-NEW DEVELOPMENT

EL DORADO HILLS APARTMENTS
August 21, 2014

EXHIBIT C

EL DORADO COUNTY SHERIFF'S OFFICE

AREAS OF CONCERN-SUFFICIENT STAFFING

OBJECTIVE

Address areas of concern in regards to change of development to the El Dorado Hills Specific Plan

PURPOSE

With the proposed change of the Specific Plan in El Dorado Hills as it pertains to housing in the Town Center area, the Sheriff's Office has gathered information to better inform the Planning Commission Board and the Board of Supervisors as it pertains to the safety and services to citizens of El Dorado County.

This information was brought to the attention of the Sheriff's Office through the Planning Department of El Dorado County as outlined in the El Dorado County General Plan 5.7.3.1-*Prior to approval of new development; the Sheriff's Department **shall** be requested to review all applications to determine the ability of the department to provide protection services. The ability to provide protection to existing development **shall** not be reduced below acceptable levels as a consequence of new development. Recommendations such as the need for additional equipment, facilities, and adequate access may be incorporated as conditions of approval.*

COVER SHEET

EL DORADO HILLS APARTMENTS

TOWN CENTER

EL DORADO COUNTY, CA

PROPERTY DESCRIPTION

ADDRESS:	TOWN CENTER BLVD EL DORADO HILLS, CA EL DORADO COUNTY
APN:	121-290-60-100, 121-290-61-100, & 121-290-62-100
PROPERTY AREA:	4.565 AC (198,862 SF)

BUILDING DESCRIPTION

±227,297 SF 4-STORY APARTMENT BUILDING

STUDIO UNITS	24
ONE-BEDROOM UNITS	131
TWO-BEDROOM UNITS	95
TOTAL UNITS	250

PARKING SUMMARY

GARAGE STALLS	433
ON-SITE (EXCLUSIVE)	4
ON-SITE ACCESSIBLE (EXCLUSIVE)	1
TOTAL PROPOSED	438

TOTAL REQUIRED (Zoning Code)

1.6 STALLS PER 1-BEDROOM/STUDIO	248
2 STALLS PER 2-BEDROOM	190
TOTAL	438

INDEX OF DRAWINGS

SHEET	TITLE
SP1	COVER SHEET
SP2	PRELIMINARY SITE PLAN
SP3	PRELIMINARY GRADING & DRAINAGE PLAN
SP4	PRELIMINARY GRADING SECTIONS
SP5	PRELIMINARY UTILITY PLAN
SP6	SITE PHOTO EXHIBIT
V1	ALTA - ACSM SURVEY
A0.1	ILLUSTRATIVE SITE PLAN
A1.0	BUILDING FLOOR PLANS – FIRST LEVEL
A1.1	BUILDING FLOOR PLANS – SECOND LEVEL
A1.2	BUILDING FLOOR PLANS – LEVEL 3 & 4
A1.3	BUILDING FLOOR PLANS – ROOF PLAN
A2.0	BUILDING FLOOR PLANS – ELEVATIONS
A2.1	BUILDING FLOOR PLANS – ELEVATIONS
A2.2	BUILDING FLOOR PLANS – ELEVATIONS
A3.0	BUILDING FLOOR PLANS – SECTIONS
A4.0	BUILDING FLOOR PLANS – PIAZZA
A5.0	BUILDING MATERIALS
L1	PRELIMINARY LANDSCAPE PLAN
L2	PRELIMINARY PLANT PALETTE
E0.1	SYMBOLS LIST, GENERAL NOTES, & LIGHTING FIXTURE SCHEDULE
E1.1	SITE PLAN - PHOTOMETRIC

PROJECT INFORMATION

KEPHART

COVER SHEET
JANUARY 27, 2014
REVISED MAY 20, 2014

TSD ENGINEERING, INC.
expect more.
31 Natoma Street, Suite #160
Folsom, CA 95630
Phone: (916) 608-0707
Fax: (916) 608-0701

SP-1

EL DORADO COUNTY SHERIFF'S OFFICE

AREAS OF CONCERN-SUFFICIENT STAFFING

OBJECTIVE

Address areas of concern in regards to change of development to the El Dorado Hills Specific Plan

PURPOSE

With the proposed change of the Specific Plan in El Dorado Hills as it pertains to housing in the Town Center area, the Sheriff's Office has gathered information to better inform the Planning Commission Board and the Board of Supervisors as it pertains to the safety and services to citizens of El Dorado County.

This information was brought to the attention of the Sheriff's Office through the Planning Department of El Dorado County as outlined in the El Dorado County General Plan 5.7.3.1-*Prior to approval of new development; the Sheriff's Department* ***shall*** *be requested to review all applications to determine the ability of the department to provide protection services. The ability to provide protection to existing development* ***shall*** *not be reduced below acceptable levels as a consequence of new development. Recommendations such as the need for additional equipment, facilities, and adequate access may be incorporated as conditions of approval.*

PROPOSED CHANGE TO SPECIFIC PLAN:

On August 20, 2014, I met with representatives from the Planning Division and representatives from the developer of the El Dorado Hills Apartments. My understanding is that in the original approved Specific Plan the area between Mercedes Lane and Town Center Boulevard was scheduled to be a temporary housing (Hotel). The developers informed the County they wanted this to change to full time residency in the form of "Higher Scale" apartments.

In their justification the plan is good for the citizens who will want to live in close proximity to the offered entertainment and businesses in the Town Center area. While the Sheriff's Office is in favor of development in the community it brings up concerns of having full time residency established in such a busy area.

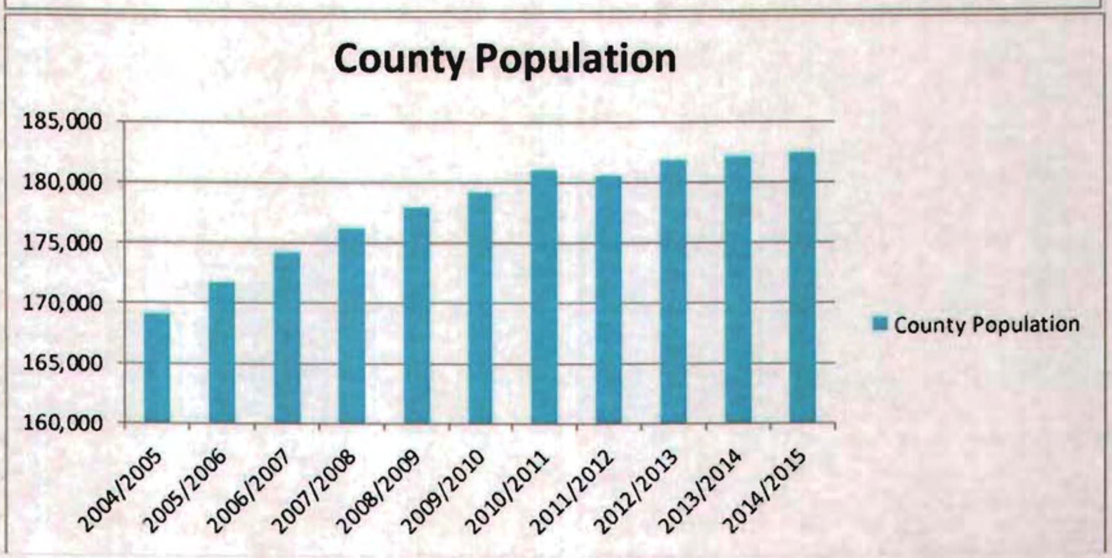
Based on past developments similar in size and locations, the developers estimated the population of the apartments to be an increase of approximately 400 new citizens to El Dorado County.

CURRENT SHERIFF STAFFING LEVELS:

For the 2014/2015 personnel allocation for the Sheriff's Office we have 164 sworn peace officers. This includes 1 Sheriff, 1 Undersheriff, 3 Captains, 7 Lieutenants, 24 Sergeants and 128 Deputy Sheriff's. Based on the most current figures of 2010 census data and total allocated positions for 2014/2015, the El Dorado County Sheriff's Office averages, one (1) sworn peace officers for every 1112 citizens. Below is a graph which illustrates the number of sworn El Dorado County Peace Officers and total population. Based on the average number of El Dorado County Sworn Peace Officers over the past ten years (173.5) we are currently 9.5 positions below our average. With this addition of population and location issues the Sheriff's Office is concerned with providing the quality of service or citizens are accustomed too, without increasing our staffing.

	SWORN PEACE OFFICERS PER 1,000 CITIZENS		
YEARS	SWORN	POPULATION	Sworn per 1000 Citizens
2004/2005	167.5	168,984	1 Sworn for every 1010 citizens
2005/2006	168.5	171,739	1 Sworn for every 1019 citizens
2006/2007	172.5	174,218	1 Sworn for every 1010 citizens
2007/2008	181.5	176,226	1 Sworn for every 971 citizens
2008/2009	197.5	177,897	1 Sworn for every 900 citizens
2009/2010	188	179,150	1 Sworn for every 953 citizens
2010/2011	184	181,058	1 Sworn for every 984 citizens
2011/2012	165	180,483	1 Sworn for every 1094 citizens
2012/2013	158	181,711	1 Sworn for every 1150 citizens
2013/2014	162	181,997	1 Sworn for every 1123 citizens
2014/2015	164	182,404	1 Sworn for every 1112 citizens

F.B.I. National Average=1.9 Officers for every 1000 people



SERVICE CONCERNS:

While the estimated population of approximately 400 new citizens is not a huge increase, the Sheriff's Office does feel the location of the apartments is going to dramatically increase our calls for service to this area. The area in which this complex is going has logistical issues which the Sheriff's Office feels will require additional staffing to provide the amount of service which will be required.

In the immediate area of Town Center there are several businesses and events which we feel will be cause for complaints by citizens who reside within the immediate area. These include a night club which serves alcohol, has dancing and remains open until 2:00 am. While the business does a good job of controlling the many visitors while at the club, the Sheriff's Office tends to get calls after these individuals leave the club at the end of the evening. The night club also offers outside seating which tends to cause calls for service from the local hotel located within the same general area. With the addition of permanent residency these calls for service will likely increase.

Also in the immediate area is a local movie theater. This movie theater is a hub for local teenagers and young adults to gather during the weekends and every night in the summer. The theater also has special showings at midnight throughout the year and on special occasions. Without permanent residency we are not called very often for noise or vehicle traffic issues. By placing permanent residency this could be a foreseen issue.

Town Center has many events throughout the year which we feel will contribute to an increase in calls for service. These events include summer concerts, holiday extravaganzas, street fairs, and farmer's markets. With the addition of permanent residency these events tend to go late in the evenings and early in the mornings. The Sheriff's Office will see an increase in calls for service regarding these events due to these new residents being permanent and being displaced due to road closures and constant activities.

Listed below is the statistical data comparing temporary residence (hotels) versus permanent residency (apartments) in the area of Town Center. Located within Town Center is the Holiday Inn Express. The closest apartment complexes to Town Center are located approximately a quarter mile away off of Valley View Drive. We used these locations to demonstrate the difference of calls for service between temporary and permanent residency.

STATISTICAL DATA ON CALLS FOR SERVICE

Holiday Inn Express (2009-2013)-**232** Calls for service

Vineyard Apartments (2009-2013)-**826** Calls for service

Valley View Apartments (2009-2013)-**1,412** Calls for service

AVERAGE CALLS PER YEAR

Holiday Inn Express-46

Vineyard Apartments-165

Valley View Apartments-282

We can correlate the increase based on a couple of different factors however, we as a Sheriff's Office feel the biggest influence between temporary and permanent residency is the type of residency that is created. People who visit a location are less likely to call for service when it is a shorter period of stay versus a permanent resident who repeatedly gets disturbed or concerned about the area they live. The permanent resident takes ownership of the area and is likely to call more quickly because of something suspicious, something that is disturbing them or something that is out of normalcy. A temporary resident doesn't know what is suspicious or out of normal and usually has a higher tolerance of reporting something when they are disturbed because they know it's only temporary.

ECONOMIC OPTIONS:

We discussed a couple of options to cover the costs of providing additional resources for this development.

- Imposing a tax or charge to the renter of the apartments to cover the cost of services (Similar to Mello Roos tax)
- Sharing the cost with the business owners of Town Center and the developers to contract with the Sheriff's Office for the needed staffing
- Contracting with the Sheriff's Office at overtime rates to have coverage on certain days and times.

CONCLUSION:

In order to support this project the Sheriff's Office would like to add staffing to continue to provide the current level of service to the citizens of El Dorado County and El Dorado Hills. Due to the figured and justified increase in calls for service, the Sheriff's Office is in need of two (2) full time Deputies to handle the increase in population based on growth and increased service requests. Two Deputies allow for the Sheriff's Office to have 24 hours coverage in this area. Below is a listed cost of hiring two (2) Deputy Sheriff's to assist in the increase of service that will need to be supplied.

DEPUTY SHERIFF (2)-$310,000

VEHICLE/EQUIPMENT COSTS-$103,966

TOTAL COSTS-$413,966

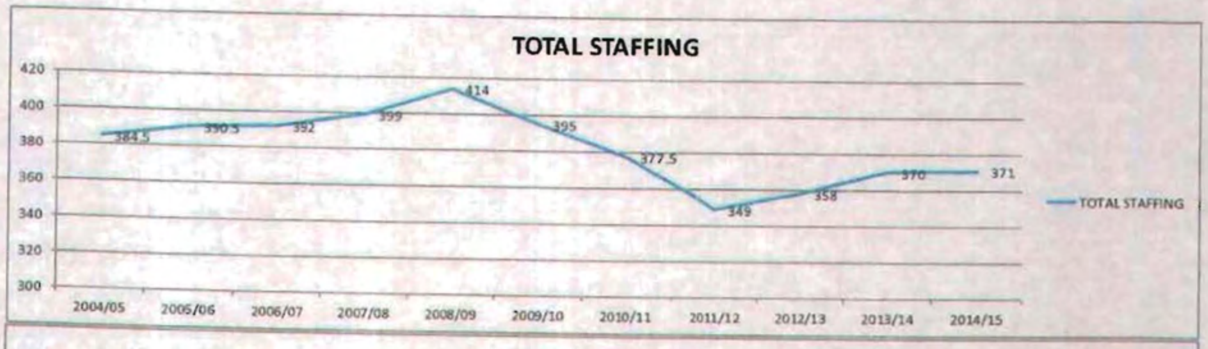
The Sheriff's Office has not increased our staffing with all the new developments especially in the west end of El Dorado County. Under the El Dorado County General Plan Policy 5.1.2.2 the Sheriff Office guidelines for the minimal levels of service are outlined that the Sheriff Office should have an 8 minute response to 80% of the population in Community Regions. In Rural Regions there is no standard listed in the General Plan. In the collection of data from 2001-2014 the Sheriff's Office has never been staffed to comply with the General Plan requirements. Listed in the back of this report is our statistical data as it relates to response times and increased calls for service.

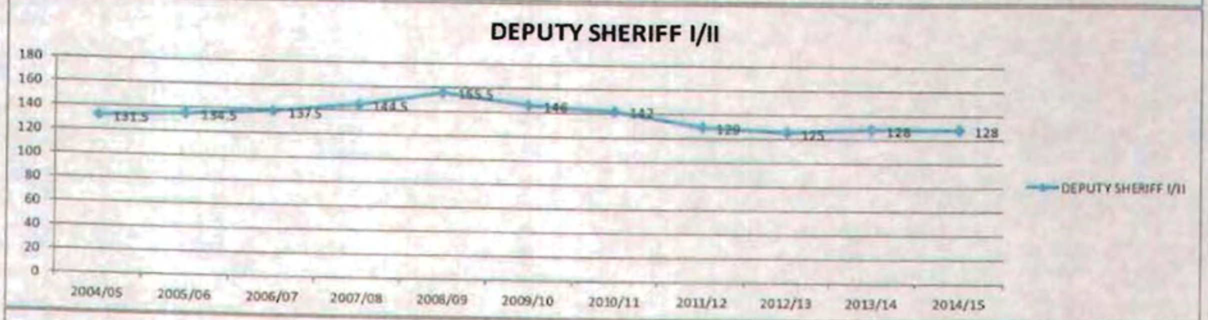
We as the Sheriff's Office are pleased to know that developers and citizens have a desire to build and move to El Dorado County. We are fully supportive of this happening. However, we have a responsibility to the current citizens and the one's hopeful in moving here to provide the quality of service that has become expected and need to increase our staffing levels to do so.

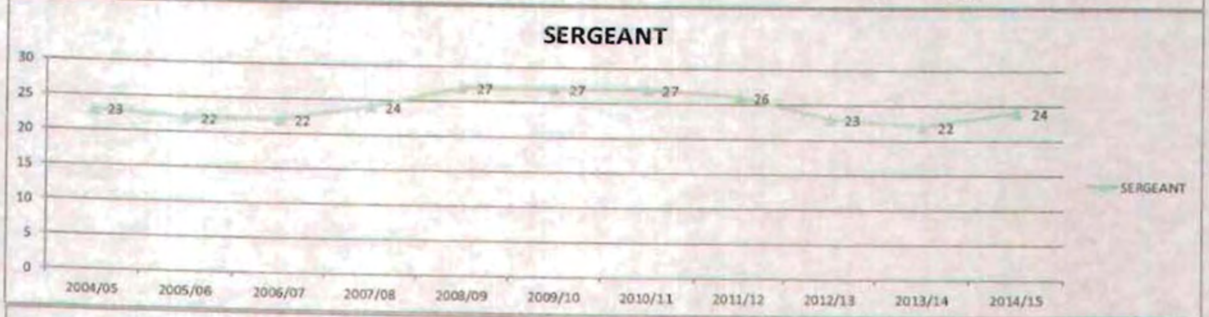
STATISTICAL INFORMATION

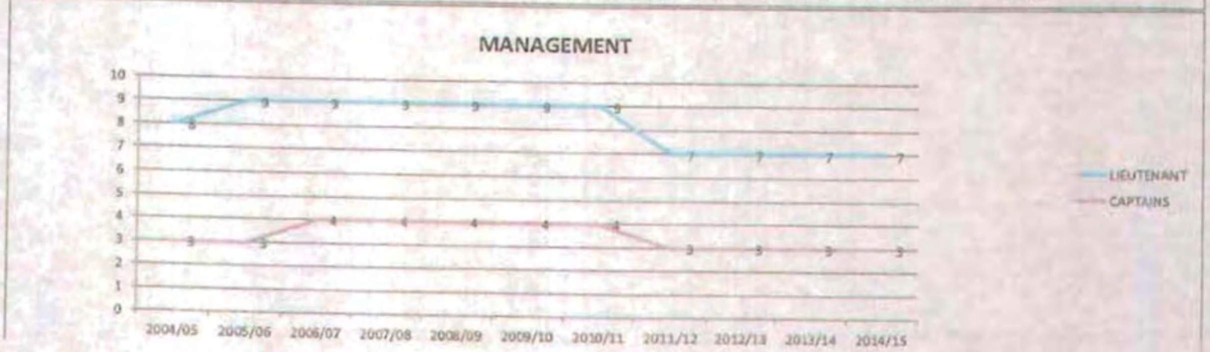
SHERIFF DEPARTMENT STAFFING NUMBERS

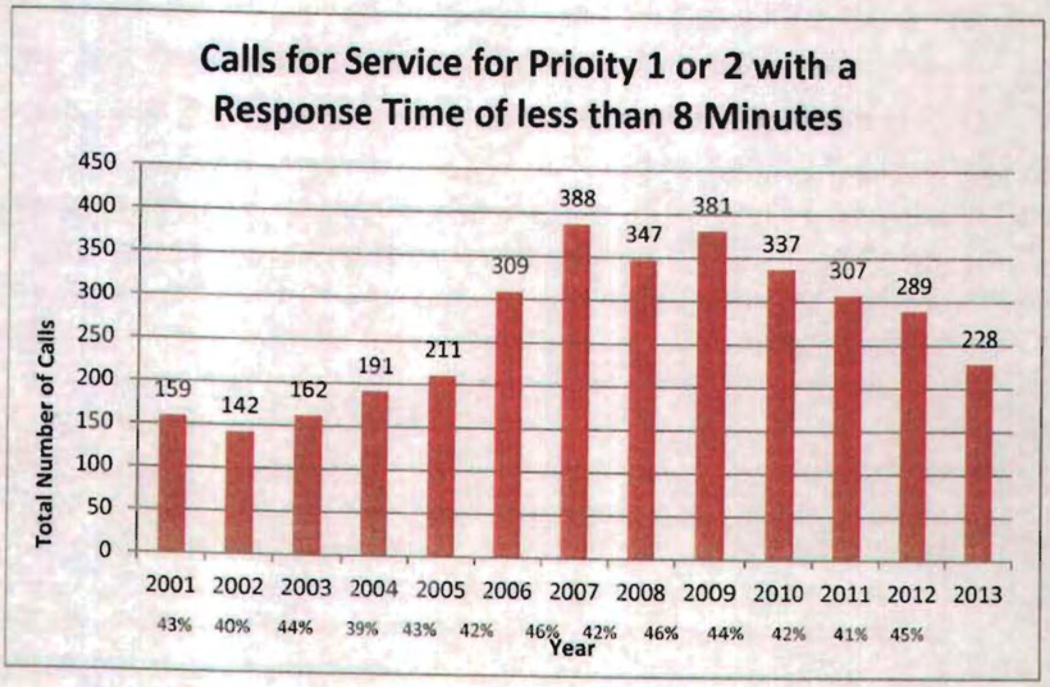
	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
DEPUTY SHERIFF'S	131.5	134.5	137.5	144.5	155.5	146	142	129	125	128	128
SHERIFF SERGEANTS	23	22	22	24	27	27	27	26	23	22	24
SHERIFF LIEUTENANTS	8	9	9	9	9	9	9	7	7	7	7
SHERIFF CAPTAINS	3	3	4	4	4	4	4	3	3	3	3
TOTAL STAFFING	384.5	390.5	392	399	414	395	377.5	349	358	370	371

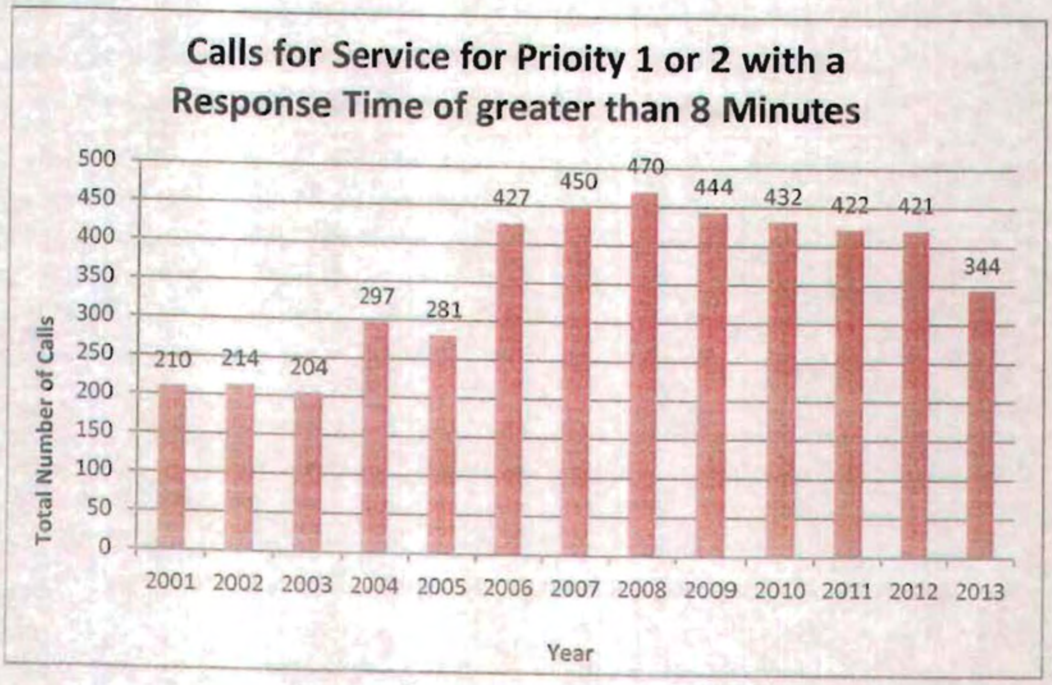









Calls for Service for Prioity 1 or 2 with a Response Time of less than 8 Minutes
Total Number of Calls
450
400
350
300
250
200
150
100
50
0
159
142
162
191
211
309
388
347
381
337
307
289
228
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
43% 40% 44% 39% 43% 42% 46% 42% 46% 44% 42% 41% 45%
Year

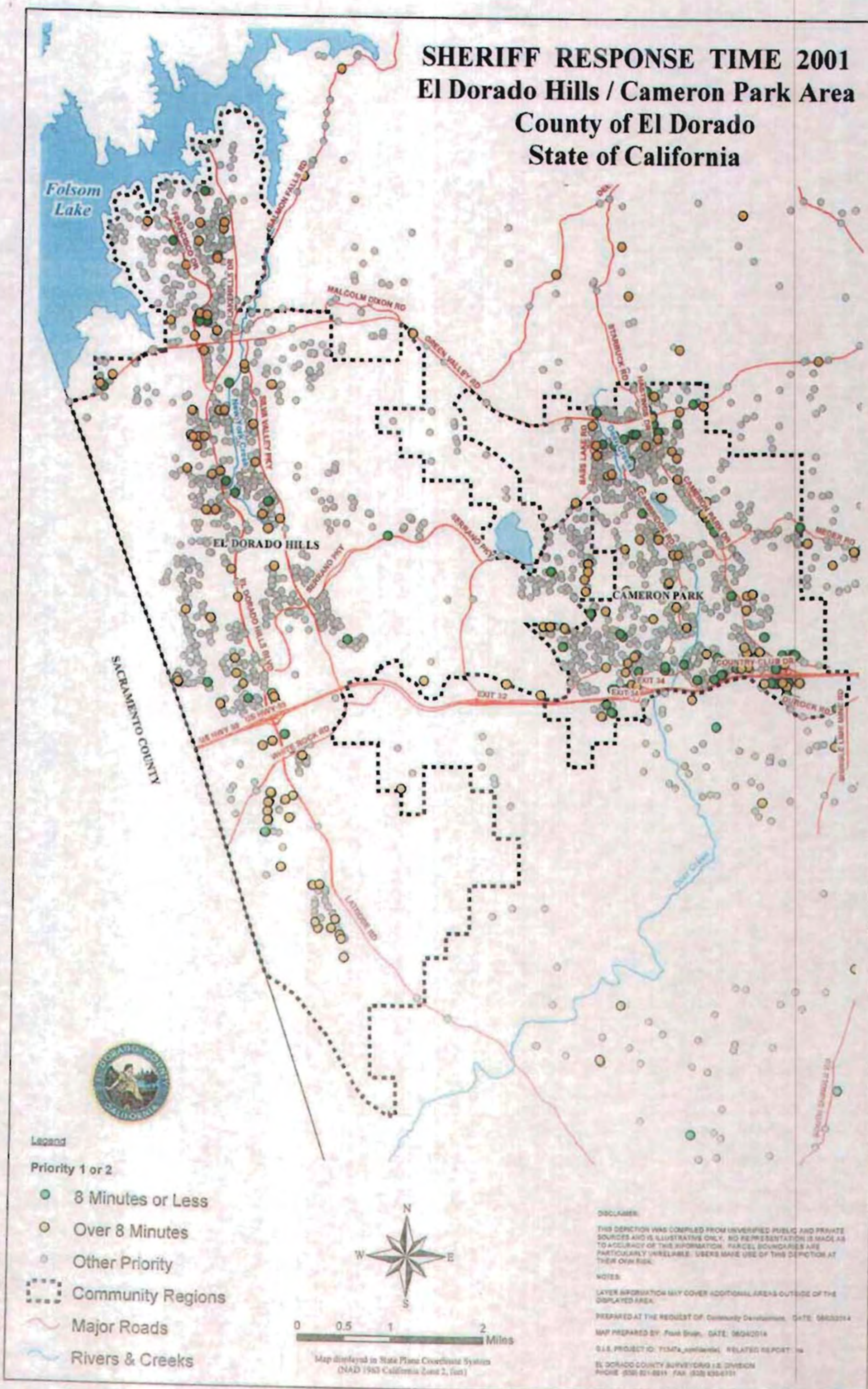

Calls for Service for Prioity 1 or 2 with a Response Time of greater than 8 Minutes
Total Number of Calls
500
450
400
350
300
250
200
150
100
50
0
210
214
204
297
281
427
450
470
444
432
422
421
344
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Year

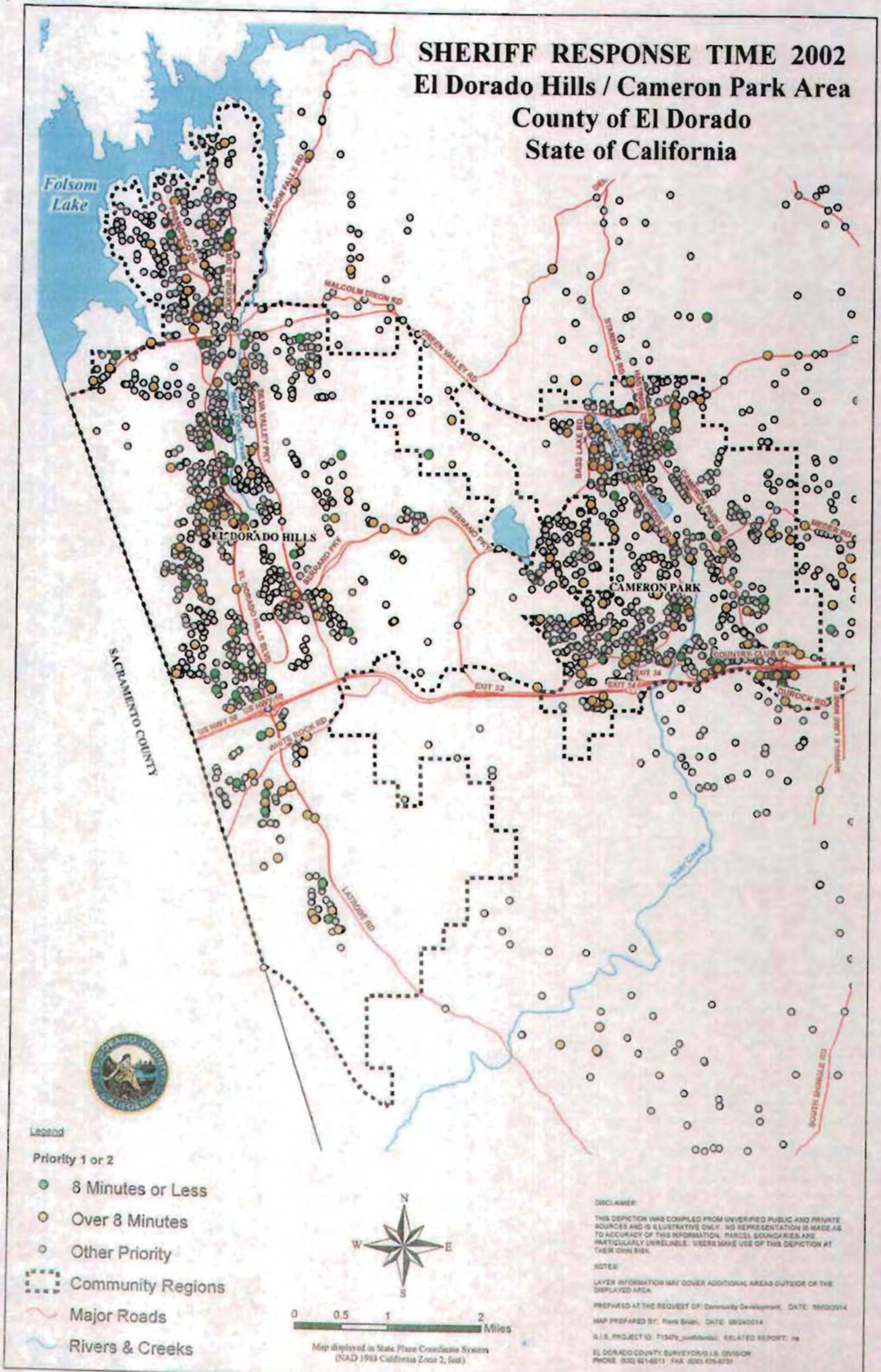
		Total Number of CFS										CFS Response Times by Zones & Priority									
		Total Number of dispatched CFS					Total Number of Self - Initated CFS					Rec/Arrive					Disp/Arrive				
Zone/Beat	Priority	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
1																					
	1	63	67	54	49	64	10	7	11	4	6	10:06	10:22	12:39	10:35	09:20	08:08	07:35	10:50	08:05	06:48
	2	773	714	758	717	639	366	307	359	262	204	13:39	14:37	14:56	15:36	16:26	10:21	10:47	11:22	10:58	10:59
	3	4649	4838	4885	4462	4416	3093	3247	2863	2701	2233	24:21	24:49	24:40	26:17	25:59	12:25	12:42	12:40	12:25	11:57
	4	3825	3566	3772	3607	3873	1036	899	1070	971	1014	32:33	31:26	31:03	33:18	36:20	13:03	13:04	12:01	12:11	12:12
	5	901	814	913	838	1246	7456	6696	6191	5862	6357	30:06	30:46	29:13	30:40	38:10	13:01	13:44	11:17	11:39	11:38
2																					
	1	81	73	51	81	62	10	9	6	13	13	10:13	07:29	08:30	12:26	11:38	05:55	05:37	06:27	07:02	06:11
	2	1049	974	931	867	706	347	320	272	285	200	12:57	11:50	13:44	13:28	14:51	07:50	07:46	08:22	08:56	08:20
	3	6136	6244	6297	5947	5835	3803	3107	2822	2739	2830	20:04	19:31	22:24	23:06	22:36	10:11	09:50	10:09	09:40	09:47
	4	4628	4609	4106	4144	4619	1454	1310	1262	1198	1233	28:02	25:59	28:16	28:28	30:19	12:13	11:48	11:37	10:31	10:26
	5	1047	1007	1037	1000	1361	9460	7936	7144	6819	8188	28:01	28:46	28:50	30:05	31:19	12:32	11:32	11:17	11:43	10:14
3																					
	1	12	5	4	7	8	1	0	0	1	1	35:12	20:49	17:58	24:53	28:06	29:37	18:56	17:05	17:07	26:37*
	2	96	120	107	95	88	61	51	57	44	36	28:46	31:24	31:12	29:32	25:50	22:56	23:50	25:14	24:35	20:25
	3	534	574	548	551	491	325	296	350	270	225	40:13	39:18	43:53	44:59	46:28	23:48	22:49	22:11	22:36	20:39
	4	628	484	564	534	597	138	120	159	167	151	43:36	40:54	40:46	43:48	54:08	20:28	19:07	19:29	15:59	17:00
	5	134	136	152	156	208	852	823	845	757	817	50:40	38:38	33:51	44:11	45:35	23:34	20:14	18:30	21:05	18:13
4																					
	1	13	8	9	15	15	2	0	5	3	0	17:50	24:57	16:40	31:23	25:17	16:46	23:18	15:20	24:20	23:38*
	2	244	244	193	209	160	142	118	96	102	81	25:13	26:04	23:42	27:37	26:55	18:13	20:31	21:05	22:43	23:24
	3	1074	981	1074	986	1013	947	794	662	497	559	35:40	37:49	39:40	48:41	55:07	20:12	20:32	21:34	21:20	23:00
	4	1266	1142	1224	1195	1138	483	406	432	364	308	41:05	36:15	41:22	55:05	1:10:02	18:16	16:56	17:35	17:39	18:16
	5	279	266	308	291	415	2220	1774	1631	1561	1450	36:04	38:49	44:16	01:04:52	58:10	17:30	19:31	19:43	18:57	16:32
51																					
	1	2	3	4	6	6	1	0	3	1	2	01:08:42*	11:24	08:04	05:54	08:24	09:45	09:40	05:17	04:17	06:13
	2	80	65	71	85	61	51	47	40	19	13	18:25	15:41	23:23	27:43	30:12	12:08	12:16	12:49	17:19	20:43
	3	339	339	339	320	304	384	364	277	232	199	17:31	16:21	19:15	19:56	21:20	11:17	10:27	11:28	11:19	10:44
	4	401	393	327	319	337	380	407	358	241	203	24:32	20:14	23:23	21:47	23:58	11:20	12:11	11:32	12:07	10:44
	5	183	187	159	183	199	1342	1240	1081	1018	783	19:45	20:24	25:40	24:20	34:13	08:56	10:47	13:60	12:16	12:09
52																					
	1	7	5	6	7	4	0	0	1	0	1	05:49	10:01	09:22	09:51	09:53	04:42	08:03	06:04	08:41	09:01
	2	93	82	83	76	73	28	32	39	28	20	12:00	15:59	10:58	11:55	16:20	07:28	10:53	07:34	08:51	25:44
	3	490	478	416	430	408	380	336	176	229	258	16:04	15:44	18:34	15:29	18:05	08:50	09:00	08:41	09:14	09:43
	4	685	677	511	609	534	369	286	246	229	177	21:12	20:43	18:54	24:48	21:42	11:39	10:34	10:34	09:30	10:17
	5	234	224	197	263	288	1541	1470	1297	1377	966	18:51	15:22	20:11	33:48	22:05	10:44	08:08	09:56	12:27	09:09
53																					
	1	1	2	3	0	0	0	0	0	2	1	24:58	23:59	19:18	29:39	29:58	23:48	02:33	14:53	18:22	18:15
	2	34	39	28	31	23	14	12	9	15	10	23:15	25:43	24:16	37:10	37:46	20:39	20:14	21:08	21:21	21:23
	3	134	138	129	106	118	86	81	63	40	62	31:28	32:42	36:54	28:53	26:09	20:27	21:05	23:22	17:31	11:53
	4	124	128	105	93	114	111	120	79	54	98	29:47	31:32	27:00	44:52	33:14	17:06	17:29	17:50	16:49	17:20
	5	57	76	54	77	104	241	249	212	244	393	25:53	28:07	32:32	44:52	36:59	18:09	14:30	24:22	16:49	17:21
55																					
	1	2	4	1	2	2	0	0	1	0	1	16:10	28:22	19:40	24:13	29:28	13:42	26:30	18:37	24:41	28:36
	2	48	46	35	37	30	35	32	17	28	11	37:44	32:01	43:18	34:46	51:06	29:56	28:17	37:27	25:58	27:24
	3	103	96	69	70	57	94	87	65	45	39	47:37	48:07	01:03:46	49:28	47:25	33:01	29:58	29:35	27:24	26:25
	4	123	95	95	101	82	75	43	47	48	42	48:51	48:30	42:05	50:57	50:59	36:27	26:06	22:52	24:54	23:41
	5	47	31	35	41	51	235	188	150	158	164	01:05:43	46:00	44:48	41:17	45:37	23:44	27:30	23:50	25:27	22:42
Totals		30619	29974	29654	28607	29749	37573	33214	30398	28628	29349										

* Caution, when using small numbers, higher averages are calculated. These have a small number os CFS'

Average Response Times are for Dispatched calls only. Self-initiated calls are not included as they would skew the average times.

	CFS Response Times by Priority (Includes all zones)									
	Rec/Arrive					Disp/Arrive				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Priority 1	13:03	11:05	11:30	13:37	13:50	09:10	08:19	09:11	09:19	09:27
Priority 2	15:52	16:10	16:55	17:42	18:28	11:05	11:53	12:13	12:39	12:42
Priority 3	23:54	23:42	25:31	27:03	27:10	12:35	12:27	12:36	12:19	12:13
Priority 5	30:43	28:40	30:30	33:15	36:11	13:49	13:02	12:51	12:25	12:07
Priority 5	29:22	28:14	28:43	32:56	34:10	13:46	13:26	12:32	13:18	11:45


SHERIFF RESPONSE TIME 2001
El Dorado Hills / Cameron Park Area
County of El Dorado
State of California
Folsom Lake
EL DORADO HILLS
CAMERON PARK
SACRAMENTO COUNTY
MALCOLM DIXON RD
GREEN VALLEY RD
SALMON FALLS RD
SERRANO PKY
EL DORADO HILLS BLVD
SILVA VALLEY PKY
WHITE ROCK RD
LATROBE RD
US HWY 50
EXIT 32
EXIT 34
COUNTRY CLUB DR
STARBUCK RD
BASS LAKE RD
CAMERON PARK DR
MEDER RD
DURock RD
Legend
Priority 1 or 2
8 Minutes or Less
Over 8 Minutes
Other Priority
Community Regions
Major Roads
Rivers & Creeks
N
S
E
W
0 0.5 1 2 Miles
Map displayed in State Plane Coordinate System (NAD 1983 California Zone 2, feet)
DISCLAIMER:
THIS DEPICTION WAS COMPILED FROM UNVERIFIED PUBLIC AND PRIVATE SOURCES AND IS ILLUSTRATIVE ONLY. NO REPRESENTATION IS MADE AS TO ACCURACY OF THIS INFORMATION. PARCEL BOUNDARIES ARE PARTICULARLY UNRELIABLE. USERS MAKE USE OF THIS DEPICTION AT THEIR OWN RISK.
NOTES:
LAYER INFORMATION MAY COVER ADDITIONAL AREAS OUTSIDE OF THE DISPLAYED AREA.
EL DORADO COUNTY SURVEYOR/G.I.S. DIVISION



SHERIFF RESPONSE TIME 2002
El Dorado Hills / Cameron Park Area
County of El Dorado
State of California
Folsom Lake
EL DORADO HILLS
CAMERON PARK
SACRAMENTO COUNTY
MALCOLM DIXON RD
GREEN VALLEY RD
SERRANO PKY
EL DORADO HILLS BLVD
WHITE ROCK RD
LATROBE RD
COUNTRY CLUB DR
US HWY 50
EXIT 32
Legend
Priority 1 or 2
8 Minutes or Less
Over 8 Minutes
Other Priority
Community Regions
Major Roads
Rivers & Creeks
N
W
E
S
0 0.5 1 2 Miles
Map displayed in State Plane Coordinate System (NAD 1983 California Zone 2, feet)
DISCLAIMER:
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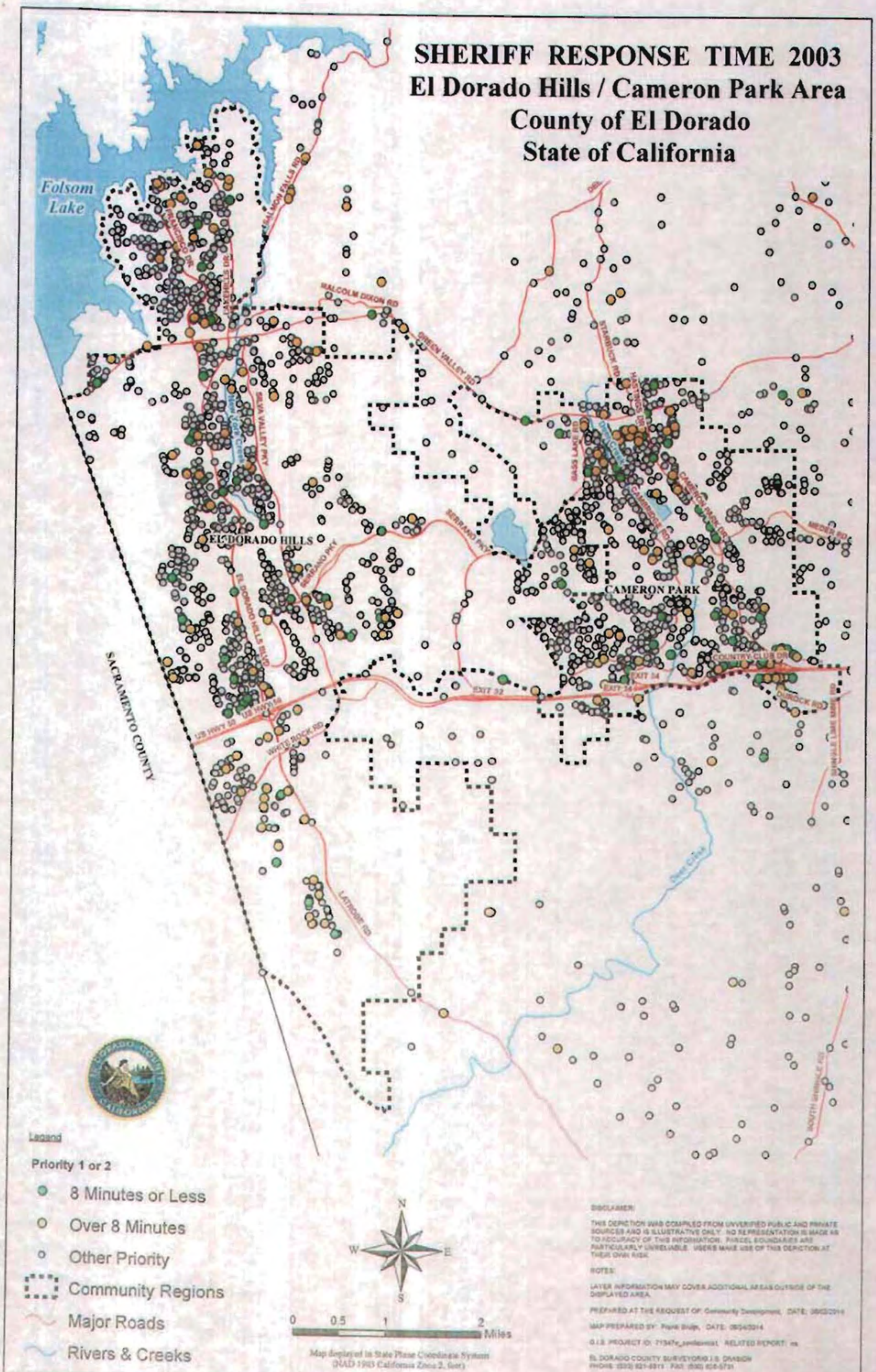
NOTES:
LAYER INFORMATION MAY COVER ADDITIONAL AREAS OUTSIDE OF THE DISPLAYED AREA.
PREPARED AT THE REQUEST OF: Community Development
MAP PREPARED BY:
EL DORADO COUNTY SURVEYOR/G.I.S. DIVISION


SHERIFF RESPONSE TIME 2003
El Dorado Hills / Cameron Park Area
County of El Dorado
State of California
Folsom Lake
EL DORADO HILLS
CAMERON PARK
SACRAMENTO COUNTY
MALCOLM DIXON RD
GREEN VALLEY RD
SERRANO PKY
EL DORADO HILLS BLVD
SILVA VALLEY PKY
WHITE ROCK RD
LATROBE RD
US HWY 50
COUNTRY CLUB DR
Legend
Priority 1 or 2
8 Minutes or Less
Over 8 Minutes
Other Priority
Community Regions
Major Roads
Rivers & Creeks
N
S
E
W
0 0.5 1 2 Miles
DISCLAIMER:
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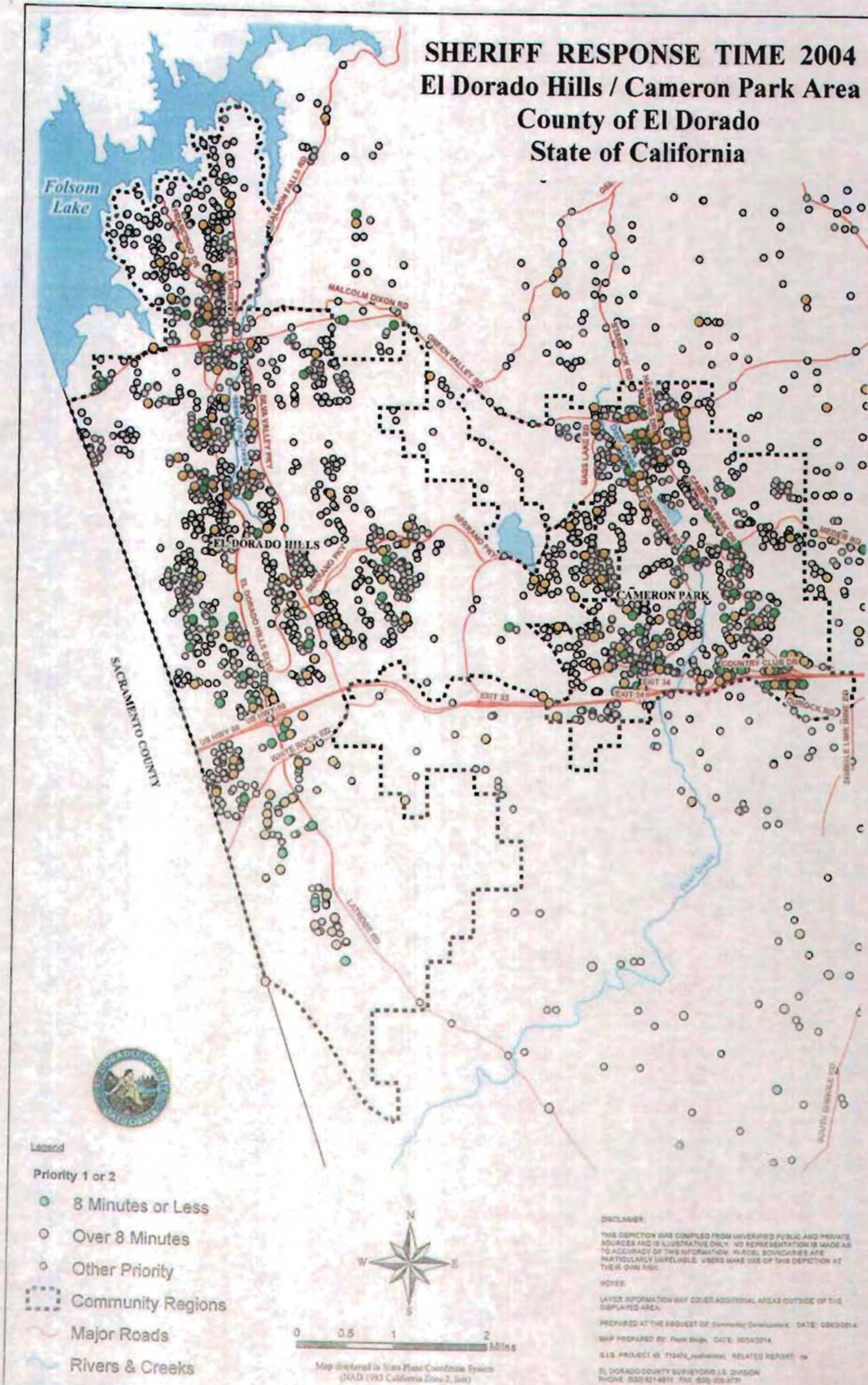
PREPARED AT THE REQUEST OF: Community Development
EL DORADO COUNTY SURVEYOR/G.I.S. DIVISION


SHERIFF RESPONSE TIME 2004
El Dorado Hills / Cameron Park Area
County of El Dorado
State of California
Folsom Lake
MALCOLM DIXON RD
GREEN VALLEY RD
EL DORADO HILLS
CAMERON PARK
SACRAMENTO COUNTY
US HWY 50
WHITE ROCK RD
LATROBE RD
EL DORADO HILLS BLVD
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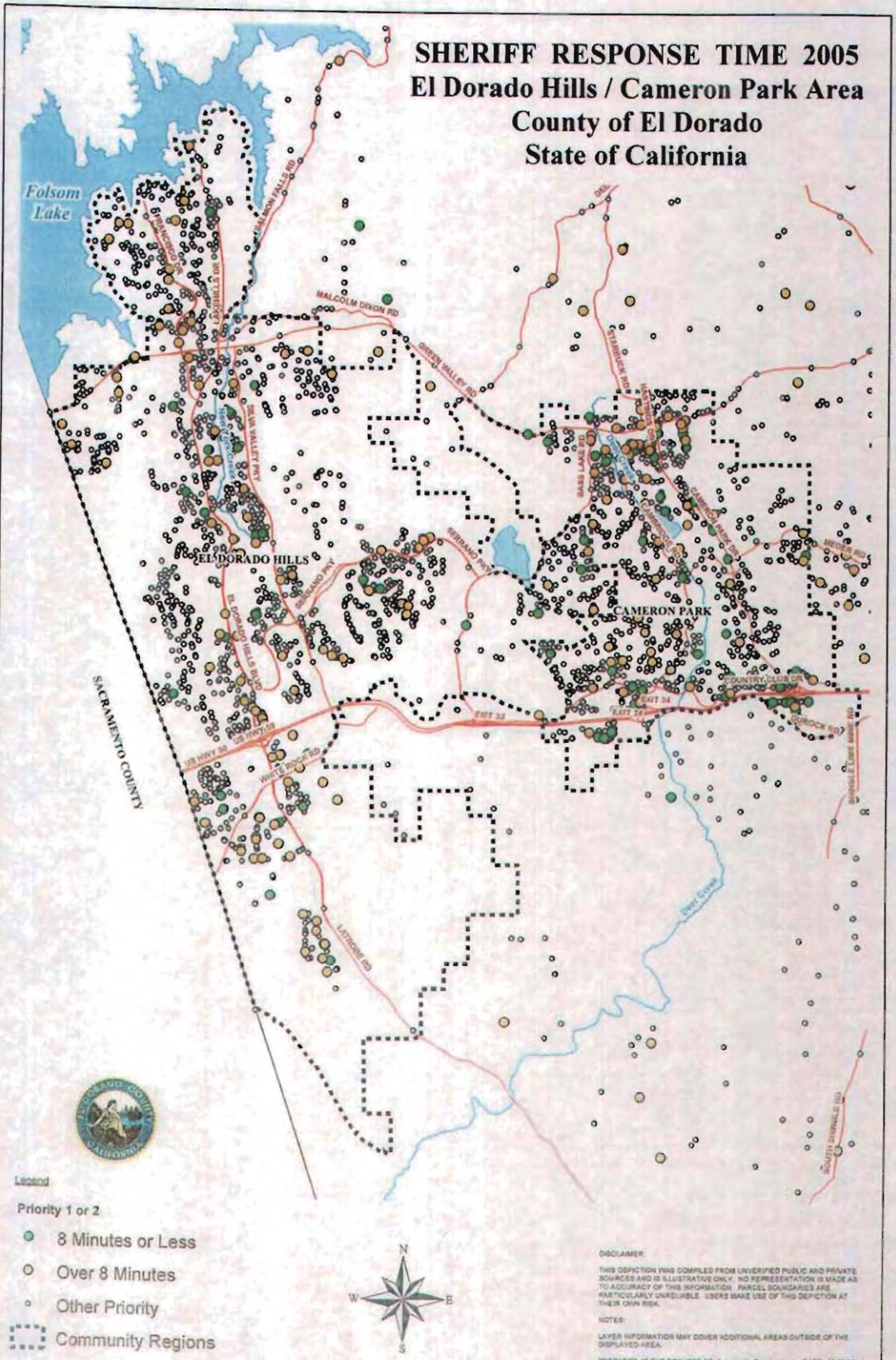
PREPARED AT THE REQUEST OF: Community Development, DATE:
MAP PREPARED BY:
G.I.S. PROJECT ID: RELATED REPORT:
EL DORADO COUNTY SURVEYOR/G.I.S. DIVISION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County of El Dorado
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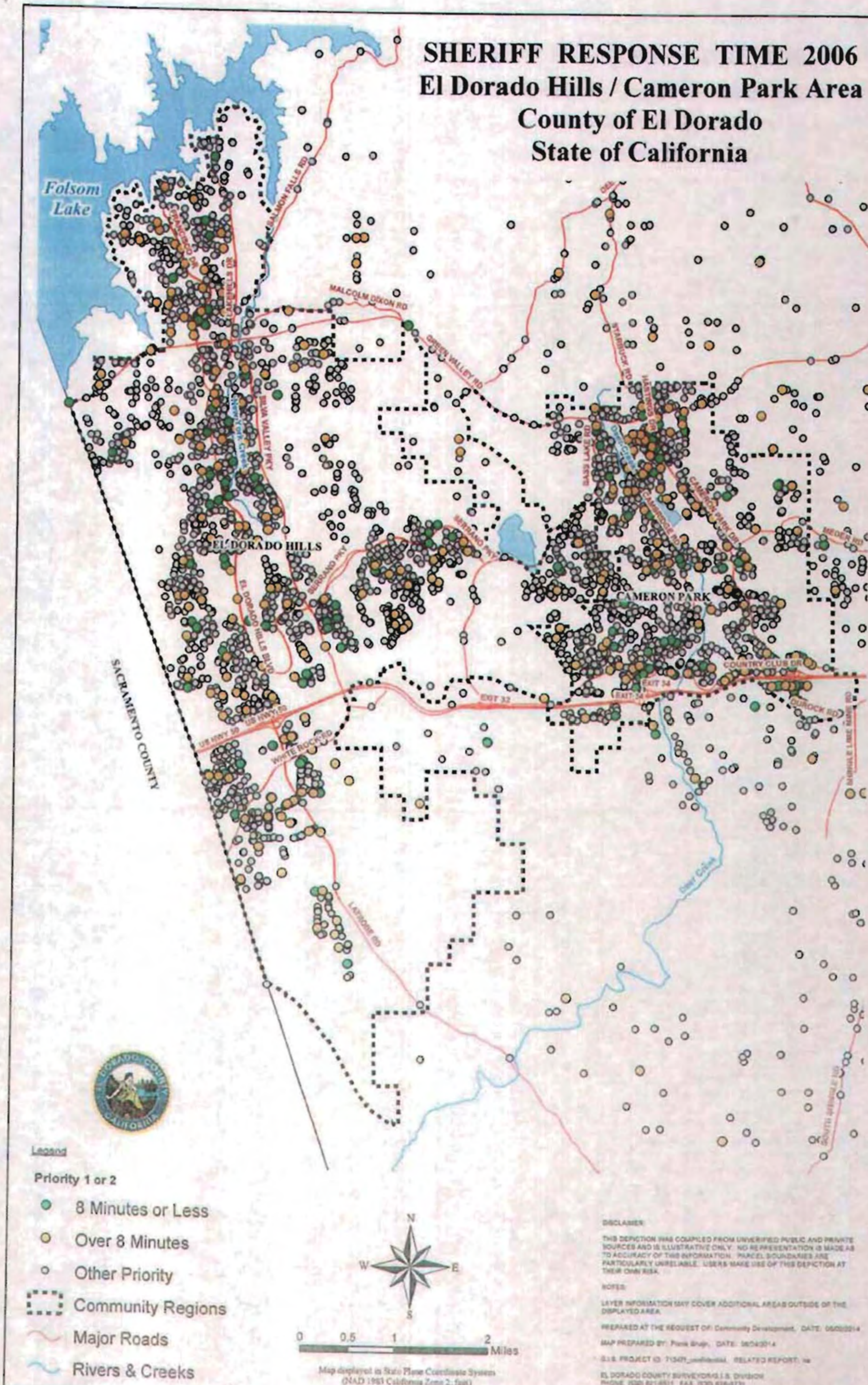

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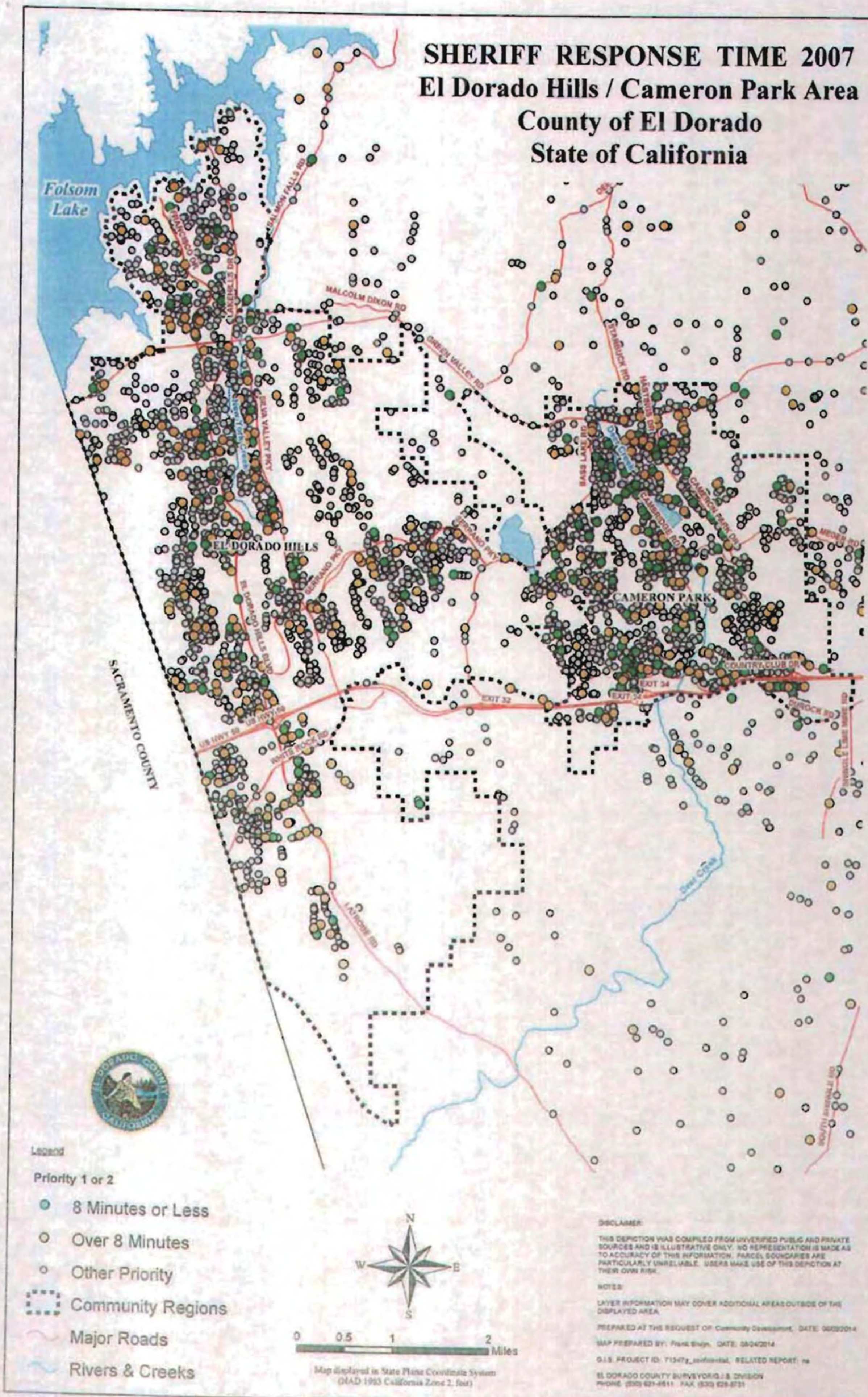
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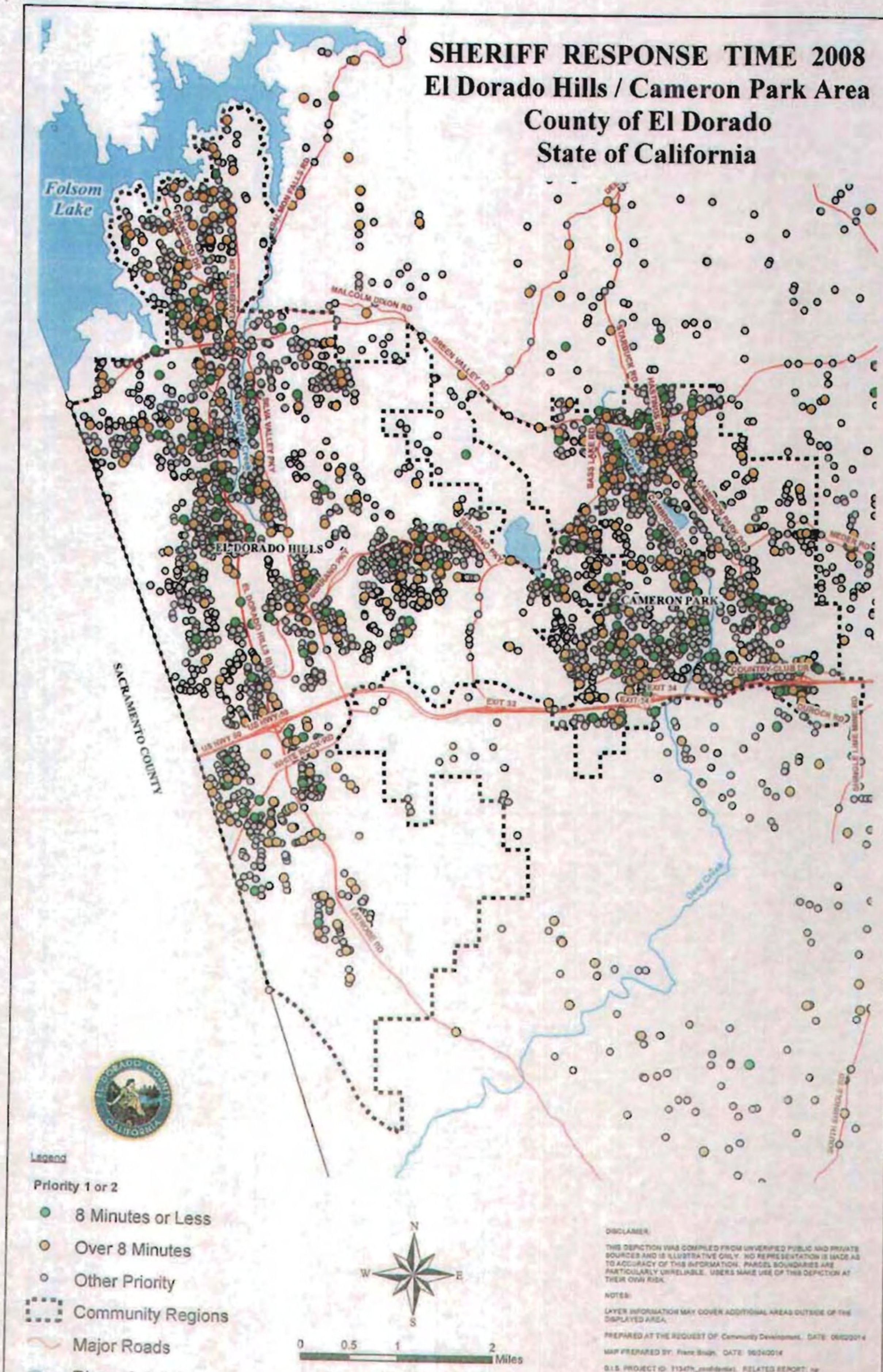
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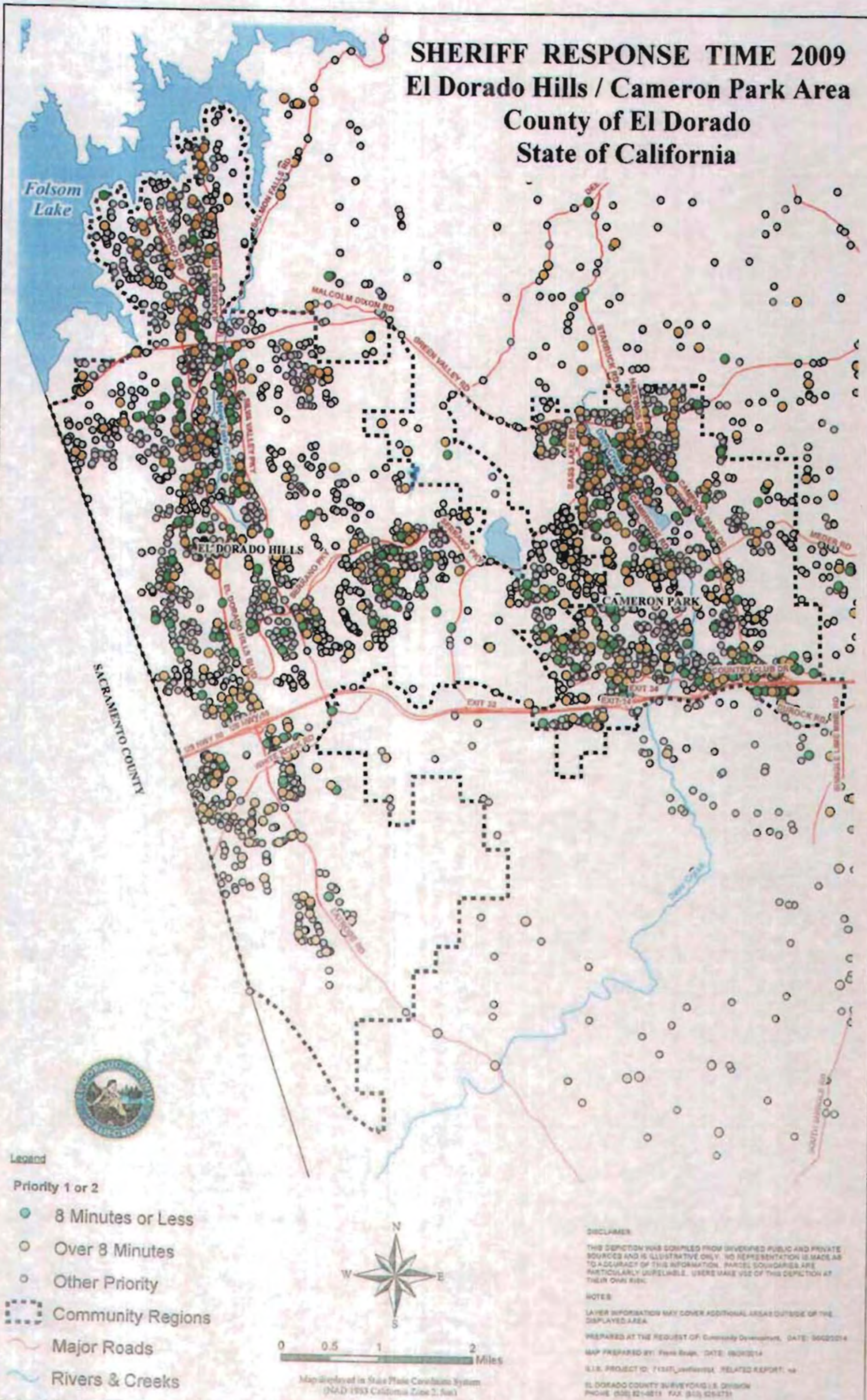
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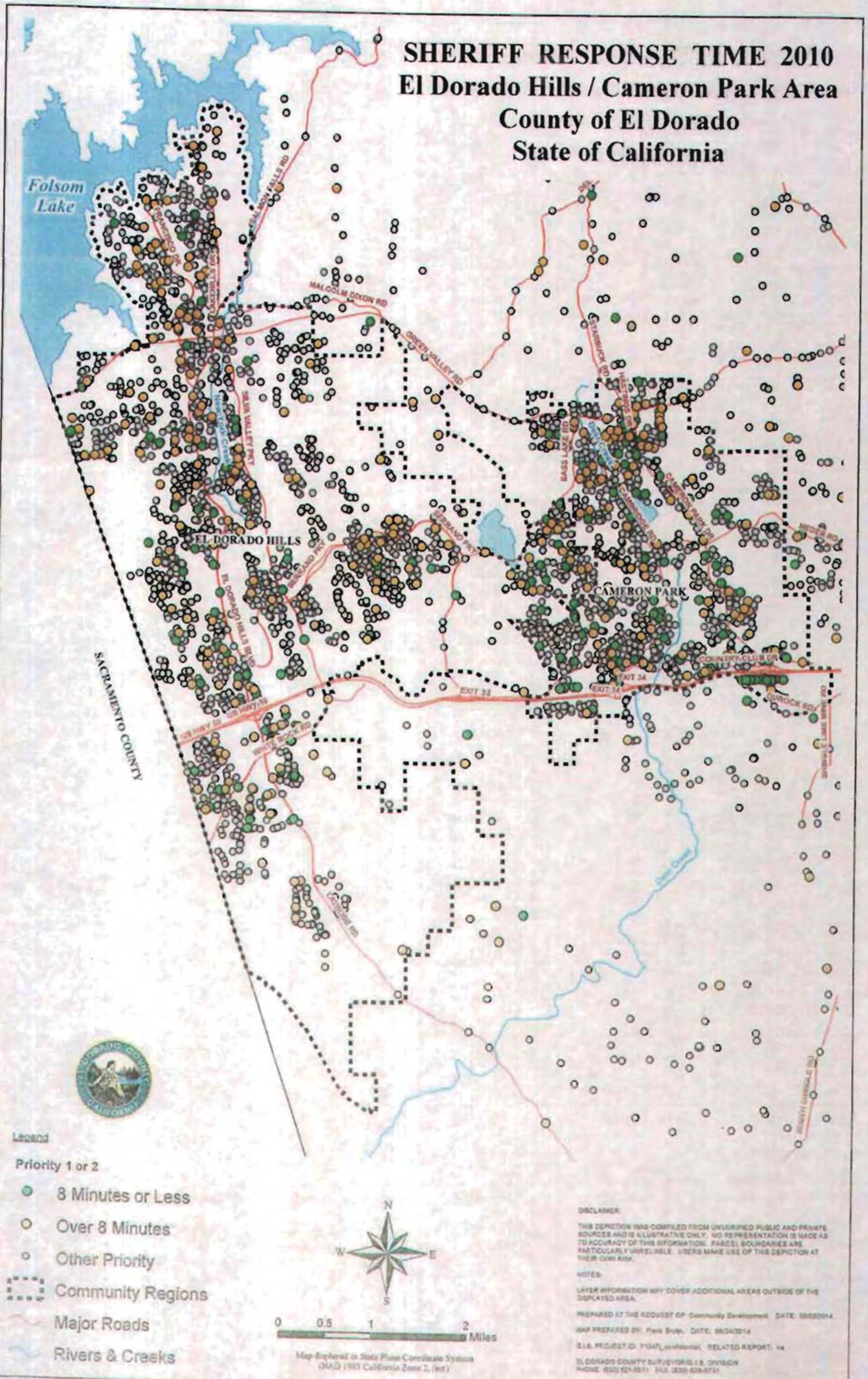
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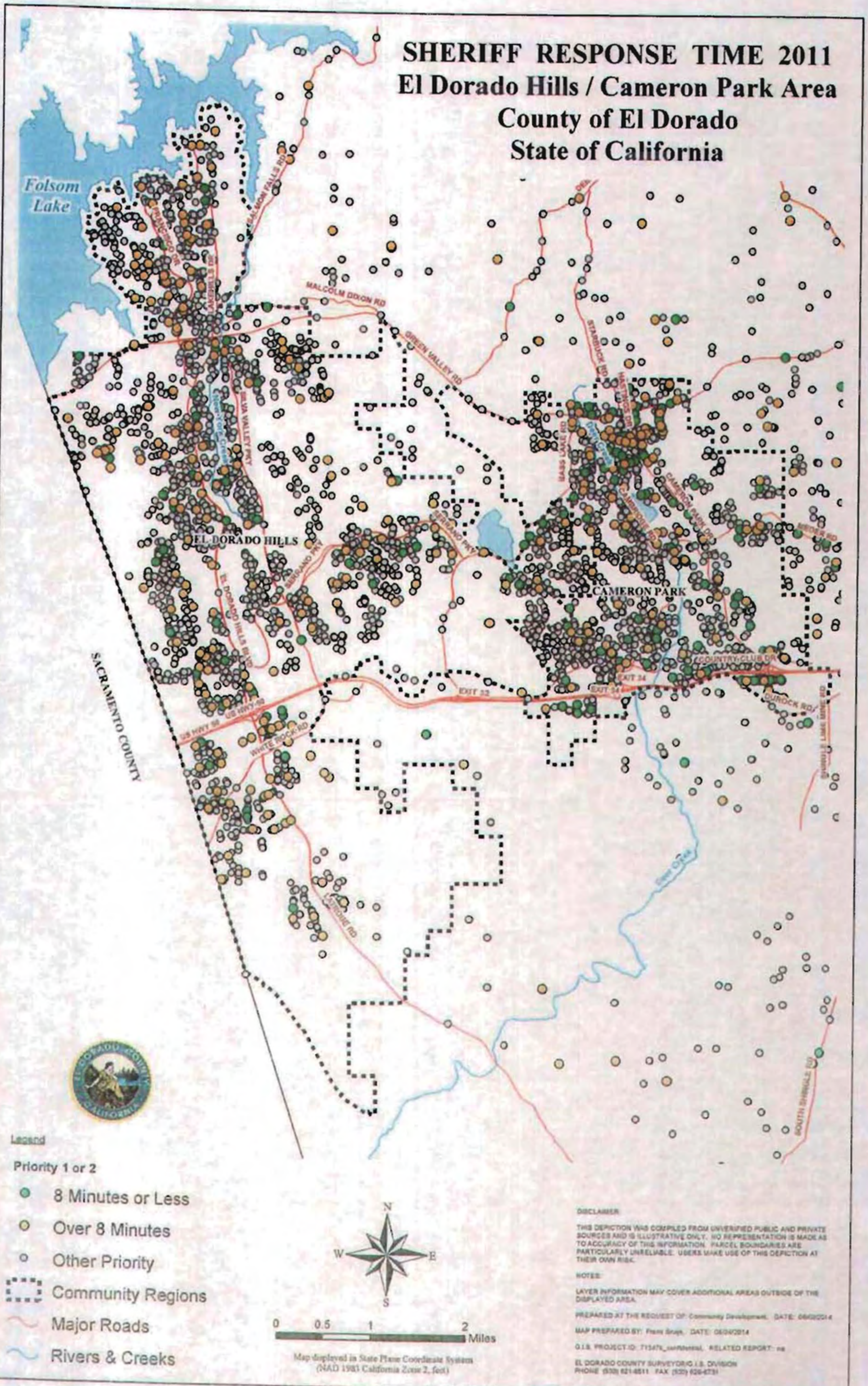
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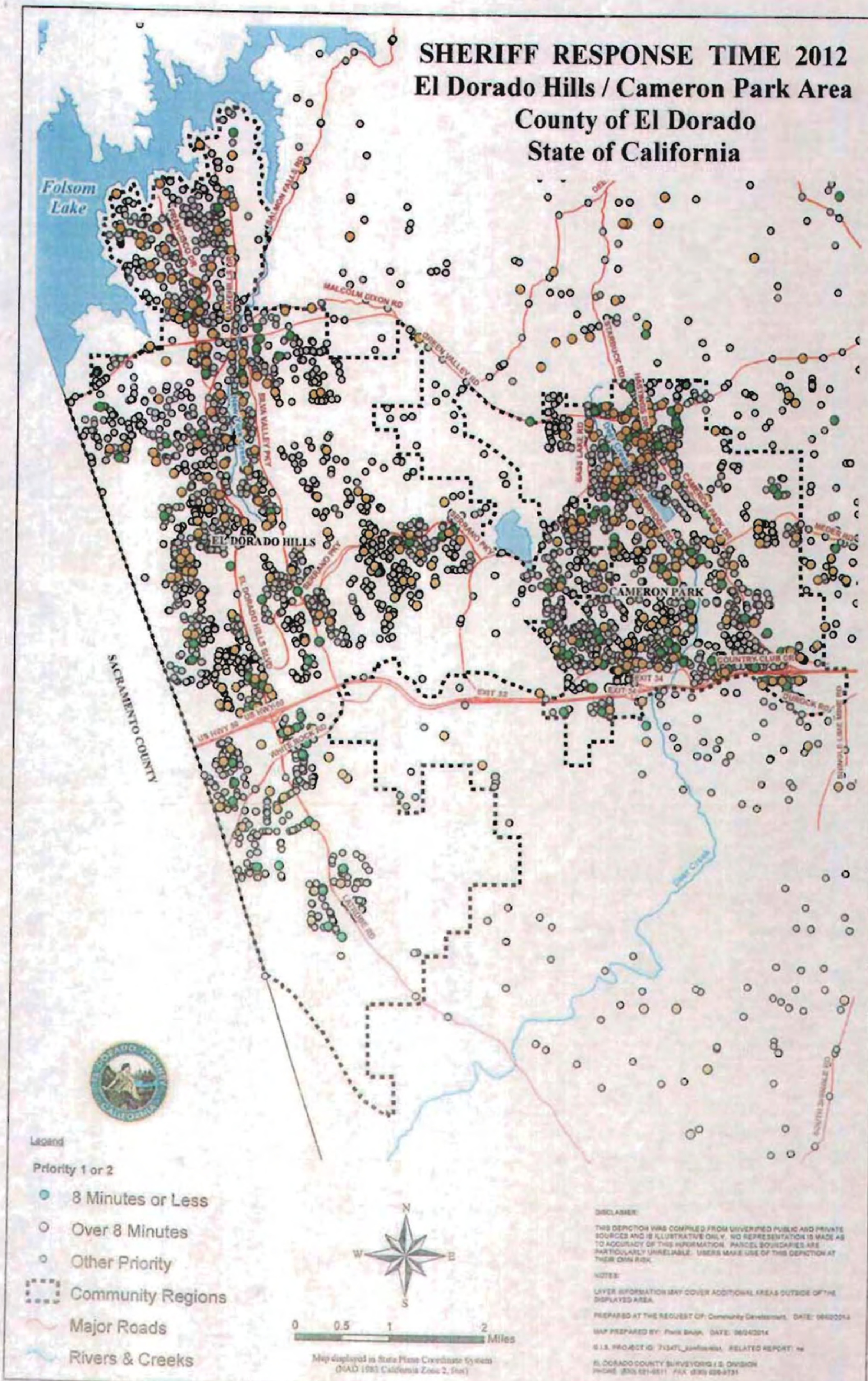
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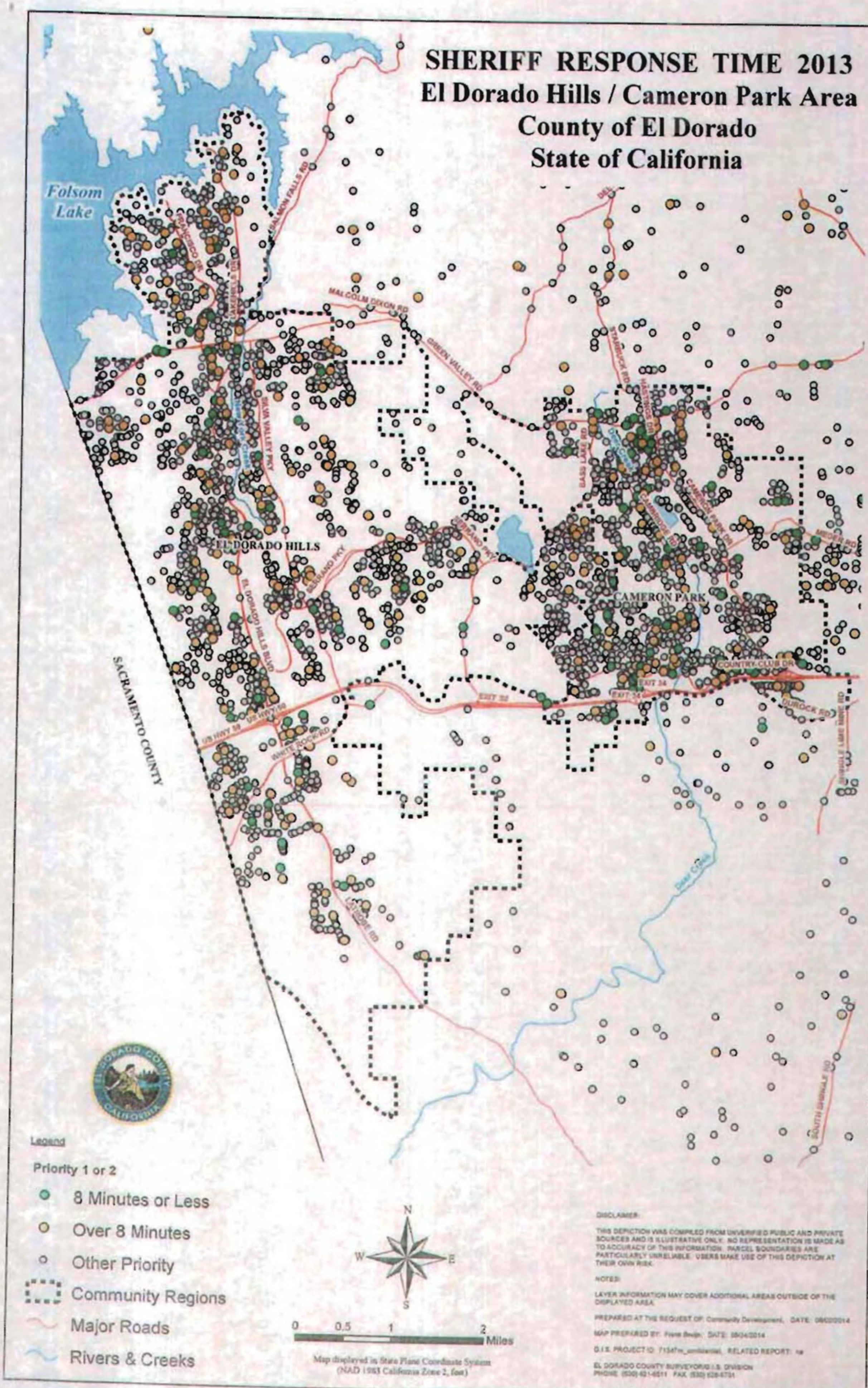

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Attachment #19

California Oak Foundation
Oaks, CEQA, Carbon Dioxide and Climate Change

The following California Environmental Quality Act public comments apply to all mitigated negative declarations and environmental impacts reports where native forests, including oak woodlands, are converted to non-forest use.

Re: Project EIR Climate Change Analysis

Dear X:

"[W]e cannot afford to ignore even modest contributions to global warming. If global warming is the result of cumulative contributions of myriad sources, any one modest in itself, is there not a danger of losing the forest by closing our eyes to the felling of the individual tree?" [Center for Biological Diversity v. National Highway Traffic Safety Administration (US Ninth Circuit Court, 2007)]

The Conservation Organization (CO) writes to advise the Lead Agency that the Project EIR is remiss in failing to meaningfully analyze or mitigate carbon dioxide (CO_2) biological emissions associated with the conversion of oak woodlands to non-forest use. By this omission, Project disregards the California Environmental Quality Act (CEQA), Office of Planning and Research (OPR) guidelines, California Attorney General opinions and Court decisions by not making a good faith effort to analyze or mitigate project oak woodlands CO_2 biological emissions.

The California Global Warming Solutions Act (AB 32) defined thresholds are to **reduce** carbon dioxide emissions by 2020 to 1990 levels, with a further 80 percent CO_2 reduction by 2050. That means every ton of CO_2 emitted back into the atmosphere by Project oak woodlands conversion, plus the loss of future increases in tree carbon sequestration, represents a measurable potential adverse environmental effect.

Carbon
Carbon storage occurs in forests and soils primarily through the natural process of photosynthesis. Atmospheric CO_2 is taken up through leaves and becomes carbon in the woody biomass of trees and is released back into the atmosphere when a tree dies. Approximately half of vegetation mass is sequestered carbon. In terms of its global warming impact, one unit of CO_2 released from dead oak biomass has the same ecological effect as one unit of CO_2 released from a car tailpipe.

The foundation of the AB 32 reduction objectives and California Forest Protocol preservation standards is the "net present value" of GHG emissions – an emission avoided today is more valuable than an emission avoided tomorrow. Thus, a ton of oak woodlands carbon currently sequestered is more critical than a ton of woodland carbon stored in the future.

A state standard (recognized universally) to measure oak woodland CO_2 biological emissions exists under the 2007 California Air Resources Board (CARB) Forest Protocol. This Protocol provides the analytic tools and methodology for measuring CEQA forest carbon baselines-impacts. Notably, COF has the Forest Protocol-accredited professional capability to calculate for any oak woodlands conversion both the amount of carbon dioxide currently sequestered and the CO_2 biological emissions if those woodlands are impacted.

CEQA

CEQA requires that the Lead Agency evaluate potential environmental effects based to the fullest extent possible on scientific and factual data. In the absence of defined thresholds, significance conclusions must be based on substantial evidence, which includes facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts. (CEQA Guidelines § 15064) Based on science, fact, expert opinion (attached) and the AB 32 defined thresholds, Project removal of X thousands of oaks on X acres is indisputably a potentially significant carbon biological emissions effect.

The fact is CEQA review doesn't require specific carbon emission regulations issued by any government agency; CEQA review only requires substantial evidence of a significant effect and a fact-based methodology to measure that impact. Scientific studies, passage of Assembly Bill 32 (2006) and adoption by the California Air Resources Board (2007) of the California Climate Action Registry Forest Protocol (2005) are all the CO2 science, fact and law necessary for CEQA review.

On January 8, 2009 the Governor's Office of Planning and Research released draft regulatory guidance with respect to the analysis and mitigation of the potential effects of greenhouse gas emissions (attached). OPR corroborates that analysis-mitigation of carbon biological emissions due to oak woodlands conversion to non-forest use and the CARB Forest Protocol are integral to CEQA review.

Significance Thresholds

In the future CARB may or may not set a numerical threshold for project carbon biological emissions. If a significance standard is set it will be very low. This is a product of oak's ability to both store atmospheric carbon dioxide (CO2) and release CO2 back into the atmosphere when killed. Thus two CO2 biological emission impacts must be considered for CEQA review. Additionally, CEQA significant oak woodland biological effects are the sum of carbon emission impacts and wildlife habitat impacts. This intrinsic duality is the focal point for CEQA oak woodlands biological analysis and mitigation.

Carbon Mitigation

Dual oak woodland CO2 emission effects must be considered for CEQA review: Direct CO2 emission impacts from dead tree disposal and cumulative impacts due to the loss of future increases in live tree carbon sequestration. Notably, the absence of **value** and **timeliness** exclude on-site oak woodlands retention or the planting of oaks as valid CO2 biological emission mitigation measures. Here's why:

The XYZ project site contains 30,000 native trees (400 acres), of which 10,000 trees (100 acres) will be removed for development.

1. The 20,000 retained trees (300 acres) won't start growing any faster, so they contribute **zero** toward mitigating for the CO2 that would've been stored had the 10,000 impacted trees (100 acres) lived.

2. Planting mitigation oaks contributes **negligible** CO2 mitigation because they don't begin to sequester significant carbon for at least 20 years, longer for slow growing blue oak. This means oak mitigation planting contributes **zero** mitigation for carbon biological emissions in the Assembly Bill 32 short-term (2020/2050) and their a long-term (Forest Protocol 100-year) ability to store CO2 is greatly exceeded by the amount of carbon that would've been sequestered by the 10,000 impacted trees over the same 100-year period.

3. On-site woodland retention and planting oaks contribute **negligible** mitigation for CO2 biological emissions associated with the disposal of 10,000 dead trees.

4. Once the carbon math is complete, by a process of elimination off-site mitigation of equivalent oak woodlands is the lone feasible and proportional mitigation measure available for XYZ. Moreover, because each XYZ impacted tree has a distinct carbon value and a distinct habitat value, **only** off-site mitigation "replacement" of at least 100 acres with similar trees can meaningfully mitigate these **dual** adverse biological effects. Any alternative oak woodland mitigation proposals will discover how technically arduous it can become trying to comply with/reconcile local standards or Public Resources Code §21083.4 (SB 1334) and the Forest Protocol.

CEQA CO2 questions to be answered include: (1) how much potential CO2 sequestration over the next 100 years will be lost due to impacts to live native trees three (3) inches dbh or greater; (2) how much sequestered CO2 will be released if the live trees, standing dead trees or woody debris are burned or otherwise disposed; (3) how will oak woodland CO2 biological emission impacts be proportionally mitigated?

California has officially designated CO2 a grave human health risk. Consequently, local jurisdictions cannot invoke ministerial or overriding consideration prerogatives in determining proportional mitigation for carbon biological emissions due to oak woodlands conversion to non-forest use. It would be an abuse of discretion to declare an inadequately mitigated oak woodland conversion a public benefit when in fact woodland conversion represents a demonstrable public health hazard.

Summary

California's official greenhouse gas policy categorically places a premium on conserving native forests over the next 100 years. Yet, the Project refuses to meaningfully analyze direct and cumulative CO2 emissions from the conversion of X acres of oak woodlands to non-forest use, despite a universally accepted California standard for measuring those carbon biological emission effects. Simply asserting that the *"project's contribution to cumulative GHG emissions is considered* ***cumulatively considerable*** *and* ***significant and unavoidable****,"* doesn't relieve the project from the CEQA responsibility to thoroughly analyze and mitigate for potentially significant CO2 effects from oak woodlands conversion. (See Center for Biological Diversity, et al. v. City of Desert Hot Springs, et al. (2008) Riverside County Superior Court - Case No. RIC 464585 and Berkeley Keep Jets Over the Bay Committee vs. Board of Port Commissioners (2001) 91 Ca.App.4th 1344, 1370-71.)

CO contends there is substantial evidence to support a "fair argument" that Project conversion of oak woodlands will have a significant effect on the environment. To provide proportional woodlands mitigation for Project significant carbon biological emission impacts, CO urges that the project adopt the following mitigation measure:

"The applicant shall preserve off-site, in perpetuity by grant of conservation easement in a form acceptable to the Director of Planning to a qualified recipient approved by the Director of Planning, at least 100 contiguous acres of oak woodland located within the County, which 100 contiguous acres shall be equivalent in ecological function and quality to the woodland on the project site."

Until these California Environmental Quality Act requirements are met, the Conservation Organization objects to approval of the project and adoption of the DEIR.

Sincerely,
Conservation Organization

Oak Woodlands Carbon Attachment

Oaks and Climate Change Explained

The current carbon dioxide contribution to global warming is in part a byproduct of mankind's conversion of the Earth's forest cover to non-forest land use: *"In the last 8,000 years about 45% of the Earth's original forest cover has disappeared, cleared mostly during the past century"* (Smithsonian 2003). Continuing *"deforestation accounts for about 20% of the carbon dioxide spewed into the atmosphere each year"* (Wall Street Journal 2008). According to the Intergovernmental Panel on Climate Change, *"Carbon dioxide is the most important anthropogenic greenhouse gas ... The global increases in CO2 concentration are due primarily to fossil fuel use and land-use change"* (2007).

Based on the latest University of California figures (2007), California Oak Foundation estimates that since 1990 California has converted 325,000 acres of oak woodlands to non-forest use. This means in California there are substantially less acres of oak forest to help reduce state CO2 emissions to 1990 levels by 2020 as required by Assembly Bill 32 (2006). Additionally, the escalating deforestation of oak woodlands (25,000 acres annually) will make it that much more difficult and expensive to meet the primary AB 32 goal of reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050.

The California Climate Change Center has reported that *"There is substantial evidence that temperatures in California are projected to rise 4.7 to 10.5 degrees Fahrenheit by the end of the century [and] temperatures can increase air quality problems"* (2007). Blue oak woodlands constitute nearly 50 percent of the state's woodlands resource. A University of California study examining the effects of California temperature increases on blue and valley oaks *"found that the areas of the state where the climate is suitable for these species to grow will shift northward and could shrink to nearly half their current size as a result of global warming"* (2005). Thus, the more that oak woodlands are converted to non-forest use, the greater the rise in California temperatures and the greater the temperature increases, the faster oaks are extrapolated from the California landscape.

The peer-reviewed publication "Oaks 2040: The Status and Future of Oaks in California" (2006) estimates that up to 750,000 acres of oak resources are at risk of conversion to non-forest use by 2040. A companion study, "Carbon Resources in California Oak Woodlands" (2008), calculates that *"California oak woodlands and forests could sequester a billion tons of carbon [and] up to 33 million tons of sequestered carbon are at risk [by 2040] of entering the atmosphere should development processes eliminate these oak woodlands and forests, and their associated carbon pools."*

The California Forest Protocol was initiated by Senate Bill 812 in 2002, approved by the California Climate Action Registry in 2005 and adopted by the California Air Resources Board (CARB) on October 25, 2007. This Forest Protocol: (1) classifies the conversion of oak woodlands to non-forest use as a CO2 biological emission; (2) establishes the methodology used to measure oak woodland biological emissions for CEQA review: Live tree biomass (including roots), standing dead tree biomass and wood lying on the ground.

On January 8, 2009 the Governor's Office of Planning and Research released draft regulatory guidance with respect to the analysis and mitigation of the potential effects of greenhouse gas emissions. OPR validates that analysis and mitigation of carbon biological emissions due to oak woodlands conversion to non-forest use and the CARB Forest Protocol are integral to CEQA review:

Preliminary Draft CEQA Guideline Amendments for Greenhouse Gas Emissions
CEQA Guidelines Appendix G
Environmental Checklist Form

EVALUATION OF ENVIRONMENTAL IMPACTS

II. AGRICULTURE AND FOREST RESOURCES … In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and the forest carbon measurement methodology provided in the Forest Protocols adopted by the California Air Resources Board. Would the project:

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)) or timberland (as defined in Public Resources Code section 4526)?

d) Result in the loss of forest land or conversion of forest land to non-forest use?

e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest use?

Forest Protocol Key Terms
Biological emissions: For the purposes of the forest protocol, biological emissions are greenhouse gas emissions that are released directly from forest biomass, both live and dead, including forest soils.

Biomass: The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass.

Bole: A trunk or main stem of a tree. For the purposes of the Protocol, any tree bole with a minimum diameter of three inches should be included in the inventory to estimate carbon stocks.

Carbon pool: A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass, which can be subdivided into smaller pools. These pools may include above-ground or below-ground biomass or roots, litter, soil, bole, branches and leaves, among others.

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California Agriculture (2007). *Research and outreach to prevent woodland loss*. Published by the University of California. http://calag.ucop.edu/0701JFM/resup02.html

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California Climate Action Team (2008). *Climate Action Initiative*. www.climatechange.ca.gov/climate_action_team/index.html

Attachment #20

1. Introduction

A. Purpose

The Purpose of this Oak Woodland Management Plan (OWMP) is to outline the County's strategy for conservation of its valuable oak woodland resources. Through the OWMP, the County identifies areas where conservation easements may be acquired from willing sellers as a means to offset and mitigate the loss or fragmentation of oak woodlands in other areas as a result of implementation of the 2004 El Dorado County General Plan (General Plan). Additionally, the OWMP provides guidance for voluntary conservation and management efforts by landowners and land managers. Lastly, the OWMP sets forth further guidance on General Plan Policy 7.4.4.4 Option A, which includes measures designed to encourage retention of existing oak canopy in areas planned for development.

Loss and fragmentation of wildlife habitat, including oaks and oak woodlands, was identified in the 2004 General Plan Environmental Impact Report (EIR) as a significant impact that would result from development under the General Plan. The County identified several mitigation measures which would reduce the severity of these impacts, although not to below a level of significance. These mitigation measures included Policies 7.4.4.4, 7.4.4.5 and 7.4.5.2, and the related implementation Measure CO-P.

Measure CO-P directs the County to develop and adopt an Oak Resources Management Plan that addresses the following:

- Mitigation standards outlined in Policy 7.4.4.4;
- Thresholds of significance for the loss of oak woodlands;
- Requirements for tree surveys and mitigation plans for discretionary projects;
- Replanting and replacement standards;
- Heritage/Landmark Tree protection standards; and
- An Oak Tree Preservation ordinance as outlined in Policy 7.4.5.2.

An Oak Tree Preservation ordinance that incorporates the standards outlined in Policy 7.4.5.2 and Heritage and Landmark Tree protection standards will be developed after the adoption of the OWMP.

At the state level, the Oak Woodlands Conservation Act of 2001 recognizes the importance of private land stewardship in conserving oak woodlands. The legislation established the California Oak Woodlands Conservation Program (COWCP), the mission of which is to "conserve the integrity and diversity of oak woodlands across California's working landscapes through incentives and education." The COWCP provides technical and financial incentives to private landowners to protect and promote biologically functional oak woodlands.

The OWMP serves multiple purposes. It defines the County's conservation strategy for oak woodland resources and implements Option B of Policy 7.4.4.4. It also partially complies with Measure CO-P, and constitutes the oak portion of the County's Integrated Natural Resources Management Plan (INRMP). Finally, it will establish a plan for voluntary conservation that landowners, the County, and others can use to seek grants and cost-sharing from State and Federal programs for oak woodland conservation in El Dorado County.

B. Goals and Objectives of Plan

The OWMP goals are guided by two General Plan Objectives: Objective 7.4.2 and Objective 7.4.4. General Plan Objective 7.4.2 states: *Identify and Protect Resources:* "Identification and protection, where feasible, of critical fish and wildlife habitat including deer winter, summer, and fawning ranges; deer migration routes; stream and river riparian habitat; lake shore habitat; fish spawning areas; wetlands; wildlife corridors; and diverse wildlife habitat."

General Plan Objective 7.4.4 states: *Forest and Oak Woodland Resources*: "Protect and conserve forest and woodland resources for their wildlife habitat, recreation, water production, domestic livestock grazing, production of a sustainable flow of wood products, and aesthetic values."

The following goals are set forth by the OWMP:

- Mitigate oak canopy removal by providing flexibility through a range of on-site and off-site mitigation alternatives;

- Establish a Conservation Fund In-Lieu Fee that is sufficient to fully fund the mitigation program;

- Identify Priority Conservation Areas (PCAs) within large expanses of contiguous oak woodland habitat where conservation easements may be acquired from willing sellers to offset the effects of increased habitat loss and fragmentation elsewhere;

- Focus conservation easement acquisition efforts within areas not currently fragmented and which are unlikely to become fragmented through implementation of the General Plan;

- When weighing acquisition opportunities for conservation easements, generally maintain the relative acreages of all five oak woodland California Wildlife Habitat Relationship (CWHR) types (Valley Oak Woodland, Blue Oak Woodland, Blue Oak-Foothill Pine, Montane Hardwood Woodland, and Montane Hardwood-Conifer Woodland), but emphasize conservation of Valley Oak Woodlands, considered a "sensitive habitat" due to its relative rarity in the county;

- Encourage voluntary conservation and management of oak woodlands, including sustainable ranching and farming operations within working landscapes;

- Provide incentives (e.g., grants or cost-sharing for fuels/fire risk management) for the voluntary protection of oak woodlands providing superior wildlife values on private land (COWCP legislative goal);

- Provide oak woodland conservation guidance to private landowners and County planners through education and outreach (COWCP goals);

- Enhance oak woodland conservation by connecting acquisitions from willing sellers with existing open space, including publicly-owned lands that are managed for oak woodland habitat values (e.g., ecological preserves, recreation lands, rangelands, or natural resource areas) consistent with the County's open space conservation goals (Goal 7.6; Policy 7.6.1.1); and

- Establish a database inventory of interested buyers and willing landowners wishing to participate in oak woodland acquisition and management mitigation options (Policy 7.4.2.8).

C. Oak Woodland Habitat in El Dorado County

The term "oak woodland" is defined in the Oak Woodland Conservation Act (Fish and Game Code §1361) as an oak stand with greater than ten percent canopy cover or that may have historically supported greater than ten percent canopy cover. For purposes of this OWMP, the conservation focus is on existing oak woodlands. The General Plan uses the term "oak woodland" interchangeably and in the same context as "oak canopy." For the purposes of mitigation, measurement of oak canopy shall apply.

The OWMP addresses the same study area (below 4,000 feet elevation) and same categories of oak woodlands (California Fire and Resource Assessment Program, or FRAP) as were addressed in the 2004 General Plan. The General Plan EIR identifies five oak woodland types, which are listed in Table 1 below, along with the acreage of each category found within the OWMP study area. A sixth woodland type is Valley-Foothill Riparian which may include Fremont cottonwood, willow and valley oak. Valley-Foothill Riparian habitats in which valley oaks are the dominant tree species are considered oak woodlands under the OWMP. Both Valley Oak Woodland and Valley-Foothill Riparian are designated as "sensitive habitats" in the General Plan EIR. Less than 3,500 acres of Valley Oak Woodland and none of the Valley Foothill Riparian appears on the FRAP mapping for El Dorado County.

Table 1: Oak Woodlands in OWMP Study Area

Oak Woodland Category	Abbreviation	Acreage	% of Total
Blue Oak Woodland	BOW	42,400	(17)
Blue Oak-Foothill Pine	BOP	12,900	(5)
Montane Hardwood Woodland	MHW	155,900	(63)
Montane Hardwood-Conifer Woodland	MHC	34,200	(14)
Valley Oak Woodland	VOW	3,400	(1)
Total Oak Woodland in Study Area		**248,800**	**(100)**

A thorough discussion of oak woodland habitat identification and values is contained in Appendix A.

D. Economic Activity, Land, and Ecosystem Values of Oak Woodlands

Agriculture and recreation-based tourism are important economic generators in El Dorado County. Oak woodlands provide value for these activities. Oak woodlands provide forage value for ranching, and contribute to the aesthetic qualities of agri-tourism. Oak woodlands contribute to soil retention and provide watershed benefits, which have benefits to the agricultural community. Deer and other game species are dependent on oak woodland habitat and provide recreational hunting opportunities, which can generate revenues for ranching land owners through hunting leases. Oak woodlands contribute to a high-quality visit for recreation tourists, whose activities among oak woodlands could include camping, fishing, hiking, bird-watching, and equestrian trail riding.

Studies have concluded that the presence of oak woodlands on properties enhance property value by providing shade, wind breaks, sound absorption, land use buffers, erosion control, and aesthetic beauty.

Oak woodlands contribute to healthy lands and watersheds. They do this by providing habitat for animals, maintaining water quality, and improving soil characteristics. Oak woodlands have been acknowledged in studies to contributing to the control of climate effects.

More information regarding economic activities, land values, and ecosystem values are available in Appendix A.

E. California Oak Woodlands Conservation Act

In September, 2004, the state Public Resources Code was amended to require a county to determine (as part of its CEQA review) whether a project may result in conversion of oak woodlands that will have a significant effect on the environment (PRC 21083.4). If it determines that a project may have a significant effect, a county shall require one or more oak woodland mitigation alternatives "to mitigate the significant effect of the conversion of oak woodlands." Alternatives include: 1) conserve oak woodlands, 2) plant an appropriate number of replacement trees and maintain those trees for seven years, 3) contribute to the Oak Woodlands Conservation Fund, or 4) other mitigation measures developed by the County. Plantings shall not fulfill more than one half of the mitigation requirements for a project. Where a county adopts, and a project incorporates, one or more of these mitigation measures, the project is deemed to be in compliance with CEQA as it relates to effects on oaks and oak woodlands. This plan incorporates a range of mitigation alternatives which conform to these requirements.

2. Policy 7.4.4.4

A. Applicability and Exemptions

Policy 7.4.4.4 of the 2004 General Plan applies to all new development projects that would result in soil disturbance (see Appendix C for complete policy) on parcels that meet one of the following criteria:

- Less than or equal to one acre with at least 10% total oak woodland canopy cover; or
- Greater than one acre with at least 1% oak woodland canopy cover.

Development, as established by the policy, is any structure requiring a building permit or grading activity requiring a grading permit. Activities that do not require one of these two permit types, such as agricultural grading requiring an agricultural grading permit, tree removal for safety reasons, or the clearing of land for purposes other than construction or grading, do not trigger the provisions of this plan. The following activities are specifically exempted from Policy 7.4.4.4:

- agricultural cultivation, and
- actions pursuant to a County-approved Fire Safe Plan necessary to protect existing structures.

These exemptions are detailed below:

Agricultural Cultivation – The removal of native vegetation, including oaks, for the purposes of producing or processing plant and animal products or the preparation of land for this purpose is exempt. This is consistent with State PRC 21083.4.

Existing Structure Defensible Space/Fire Safe Measures – The intent of this exemption is to exempt oak tree removal from mitigation in the 100-foot defensible space zone around an existing building or structure. Defensible space, for the purposes of this plan, is the 100-foot area around an existing structure, or to the property line, whichever is closer. Defensible space is required pursuant to Public Resources Code (PRC) 4291 and Title 14 California Code of Regulations (CCR) 1299.

Fuel modification actions, inside and outside of the 100-foot defensible space zone, are also exempt from Policy 7.4.4.4 mitigation. Examples are actions to ensure the safety of emergency fire equipment and personnel; to allow evacuation of civilians; to provide a point of attack or defense for firefighters during a wildland fire; to prevent the movement of a wildfire from a structure to the vegetated landscape; and/or the maintenance or creation of fuel breaks for fire safety, where no grading permit or building permit is applicable.

The County encourages the creation of defensible space around existing structures and the provisions of the OWMP are by no means intended to impede the fuels reduction required by law to protect existing structures. However, oak tree removal in the 100-foot defensible space zone, pursuant to PRC 4290 and Title 14 CCR 1270-1276 of the Fire Safe Regulations, and fuel modification actions pursuant to a Fire Safe Plan, inside and outside of the 100-foot defensible space zone for all new development projects, is not exempt from Policy 7.4.4.4 mitigation. The 100-foot defensible space zone, and fuels modification necessary for a Fire Safe Plan, is part of the project footprint and oak canopy removed shall be counted in the project total oak canopy removal. Any oak trees that can be safely retained, even if separated from the oak woodland, will count as oak canopy retained.

The County further encourages developers and landowners to review the 100-foot defensible space information available from CAL FIRE; specimens of oak trees and native habitat can be retained in the 100-foot defensible space by keeping lower branches of oak trees pruned, removing surface litter, separating trees and shrubs (horizontally), and reducing ladder fuels (vertically separating trees and shrubs). See CAL FIRE's website or brochures for detailed information.

Because of the ability to safely retain some of the oak canopy within the defensible space, when calculating oak tree canopy loss with new subdivisions and parcel maps, an applicant may assume 20% retention of the oak tree canopy within the defensible space area around building pads or sites.

Additionally, the OWMP provides for reductions to oak canopy mitigation for affordable housing projects as described below and provides for an exemption for public road safety projects and public utility projects.

Affordable Housing – Development projects that propose a minimum of 10 percent of the dwelling units as income restricted affordable units, as defined by California Health and Safety Code §50052.5, 50053, and 50093, shall be granted a reduction in the amount of oak canopy that is required to be protected under Option A, or the amount of fee to be paid under Option B, as set forth in Table 2.

Table 2: Affordable Housing Reduction

Affordable Housing Type (Household Income Level)	**% Reduction of Oak Canopy Mitigation for portion of project that is income restricted**
Very Low	200%
Lower	100%
Moderate	50%

Example: A project proposes 25% of the units to be affordable in the lower income category. The amount of on-site retention or Conservation Fund In-Lieu Fee may be reduced by 25%. A moderate income project that provides all units at that income level may reduce the retention and/or fee by 50%. A project with 20% very low income units would receive a 40% reduction. (Note: PRC §21083.4(d) provides exemptions for affordable housing projects in urbanized areas for lower income households.)

Public Road and Public Utility Projects Exempt from Policy 7.4.4.4 – Oak canopy removal necessary to complete County capital improvement projects are exempt from the canopy retention and replacement standards, when the new alignment is dependent on the existing alignment. This exemption applies to road widening and realignments which are necessary to increase capacity, to protect the public's health, and to improve the safe movement of people and goods in existing public road rights-of-way, as well as acquired rights-of-way necessary to complete the project. This exemption shall also apply to removal of oak canopy necessary to comply with the safety regulations of the Public Utilities Commission and necessary to maintain a safe operation of utility facilities. The County shall minimize, where feasible, the impacts to oaks through the design process and right-of-way acquisition for such projects.

This exemption to the oak canopy retention and replacement standards does not apply to new roads or utility installation, or to internal circulation roads within new development.

B. Replacement Objectives

When determining the amount of oak canopy replacement on a parcel, consistency can be achieved by a combination of Policy 7.4.4.4 Options A and B. These replacement objectives may be achieved, subject to County approval, by:

1. Replacement planting on-site at a 1:1 canopy surface area ratio; or
2. Contributing to the County's INRMP/Conservation fund at a 2:1 ratio; or
3. Acquiring an off-site conservation easement on oak woodlands at a 2:1 ratio; or
4. A combination of 1, 2, or 3 above.

C. Mitigation Option A

Option A sets forth limitations on the amount of oak canopy that may be removed with each project, based on calculations of the percent of oak canopy existing on the subject parcel. Oak canopy must be retained in the amount established in the Table of Policy 7.4.4.4, provided below as Table 3.

Table 3: Canopy Retention Requirements from Policy 7.4.4.4

Percent Existing Canopy Cover	Canopy Cover to be Retained
80 – 100	60% of existing canopy cover
60 – 79	70% of existing canopy cover
40 – 69	80% of existing canopy cover
20 – 39	85% of existing canopy cover
10 – 19	90% of existing canopy cover
1 – 9 for parcels > 1 acre	90% of existing canopy cover

In addition to retention, Option A requires that removed oak canopy be replaced at a 1:1 ratio. The size of the designated replacement area shall equal the total area of the oak canopy cover proposed to be removed. For example, removal of 2 acres of oak canopy requires replacement of 2 acres of oak canopy; removal of 5,000 square feet of oak canopy requires replacement of 5,000 square feet of oak canopy.

D. On-Site Mitigation – Replanting and Replacement (Option A)

As provided under Option A, Policy 7.4.4.4, all oak canopy removed for development must be replaced at a 1:1 ratio. In lieu of on-site replacement, where such replacement is not feasible due to soil/habitat considerations and/or land use constraints, off-site mitigation may be substituted for replacement plantings by payment of the Conservation Fund In-Lieu Fee at a 1:1 canopy surface area ratio or dedication of an off-site conservation easement as described in Section 4.C, also at a 1:1 ratio. Off-site replacement at a 1:1 ratio is offered to avoid circumstances that would result in replacement plantings occurring in marginal habitat or at the expense of other existing habitat. The following provisions apply to on-site and off-site replacement:

- Replacement plantings may be accepted if adequate openings exist on-site and the replanting area likely would support oak woodland (e.g., soil type and general environment). The intent is not to remove existing natural habitats for plantings or to create a continuous canopy that would reduce wildlife value or contribute to increased fire hazard. Replacement plantings shall meet the County's replanting and replacement standards and is subject to County approval.

- Oak canopy replacement plans shall be prepared by a qualified professional (such as a certified arborist, registered professional forester, certified rangeland manager, or biologist, as described in Section 8.A, Appendix A). Replacement plans shall address the following: (For more detailed criteria, please see Appendix E.)

    - An oak planting mitigation plan consistent with the standards established in the 2004 University of California publication, Regenerating Rangeland Oaks in California, How to Grow California Oaks, How to Collect, Store and Plant Acorns, and other publications and protocols that may be established by the University of California Integrated Hardwood Range Management Program.
    - The suitability of the site for oak woodlands shall be demonstrated with soil information, aerial photography, or other resources. The qualified professional shall demonstrate that the replanting plan does not remove existing non-oak woodland and enhances existing oak woodland habitat.
    - The density of replanting shall be determined by the qualified professional, based on accepted practice and current research.
    - The intent of the replacement plan is to provide replacement oak trees or acorns with a similar mix of species as those removed, however, the species may vary based on site specific conditions, as determined by the qualified professional.
    - The source of acorns or saplings for replanting shall be from local sources when available, to maintain local genetic strains.
    - Replacement planting should not be located within the 0-100' defensible space zone from an existing or proposed structure unless otherwise consistent with CAL FIRE's defensible space guidelines and fuels reduction requirements mandated under California Public Resources Code (PRC) §4291.
    - Replacement plantings shall be maintained in a manner determined by the qualified professional, based on the site-specific conditions, which may include

weed control, irrigation (if appropriate), herbivory/grazing protection, fertilization, and planting methods.
  - The replacement plan shall identify the frequency and methods of maintenance and monitoring, as well as contingencies or alternatives if the success criteria are not met at the end of the monitoring term along with a means to ensure compliance with the replacement plan. The monitoring term shall be seven years (PRC 21083.4).
  - Best Management Practices (BMPs) for protection of retained oaks during and after construction (refer to Appendix D).
  - An estimate of the total costs associated with implementation of the replacement plan.

- An oak tree easement shall be recorded on each property by the County, project applicant, or landowner for all replanting areas approved by the County as mitigation, prior to issuance of a permit.

E. Mitigation Option B

Option B does not require the retention of a minimum percentage of oak canopy on-site. This mitigation alternative is intended to preserve existing oak woodland canopy of equal or greater biological value as those lost. To compensate for both habitat loss and fragmentation, the preservation mitigation ratio was set at 2:1 based on the acreage of oak canopy affected. For purposes of the fee program, the standard for off-site mitigation under Option B is payment of the Conservation Fund In-Lieu fee at a ratio of 2:1. In other words, for each acre of oak canopy that is lost, the payment is the fee per acre multiplied by two. The Conservation In-Lieu Fee Mitigation Method is described in detail in Appendix B.

Alternatives to the Conservation Fund In-Lieu Fee, including dedication of off-site conservation easements by a landowner/developer as direct mitigation at a 2:1 ratio are considered the functional equivalent of the Option B in-lieu fee, and will be permitted, subject to County approval. While landowners/developers will not have to pay the Acquisition Component of the fee as they are themselves acquiring a conservation easement, they are still required to pay the Management Component and Monitoring Component of the Conservation Fund In-Lieu Fee to provide for the ongoing endowment for management and monitoring.

F. Mitigation Program Flexibility

The OWMP provides for flexibility in meeting the oak canopy mitigation requirements. An applicant for a development project may comply with the provisions of Policy 7.4.4.4 by meeting the retention and 1:1 replacement requirements of Option A, providing off-site mitigation through the payment of the OWMP fee as established by the OWMP and the implementing fee ordinance, or a combination of the two provisions. Additionally, off-site mitigation may be accomplished through private agreements between the applicant and another private party consistent with the 2:1 replacement provisions of Option B and subject to approval by the County of the suitability of the oak woodland to be protected. When dedication of off-site conservation easements is proposed by a developer, a biological study shall be required for the off-site mitigation location to demonstrate that the site is of equal or greater biological value as the oak woodland proposed to be removed. The biological study shall evaluate and demonstrate parity of habitat elements such as snags, large woody debris, and the diversity and structure of the understory between the oak woodlands lost and those being protected. If the off-site conservation easement is to mitigate for Valley Oak Woodland removed, then the easement must be within Valley Oak Woodland of equal or greater biological value. A developer that dedicates a County-approved conservation easement is not subject to the Acquisition Component of the Conservation Fund In-Lieu Fee, but is subject to the Management Component and Monitoring Component of the fee.

3. Conservation Fund In-Lieu Fee Methodology

The Conservation Fund In-Lieu Fee is based on the costs of acquisition of conservation easements, along with management, monitoring, and administrative costs. A breakdown of costs per acre is provided in Table 4. Details of the analysis to establish the fee is contained in Appendix B.

Table 4: Conservation Fund In-Lieu Fee

Activity	Cost Per Acre
Acquisition [1]	$ 2,300
Management [2]	$1,200
Monitoring [3]	$ 1,200
Total Cost/Fee Per Acre	**$4,700**

(1) Conservation easement on rural land acquisition of 125 acres, which is the average parcel size within the PCAs. Acquisition costs include the easement land value (approximately $1,800, or 40% discount value) and conveyance costs.
(2) Includes biological survey/baseline documentation, weed control and fuels treatment.
(3) Includes endowment for on-going monitoring.

As provided in Option B of Policy 7.4.4.4, off-site mitigation in the form of payment of the fee shall be made at a 2:1 canopy surface area ratio, requiring the payment of $9,400 for every acre of oak canopy removed in excess of the amount provided in the table of Option A. To meet the Option A 1:1 replacement standard, an applicant may opt to pay the Conservation Fund In-Lieu Fee at the 1:1 rate for that portion of oak canopy removed consistent with the table. If payment into the Conservation Fund is utilized for the replacement portion of Option A, then on-site retention requirements would still apply.

The County shall deposit all Conservation Fund In-Lieu fees into an Oak Woodland Conservation Fund, which shall be used to acquire conservation easements from willing sellers in the PCAs as described below in Section 4. This fund shall also be used for ongoing monitoring and management activities, including but not limited to fuels treatment, weed control, periodic surveys, and reporting. The County may provide management services by employees or contract management and monitoring activities with a qualified firm, individual, outside agency, or non-profit organization. Funding to support the identification of willing sellers, negotiation of the purchase price, and oversight of the land transaction is included in the management component of the Conservation Fund In-Lieu Fee.

As costs for off-site mitigation change over time, there will be a need to adjust the fee to closely match future cost increases or decreases. Appendix B details the fee adjustment approach. A report regarding fee adjustments will be included in an annual report to be submitted to the Planning Commission and Board of Supervisors each March, as described in Appendix A. The first fee adjustment study would occur at least 12 months after adoption of the OWMP.

4. Priority Conservation Areas

A. Identification of Priority Conservation Areas

Figure 1 identifies the areas in which conservation easements shall be acquired from willing sellers using the Oak Woodland Conservation Fund generated by the payment of the Conservation Fund In-Lieu Fee described above. These areas were identified using the FRAP classification of the five oak woodland habitat types in the county. After those areas were mapped, the areas were narrowed down to large expanses consisting of 500 acres or more. Those large expanses were further narrowed to lands where oak woodland habitat would not likely undergo substantial fragmentation and oak woodland conservation would be consistent with the 2004 General Plan land use designations. Areas specifically excluded were lands within Community Regions and Rural Centers and lands designated Low Density Residential. These resulting areas are classified as Priority Conservation Areas (PCAs).

The 500-acre PCAs are generally made up of 40-acre and larger privately owned parcels. A breakdown of parcel sizes within the large expanses is shown in Table 5. A more detailed description of the mapping process and data used to identify PCAs is provided in Appendix G. Figure 1 also shows existing public lands with high-value oak woodlands contiguous to the PCAs.

Table 5 – PCA Parcel Statistics

Parcel size (Acres)	# of parcels	Acres
40-60	170	7,666.3
60.1-120	155	13,176.7
120.1-340	175	31,674.3
340.1+	29	13,535.5
Total	***529***	***66,052.8***
	Avg. Size Median Size	**124.9** **84.3**
*Data produced using parcel data from El Dorado County and the PCA shapefile for the Draft Plan (VOWH_PRVT_grtr500ac.shp)		

Oak woodland offered as mitigation must be configured in such a manner as to best preserve the integrity of the oak woodland ecosystem. Priority should be given to conserving oak woodland habitat within PCAs adjacent to existing woodlands under or subject to an Important Biological Corridor, conservation easement, public lands, open space lands, riparian corridors, ecological preserves or other PCAs lying west of the National Forest.

Valley Oak Woodland within the PCAs will be specifically acquired to mitigate for losses of Valley Oak Woodland as a result of new development. Only Valley Oak Woodlands will be targeted this way in order to provide a method ensuring that this General Plan-designated "sensitive habitat" is adequately preserved. If the Valley Oak Woodland habitat within currently designated PCAs becomes insufficient, then additional acreage of this habitat type will be added to the PCAs as necessary upon annual review of the OWMP.

The OWMP establishes an oak woodlands resource base that, when managed for conservation and preservation purposes, conserves a substantial portion of oak woodland habitat to offset the effects of increased habitat loss and fragmentation elsewhere in the county. This approach is considered superior to one that attempts to conserve oak woodlands in areas designated for development. Such areas are less desirable for mitigation lands because they are more expensive, have reduced habitat values, and would conflict with approved General Plan land use designations. Subsequent adoption and implementation of the INRMP, and incorporation of this plan into that document, will ensure connectivity between the PCAs. The INRMP will also address north-south connectivity across Highway 50 and the potential role of oak woodlands less than 40 acres in maintaining connectivity between larger expanses of oak woodlands. Existing public lands, Important Biological Corridors as identified on the 2004 General Plan land use diagram, and stream setback requirements provided under Policy 7.3.3.4 provide sufficient interim connectivity to provide wildlife movement between the PCAs (See Figure 2).

B. Management of PCAs

Existing native oak woodland identified as mitigation for project impacts, whether on or off the project site, will be protected from further development through a conservation easement granted to the County or a land conservation group approved by the County. Management activities may include, but are not limited to, one or more of the following activities, as determined through monitoring of the sites: inspections, biological surveys, fuels treatment to reduce risk of wildfire and to improve habitat, weed control, database management, and mapping.

C. Conservation Easements

Conservation easements for oak woodlands shall be granted to the County in perpetuity. The easement shall be provided on a form approved by the County and shall be recorded with the County Clerk/Recorder.

5. Application of OWMP to Development Review Process

Determination of the applicability of the OWMP to a development project shall be made as follows:

1. Planning staff and applicant determines if oak woodland exists on the parcel and if the proposed project impacts any of the oak canopy.

2. Oak canopy loss is calculated by a consultant hired by the applicant, utilizing either an on-site survey by a qualified professional, aerial photography, or other means acceptable to the County to determine total oak canopy area and the area proposed to be removed as a part of the project. Canopy loss is calculated by identifying all disturbed areas as proposed, including:

   a. Roads, driveways, and access drives;

   b. Graded areas for building pads, parking lots and other improvements; and

   c. Other disturbed areas resulting in tree removal including septic system leach fields and fire safety defensible space vegetation removal for new construction.

   d. Fire Safe Plans allow for some retention of oak canopy. To simplify the calculation of oak canopy retention in this zone, the OWMP assumes 20% retention. A site specific analysis of tree removal may be utilized instead of the 20% retention assumption.

3. The proposed oak canopy removal is compared with the retention standards provided in the Option A table.

4. If the amount of oak canopy removed is within the retention standards set forth in the Option A table, the applicant may mitigate for the loss by one of the following:

   a. Planting on-site at a 1:1 canopy surface area ratio the area of oak canopy removed; or

   b. Paying into the Oak Woodland Conservation Fund an amount equal to 1:1 replacement for the oak canopy removed; or

   c. Acquire a conservation easement from a willing seller for an area equal to the area (i.e., 1:1 ratio) of removed oak canopy, in an area either within the PCA or other area acceptable to the County; or

   d. A combination of two or more of the above provisions.

5. If the amount of oak woodland canopy removed exceeds the amount permitted under the Option A retention table, in addition to the provisions of steps 1 through 3, above, the applicant shall do one of the following for oak canopy removed in excess of that permitted under Option A:

a. Pay into the County’s Oak Woodland Conservation Fund the fee amount based on a 2:1 replacement ratio; or

b. Acquire a conservation easement from a willing seller for two times the area of oak canopy removed in excess of that permitted under the Option A table, in an area either within the PCA or other area acceptable to the County, along with fees for management and monitoring; or

c. A combination of the above provisions.

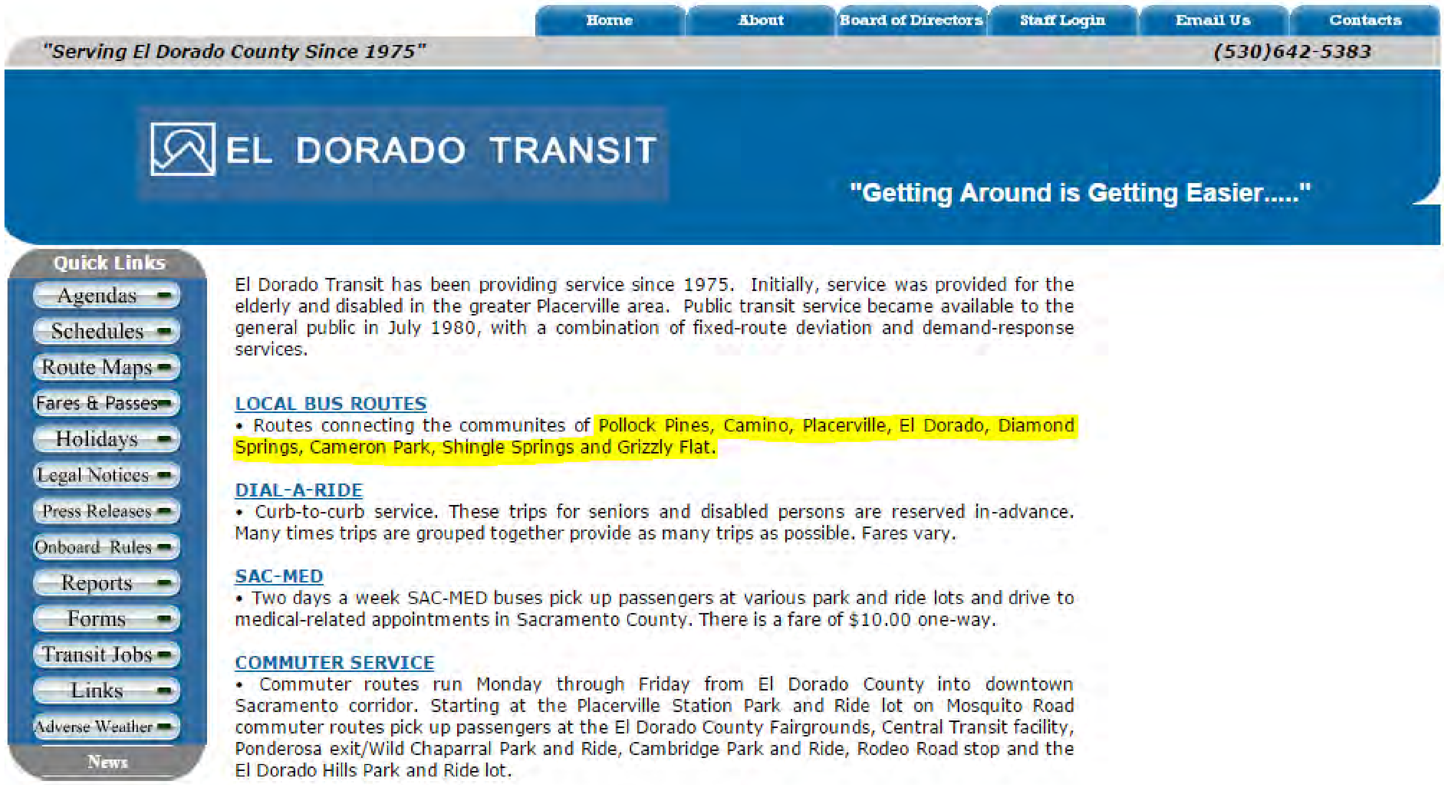
6. Payment of applicable fees and granting of any required easements shall be required as a condition of approval of all discretionary permits for which these provisions apply, and shall be completed prior to issuance of a grading or building permit, filing of a parcel or final map, or otherwise commencing with the project. The payment of the fee may be phased to reflect the timing of the tree canopy removal.

7. Payment of applicable fees and granting of any required easements if necessary shall be completed prior to issuance of a building or grading permit for ministerial projects.

Attachment #21

Vandyke comments Dixon DEIR Attachment 21

El Dorado Hills and Rescue do not have local bus routes.

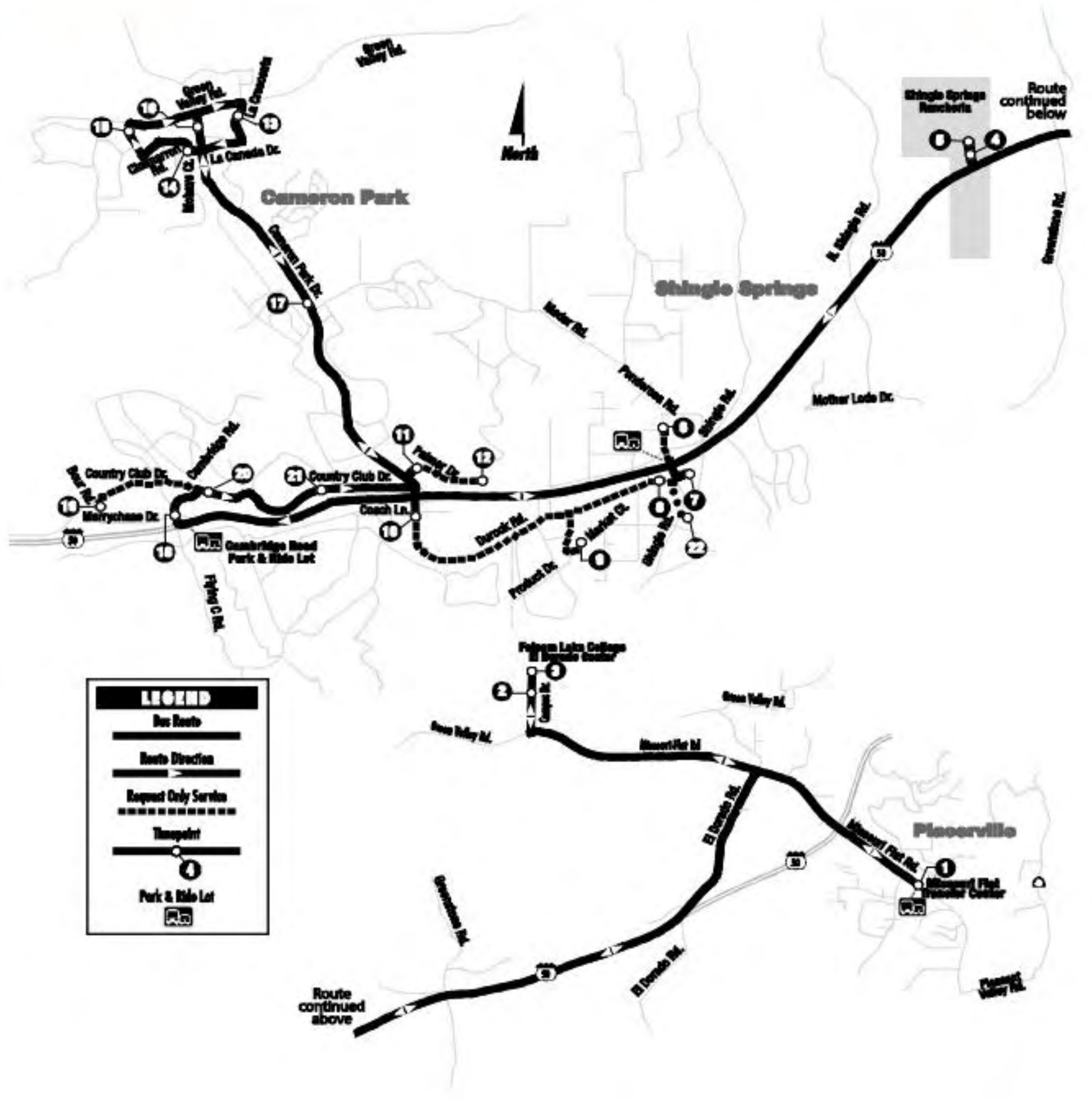


This is the Cameron Park map below. There is no such map for EDH or Rescue, and no connection to the project site on Green Valley Rd:

CAMERON PARK

FROM: Missouri Flat Transfer Center **TO:** Cameron Park **Returning To:** Missouri Flat Transfer Center

CP

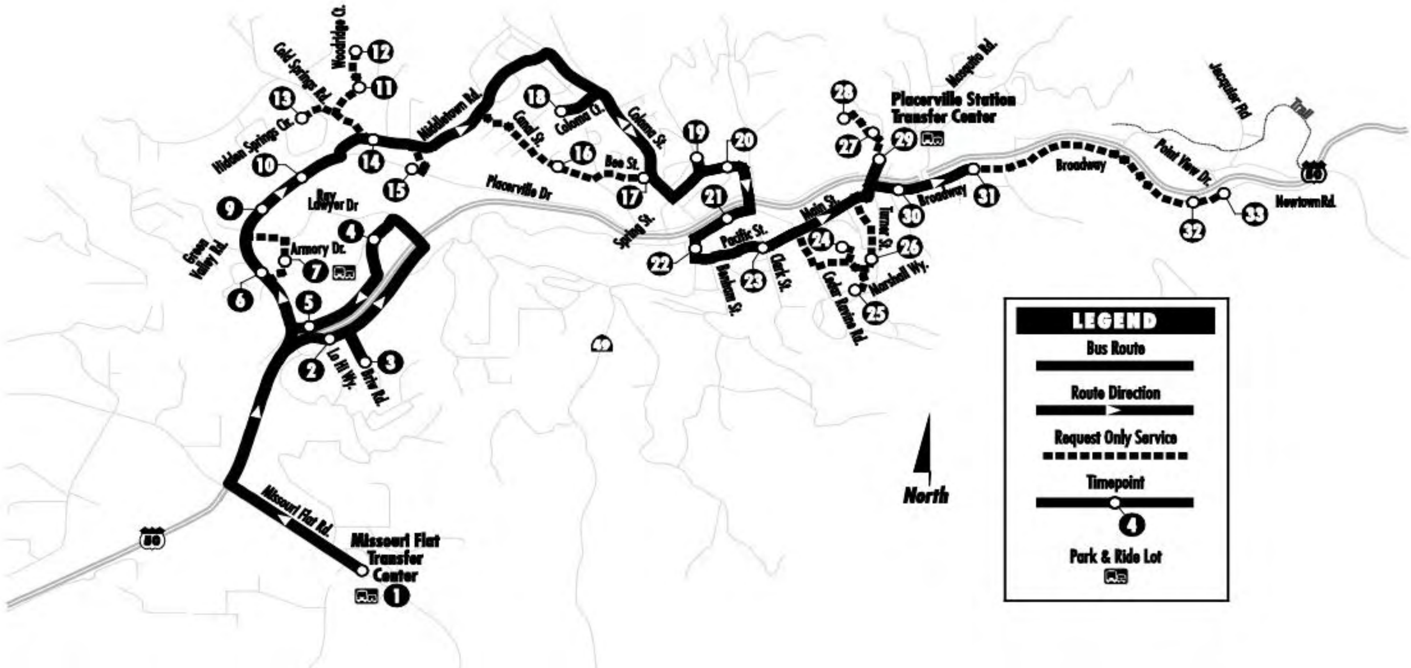


Placerville area:

PLACERVILLE - EASTBOUND

FROM: Missouri Flat Transfer Center **TO:** Broadway and Point View Dr. Monday through Friday

PL EAST



This map shows Dixon roughly in zone 'F'. This is for 'fare' purposes for carefully advanced scheduled shuttles on Tuesdays or Thursdays, that may or may not be available to accommodate the passenger:

DIAL-A-RIDE SYSTEM MAP and ZONE FARES
Effective April 6, 2009

ZONE A FARE
$2.00 S/D + 50¢ per zone crossing
$4 General + $1 per zone crossing

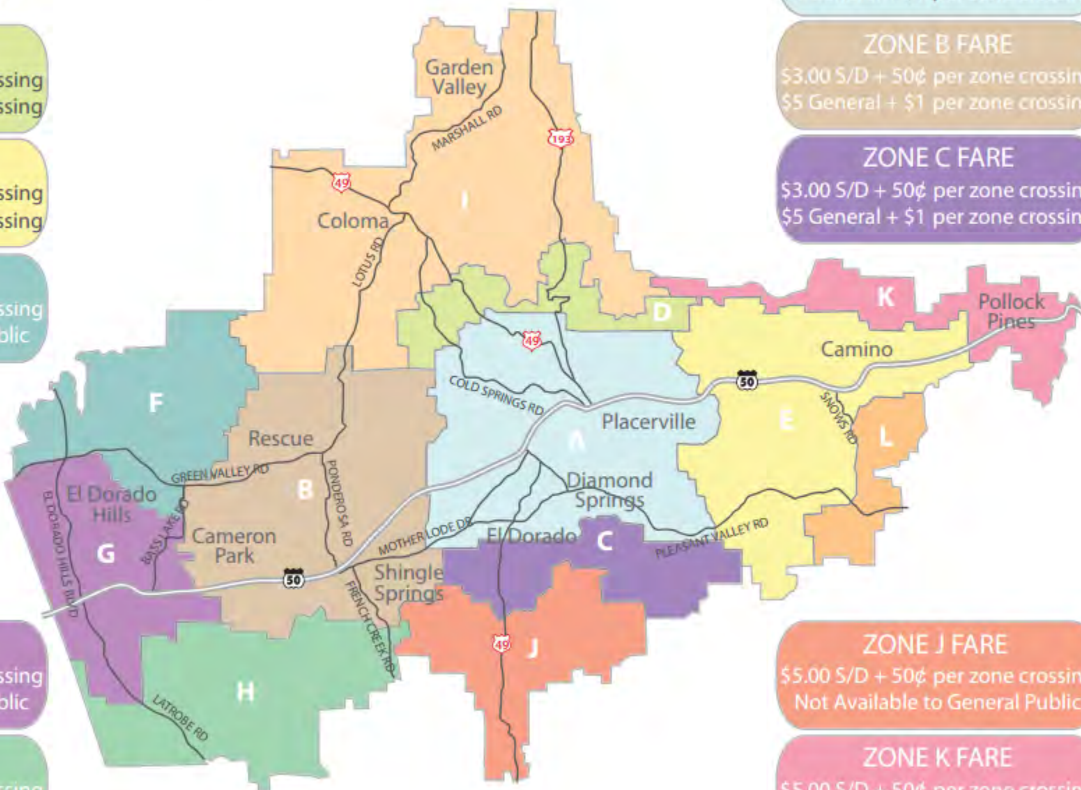
ZONE B FARE
$3.00 S/D + 50¢ per zone crossing
$5 General + $1 per zone crossing

ZONE C FARE
$3.00 S/D + 50¢ per zone crossing
$5 General + $1 per zone crossing

ZONE D FARE
$3.00 S/D + 50¢ per zone crossing
$5 General + $1 per zone crossing

ZONE E FARE
$3.00 S/D + 50¢ per zone crossing
$5 General + $1 per zone crossing

ZONE F FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public



ZONE G FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public

ZONE H FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public

ZONE I FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public

ZONE J FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public

ZONE K FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public

ZONE L FARE
$5.00 S/D + 50¢ per zone crossing
Not Available to General Public

Attachment #22

Oaks 2040

The Status and Future of Oaks in California

By Tom Gaman and Jeffrey Firman
Published by the California Oak Foundation

Oaks 2040: The Status and Future of Oaks in California

By Tom Gaman and Jeffrey Firman[1]

Introduction: Developing planning tools for oak futures in California

Ecological functions, wildlife habitat, recreational opportunities and scenic values are seriously impaired as population densities and other landscape use pressures increase. Managers of oak woodlands and forests need to balance the biological, sociological and economic interests of private landowners, public agencies, business, universities, environmental groups and concerned individuals. Planning must address the complexities of local, regional and state-wide oak issues within the context of practical on-the-ground land use decisions.

Oaks 2040 is based on objective oak data and is designed to serve decision makers who may develop local and regional Oak Woodlands Management Plans or advance other conservation strategies. A statewide map of oak distribution and a current forest and woodland inventory, created by state and federal researchers, were the starting points for Oaks 2040. From those, regional analyses of forest structure and oak types as well as region-specific oak inventory summaries have been developed. By evaluating these maps and inventories against current economic growth projections, Oaks 2040 identifies the location and extent of oaks most at risk.

Cover photo: Black Oak at Big Sur

[1] Tom Gaman tgaman@forestdata.com and Jeffrey Firman jfirman@forestdata.com of Forest Data, P.O. Box 276, Inverness, CA 94937. Gaman and Firman (see www.forestdata.com) have been active many years in forest inventory, data analysis, mapping and forest conservation. Both have master's degrees in forestry from Yale University. Gaman is a registered professional forester and a board member of the California Oak Foundation.

Oaks 2040

Citizens Concerned with Oak Conservation:

Oaks are more than a distinct component of the landscape for many of us who live in California. For hundreds of years, people have lived in, raised families under, and worked around these generous, natural and cultural icons. Today, increasing population pressures and poorly-planned development are threatening oak sustainability.

The Oak Woodland Conservation Act requires cities and counties to assess their wealth in oak resources and to adopt Oak Woodlands Management Plans in order to meet the need for healthy watersheds, clean air and water, and sufficient high quality wildlife habitat. These Plans must include a description of native oak species and their current and historical distribution, as well as existing threats, status of natural regeneration and urban growth trends. These Plans must also recognize the economic value of oak woodlands in their respective jurisdictions and encourage and support farming, ranching and grazing operations compatible with oak woodland conservation.

Oaks 2040 is designed to provide various stakeholders involved with developing or updating their community's Oak Woodlands Management Plan with current information on 48 of the 58 counties that contain significant oak resources. Every effort has been made to present this important information fairly.

Readers must realize, however, that COF is an advocate for sustainable oak resources. To that end, the full report mentions the importance of using available tools, such as acquisition in fee, conservation easements in perpetuity, deed restrictions and oak mitigation banks, in a timely fashion to achieve conservation of oak resources.

COF's Board of Directors thanks its members, associates and friends for their individual and collective efforts to establish a viable Oak Reserve system made up of well-managed oak woodlands and forests on private and public lands throughout California.

Sincerely,
Janet Santos Cobb

Methods

MAPPING OAK TYPES

A number of overall vegetation maps, maps of hardwoods in general, and oak-specific maps have been generated over the years. Currently, the most reliable statewide vegetation map available is the "LCMMP Vegetation Map" (FRAP map) produced by the California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP) in conjunction with the US Forest Service (USFS) Region 5 Remote Sensing Lab (RSL) in Sacramento. While these maps do not focus specifically on oaks, oak habitat types can easily be extracted from these vegetation types. Using these maps as a foundation (supplemented by other earlier mapping efforts), species-specific range maps of oak types throughout the state (FRAP 2005) have been generated.

The FRAP map uses the *Calveg* classification system which first divides all vegetation into *Covertype*. Covertype can be equal to the following: conifer (CON), shrub (SHB), barren (BAR), hardwood (HDW), grass (HEB), water (WAT), conifer/hardwood mix (MIX), urban (URB), or agricultural (AGR). For finding oak habitat, only two *Covertypes* are relevant. All *woodland* classified as 'hardwood' (HDW) or *forest* classified as 'conifer/hardwood mix' (MIX) can potentially be oak habitat provided it contains the relevant hardwood species. All other *Covertypes* were eliminated from the analysis.

"The Oak Woodland Conservation Act requires cities and counties to assess their wealth in oak resources and to adopt Oak Woodlands Management Plans in order to meet the need for healthy watersheds, clean air and water, and sufficient high quality wildlife habitat."

After *Covertype*, the Calveg system also specifies *Vegtype*, which identifies the dominant species association. For both HDW and MIX covertypes, the data were screened to ensure that the hardwood associations being mapped in a particular location are oaks. Dozens of hardwood *Vegtypes* are mapped throughout the state, but only twelve are dominated by tree oaks. Nine of these are dominated by a single species, each forming its own Oak Habitat Type, or "Oak Type." Three heterogeneous hardwood types were combined to generate a "mixed" Oak Type. The ten resulting Oak Types, each potentially occurring in both "woodlands" and "forests"[2], are listed in the following Table 1:

This rigorous selection and reclassification process was applied to the FRAP maps. The results are GIS layers and maps depicting the distribution of woodland and forest oak habitat types throughout California. These geographic data provide the foundation for the landscape-level analysis of the distribution and diversity of California's oak woodlands and oak forests. See the tables in Appendix A for acres of cover where oaks dominate the woodland by county and Oak Type and acres of cover where oaks are present in the forest by county and Oak Type.

OAK TYPE	SCIENTIFIC NAME	TYPE(S)
Black Oak	*Quercus kelloggii*	QK
Blue Oak	*Quercus douglasii*	QD
Canyon Live Oak	*Quercus chrysolepis*	QC
Coast Live Oak	*Quercus agrifolia*	QA
Engelmann Oak	*Quercus engelmannii*	QN
Interior Live Oak	*Quercus wislizeni*	QW
Oregon White Oak	*Quercus garryana*	QG
Tanbark Oak	*Lithocarpus densiflorus*	QT
Valley Oak	*Quercus lobata*	QL
Mixed Oaks	not applicable	EX/NX/TX

Table 1. Oak Types

[2] "Oak Woodlands" are considered to be those mapped vegetation types where oaks dominate the landscape. By definition, they have at least 10% canopy cover. "Oak Forests" are those vegetation types dominated by trees, but *Quercus spp.* or *Lithocarpus densiflorus* may not necessarily be among the dominant species.

OWNERSHIP AND AT RISK ANALYSIS

Two additional layers are added to further intensify the oak mapping analysis. Land ownership and development risk layers are incorporated into the map to assess pertinent conservation issues. The land ownership data is courtesy of the California Department of Forestry's Forest and Rangeland Resources Assessment Program (FRAP 1999). Using the FRAP layer, the state is divided into a variety of public and private ownership categories. The statewide ownership layer overlaid on top of the Oak Type map reveals ownership patterns of California's oaks.

The development risk data has been derived from the California Department of Finance's projected development layer. This dataset is based on 2000 US Census Data (FRAP 2001). This layer tracks past development by decade and predicts future development through 2040. Using this information, three categories were defined. 'Developed' is defined as anything that has been developed (greater than 32 housing units per square mile) by 2000. 'At Risk' refers to anything that has not been developed by 2000 but is expected to develop by 2040. 'Stable' refers to anything that has not been developed by 2000 and is unlikely to be developed before 2040.[3] Once the layer was divided into these three categories, it was overlaid on top of the Oak Type Map. The oak woodlands of the state were thereby divided into groups by oak type, ownership and development risk.

INVENTORY AND ANALYSIS

The other critical element for assessment of mapped oak types is the inventory summary, which is based upon data obtained from the USFS Forest Inventory and Analysis Program (FIA). This statewide grid of permanent forest survey sample "plots" yields information about what the mapped oak forests and woodlands look like on the ground. The plots provide information not obtainable via remote sensing techniques – an inventory of forest fuels, species distribution, specific size, growth, regeneration, habitat features, pest and disease. With point-specific data ranging from species composition to seedling regeneration to tree size and density, these plots help one understand the makeup of each of the ten oak types.

The most recent FIA field data was obtained to provide an inventory of each of the oak types discussed above. Combining the ground-based survey data and the GIS mapping data enabled the authors to provide a comprehensive oak inventory using new vegetation maps and the 2001-2004 FIA inventory data.

Using conventional computer programs, inventory data was processed to produce summaries of each plot. The survey plots were grouped by oak type within each region and a customized program was used to produce inventory summaries per acre by oak type by region. Regional totals were then summed up to provide an inventory for the entire state. A variety of other factors were analyzed using the inventory data including basal area and tree counts per acre of oaks relative to total trees, size distribution, regeneration status, and determination of associated hardwood and conifer species. Appendix B summarizes these details for woodlands and forests statewide by oak type.

[3] The 'developed' and 'at risk' designations are assigned to privately owned lands only, as those held in public ownership are considered 'stable' with regard to development. However, publicly-owned lands do face other challenges such as poor oak regeneration and non-sustainable land management practices.

California oaks: the statewide analysis

To facilitate statewide analysis, California counties have been grouped into six distinct regions, each of which is discussed later in this report. In an attempt to represent the levels at which conservation policy is often decided, county boundaries have been utilized for this regional split (see Figure 1), rather than natural boundaries such as watersheds or bioregions.[4] The tables in Appendix B summarize inventory details for woodlands and forests statewide by oak type.

"The plots provide information not obtainable via remote sensing techniques – an inventory of forest fuels, species distribution, specific size, growth, regeneration, habitat features, pest and disease."

Figure 1 – California is divided into six regional groupings of counties.

[4] These are the same regions used in Bolsinger's 1988 *The Hardwoods of California's Timberlands, Woodlands, and Savannas,* except that the San Joaquin Valley has been separated from the rest of Southern California.

OAKS PLAY A MAJOR ROLE IN THE CALIFORNIA LANDSCAPE

California has approximately 8.5 million acres of oak woodland and 4.5 million acres of oak forest. These 13 million acres comprise more than one-eighth of the state's area (see Figure 2). The Sacramento and San Joaquin regions are home to more than half of California's oak woodland. Oak forests are concentrated in the North Coast and North Interior regions. California currently has approximately two billion oaks greater than 1" DBH. More than 800 million of these oaks are larger than 5" DBH.

California oaks are diverse. Blue oak is California's dominant oak species, representing more than one-third of the state's oak woodlands. Canyon, coast and interior live oak woodlands comprise approximately one-third of California's oak woodlands. Tanbark, black and canyon live oak forests account for more than 80 percent of California's oak forests.

In oak woodland, oaks comprise 60 percent of the total tree basal area, 67 percent of trees greater than 5" DBH and 37 percent of trees greater than 24" DBH. In oak forest, oaks comprise 18 percent of the total tree basal area, less than 24 percent of trees greater than 5" DBH and eight percent of trees greater than 24" DBH. Blue oak, Oregon white oak and, to a lesser extent, interior live oak, are regenerating poorly. Blue oak averages about one seedling per thousand square feet in woodlands, and less than one seedling (one foot or more in height) per two established oak trees. Not a single Engelmann oak or valley oak seedling was tallied on any of the 932 FIA plots.

OAKS 2040: FUTURE PROSPECTS FOR CALIFORNIA'S OAKS

More than one million acres of California's oak woodlands are developed and approximately 750,000 are at risk of development before 2040. Twenty percent of California's oak woodlands are facing rapid and increasing urbanization by 2040. The oak woodlands of the Central Valley and Sierra Foothills face the most immediate threats. Eighty percent of California's oak woodlands that are at risk of development are located in the Sacramento and San Joaquin regions. See Figure 3.

"More than one million acres of California's oak woodlands are developed and approximately 750,000 are at risk of development before 2040."

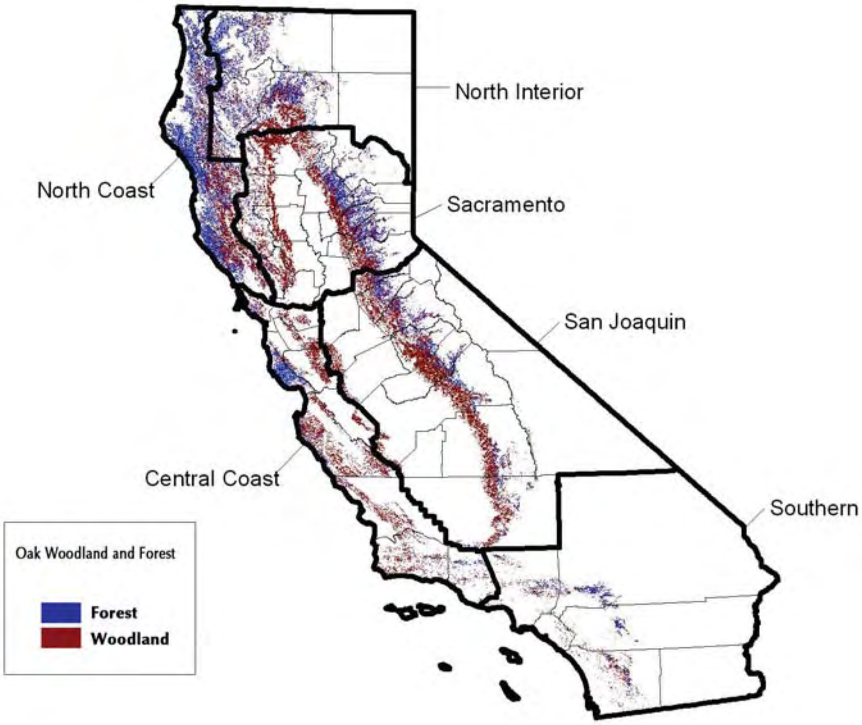


Figure 2 – This map shows the distribution of oak woodlands and oak forests.

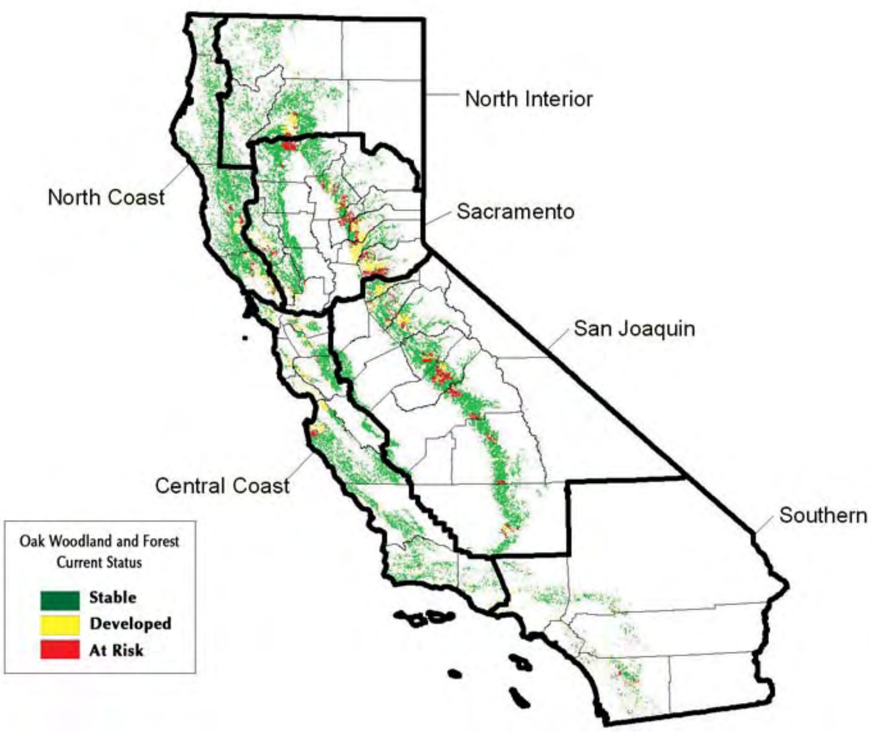


Figure 3 – This map illustrates the distribution of California's oaks 'developed,' 'at risk' and 'stable.'

North Coast Region

Del Norte

Humboldt

Mendocino

Sonoma

California oaks: the regional analyses

This section provides regional summaries. Each regional description includes oak distribution, oak woodland, oak forest diversity and oaks at risk.[5]

Oaks 2040 co-author Tom Gaman is pictured in a mixed forest of Oregon white oak, interior live oak and canyon live oak.

[5] Appendix B summaries herein presented statewide are further detailed by region in the full report online at http://www.californiaoaks.org/Oaks2040.

North Coast Region

Counties included in this region are Del Norte, Humboldt, Mendocino and Sonoma.

OAK DISTRIBUTION

The North Coast Region has 1.3 million acres of oak woodland and 1.5 million acres of oak forest. In fact 35 percent of California's oak forest is found in the North Coast region, and oaks are present on 45 percent of the region's land (more coverage than any other region).

Mendocino County contains more than one-half of the region's oak woodland, but Humboldt and Sonoma counties also have significant stands. The North Coast's oak forests are found primarily within Humboldt and Mendocino counties.

In the North Coast region, there are 210 million oaks greater than 1" DBH and 110 million oaks greater than 5" DBH. Only the Central Coast tops the North Coast's two million oaks with DBH greater than 24".

NORTH COAST OAK DIVERSITY

The North Coast oak woodlands feature Oregon white oak, tanbark oak and mixed oak. Canyon live oaks and black oaks are also present, mixing in with Douglas-fir, madrone and bay. Oaks comprise approximately one-half of the basal area, trees/acre, and trees greater than 5" DBH/acre in white oak woodlands. In tanbark oak woodlands, *Quercus spp.* (true oaks) comprise less than 20 percent of the basal area, trees/acre, and trees greater than 5" DBH/acre, but when including tanbark oak *(Lithocarpus densiflorus)* oaks then comprise 48 percent of basal area and number of trees per acre.

In the North Coast's oak forests, tanbark oak is predominant. Associated species include Douglas-fir, redwood, madrone, bay, canyon live oak and black oak. In tanbark oak forests, oaks provide 42 percent of the basal area and more than half of total trees greater than 1" DBH.

OAKS AT RISK IN THE NORTH COAST REGION

In terms of ownership, 84 percent of the North Coast's oak woodlands are located on private property. Most of the remainder is owned by the USFS and various other federal government agencies. Private ownership of oak woodland increases moving southward, ranging from 40 percent in Del Norte County to 95 percent in Sonoma County. Eight percent of North Coast oak woodlands have already been developed and four percent are at risk of near-time development. Nearly 90 percent of the oak woodlands are reasonably stable for the time being.

Sonoma County has experienced the most urbanization with 20 percent of oak woodlands developed and 10 percent at risk. Oak woodland development rates are relatively low in Del Norte and Humboldt counties with more than 95 percent of oak woodlands being stable for now. Mendocino County oak woodland is already five percent developed and another five percent is at risk of development before 2040.

North Interior Region

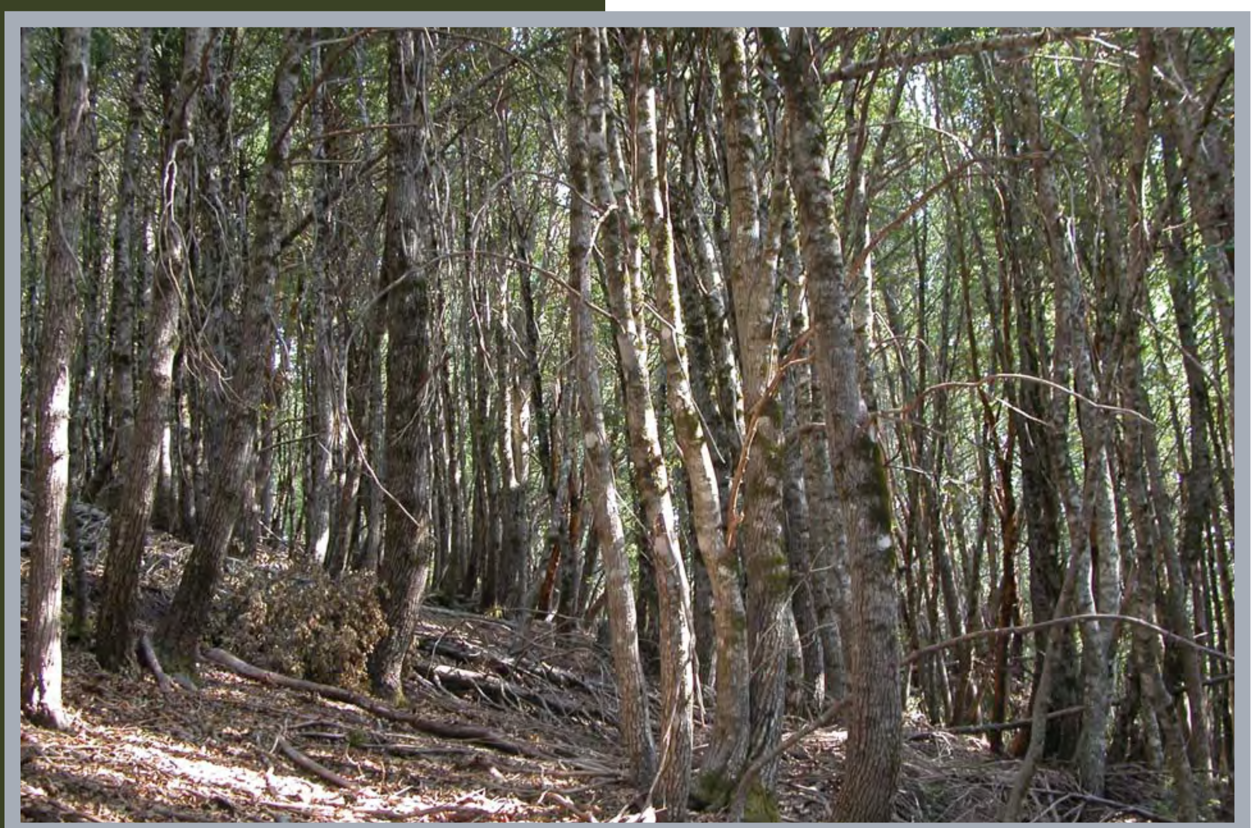
Lassen

Modoc

Shasta

Siskiyou

Trinity



Tanbark oak forest

North Interior Region

Counties in this region are Lassen, Modoc, Shasta, Siskiyou and Trinity.

OAK DISTRIBUTION

Nearly one million acres of oak woodland and 1.1 million acres of oak forest reside within the North Interior. The North Interior and the North Coast are the only two regions with more oak forest than oak woodland. With over 550,000 acres of oak woodland, Shasta County contains more than half of the region's totals. Trinity and Siskiyou Counties also contain large areas of oaks, with nearly 800,000 acres of oak forest and more than 400,000 acres of oak woodland in total. The North Interior has nearly 400 million oak trees, and 150 million of these oaks are greater than 5" DBH.

NORTH INTERIOR REGION OAK DIVERSITY

In this region, a balanced mixture of blue oak, black oak, canyon live oak and Oregon white oak woodlands is found. Blue oak woodlands typically include gray pine and either interior or coast live oak, and oaks comprise more than 80 percent of the basal area and more than 90 percent of the trees. Oregon white oak woodlands include black oak, Douglas-fir, and ponderosa pine, and oaks make up 40 percent of the basal area and more than half of the trees greater than 5" DBH. In black oak and canyon live oak woodlands, oaks comprise 50 percent of the basal area and 70 percent of the trees greater than 5" DBH.

In the North Interior oak forests, canyon live oak and black oak are prominent. These two oak species mix in with the local conifer species, including Douglas-fir, ponderosa pine, sugar pine and madrone. In black oak forests, oaks comprise one-fifth of the basal area. One-third of the trees greater than 5" DBH are oaks. In canyon live oak forests, one-third of the tree basal area is oaks and less than half of the trees greater than 5" DBH are oaks.

OAKS AT RISK IN THE NORTH INTERIOR REGION

In terms of ownership, 60 percent of North Interior oak woodlands are privately owned. The USFS manages 33 percent and the Bureau of Land Management (BLM) manages six percent. Excluding Shasta County, oak woodland ownership is split roughly 50-50 between private and public; the USFS manages most of the public oak woodland. Shasta County's oak woodland ownership is 73 percent private, 20 percent USFS, and six percent BLM.

Ten percent of the region's oak woodland has already been developed. Three percent is at risk for development by 2040. Eighty-seven percent is unlikely to develop before 2040. Shasta County oak woodland is most at risk with fifteen percent having been developed and five percent more to be developed by 2040. Oak woodlands in Trinity, Siskiyou, Modoc and Lassen Counties are all less than five percent developed and less than one percent at risk.

Central Coast Region

Alameda

Contra Costa

Marin

Monterey

San Benito

San Francisco

San Luis Obispo

San Mateo

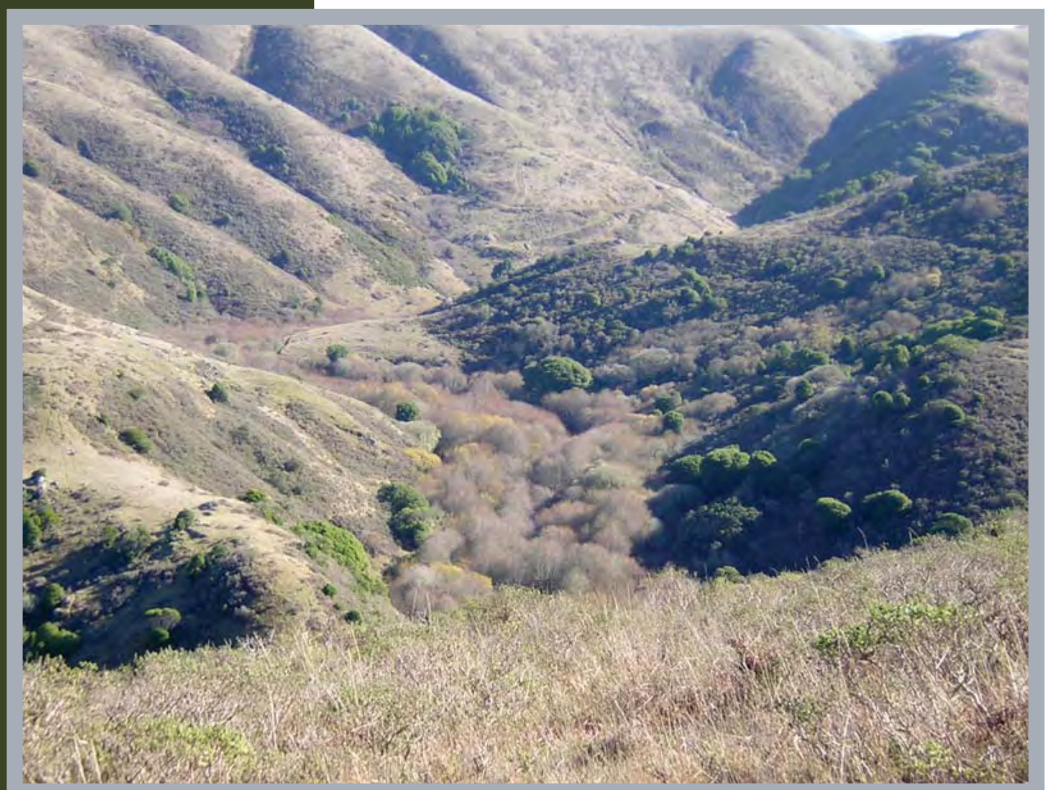
Santa Barbara

Santa Clara

Santa Cruz

Solano

Ventura



Coast live oak savannah in Marin County

Central Coast Region

Counties included in this region are Alameda, Contra Costa, Marin, Monterey, San Benito, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano and Ventura.

OAK DISTRIBUTION

The Central Coast is home to 1.6 million acres of oak woodlands and 300,000 acres of oak forests. Oaks are present on 17.5 percent of the region's area.

Four counties provide 75 percent of the Central Coast oak woodlands: Monterey, Santa Barbara, Santa Clara and San Luis Obispo. Oak woodlands comprise more than 20 percent of the area in Alameda, Monterey and Santa Clara counties. Santa Cruz County has more than 100,000 acres of forest oaks, and there are oaks present on over 50 percent of county land.

CENTRAL COAST OAK DIVERSITY

One-half of the Central Coast's oak woodland is coast live oak, and one-third is blue oak. Eighty percent of California's coast live oak woodland is in the Central Coast. Coast live oak woodland regularly includes bay trees, but oaks account for nearly 80 percent of the basal area in this oak type and over 90 percent of the trees greater than 10" in diameter. Blue oak woodland often includes coast live oaks.

Overall, more than 95 percent of trees in all size classes are oaks. Mixed oak woodlands include coast live oak and bay mixing with black and/or blue oaks. Oaks account for more than 60 percent of the basal area and more than 50 percent of the trees greater than 5" DBH in these stands. Thirty percent of the state's valley oak woodland is in the Central Coast, but there is not adequate inventory data to confidently describe this critical oak type.

Tanbark oak and coast live oak account for three-quarters of the region's oak forests. Redwood and Douglas-fir are dominant in tanbark oak forests, but oaks comprise 40 percent of the trees greater than 5" DBH and one-quarter of the basal area. Coast live oak forests often include canyon and/or interior live oak, with bay and redwood or Douglas-fir. Overall, oaks account for 10 percent of the basal area of oak forest stands and provide more than 20 percent of the trees greater than 5" DBH.

OAKS AT RISK IN THE CENTRAL COAST REGION

A complex land ownership matrix covers the oak woodlands of the Central Coast. Private ownership of oak woodlands predominates, averaging 75 percent throughout the region and ranging from 65 percent in Santa Barbara County to 95 percent in Alameda County. Another 15 percent is managed by the Los Padres National Forest, five percent by the US Military, and five percent by state and local governments. The Los Padres National Forest covers much of the oak woodlands in Ventura, Santa Barbara, San Luis Obispo and Monterey counties. Additionally, the BLM manages 20 percent of San Benito's oak woodlands and Fort Hunter-Liggett holds 12 percent of Monterey's oak woodlands. The state owns approximately 10 percent of oak woodland in Santa Clara, Contra Costa and Santa Cruz counties. Local ownership covers nearly 20 percent of oak woodland in Marin and Contra Costa counties.

Almost 85 percent of the Central Coast oak woodlands are unlikely to be developed before 2040. Most of the remaining areas have already been developed. Less than three percent is still at risk of development. Monterey County once again leads the way with 24,000 acres of oak woodland at risk, more than half of the region's total. Santa Clara, Santa Barbara, and San Luis Obispo counties are next on the list. Four percent of Monterey's oak woodlands are at risk, topped in the region only by Santa Cruz County at eight percent. In fact, more than three-quarters of Santa Cruz's oak woodlands have already been developed and less than 16 percent are currently in the stable category. Both of these figures are records for the state.

Sacramento Region

Butte

Colusa

El Dorado

Glenn

Lake

Napa

Nevada

Placer

Plumas

Sacramento

Sierra

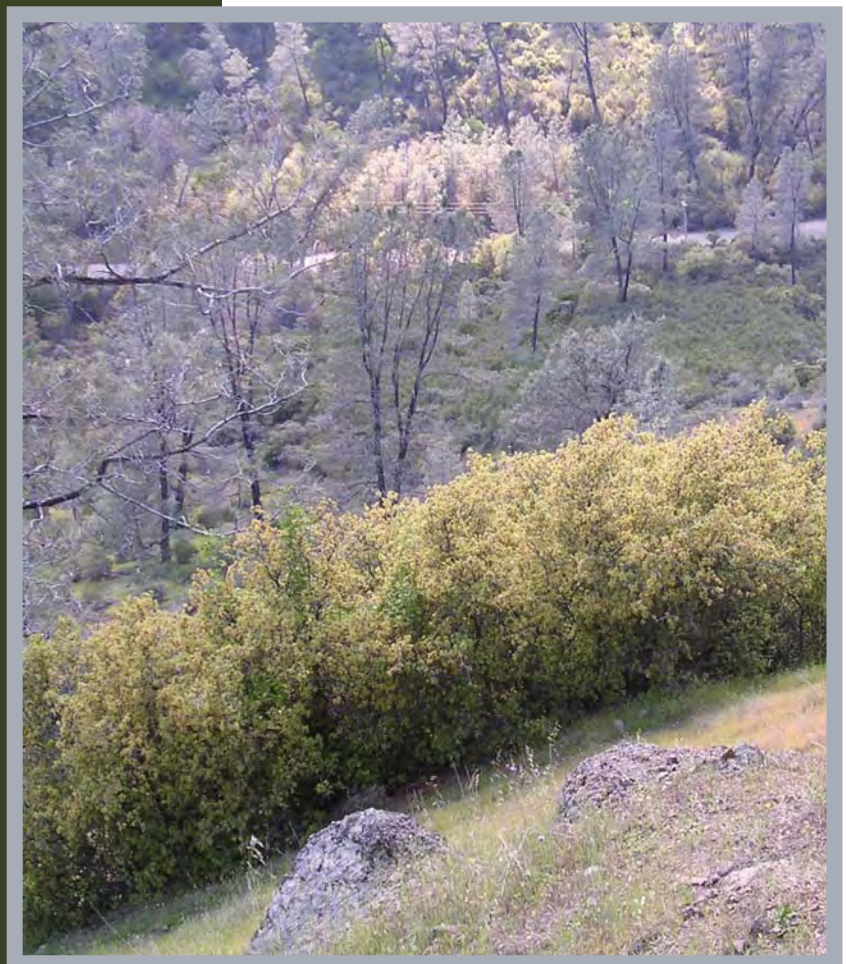
Solano

Sutter

Tehama

Yolo

Yuba



Mixed oak woodland dominated by gray pine

Sacramento Region

Counties in this region include Butte, Colusa, El Dorado, Glenn, Lake, Napa, Nevada, Placer, Plumas, Sacramento, Sierra, Solano, Sutter, Tehama, Yolo and Yuba.

OAK DISTRIBUTION

The Sacramento region's 2.1 million acres of oak woodlands provide nearly one-quarter of the state's total. Oaks are present on 20 percent of the region's land.

Tehama County has more oak woodlands than any other county in the region, but large oak populations are found in many counties. Thirty-three percent of Napa County is covered by oak woodlands, giving it the greatest density of oak woodlands in the state. Tehama, Yuba, Lake and Nevada counties are each at least 20 percent covered by oak woodlands.

SACRAMENTO REGION OAK DIVERSITY

More than half of the Sacramento region's oak woodlands are blue oak. Gray pines mix in, but oaks comprise 70 percent of the basal area and 80 percent of the trees greater than 5" DBH. The region contains more than one-third of the state's blue oak woodland.

Interior live oak woodland contains blue oak, valley oak, black oak, gray pine, and ponderosa pine. Canyon live oak and black oak woodlands include Douglas-fir, ponderosa pine, and incense cedar. In canyon and interior live oak woodland, oaks make up 80 percent of the basal area and 90 percent of the trees.

The Sacramento region has more than one-third of California's valley oak woodland. Tehama County has the most blue oak, valley oak and canyon live oak woodland. El Dorado has the most interior live oak and black oak woodland.

Black oak and canyon live oak dominate the region's oak forests. Canyon live oak forests are 60 percent oaks, mixing with ponderosa pines and Douglas-firs. Black oak forests are 25 percent oaks, along with Douglas-fir, ponderosa pine, white fir and incense cedar.

OAKS AT RISK IN THE SACRAMENTO REGION

More than 80 percent of the Sacramento region's oak woodland is privately owned. The USFS owns about 60 percent of the remaining public lands, including large portions of the oak woodlands in Plumas (81 percent), Sierra (74 percent), Glenn (28 percent), Placer (20 percent) and Lake (19 percent) counties.

Private ownership of oak woodlands surpasses 80 percent in all other counties, topped off by Solano (98 percent), Yolo (97 percent), Sacramento (96 percent), Colusa (94 percent), and Napa (93 percent) counties.

The Sacramento region is more at risk of development than any other. Only two-thirds of its oak woodlands are considered 'stable.' One-sixth is developed and one-sixth is at risk. More than 300,000 acres of oak woodland could be developed in the Sacramento region by 2040.

El Dorado County has more oak woodlands at risk than any other county in the state, but Tehama, Butte and Yuba counties are not far behind. By 2040, 80 percent of El Dorado's oak woodlands and more than half of the oak woodlands in Nevada, Yuba and Placer counties may be developed.

San Joaquin Region

Alpine

Amador

Calaveras

Fresno

Inyo

Kern

Kings

Madera

Mariposa

Merced

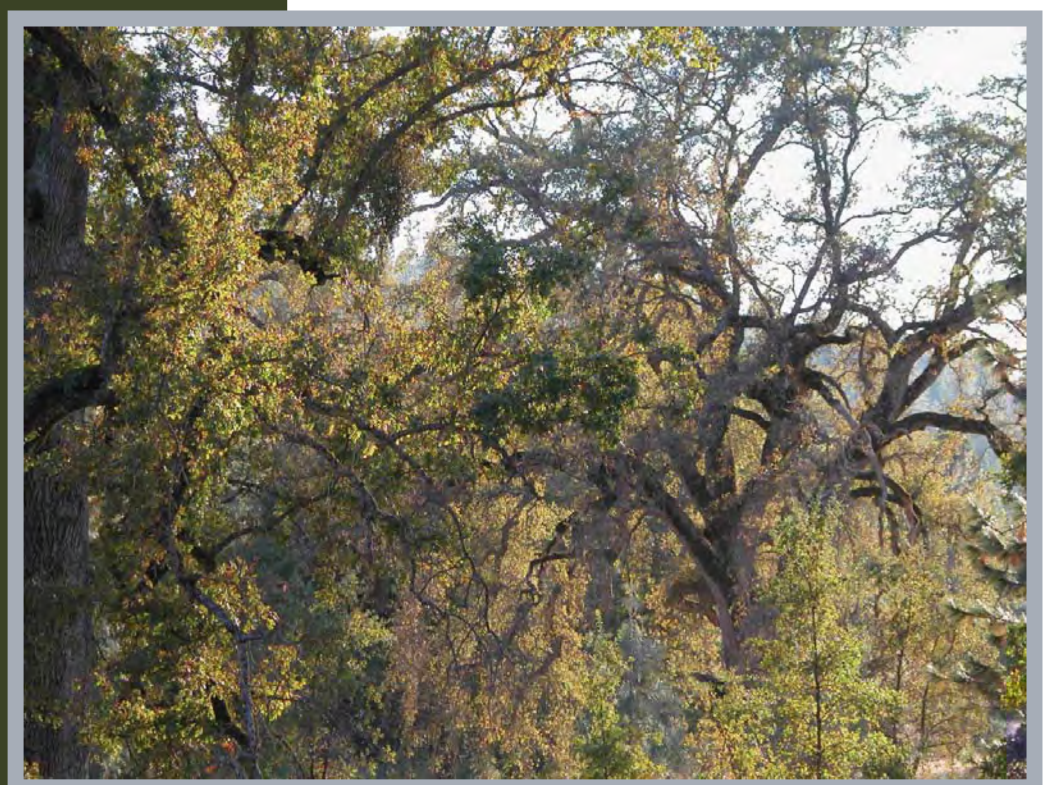
Mono

San Joaquin

Stanislaus

Tulare

Tuolumne



Valley oaks in Calaveras County

San Joaquin Region

Counties in this region are Alpine, Amador, Calaveras, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare and Tuolumne.

OAK DISTRIBUTION

The San Joaquin region has more than 2.3 million acres of oak woodlands and 500,000 acres of oak forests. Oaks are present on only 10 percent of the region's land. However, certain portions of the region have far greater oak woodland density than others. Twenty-seven percent of the state's oak woodlands fall within these 15 counties. The San Joaquin region currently has more than 450 million oak trees. More than one-third of these oaks are larger than 5" DBH.

SAN JOAQUIN REGION OAK DIVERSITY

More than half of the region's oak woodlands are blue oak and another 25 percent are interior live oak. Associated species include gray pine and buckeye, as well as valley oak, blue oak and canyon and interior live oaks. The San Joaquin region has more blue oak woodlands and interior live oak woodlands than any other region. In blue oak woodlands, oaks account for 70 percent of the trees and 80 percent of the basal area and trees greater than 5" DBH. In interior live oak woodlands, oaks provide 70 percent of the tree basal area and more than 80 percent of all trees. In canyon live oak woodlands, oaks comprise 55 percent of the basal area, 62 percent of all trees and 67 percent of trees greater than 5" DBH.

Canyon live oak and black oak comprise almost 90 percent of oak forests. Associated species in San Joaquin oak forests include incense cedar, ponderosa pine, sugar pine and white fir. In canyon live oak forests, oaks provide one-third of the basal area and nearly one-half of the trees. In black oak forest, oaks comprise more than half of the trees, but only one-third of the trees greater than 5" DBH and only one-quarter of the tree basal area.

OAKS AT RISK IN THE SAN JOAQUIN REGION

Seventy-three percent of the San Joaquin region's oak woodlands are privately owned. The USFS owns 18 percent and BLM owns five percent. Ten percent of the oak woodlands in the region have already been developed. Ten percent are at high risk of development by 2040. Eighty percent are currently stable, however targeted planning could ensure that a greater number of acres are conserved for the long-term. Nearly 250,000 acres of oak woodlands in the San Joaquin region are at risk of development by 2040. Only the Sacramento region contains more oak woodlands at risk. In Madera, Amador and Calaveras counties combined, more than one-third of all oak woodland may be developed before 2040.

Southern Region

Imperial

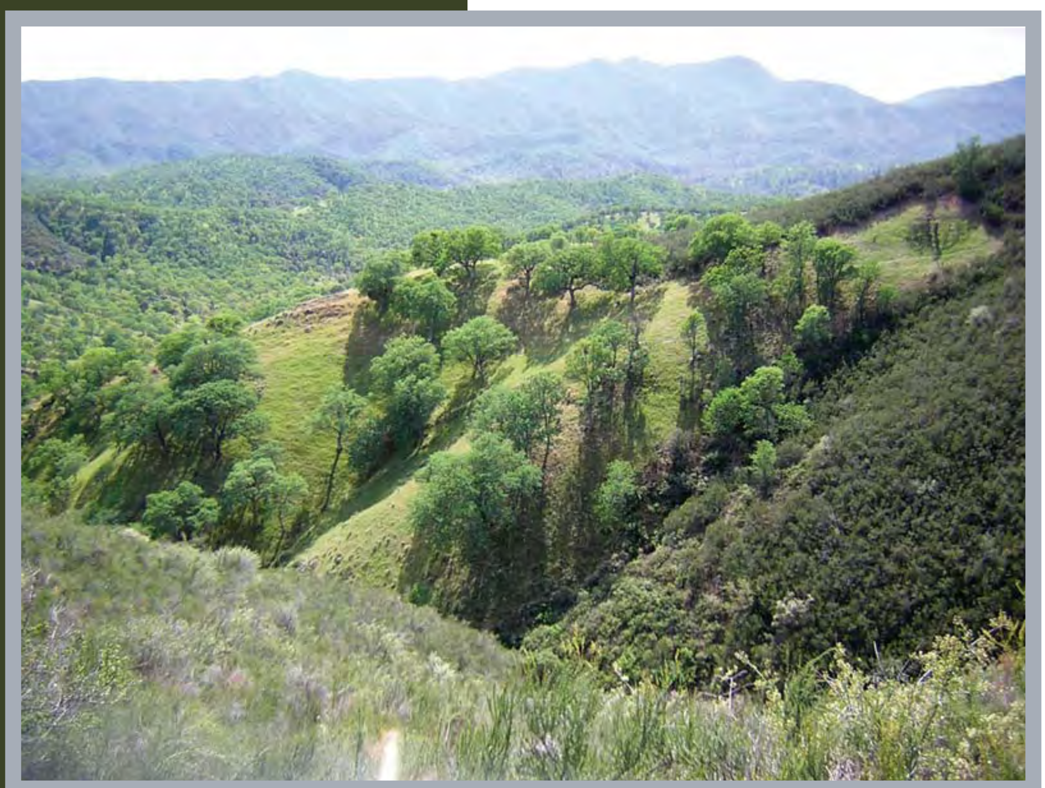
Los Angeles

Orange

Riverside

San Bernardino

San Diego



Blue oak woodland in Machesna Mountain Wilderness, Los Padres National Forest

Southern Region

Counties in this region are Imperial, Los Angeles, Orange, Riverside, San Bernardino and San Diego.

OAK DISTRIBUTION

The Southern region is home to more than 300,000 acres of oak woodlands and more than 200,000 acres of oak forests. Combined, these 500,000 acres comprise only two percent of the region. However, discounting urban areas and desert, oak woodland concentration is much higher. San Diego and Los Angeles counties collectively contain more than two-thirds of the Southern region's oak woodlands. San Bernardino County has the greatest area (90,000 acres) of oak forests in the region.

SOUTHERN REGION OAK DIVERSITY

Coast live oak and canyon live oak are most prevalent, but black oak and Engelmann oak populations are also significant. Eighty-five percent of the basal area is comprised of oaks. Ninety-two percent of the trees greater than 5” DBH are oaks and 96 percent of the trees greater than 1” DBH are oaks. The rare Engelmann oak is found only within this region, mostly in San Diego County. Los Angeles County is home to the majority of the region's blue oak and valley oak woodlands.

Canyon live oak and black oak dominate in the Southern region's oak forests. These oaks mix with Coulter pine, Jeffrey pine, incense cedar and white fir.

Oaks comprise less than 50 percent of the basal area but more than 80 percent of the trees and 65 percent of the trees greater than 5” DBH.

OAKS AT RISK IN THE SOUTHERN REGION

The oak woodlands of the Southern region have the highest levels of public ownership found in the state. USFS owns 44 percent of the region's oak woodlands. Eleven percent of oak woodlands are owned by other government agencies, and 45 percent are privately owned. The land ownership patterns within this region are variable. The oak woodlands in San Diego and Orange counties are predominantly privately-owned, but the USFS owns most of the oak woodlands in San Bernardino, Riverside and Los Angeles counties.

Twenty percent of the Southern region's oak woodlands have already been developed. Ten percent are at risk of development by 2040. Development of the remaining 70 percent is not anticipated in the near future. Oak woodland development percentages are higher than in any other region in the state. Only the Sacramento region has a lower percentage of oak woodlands that are considered stable.

Riverside and San Diego counties lead the region with almost 20 percent of their oak woodlands at risk. Both Orange and Los Angeles counties have already had over 20 percent of their oak woodlands developed.

San Diego and Orange counties have the lowest percentages of stable oak woodland with 65 percent in each county. San Bernardino tops the list with 78 percent stable for the time being.

Oaks 2040

Post-fire black oak regeneration in Mendocino National Forest

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APPENDIX A – TABLE ONE: ACRES OF COVER WHERE OAKS DOMINATE THE WOODLAND BY COUNTY AND OAK TYPE

REGION	COUNTY	OAK TYPE										
		Black Oak	*Blue Oak*	*Canyon Live Oak*	*Coast Live Oak*	*Engelmann Oak*	*Interior Live Oak*	*Mixed Oak*	*Oregon White Oak*	*Tan Oak*	*Valley Oak*	*Total Acres*
North Coast	Del Norte	84	0	1,011	0	0	0	2,939	355	42,778	0	47,168
	Humboldt	16,671	0	20,831	10	0	0	13,572	100,484	153,873	0	305,442
	Mendocino	49,553	12,040	60,603	863	0	16,715	119,231	283,036	104,631	4,206	650,879
	Sonoma	3,212	524	7,354	21,601	0	1,484	176,852	41,124	30,402	524	283,077
North Interior	Lassen	7,965	0	0	0	0	0	0	438	0	0	8,403
	Modoc	737	0	0	0	0	0	0	369	0	0	1,106
	Shasta	170,028	268,857	83,918	0	0	4,643	46	21,116	336	6,055	554,998
	Siskiyou	13,053	0	57,570	0	0	0	10,141	97,529	5,646	0	183,938
	Trinity	51,154	275	84,077	0	0	0	0	80,692	15,747	11	231,956
Central Coast	Alameda	0	29,273	12	40,340	0	0	28,255	0	0	1,396	99,275
	Contra Costa	30	29,758	50	32,564	0	2,462	5,051	0	0	691	70,605
	Marin	0	310	0	10,383	0	0	36,792	875	0	108	48,468
	Monterey	679	252,092	0	266,145	0	0	12	0	26,776	6,641	552,345
	San Benito	0	61,729	0	44	0	0	753	0	0	8	62,534
	San Luis Obispo	1,773	68,413	92	83,636	0	0	25,419	0	31	8,672	188,035
	San Mateo	0	515	0	15,021	0	0	3,089	0	65	1,403	20,093
	Santa Barbara	0	22,548	26,794	170,970	0	0	0	0	197	2,925	223,435
	Santa Clara	52	58,083	110	74,259	0	0	58,888	0	10	3,543	194,946
	Santa Cruz	0	0	0	22,474	0	0	6,362	0	48	0	28,884
	Ventura	61	151	14,427	49,929	0	0	0	0	0	1,179	65,747
Sacramento	Butte	20,042	100,835	31,037	0	0	46,668	4,045	0	5,031	429	208,084
	Colusa	353	112,868	3,342	0	0	167	0	450	0	1,563	118,741
	El Dorado	35,900	46,247	24,591	0	0	90,549	15,893	0	0	3,708	216,888
	Glenn	5,842	83,184	23,385	0	0	23	0	2,755	0	2,626	117,816
	Lake	23,948	90,203	34,348	42	0	3,508	15,013	7,777	1,091	2,126	178,056
	Napa	1,236	62,243	941	5,719	0	6,682	88,715	1,380	12	1,474	168,400
	Nevada	27,129	34,650	12,328	0	0	49,647	2,686	0	84	2,172	128,697
	Placer	35,541	49,754	41,854	0	0	24,333	12,212	0	0	2,709	166,403
	Plumas	18,543	0	11,730	0	0	0	38	0	102	0	30,413
	Sacramento	0	7,254	0	0	0	789	26	0	0	49	8,119
	Sierra	9,200	8	8,512	0	0	8	3	0	79	0	17,809
	Solano	44	17,365	0	2,010	0	848	6,228	0	0	1,074	27,568
	Tehama	24,505	443,003	46,383	0	0	1,973	0	1,069	71	12,238	529,242
	Yolo	0	78,912	61	9	0	1,313	0	0	0	1,155	81,450
	Yuba	10,459	47,733	4,150	0	0	26,186	527	0	1,685	1,384	92,122
San Joaquin	Alpine	612	0	130	0	0	0	0	0	0	0	742
	Amador	9,360	49,802	12,071	0	0	44,813	5,912	0	0	1,631	123,588
	Calaveras	11,729	112,449	26,552	0	0	42,538	860	0	0	235	194,362
	Fresno	15,929	228,915	41,437	0	0	81,779	22,354	0	0	424	390,838
	Inyo	590	0	3,546	0	0	0	25	0	0	0	4,161
	Kern	16,732	153,891	49,437	10	0	73,062	22,822	0	0	7,059	323,013
	Kings	0	9,576	0	0	0	343	111	0	0	0	10,029
	Madera	9,407	124,132	29,844	0	0	98,561	1,896	0	0	2,320	266,160
	Mariposa	12,317	120,825	42,628	0	0	106,607	684	0	0	798	283,858
	Merced	0	50,868	0	2,411	0	5	3,973	0	0	532	57,790
	San Joaquin	0	17,484	0	424	0	437	1,686	0	0	18	20,049
	Stanislaus	0	104,218	0	1,288	0	1,279	1,074	0	0	181	108,038
	Tulare	43,406	157,740	43,210	0	0	67,799	33,504	0	0	256	345,915
	Tuolumne	18,082	72,807	48,071	0	0	72,308	349	0	0	186	211,803
Southern	Los Angeles	1,596	2,487	60,102	30,790	32	351	970	0	0	2,177	98,503
	Orange	0	0	2,419	10,440	0	0	0	0	0	0	12,859
	Riverside	3,248	0	14,207	12,128	2,371	910	172	0	0	0	33,036
	San Bernardino	11,083	0	33,953	2,534	0	538	761	0	0	0	48,869
	San Diego	10,623	0	9,255	74,491	17,964	54	8,515	0	0	0	120,903
	ALL COUNTIES	692,507	3,184,018	1,016,373	930,534	20,367	869,380	738,455	639,449	388,695	85,882	8,565,659

APPENDIX A – TABLE TWO: ACRES OF COVER WHERE OAKS ARE PRESENT IN THE FOREST BY COUNTY AND OAK TYPE

REGION	COUNTY	OAK TYPE										
		Black Oak	*Blue Oak*	*Canyon Live Oak*	*Coast Live Oak*	*Engelmann Oak*	*Interior Live Oak*	*Mixed Oak*	*Oregon White Oak*	*Tan Oak*	*Valley Oak*	*Total Acres*
North Coast	Del Norte	1,344	0	1,611	0	0	0	8,762	948	130,743	0	143,408
	Humboldt	18,556	0	32,777	0	0	0	42,345	43,757	519,090	0	656,524
	Mendocino	39,223	544	33,603	484	0	2,100	39,060	69,662	395,741	0	580,416
	Sonoma	675	0	2,618	3,849	0	29	47,157	7,767	68,488	0	130,583
North Interior	Lassen	2,446	0	0	0	0	0	0	0	0	0	2,446
	Shasta	231,378	5,066	48,675	0	0	93	24	13,894	468	0	299,597
	Siskiyou	32,313	0	180,891	0	0	0	73,999	99,747	85,800	0	472,749
	Trinity	76,489	0	130,061	0	0	0	0	49,701	61,739	0	317,989
Central Coast	Alameda	0	0	0	432	0	0	413	0	0	0	844
	Contra Costa	4	286	98	1,042	0	294	236	0	0	0	1,959
	Marin	0	0	0	118	0	0	15,125	0	2,429	0	17,672
	Monterey	0	229	0	24,421	0	0	6	0	26,414	0	51,069
	San Benito	0	50	0	0	0	0	0	0	0	0	50
	San Luis Obispo	1,542	44	0	1,162	0	0	1,775	0	0	0	4,522
	San Mateo	0	0	0	8,113	0	0	2,347	0	46,577	121	57,158
	Santa Barbara	0	0	13,708	4,813	0	0	0	0	0	0	18,521
	Santa Clara	193	36	0	5,080	0	0	4,271	0	5,911	0	15,491
	Santa Cruz	0	0	0	58,378	0	0	7,473	0	50,895	0	116,746
	Ventura	0	0	27,705	801	0	0	0	0	0	0	28,505
Sacramento	Butte	50,365	3,010	28,510	0	0	4,718	9,460	0	41,470	0	137,533
	Colusa	2,088	193	6,071	0	0	0	0	2,551	0	0	10,904
	El Dorado	59,220	157	16,225	0	0	4,155	7,829	0	100	64	87,750
	Glenn	5,522	75	3,954	0	0	0	0	2,483	0	0	12,033
	Lake	17,725	503	18,082	0	0	214	5,601	5,169	284	33	47,612
	Napa	410	68	512	31	0	0	17,396	159	10	0	18,587
	Nevada	75,680	724	18,602	0	0	4,133	407	0	1,328	67	100,941
	Placer	69,336	146	22,150	0	0	752	8,569	0	0	72	101,025
	Plumas	43,057	0	10,980	0	0	0	146	0	237	0	54,420
	Sierra	29,495	0	12,706	0	0	0	84	0	427	0	42,713
	Solano	0	0	0	0	0	6	0	0	0	0	6
	Tehama	32,200	1,004	16,577	0	0	172	0	2,152	61	0	52,166
	Yuba	24,450	86	5,272	0	0	1,725	648	0	17,245	156	49,582
San Joaquin	Alpine	250	0	90	0	0	0	0	0	0	0	340
	Amador	15,502	0	7,446	0	0	3,115	1,644	0	0	47	27,754
	Calaveras	22,842	0	35,566	0	0	13,537	850	0	0	0	72,795
	Fresno	38,798	2,212	37,285	0	0	1,166	65	0	0	0	79,526
	Inyo	173	0	8,147	0	0	0	0	0	0	0	8,320
	Kern	23,428	818	37,609	0	0	572	947	0	0	53	63,427
	Kings	0	213	0	0	0	0	0	0	0	0	213
	Madera	24,728	37	23,870	0	0	5,249	23	0	0	320	54,227
	Mariposa	35,742	34	26,151	0	0	11,900	44	0	0	92	73,964
	Tulare	37,483	9	14,208	0	0	326	631	0	0	0	52,656
	Tuolumne	37,778	83	41,705	0	0	14,112	31	0	0	25	93,736
Southern	Los Angeles	2,863	306	42,577	464	0	14	60	0	0	0	46,283
	Orange	0	0	919	14	0	0	0	0	0	0	933
	Riverside	2,948	0	32,346	183	0	252	0	0	0	0	35,728
	San Bernardino	46,395	0	35,057	32	0	130	151	0	0	0	81,764
	San Diego	16,302	0	8,390	6,490	0	0	8,654	0	0	0	39,836
	ALL COUNTIES	1,118,940	15,933	982,753	115,906	0	68,762	306,234	297,989	1,455,456	1,050	4,363,023

APPENDIX B – OAK INVENTORY SUMMARY FOR 932 FOREST INVENTORY AND ANALYSIS (FIA) PLOTS IN CALIFORNIA OAK WOODLANDS AND FORESTS 2001-2004

OAK WOODLAND

Oak Type	ACRES	# FIA PLOTS	TOTAL BASAL AREA SQ FT /ACRE	OAK BASAL AREA SQ FT /ACRE	NON-OAK REGEN-ERATION SEEDLINGS /AC	OAK REGEN-ERATION SEEDLINGS /AC	# TOTAL TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE 1-5" DBH	# OAK TREES /ACRE 5-10" DBH	# OAK TREES /ACRE 10-16" DBH	# OAK TREES /ACRE 16-24" DBH	# OAK TREES /ACRE 24-32" DBH	# OAK TREES /ACRE >32" DBH
Black Oak	692507	35	91	39	272	454	382	223	135	72	14	1	0	0
Blue Oak	3184018	244	23	19	31	49	101	81	49	22	7	2	0	0
Canyon Live Oak	1016373	76	77	53	129	190	307	239	128	89	17	4	0	0
Coast Live Oak	930534	79	44	36	94	192	234	136	92	23	15	5	1	0
Engelmann Oak	20367	2	20	20	0	0	10	10	0	0	6	3	1	1
Interior Live Oak	869380	60	42	31	70	135	196	172	110	51	8	2	0	0
Mixed Oak	738455	74	59	37	240	138	154	70	25	22	16	6	1	0
Oregon White Oak	639449	40	68	34	223	144	189	121	73	31	14	3	1	0
Tanbark Oak	388695	20	148	68	615	300	610	292	161	95	30	4	1	0
Valley Oak	85882	4	28	20	0	0	67	44	19	18	6	0	1	1

OAK FOREST

Oak Type	ACRES	# FIA PLOTS	TOTAL BASAL AREA SQ FT /ACRE	OAK BASAL AREA SQ FT /ACRE	NON-OAK REGEN-ERATION SEEDLINGS /AC	OAK REGEN-ERATION SEEDLINGS /AC	# TOTAL TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE >=1.0" DBH	# OAK TREES /ACRE 1-5" DBH	# OAK TREES /ACRE 5-10" DBH	# OAK TREES /ACRE 10-16" DBH	# OAK TREES /ACRE 16-24" DBH	# OAK TREES /ACRE 24-32" DBH	# OAK TREES /ACRE >32" DBH
Black Oak	1118940	70	143	44	689	326	533	200	135	43	17	4	1	0
Blue Oak	15933	2	72	17	712	263	165	18	0	3	12	3	0	0
Canyon Live Oak	982753	65	117	43	344	404	397	196	125	52	15	4	1	0
Coast Live Oak	115906	7	204	39	129	96	334	137	64	57	10	4	1	0
Engelmann Oak	0	NO PLOTS IN THIS TYPE												
Interior Live Oak	68762	8	74	13	1312	347	123	28	9	11	6	1	0	0
Mixed Oak	306234	16	169	46	586	187	456	175	103	48	20	3	1	0
Oregon White Oak	297989	22	82	22	406	174	259	90	51	30	6	2	0	0
Tanbark Oak	1455456	108	173	63	919	293	497	266	169	69	19	8	1	0
Valley Oak	1050	NO PLOTS IN THIS TYPE												

Regional summaries are available at www.californiaoaks.org/Oaks2040.

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October 2006

California Oak Foundation

Our mission is to protect and perpetuate native oak woodlands.

Oaks

California Oak Foundation

Our mission is to protect and perpetuate native oak woodlands

Attachment #23

DEPARTMENT OF TRANSPORTATION
DISTRICT 3
703 B STREET
MARYSVILLE, CA 95901
PHONE (530) 741-4233
FAX (530) 741-4245
TTY 711

Flex your power!
Be energy efficient!

September 25, 2013

Kimberly A. Kerr, Acting Director
El Dorado County Community Development Agency
2850 Fairlane Court
Placerville, CA 95667-4197

Dear Ms. Kerr:

Thank you for your letter dated September 13, 2013, wherein you posed a series of questions related to Level of Service (LOS), performance measures, planned state highway improvements, and PeMS data regarding US Highway 50 (US 50) within El Dorado County.

Your questions and our responses are as follows:

1. *How does Caltrans calculate LOS on U.S. Highway 50 (i.e., by use of the Highway Capacity Manual 2010 Planning-level analysis, Design-Level analysis, Operational-level analysis methodologies or other methodologies)? Were HOV and/or Auxiliary lanes and volumes considered? Which performance measure or alternative tools are used in the determination of service flow rates? If a 15-minute analysis period under prevailing conditions was assumed, what peak-hour factor was applied?*

   LOS calculations used in the Caltrans District 3 System Planning Program documents are derived from a *Highway Capacity Manual 2010* freeway planning-level analysis. Highway Capacity Software 2010 is used in conjunction with several data sources, including:

   - Traffic Volumes on California State Highways
   - Annual Average Daily Truck Traffic on California State Highways
   - California Highway Log
   - Caltrans Digital Photolog

   HOV and auxiliary lane volumes are excluded from the mixed flow LOS Calculations, since including the HOV lanes would not provide an accurate indicator of the LOS for the mixed flow lanes. HOV lane LOS calculations are derived separately. Peak Hour Factors are used in the LOS calculations. The *Highway Capacity Manual 2010* states that typical freeway Peak Hour Factors range from 0.85 to 0.98. In our planning level studies, default values from the Highway Capacity Software are used because of data limitations. These values are 0.94 for urban freeways and 0.88 for rural freeways.

2. *What effect, if any, does construction activity on the highway or within Caltrans Right-of-Way have on the LOS measurements or projections? Do temporary delays during such construction factor into the LOS analysis? If LOS is calculated during construction activity is it annotated as such? Does LOS analysis reflect accident/incident history on U.S. Highway 50?*

   Construction activity has minimal or no effect on LOS calculations because the traffic volumes used from the annual *Traffic Volumes on California State Highways* take sample counts, schedule counts to avoid routes with construction activity and make adjustments to compensate for seasonal influence, weekly variations and other variables which may be present. These normalized volumes are then used to calculate LOS.

3. *What has Caltrans determined the LOS to be along U.S. Highway 50 within El Dorado County? Specifically, what is LOS determined to be from the West County line on U.S. Highway 50 to Cameron Park Drive?*

   As part of the Caltrans System Planning Program, every State Highway System route is analyzed on a segment by segment basis based on the Highway Capacity Manual 2010 freeway analysis and plans for the route are summarized in documents entitled "transportation concept reports" (TCRs) and "Corridor System Management Plans (CSMPs)". Route segmentation for both the CSMPs and TCRs is based on political boundaries, geometric changes in the route facility and significant changes in traffic volumes.

   The LOS on US 50 for the segment between the Sacramento/El Dorado County Line and Cameron Park Drive is currently operating at LOS E. However, the portion of the segment from the County Line to the El Dorado Hills Blvd. Interchange operates at LOS F during the peak hour.

4. *What does Caltrans project the LOS to be on Highway 50 through 2035 within El Dorado County?*

   The projected 2035 LOS for segments of US 50 in El Dorado County, as currently indicated in our latest draft US 50 TCR and draft US 50 CSMP, are indicated in the following table:

DRAFT US 50 CSMP				
Location		Current Traffic Data 2012	Future Traffic Data-2035 (No Build)	Future Traffic Data-2035 (Build)
County	Description/Location	LOS	LOS	LOS
ED	SAC/ED County Line to Cameron Park Drive	E	F	F
ED	Cameron Park Drive to Missouri Flat Road	D	E	D
ED	Missouri Flat Road to End of Freeway in Placerville	D	D	E
ED	End of Freeway in Placerville to Bedford Avenue	C	C	C
ED	Bedford Avenue to Cedar Grove Exit	C	C	C

DRAFT US 50 TCR				
Location		Current Traffic Data 2012	Future Traffic Data-2035 (No Build)	Future Traffic Data-2035 (Build)
County	Description/Location	LOS	LOS	LOS
ED	Cedar Grove Exit to 0.67 mi east of Sly Park Road	B	C	C
ED	0.67 mi east of Sly Park Road to Ice House Road	B	C	C
ED	Ice House Road to Echo Summit	E	F	F
ED	Echo Summit to State Route 89 South/Luther Pass Road	E	E	E
ED	State Route 89/Luther Pass Road to State Route 89North/Lake Tahoe Blvd	E	F	F
ED	State Route 89 North/Lake Tahoe Blvd to Nevada State Line	E	F	F

The LOS information above includes both the "Build" and "No Build" scenarios. The "No Build" scenario assumes no improvements are made to US50. The "Build" scenario assumes the construction of the projects indicated in Attachment A.

5. *What population growth rate was assumed by Caltrans in the LOS projection for U.S. Highway 50 in El Dorado County through 2035?*

   The Sacramento Area Council of Governments' (SACOG) SACSIM model was used to determine the growth of traffic volumes and the impact of potential projects on those volumes. The boundary of the SACSIM model ends at the summit, from that point growth factors were developed using a linear regression methodology.

6. *What Caltrans improvements are planned and assumed in the LOS projection for U.S. Highway 50 in El Dorado County through 2035?*

   The improvements indicated in Attachment A are included in our projected 2035 LOS calculations based on the projects' inclusion in the latest financially constrained long-range plans of SACOG, the El Dorado County Transportation Commission (EDCTC) and the Tahoe Regional Planning Agency.

7. *What are the parameters and assumptions used for the PeMS data? How do these parameters and assumptions relate to question #1?*

   In our planning documents, PeMS is used to report various outcome performance measures, including peak hour speeds, peak hour and daily vehicle hours of delay, peak hour and daily vehicle miles of travel and specific bottleneck data. Since these performance measures are used to describe recurrent congestion, we only capture and report data from Tuesdays, Wednesdays and Thursdays.

Your letter also indicated that mention has been made that Caltrans has no plans to provide any improvements to US 50 during the next 20 years. Caltrans does, in fact, have plans to improve US 50 during the next 20 years. These projects are indicated in Attachment A. However, these projects will not prevent certain segments of US 50 from operating at LOS F, as indicated in the table.

Caltrans is currently updating our CSMP and TCR for the entire length of US 50 in California. It is likely that the route segmentation may change from that used in the current Plan to more accurately reflect operating conditions, such as including a separate segment from the County Line to the El Dorado Hills Blvd. Interchange. Also, our *District System Management and Development Plan*, which provides guidance for the System Planning Program, indicates a concept level of service standard (lowest acceptable LOS) of D for rural areas and E for urban areas. At this juncture, we intend to include those standards in our plan for US 50. For those segments of US 50 which are projected to fall below these standards, we will identify the US 50 improvement projects which must be built to maintain the concept LOS standard. We look forward to sharing a draft of this Plan with you in the next few months.

The determination of LOS is a complicated process with many variables. We also fully realize that LOS indicators are a key ingredient in how the El Dorado County Board of Supervisors implements Measure Y and makes other decisions. Therefore, we would like to meet with you, SACOG and EDCTC to come to a consensus agreement on how to mutually determine and report LOS for US 50 in El Dorado County. We will schedule this meeting for as soon as feasible and look forward to continuing our close working relationship.

Meanwhile, if you have any additional questions, please contact Susan Zanchi, Acting Chief, Office of System Management Planning and Project Delivery at (530) 741-4199 or via email at susan.zanchi@dot.ca.gov.

Sincerely,

JODY JONES
District Director

c: David Defanti, El Dorado County CDA Assistant Director
Claudia Wade, El Dorado County CDA Long Range Planning Division
Natalie Porter, El Dorado County CDA Long Range Planning Division
Sharon Scherzinger, EDCTC
Nathan Strong, City of Placerville
Jeff Pulverman, Deputy District Director, Planning & Local Assistance, Caltrans
Nieves Castro, Supervising Transportation Planner, Planning & Local Assistance, Caltrans

JJ/tw

US 50 Planned and Programmed State Highway Projects

County	Rte	Post Mile Limits	Project Lead	Project Name	Project Description	Type of Project	Agency Source	Estimated Total Cost (1,000s)	Proposed Completion Year
ELD	50	16.276	City of Placerville	Western Placerville Interchanges (Ph 1B)	Realign Fair Lane to correct a non-standard curve and construct Class II Bike Lanes, sidewalks and retaining walls.	Bike Lanes/ Pedestrian	MTP	$820	2014
ELD	50	18.517	City of Placerville	US 50 Broadway EB signalization and lengthening	Lengthen EB exit ramp of US 50 at Broadway and install traffic signal	Signalization and Ramp Improvements	MTP	$2,000	2035
ELD	50		ELD County	US 50 WB Auxiliary Lane - Silva Valley Parkway to Empire Ranch Rd	Construct new WB auxiliary lane within median of US 50 between Silva Valley Parkway and Empire Ranch Rd future new interchanges.	Auxiliary Lanes	MTP	$2,500	2035
ELD	50	R14.01	ELD County	US 50/El Dorado Rd Interchange Improvements (Ph.1)	Includes signalization and widening of existing ramps	Interchange Improvements	MTP	$3,538	2035
ELD	50	0.00/ 0.86	ELD County	US 50 Widen and WB Auxiliary Lane - El Dorado Hills to Empire Ranch Rd	Widen US 50 and add auxiliary lane to WB US 50 connecting the El Dorado Hills Blvd/ Latrobe Rd Interchange to the future Empire Ranch Rd Interchange located in Folsom. Construction to be concurrent with or after the El Dorado Hills Blvd I/C.	Widen US 50; Auxiliary Lanes	MTP	$3,688	2035
ELD	50	R1.65	ELD County	US 50/Silva Valley Pkwy Interchange (Ph 2)	Final Phase of new interchange: construct EB diagonal and WB loop on-ramps to US 50	New Interchange	MTP	$14,200	2035
ELD	50	4.96/ R8.56	ELD County	US 50 Auxiliary Lane EB - Cambridge to Ponderosa	EB US 50 auxiliary lane between Cambridge Rd and Ponderosa Rd Interchanges	Auxiliary Lanes	MTP	$14,550	2035
ELD	50	EB 4.96/6.57 WB 6.57/R3.23	ELD County	US 50 Auxiliary Lane at Cambridge Road	EB US 50 between Cambridge Rd and Cameron Park Dr Interchanges; and WB between Cameron Park Dr and Bass Lake Rd Interchanges. Includes bridge widening to add two lanes and ramp widening.	Auxiliary Lanes	MTP	$15,500	2035
ELD	50	0.86	ELD County	US 50/El Dorado Hills Blvd Interchange Westbound ramps	Final Phase: Construct new WB off-ramp undercrossing, improve WB on-/off-ramps with dedicated HOV on-ramp lane, ramp metering and 1,000 ft merge lane.	Interchange Improvements	MTP	$19,160	2015
ELD	50	R15.06	ELD County	US 50/Missouri Flat Rd Interchange Improvements (Phase 2)	Highway and Interchange improvements for additional traffic capacity needed to accommodate local development projects.	Interchange Improvements	ELD County	$20,000	2035
ELD	50	R1.65/R3.23	ELD County	US 50/ Bass Lake Rd Interchange (Ph. 1); WB Auxiliary Lane	Interchange Improvements: Phase 1, ramp widening, road widening, signals and WB auxiliary lane between Bass Lake and Silva Valley Interchanges; Phase 1 assumes bridge replacement.	Interchange Auxiliary Lanes	MTP	$20,829	2035
ELD	50	R8.56	ELD County	US 50/Ponderosa Rd North Shingle Rd Realignment	Realign approximately 1/4 mile of Durock Rd to Sunset Ln and signalize new intersection. Durock Rd will be two through lanes with turn pockets at the intersection and center turn lane.	Interchange Improvements	MTP	$5,020	2024
SAC	50	R9.51	City of Rancho Cordova	Mather Field Rd./US 50 Interchange	Interchange Modification: at U.S. 50/Mather Field Rd.	Interchange Improvements	MTP	$5,647	2025
ELD	50	0.86	ELD County	US 50/El Dorado Hills Blvd Interchange Eastbound Ramps	Reconstruct EB diagonal on-ramp and EB loop off-ramp for the ultimate configuration; add a lane to NB El Dorado Hills Blvd under the overpass (eliminates merge lane and improves traffic flow from the EB loop off-ramp); EB diagonal on-ramp will be metered with an HOV bypass.	Interchange Improvements	MTP	$5,904	2035
ELD	50	6.57/ R8.56	ELD County	US 50 Bus/Carpool Lanes (Phase 2B)	Phase 2B: US 50- Cameron Park Dr to Ponderosa Rd Interchange - Add HOV lanes in median. PA&ED completed by Caltrans, and Caltrans advancing project design through Co-Op Agreement with the County. Intergovernmental Agreement between the County and Shingle Springs Band of Miwok Tribe for funding.	Bus/Carpool Lanes	MTP/MTI P	$22,637	2025
ELD	50	R8.56	ELD County	US 50/Ponderosa Rd Interchange Durock Rd Realignment	Realign approximately 1/4 mile of Durock Rd to Sunset Ln and signalize new inter-section. Durock Rd will be two through lanes with turn pockets at the intersection and center turn lane.	Interchange Improvements	MTP	$7,151	2026
ELD	50	R14.01	ELD County	US 50/El Dorado Rd Interchange Improvements (Ph.2)	Construction of left- and right-turn lanes and additional through traffic lanes in all approaches to the interchange	Interchange Improvements	MTP	$7,265	2035
ELD	50	15.29/16.503	City of Placerville	US 50 Western Placerville Interchanges (Ph 1A)	At US 50/Ray Lawyer Dr, Construct WB access ramp from R. Lawyer Dr onto US50, Auxiliary lane between WB access ramp and existing WB off-ramp at Placerville Dr	Interchange Improvements, Operational Improvements	MTP	$9,215	2014

ELD	50	4.96	ELD County	US 50/ Cambridge Rd Interchange Improvements (Ph. 1)	Includes widening existing EB and WB on-/off-ramps; addition of new WB on-ramp; reconstruction of local intersections; and installation of traffic signals at EB and WB ramp terminal intersections; preliminary engineering for Phase 2 to be performed under Phase 1.	Interchange Improvements	MTP	$10,645	2035
ELD	50	R3.23/4.96	ELD County	US 50 Auxiliary Lane at Bass Lake Road	WB US 50 between Bass Lake Rd and Cambridge Rd Interchanges. Includes additional ramp and road widening.	Auxiliary Lanes	MTP	$23,640	2035
ELD	50	R8.56/R12.19	ELD County	US 50 Bus/Carpool Lanes (Ph 3)	Phase 3: US 50-Ponderosa Road to Greenstone Road	Bus/Carpool Lanes	MTP	$34,730	2035
SAC	50	16.9/ 17.2	CT	Natomas OC Ramp Meter & Widening	Add ramp meter and widen Natomas OC	Transportation Management Systems	SHOPP	$3,240	2020
SAC	50	12.50/21.50	CT	US 50 Auxiliary Lane	Add Aux Lane(s) - EB from Sunrise to Scott	Auxiliary Lanes	CT	$3,500	2025
ELD	50	R8.56	ELD County	US 50/Ponderosa Rd/So Shingle Rd Interchange improvements	Widen existing US 50 overcrossing to accommodate 5 lanes, and realignment of WB loop on-ramp, ramp widening, and widening of Ponderosa Rd, Mother Lode Dr, and So. Shingle Rd.	Interchange Improvements	MTP	$16,339	2028
SAC	50	21.5	City of Folsom	US 50 at Scott Road	Ramp modifications and overpass widening for US 50/East Bidwell/Scott Road Interchange to improve access to development south of US 50.	Capacity Enhancement	MTP	$3,740	2020

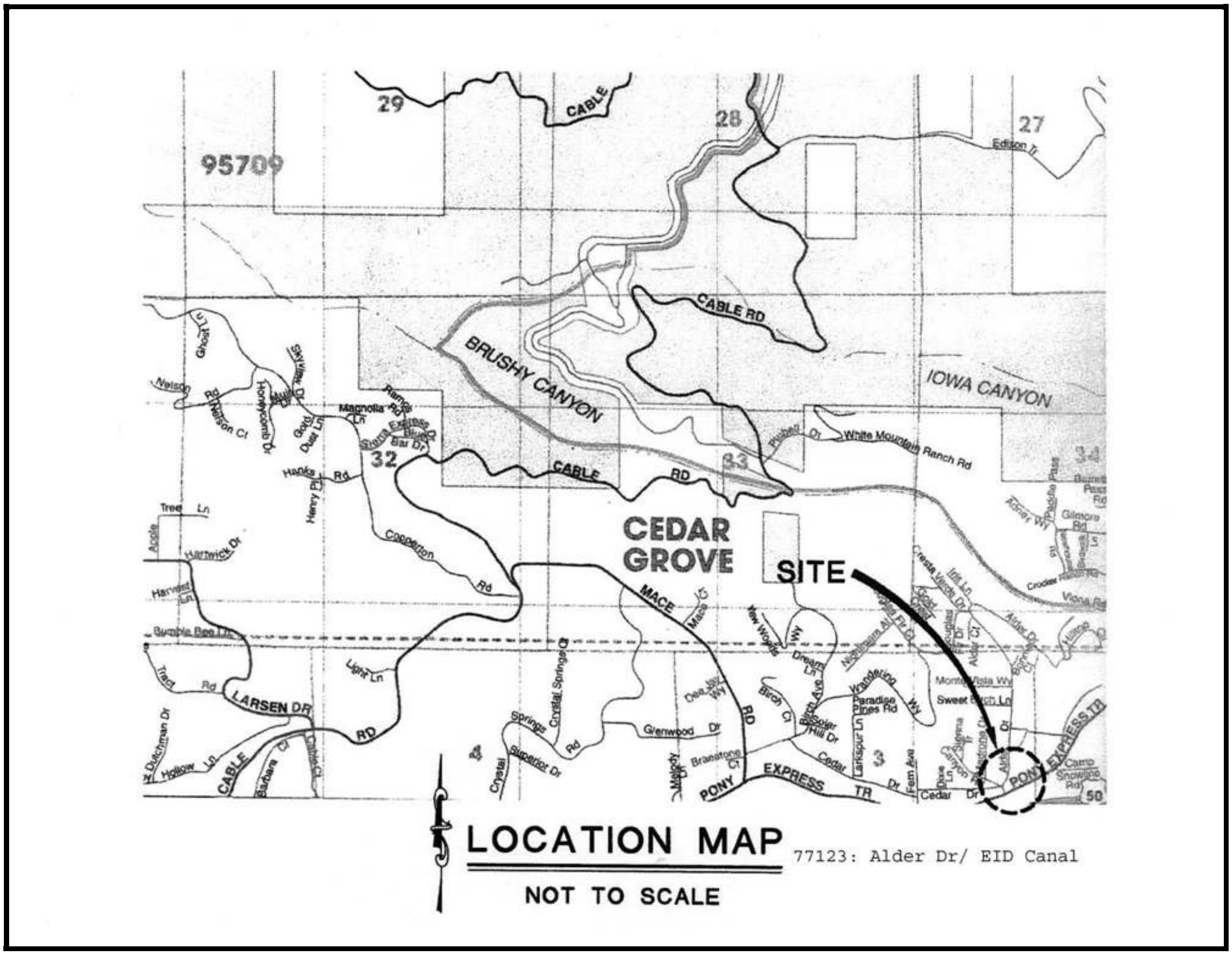
Attachment #24

Section 8.1
West Slope Road/Bridge
Individual Project Summaries

Alder Drive at EID Canal - Bridge Replacement

CIP Project Summary

Project No: 77123 | **Type: Bridge** | **Supervisor District(s) 3**



Project Description:

Project includes replacement of the bridge with culverts at the EID canal crossing, widening and minor realignment at the bridge approaches.

Original Budget: $2,180,000 Expenditures thru 6/30/2013: $139,809 Project Initiation Date: 12/16/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Alder Drive at EID Canal - Bridge Replacement

Financing Plan & Tentative Schedule

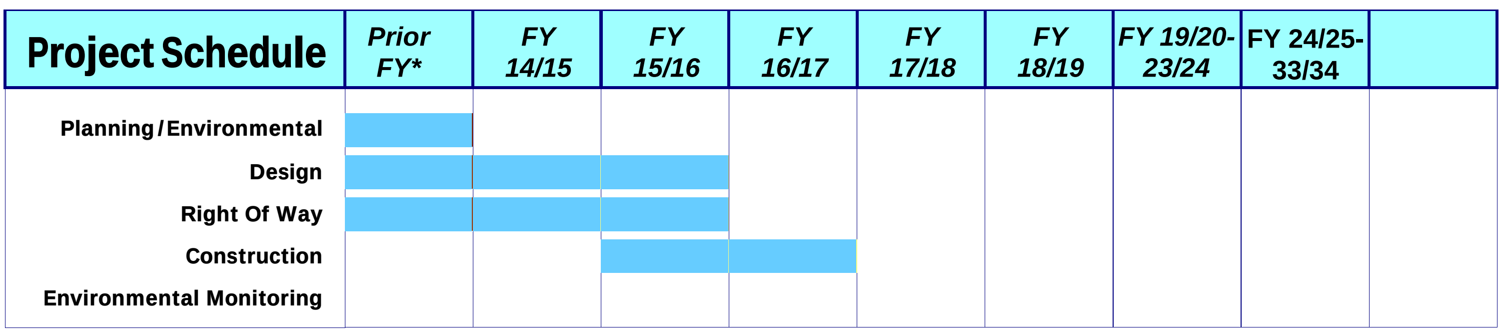
Project No: 77123 **Type: Bridge** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	$315	$158	$238	$359	$0	$0	$0	$0	$1,070
Total	$315	$158	$238	$359	$0	$0	$0	$0	$1,070

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$109	$0	$0	$0	$0	$0	$0	$0	$109
Planning/Env - Staff	$136	$0	$0	$0	$0	$0	$0	$0	$136
Design - Staff	$60	$95	$78	$0	$0	$0	$0	$0	$233
Right of Way - Acquisition	$0	$0	$4	$0	$0	$0	$0	$0	$4
Right of Way - Consultant	$0	$30	$20	$0	$0	$0	$0	$0	$50
Right of Way - Staff	$10	$33	$87	$0	$0	$0	$0	$0	$131
Construction Mgmt - Consultant	$0	$0	$16	$0	$0	$0	$0	$0	$16
Construction Mgmt - Staff	$0	$0	$5	$55	$0	$0	$0	$0	$60
Direct Construction Costs	$0	$0	$28	$304	$0	$0	$0	$0	$331
Total	$315	$158	$238	$359	$0	$0	$0	$0	$1,070

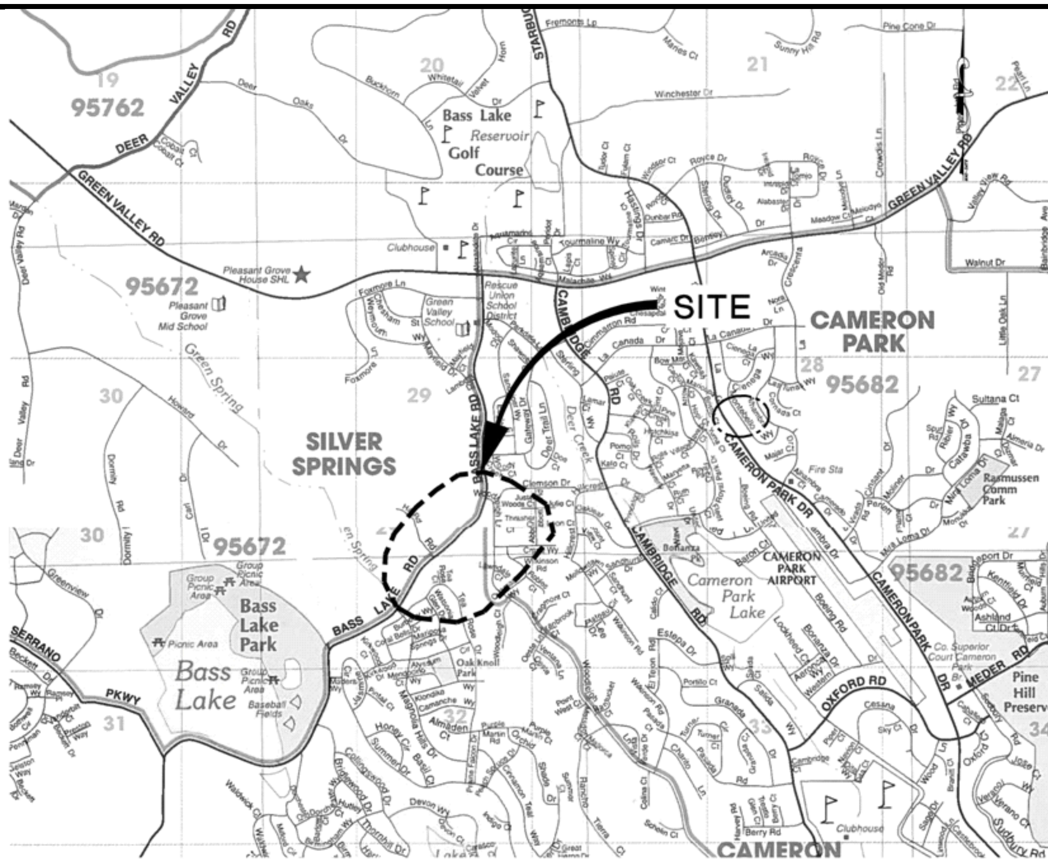


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bass Lake Frontage Improvements-Silver Springs

CIP Project Summary

Project No: 66115 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Roadway improvements to the existing Bass Lake Road east of Silver Springs Parkway, including full width improvements, curb, gutter, sidewalk (on northwest side of Bass Lake Road only), slurry sealing the pavement and restriping. Utility work consists of water connections and relocation of several poles.

Original Budget: $1,576,071 Expenditures thru 6/30/2013: $70,582 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bass Lake Frontage Improvements-Silver Springs

Financing Plan & Tentative Schedule

Project No: 66115 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	*$11*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$11*
Developer Funded	*$59*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,431*	*$1,490*
Total	*$70*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,431*	*$1,501*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$29*	*$32*
Design - Staff	*$60*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$36*	*$96*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$18*	*$18*
Right of Way - Staff	*$8*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$17*	*$25*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$150*	*$150*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,181*	*$1,181*
Total	*$71*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,431*	*$1,501*

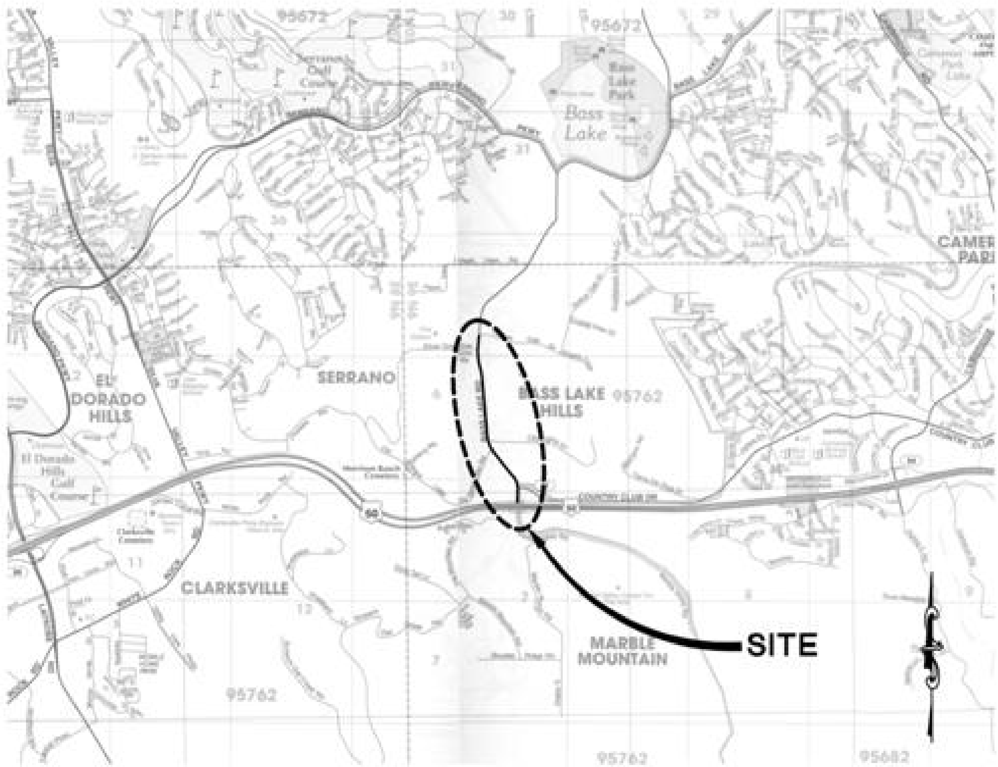
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bass Lake Road Full Improvements - Phase 1A

CIP Project Summary

Project No: 66109 | **Type: Roadway** | **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Bass Lake Road from US 50 to Hollow Oak Road: widen and reconstruct to two-lane divided road with 4-foot shoulders and pedestrian/bike paths. Phase 1A improvements of the Bass Lake Hills Specific Plan PFFP; full improvements to include development of 8-foot median, sidewalk and bike lane from Hollow Oak Road to US 50; median improvements only from Hollow Oak Road to Serrano Parkway. Phase 1B improvements in project GP166. Funding for sidewalks, signals, bike lanes, median landscaping and median irrigation to come from PFFP. The expenditure for FY's 2011/2012 and 2012/2013 is advancement of the culvert under Bass Lake Road which is needed as part of the Hollow Oak Road Drainage Project (72369).

Original Budget: $7,831,500 Expenditures thru 6/30/2013: $507,487 Project Initiation Date: 09/01/05

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bass Lake Road Full Improvements - Phase 1A

Financing Plan & Tentative Schedule

Project No: 66109 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Bass Lake Hills PFFP	$0	$0	$0	$0	$0	$0	$0	$712	$712
Developer Advance - EDH TIM	$254	$0	$0	$0	$0	$0	$0	$6,216	$6,470
Road Fund/Discretionary	($8)	$0	$0	$0	$0	$0	$0	$0	($8)
RSTP Exchange Funds-Caltrans	$226	$0	$0	$0	$0	$0	$0	$0	$226
RSTP Exchange Funds-Rural-EDCTC	$37	$0	$0	$0	$0	$0	$0	$0	$37
Total	$508	$0	$0	$0	$0	$0	$0	$6,929	$7,437

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$22	$0	$0	$0	$0	$0	$0	$38	$60
Planning/Env - Staff	$8	$0	$0	$0	$0	$0	$0	$35	$43
Design - Consultant	$6	$0	$0	$0	$0	$0	$0	$0	$6
Design - Staff	$206	$0	$0	$0	$0	$0	$0	$331	$537
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$317	$317
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$25	$25
Right of Way - Staff	$89	$0	$0	$0	$0	$0	$0	$50	$139
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$83	$83
Construction Mgmt - Staff	$43	$0	$0	$0	$0	$0	$0	$550	$593
Direct Construction Costs	$135	$0	$0	$0	$0	$0	$0	$5,500	$5,635
Total	$508	$0	$0	$0	$0	$0	$0	$6,929	$7,437

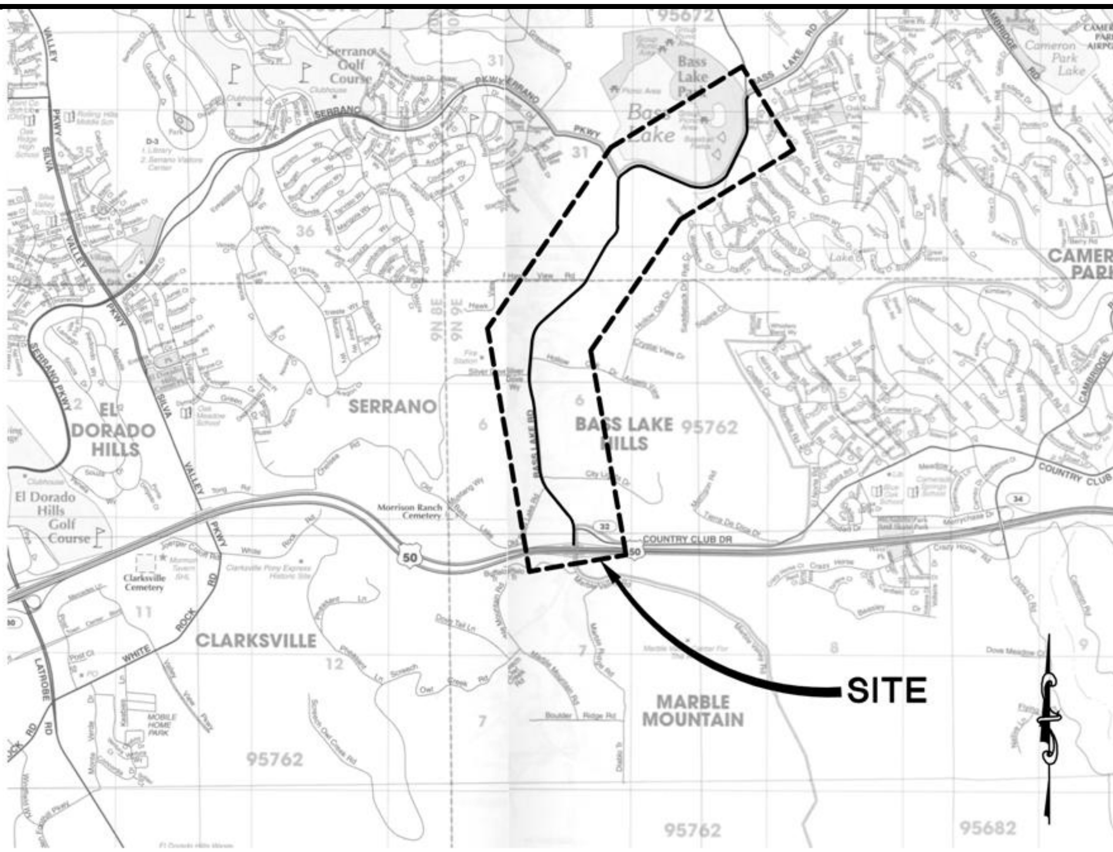
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bass Lake Road Widening - U.S. 50 to Silver Springs Parkway, Phase 1B

CIP Project Summary

Project No: GP166 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Bass Lake Road from US 50 to Silver Springs Parkway: widen from two to four-lane divided roadway; includes curb, gutter, sidewalk, shoulders (4' shoulder existing) for 2.4 miles (US 50 to Silver Springs Parkway). Phase 1B improvements of the Bass Lake Hills Specific Plan PFFP. See 66109 for Phase 1. This estimate includes improving the portion of Bass Lake Road from Serrano Parkway to approximately Madera Way from the substandard 2 lane existing road up to the 4 lane divided ultimate. The estimate also includes upgrading just north of Sienna Ridge to Silver Spring Pkwy to standard 2 lanes.

Original Budget: $11,200,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bass Lake Road Widening - U.S. 50 to Silver Springs Parkway, Phase 1B

Financing Plan & Tentative Schedule

Project No: GP166 | **Type: Roadway** | **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$15,385*	*$15,385*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$15,385*	*$15,385*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$530*	*$530*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,000*	*$2,000*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,260*	*$1,260*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$70*	*$70*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$130*	*$130*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,000*	*$1,000*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10,395*	*$10,395*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$15,385*	*$15,385*

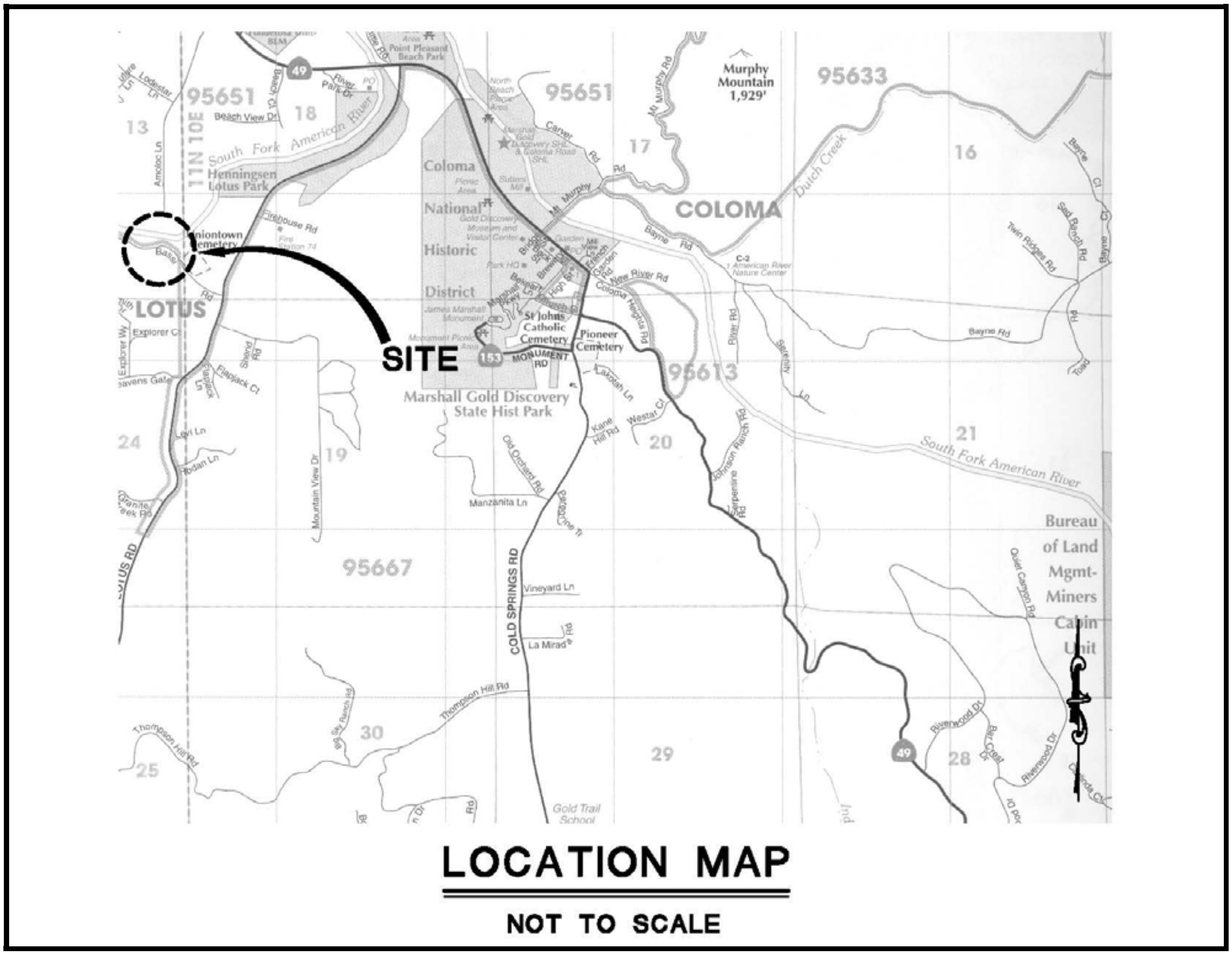
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bassi Road at Granite Creek - Bridge Replacement

CIP Project Summary

Project No: 77128 | **Type: Bridge** | **Supervisor District(s) 4**



Project Description:

Project includes replacement of the bridge at the Granite Creek crossing, widening and minor realignment at the bridge approaches.

Original Budget: $4,230,000   Expenditures thru 6/30/2013: $209,975   Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bassi Road at Granite Creek - Bridge Replacement

Financing Plan & Tentative Schedule

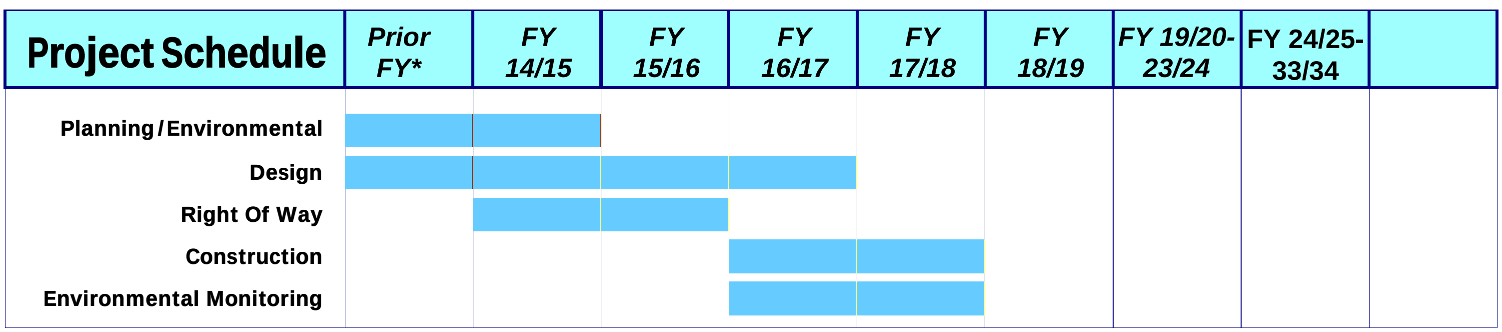
Project No: 77128 | **Type: Bridge** | **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$350	$308	$395	$1,534	$1,494	$0	$0	$0	$4,080
Total	$350	$308	$395	$1,534	$1,494	$0	$0	$0	$4,080

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$114	$80	$0	$0	$0	$0	$0	$0	$194
Planning/Env - Staff	$158	$52	$0	$0	$0	$0	$0	$0	$210
Design - Consultant	$41	$20	$21	$0	$0	$0	$0	$0	$82
Design - Staff	$39	$80	$80	$60	$0	$0	$0	$0	$259
Right of Way - Acquisition	$0	$0	$100	$0	$0	$0	$0	$0	$100
Right of Way - Consultant	$0	$66	$144	$0	$0	$0	$0	$0	$210
Right of Way - Staff	$0	$10	$50	$0	$0	$0	$0	$0	$60
Construction Mgmt - Consultant	$0	$0	$0	$13	$13	$0	$0	$0	$25
Construction Mgmt - Staff	$0	$0	$0	$200	$200	$0	$0	$0	$400
Direct Construction Costs	$0	$0	$0	$1,250	$1,250	$0	$0	$0	$2,500
Env Monitoring - Consultant	$0	$0	$0	$8	$27	$0	$0	$0	$35
Env Monitoring - Staff	$0	$0	$0	$3	$4	$0	$0	$0	$7
Total	$351	$308	$395	$1,534	$1,494	$0	$0	$0	$4,081

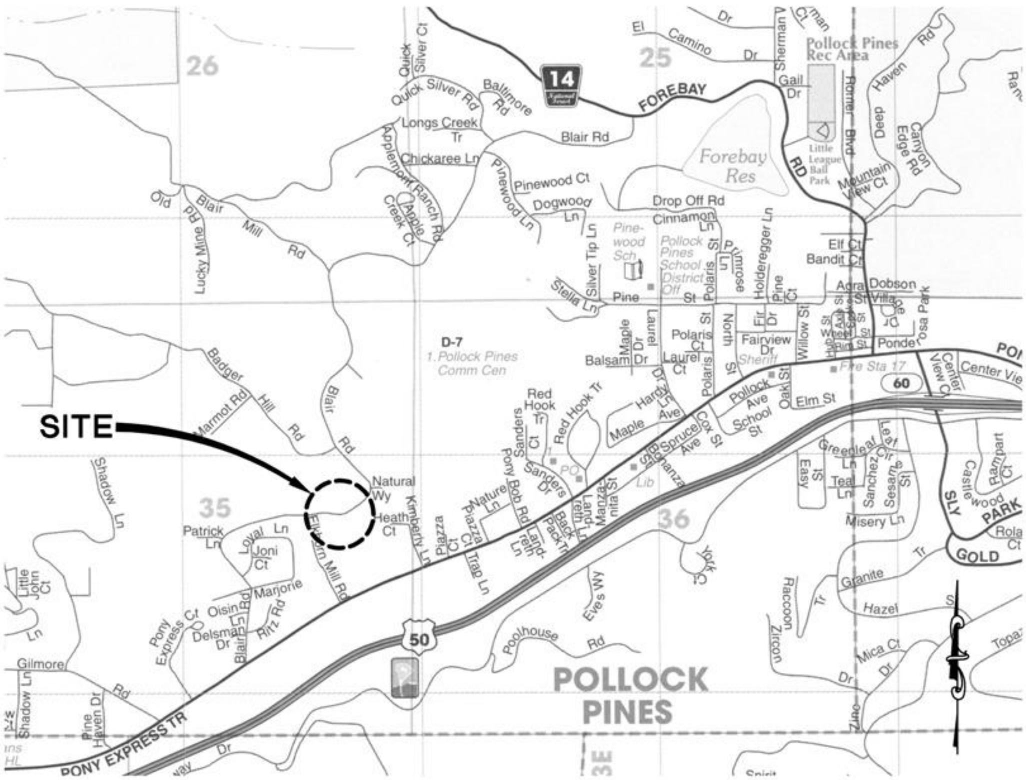


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Blair Road at EID Canal - Bridge Replacement

CIP Project Summary

Project No: 77119 **Type: Bridge** **Supervisor District(s) 5**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge with culverts at the EID canal crossing, widening and minor realignment at the bridge approaches. The current estimate is a decrease from the original estimate due to advanced planning studies. Type selection resulted in advancing a culvert structure as the preferred alternative.

Original Budget: $2,172,000 Expenditures thru 6/30/2013: $145,162 Project Initiation Date: 12/16/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Blair Road at EID Canal - Bridge Replacement

Financing Plan & Tentative Schedule

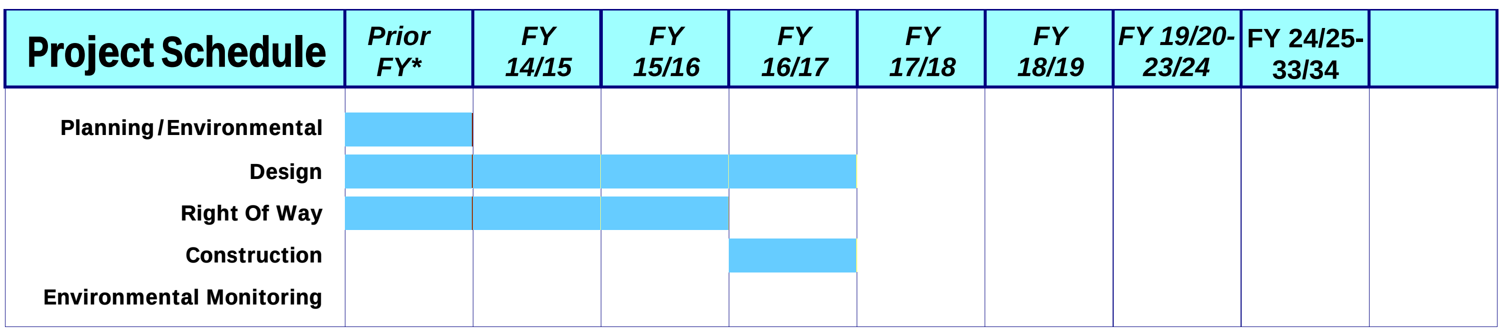
Project No: 77119 **Type: Bridge** **Supervisor District(s) 5**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$277	$123	$149	$901	$0	$0	$0	$0	$1,450
RSTP Exchange Funds-Caltrans	$12	$0	$0	$0	$0	$0	$0	$0	$12
Total	$289	$123	$149	$901	$0	$0	$0	$0	$1,462

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$118	$0	$0	$0	$0	$0	$0	$0	$118
Planning/Env - Staff	$147	$0	$0	$0	$0	$0	$0	$0	$147
Design - Staff	$22	$100	$101	$6	$0	$0	$0	$0	$229
Right of Way - Acquisition	$0	$0	$4	$0	$0	$0	$0	$0	$4
Right of Way - Consultant	$0	$3	$0	$0	$0	$0	$0	$0	$3
Right of Way - Staff	$3	$21	$44	$0	$0	$0	$0	$0	$67
Construction Mgmt - Consultant	$0	$0	$0	$15	$0	$0	$0	$0	$15
Construction Mgmt - Staff	$0	$0	$0	$111	$0	$0	$0	$0	$111
Direct Construction Costs	$0	$0	$0	$768	$0	$0	$0	$0	$768
Total	$290	$123	$149	$901	$0	$0	$0	$0	$1,463

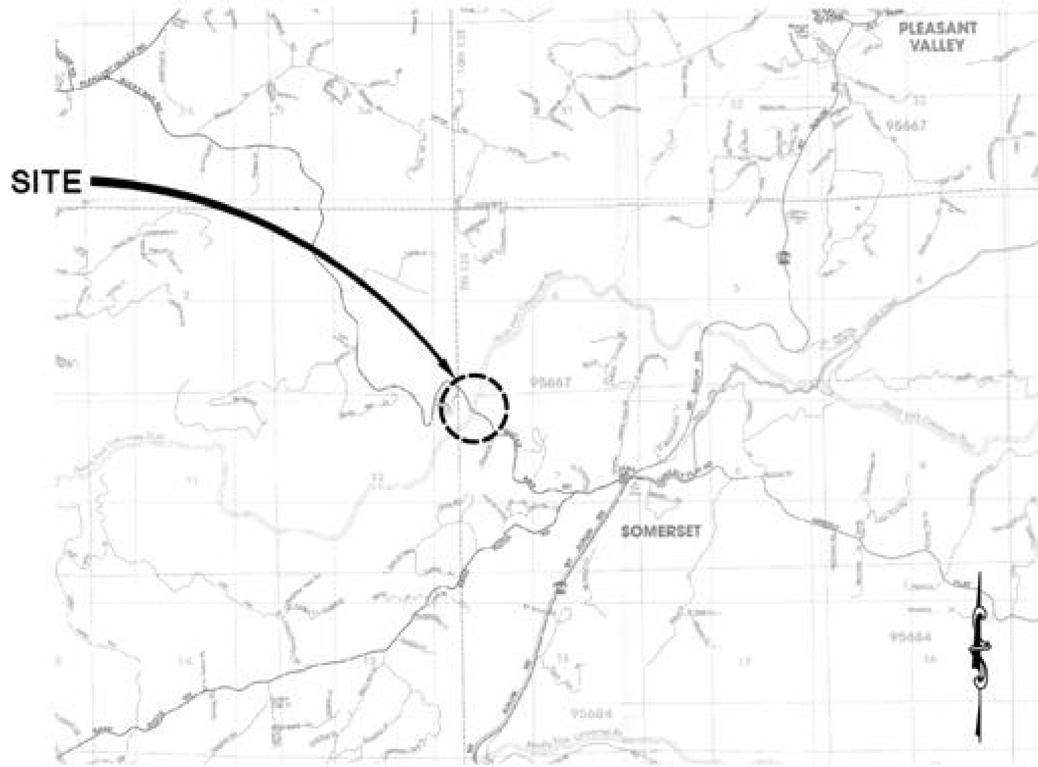


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bucks Bar Road at the North Fork Cosumnes River - Bridge Replacement

CIP Project Summary

Project No: 77116 | **Type: Bridge** | **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the existing bridge at North Fork Cosumnes River, in addition to widening and minor realignment of Bucks Bar Road at the bridge approaches.

Original Budget: $4,849,000 Expenditures thru 6/30/2013: $432,242 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Bucks Bar Road at the North Fork Cosumnes River - Bridge Replacement

Financing Plan & Tentative Schedule

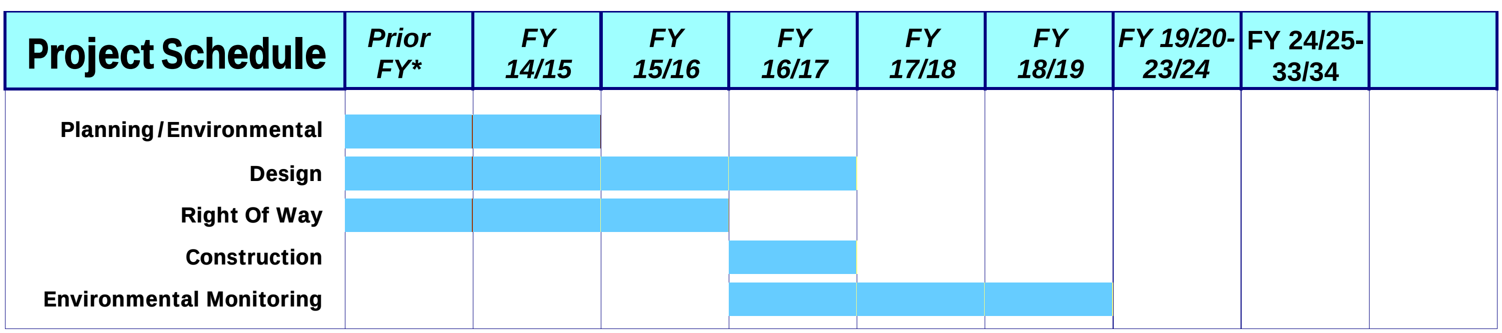
Project No: 77116 | **Type: Bridge** | **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$448	$390	$571	$4,210	$9	$9	$0	$0	$5,636
RSTP Exchange Funds-Caltrans	$55	$0	$0	$0	$0	$0	$0	$0	$55
RSTP Exchange Funds-Rural-EDCTC	$9	$50	$74	$545	$1	$1	$0	$0	$681
Total	$512	$440	$645	$4,755	$10	$10	$0	$0	$6,372

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$230	$50	$0	$0	$0	$0	$0	$0	$280
Planning/Env - Staff	$183	$40	$0	$0	$0	$0	$0	$0	$223
Design - Consultant	$25	$250	$225	$85	$0	$0	$0	$0	$585
Design - Staff	$72	$80	$90	$50	$0	$0	$0	$0	$292
Right of Way - Acquisition	$0	$0	$250	$0	$0	$0	$0	$0	$250
Right of Way - Consultant	$0	$0	$40	$0	$0	$0	$0	$0	$40
Right of Way - Staff	$3	$20	$40	$0	$0	$0	$0	$0	$63
Construction Mgmt - Consultant	$0	$0	$0	$40	$0	$0	$0	$0	$40
Construction Mgmt - Staff	$0	$0	$0	$560	$0	$0	$0	$0	$560
Direct Construction Costs	$0	$0	$0	$4,000	$0	$0	$0	$0	$4,000
Env Monitoring - Consultant	$0	$0	$0	$10	$5	$5	$0	$0	$20
Env Monitoring - Staff	$0	$0	$0	$10	$5	$5	$0	$0	$20
Total	$512	$440	$645	$4,755	$10	$10	$0	$0	$6,372

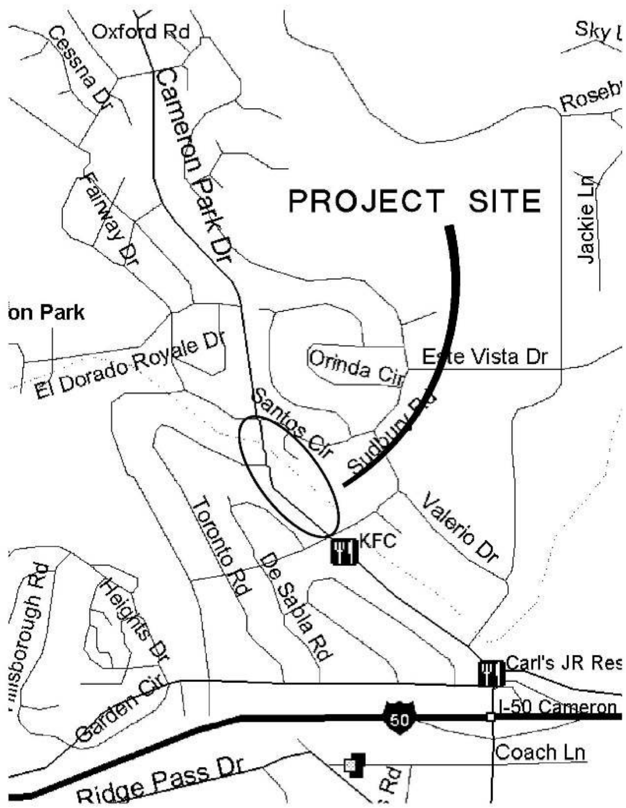


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Class 2 Bike Lanes

CIP Project Summary

Project No: 72307 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 2, 4**



Project Description:

Design and construct Class 2 bike lanes on both sides of Cameron Park Drive between Palmer Drive and Hacienda Road; includes minor shoulder widening, striping, pavement markings and signs.

Original Budget: $160,000 Expenditures thru 6/30/2013: $28,021 Project Initiation Date: 09/01/11

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Class 2 Bike Lanes

Financing Plan & Tentative Schedule

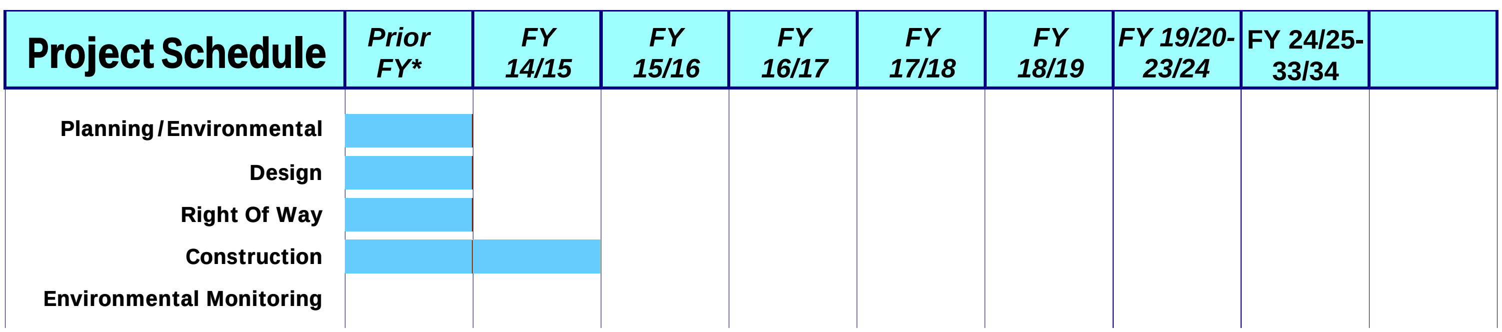
Project No: 72307 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 2, 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
EDC AQMD	*$97*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$97*
RSTP Exchange Funds-Caltrans	*$28*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$28*
Transportation Development Act (TDA)	*$23*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$38*
Total	*$148*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$163*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5*
Design - Staff	*$43*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$43*
Right of Way - Staff	*$2*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2*
Construction Mgmt - Staff	*$17*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$22*
Direct Construction Costs	*$80*	*$10*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$90*
Total	*$147*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$162*

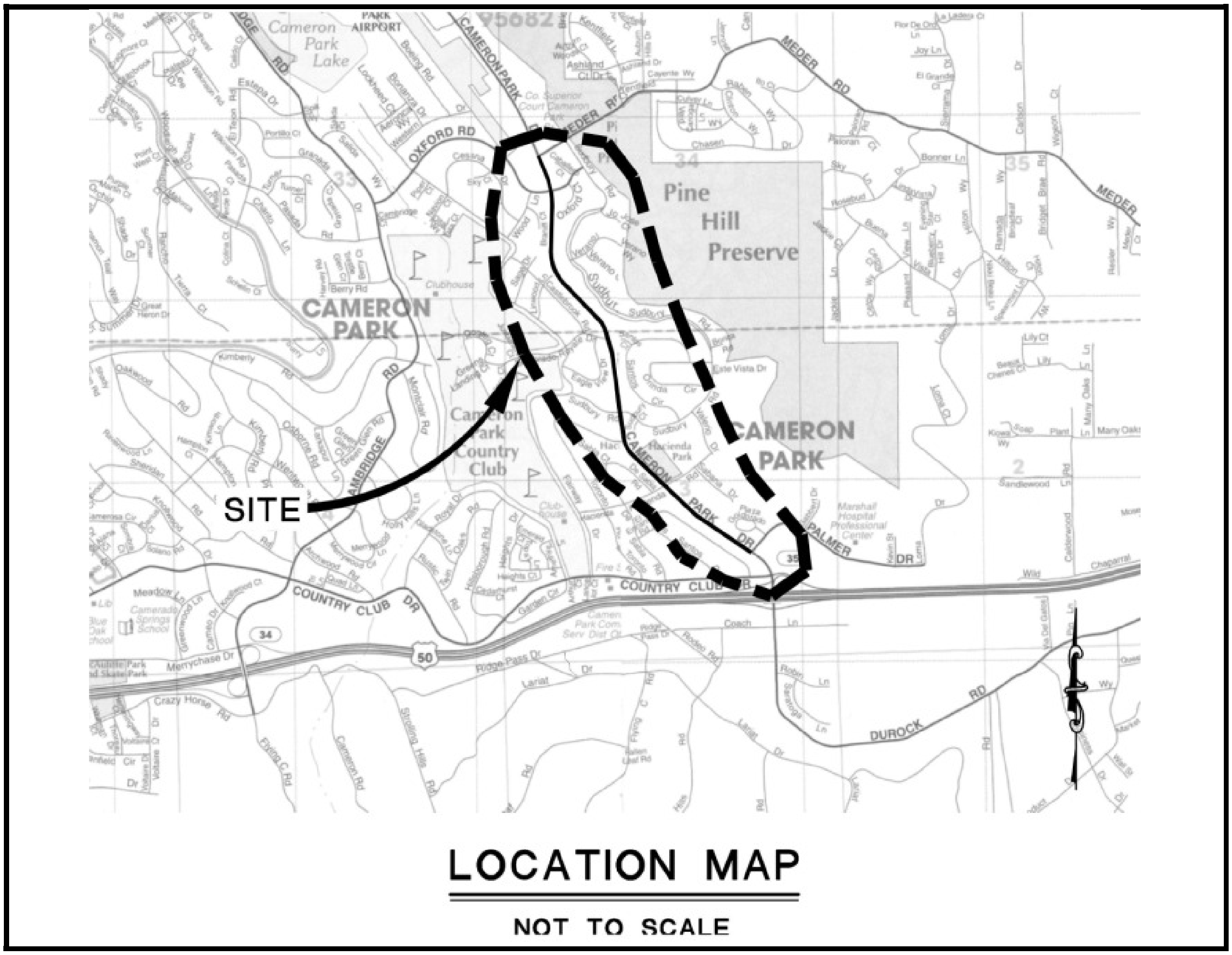


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Drive Widening - Palmer Drive to Meder Road

CIP Project Summary

Project No: GP144 **Type: Roadway** **Supervisor District(s) 2, 3**



Project Description:

Widen Cameron Park Drive two-lane undivided roadway to a four-lane divided roadway, from Palmer Drive to Meder Rd. Improvements include curb, gutter and sidewalk.

Original Budget: $14,800,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Drive Widening - Palmer Drive to Meder Road

Financing Plan & Tentative Schedule

Project No: GP144 | **Type: Roadway** | **Supervisor District(s) 2, 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$12,520	$12,520
Total	$0	$0	$0	$0	$0	$0	$0	$12,520	$12,520

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$370	$370
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$1,400	$1,400
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$2,170	$2,170
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$10	$10
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$120	$120
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$770	$770
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$7,680	$7,680
Total	$0	$0	$0	$0	$0	$0	$0	$12,520	$12,520

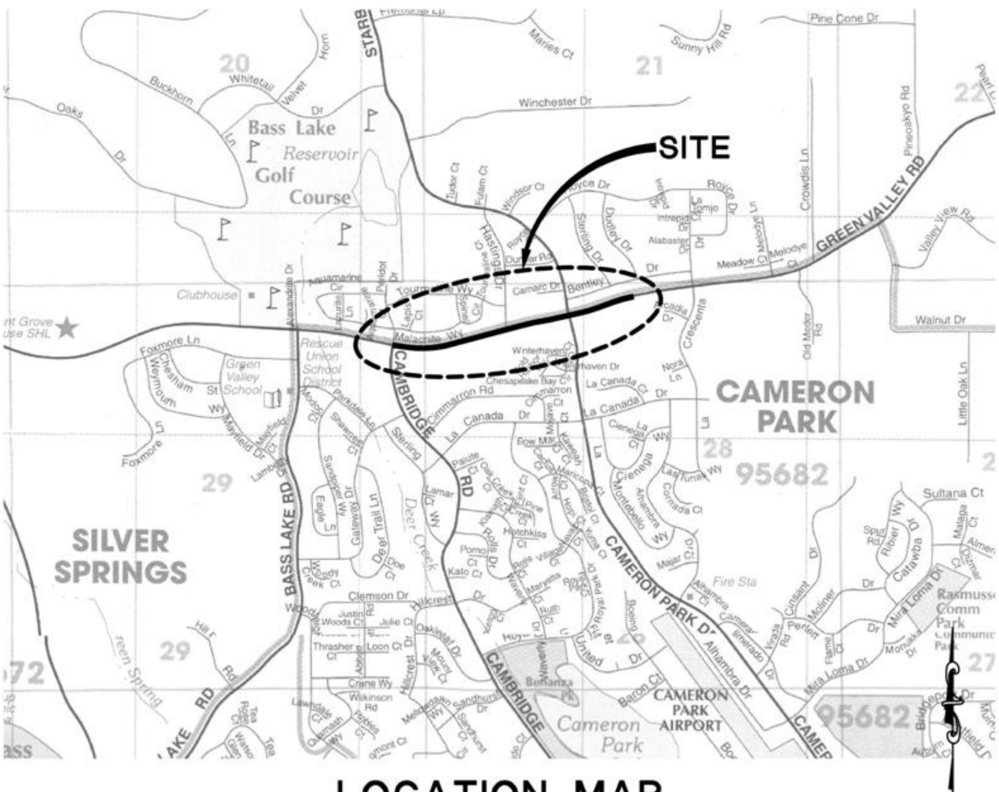
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Drive/Green Valley Road Intersection Improvements

CIP Project Summary

Project No: 73150 **Type: Intersection** **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

In Cameron Park, intersection improvements at Cameron Park Drive and Green Valley Road to include new traffic signals with alignment improvements; will also include widening Cameron Park Drive to accommodate extension of two-way left turn lane from Winterhaven Drive to Green Valley Road and widening of Green Valley Road from Cambridge Road to Cameron Park Drive to accommodate General Plan anticipated traffic. Other improvements to include sidewalk, crosswalks and drainage system. This project to be funded out of the TIM Fee Program line item for intersection signalization and safety improvements.

Original Budget: $6,995,886 Expenditures thru 6/30/2013: $500,700 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Drive/Green Valley Road Intersection Improvements

Financing Plan & Tentative Schedule

Project No: 73150 **Type: Intersection** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$461	$0	$0	$0	$0	$0	$0	$6,479	$6,940
RSTP Exchange Funds-Rural-EDCTC	$40	$0	$0	$0	$0	$0	$0	$0	$40
Total	$501	$0	$0	$0	$0	$0	$0	$6,479	$6,980

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$30	$0	$0	$0	$0	$0	$0	$0	$30
Planning/Env - Staff	$107	$0	$0	$0	$0	$0	$0	$0	$107
Design - Consultant	$12	$0	$0	$0	$0	$0	$0	$10	$22
Design - Staff	$351	$0	$0	$0	$0	$0	$0	$594	$946
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$80	$80
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$25	$25
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$100	$100
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$870	$870
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$4,800	$4,800
Total	$501	$0	$0	$0	$0	$0	$0	$6,479	$6,980

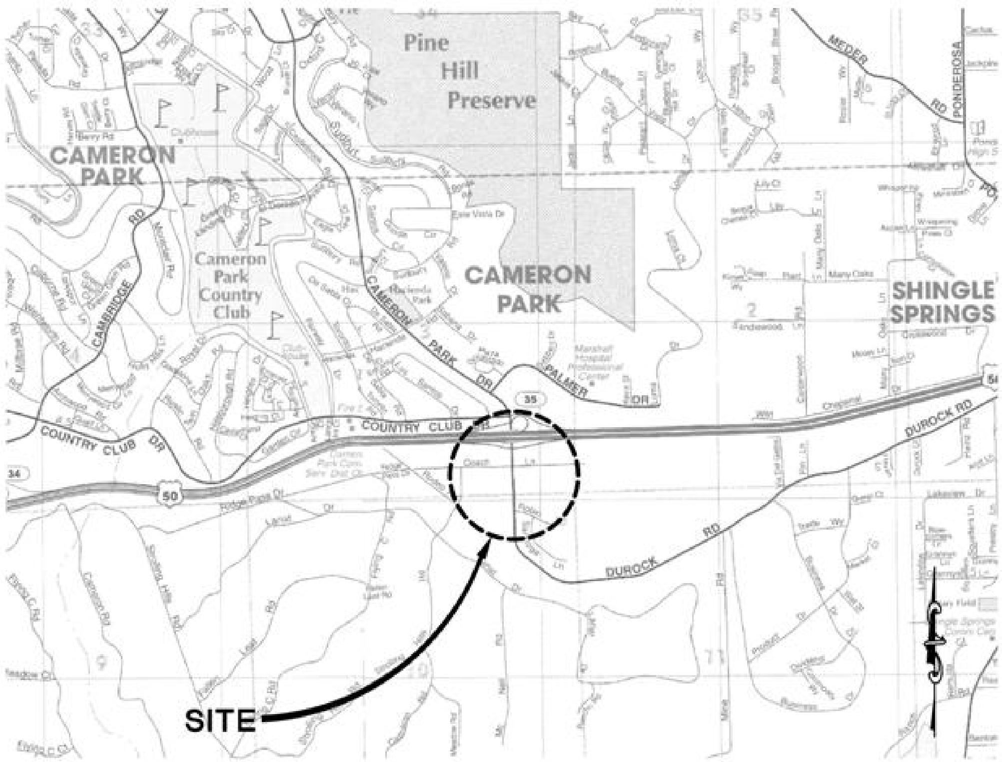
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Widening - Durock Road to Coach Lane

CIP Project Summary

Project No: 72367 **Type: Roadway** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Project widens Cameron Park Drive to five-lanes, including two northbound lanes plus right and left turn pockets, and 3 southbound through lanes plus dual right turn lanes at Robin Lane. The project also includes a median and signal modification at the Coach Lane intersection. The project realigns the Robin Lane intersection for a future extension to Rodeo Drive and constructs a signal. This project needs to be coordinated with US 50/Cameron Park Drive Interchange (project 72361).

Original Budget: $1,100,000 Expenditures thru 6/30/2013: $3,985 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cameron Park Widening - Durock Road to Coach Lane

Financing Plan & Tentative Schedule

Project No: 72367 **Type: Roadway** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$4	$0	$0	$0	$0	$0	$0	$7,334	$7,338
Total	$4	$0	$0	$0	$0	$0	$0	$7,334	$7,338

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$0	$100	$100
Planning/Env - Staff	$4	$0	$0	$0	$0	$0	$0	$20	$24
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$300	$300
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$4,664	$4,664
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$100	$100
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$50	$50
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$300	$300
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$1,800	$1,800
Total	$4	$0	$0	$0	$0	$0	$0	$7,334	$7,338

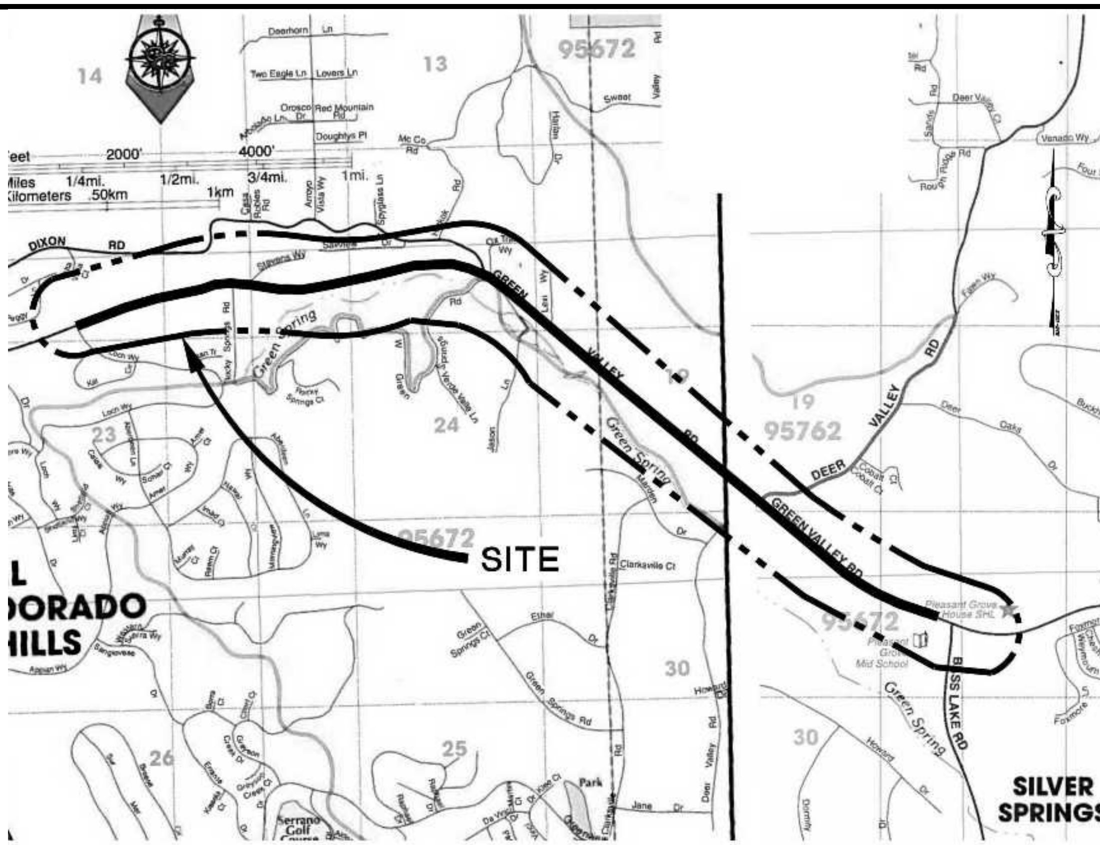
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Class II Bikeway - Green Valley Road from Loch Way to Signalized Entrance to Pleasant Grove Middle School

CIP Project Summary

Project No: 72309 | **Type: Pedestrian Way and Bike Path** | **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Class II Bikeway along both sides of Green Valley Road from Loch Way in the urbanized area of El Dorado Hills to the signalized entrance to Pleasant Grove Middle School in the rural community of Rescue.

Original Budget: $320,000 Expenditures thru 6/30/2013: $3,732 Project Initiation Date: 12/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Class II Bikeway - Green Valley Road from Loch Way to Signalized Entrance to Pleasant Grove Middle School

Financing Plan & Tentative Schedule

Project No: 72309 | **Type: Pedestrian Way and Bike Path** | **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Bicycle Transportation Account (BTA)	$45	$241	$0	$0	$0	$0	$0	$0	$286
RSTP Exchange Funds-Caltrans	$2	$0	$0	$0	$0	$0	$0	$0	$2
Transportation Development Act (TDA)	$5	$27	$0	$0	$0	$0	$0	$0	$32
Total	$52	$268	$0	$0	$0	$0	$0	$0	$320

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	$10	$0	$0	$0	$0	$0	$0	$0	$10
Design - Staff	$40	$30	$0	$0	$0	$0	$0	$0	$70
Right of Way - Staff	$2	$7	$0	$0	$0	$0	$0	$0	$9
Construction Mgmt - Staff	$0	$31	$0	$0	$0	$0	$0	$0	$31
Direct Construction Costs	$0	$200	$0	$0	$0	$0	$0	$0	$200
Total	$52	$268	$0	$0	$0	$0	$0	$0	$320

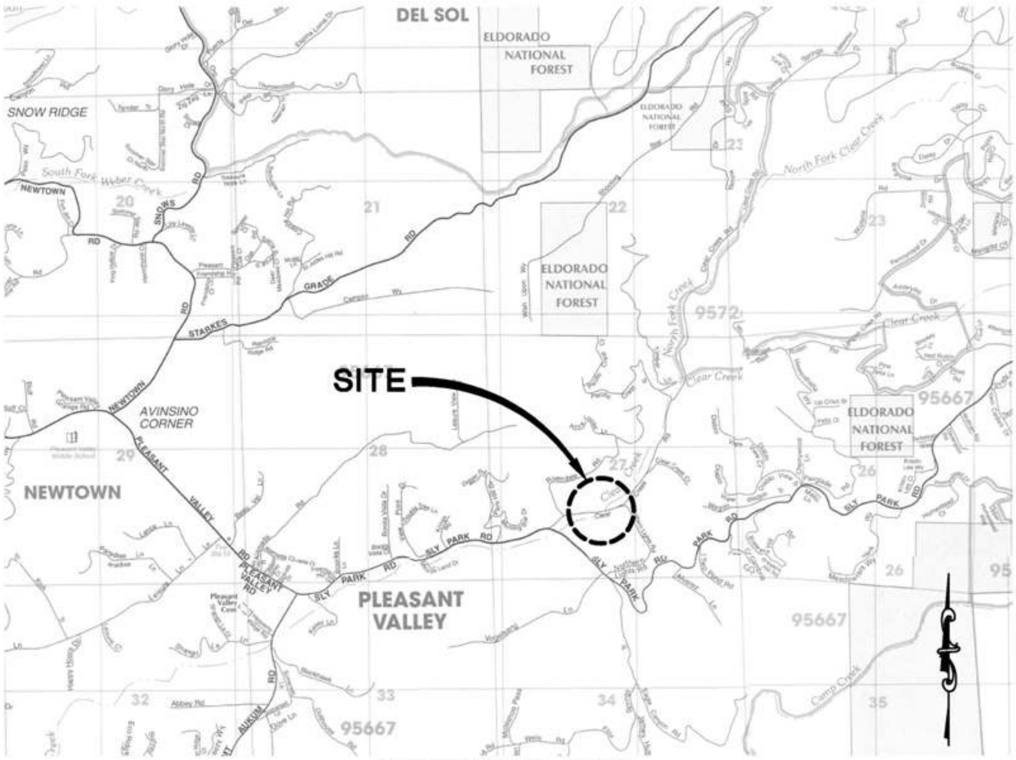
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Clear Creek Road at Clear Creek (PM 0.25) - Bridge Replacement

CIP Project Summary

Project No: 77139 | **Type: Bridge** | **Supervisor District(s) 2**



LOCATION MAP
CLEAR CREEK RD AT CLEAR CREEK (M.P. 0.25)
BRIDGE NO. 25C0079
NOT TO SCALE

Project Description:

Project includes replacement of the bridge at the Clear Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $4,585,250 | Expenditures thru 6/30/2013: $35,996 | Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Clear Creek Road at Clear Creek (PM 0.25) - Bridge Replacement

Financing Plan & Tentative Schedule

Project No: 77139 **Type: Bridge** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$166	$207	$360	$252	$0	$0	$3,600	$0	$4,585
Total	$166	$207	$360	$252	$0	$0	$3,600	$0	$4,585

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$44	$77	$55	$0	$0	$0	$0	$0	$176
Planning/Env - Staff	$122	$60	$60	$28	$0	$0	$0	$0	$270
Design - Consultant	$0	$10	$20	$15	$0	$0	$0	$0	$45
Design - Staff	$0	$60	$140	$120	$0	$0	$30	$0	$350
Right of Way - Acquisition	$0	$0	$33	$33	$0	$0	$0	$0	$66
Right of Way - Consultant	$0	$0	$16	$16	$0	$0	$0	$0	$32
Right of Way - Staff	$0	$0	$36	$40	$0	$0	$0	$0	$76
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$490	$0	$490
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$3,025	$0	$3,025
Env Monitoring - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Env Monitoring - Staff	$0	$0	$0	$0	$0	$0	$5	$0	$5
Total	$166	$207	$360	$252	$0	$0	$3,600	$0	$4,585

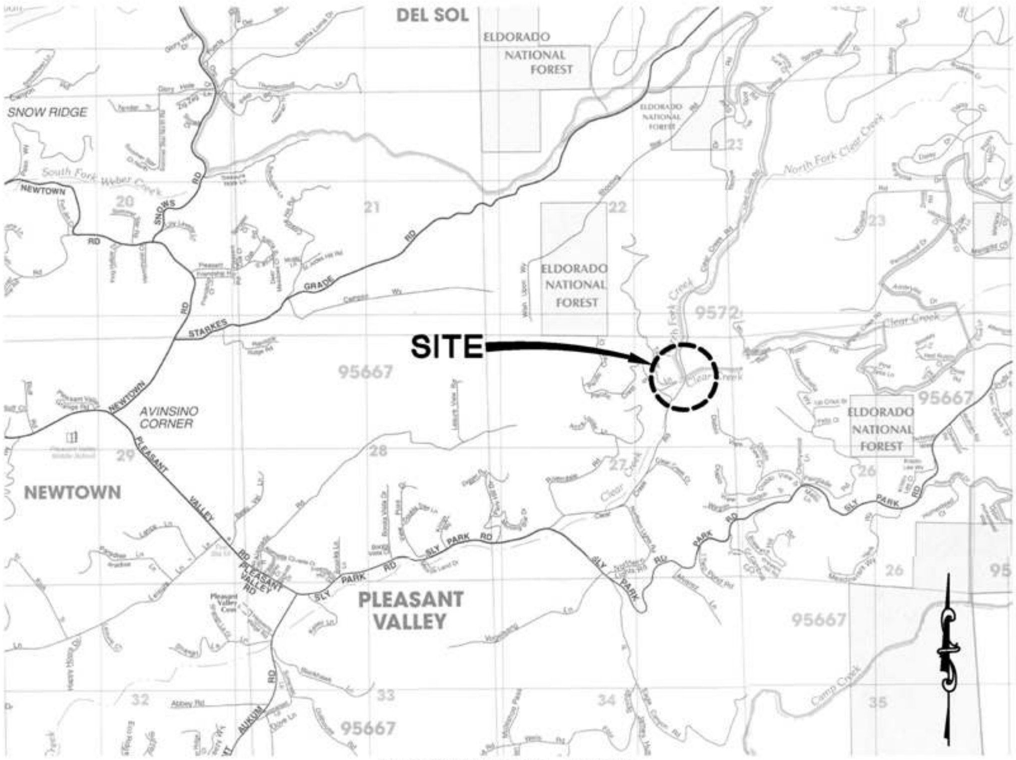
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Clear Creek Road at Clear Creek (PM 1.82) - Bridge Replacement

CIP Project Summary

Project No: 77138 | **Type: Bridge** | **Supervisor District(s) 2**



LOCATION MAP
CLEAR CREEK RD AT CLEAR CREEK (M.P. 1.82)
BRIDGE NO. 25C0080
NOT TO SCALE

Project Description:

Project includes replacement of the bridge at the Clear Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $4,134,375 Expenditures thru 6/30/2013: $35,559 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Clear Creek Road at Clear Creek (PM 1.82) - Bridge Replacement

Financing Plan & Tentative Schedule

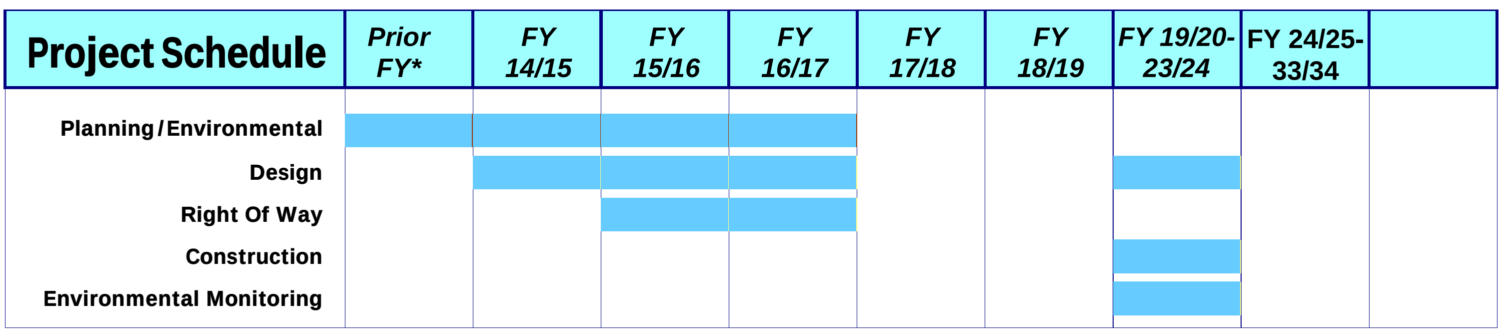
Project No: 77138 **Type: Bridge** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	$165	$223	$329	$268	$0	$0	$3,600	$0	$4,585
Total	$165	$223	$329	$268	$0	$0	$3,600	$0	$4,585

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$44	$53	$20	$0	$0	$0	$0	$0	$116
Planning/Env - Staff	$122	$45	$30	$28	$0	$0	$0	$0	$225
Design - Consultant	$0	$75	$20	$15	$0	$0	$0	$0	$110
Design - Staff	$0	$50	$160	$120	$0	$0	$30	$0	$360
Right of Way - Acquisition	$0	$0	$33	$33	$0	$0	$0	$0	$66
Right of Way - Consultant	$0	$0	$30	$32	$0	$0	$0	$0	$62
Right of Way - Staff	$0	$0	$36	$40	$0	$0	$0	$0	$76
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$490	$0	$490
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$3,025	$0	$3,025
Env Monitoring - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Env Monitoring - Staff	$0	$0	$0	$0	$0	$0	$5	$0	$5
Total	$166	$223	$329	$268	$0	$0	$3,600	$0	$4,585

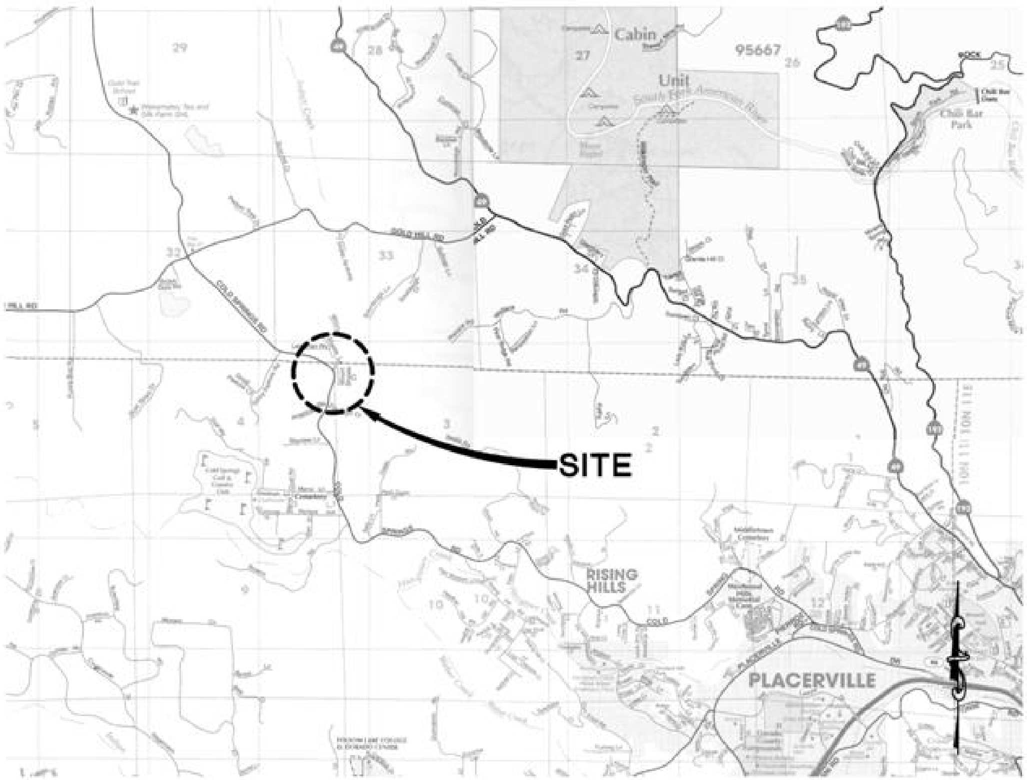


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cold Springs Road Realignment

CIP Project Summary

Project No: 73360 | **Type: Roadway** | **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Realign existing curve radius between mile posts 3.4 and 3.55, widen the roadway, add shoulders, superelevate the curve, improve drainage, and add flashing beacon warning signs. Highway Safety Improvement Grant received in FY 09/10.

Original Budget: $1,098,000 Expenditures thru 6/30/2013: $394,197 Project Initiation Date: 12/16/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cold Springs Road Realignment

Financing Plan & Tentative Schedule

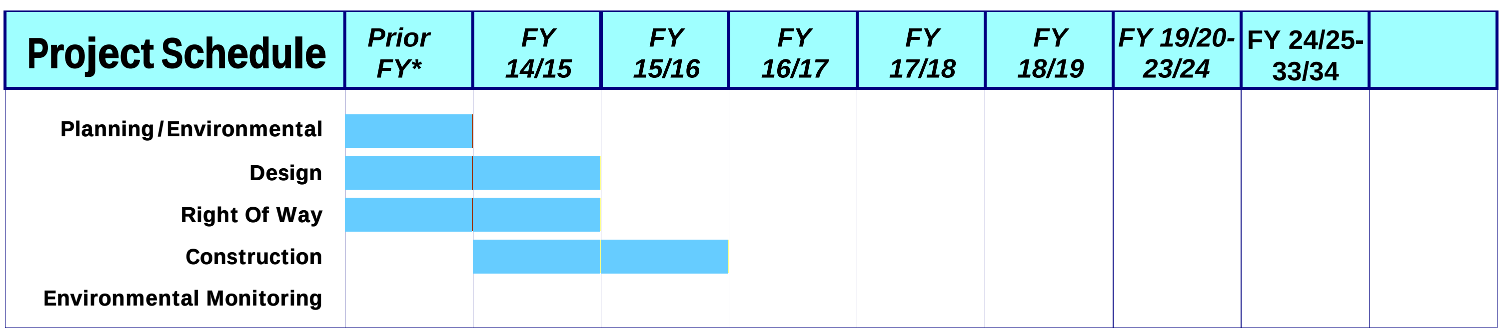
Project No: 73360 **Type: Roadway** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Safety Improvement Program	*$274*	*$1,107*	*$153*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,535*
Road Fund/Discretionary	*($5)*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*($5)*
RSTP Exchange Funds-Caltrans	*$215*	*$26*	*$17*	*$0*	*$0*	*$0*	*$0*	*$0*	*$259*
RSTP Match Funds-Caltrans	*$0*	*$124*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$124*
Total	*$485*	*$1,257*	*$170*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,912*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$60*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$60*
Planning/Env - Staff	*$185*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$185*
Design - Consultant	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*
Design - Staff	*$164*	*$77*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$241*
Right of Way - Acquisition	*$0*	*$40*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$40*
Right of Way - Consultant	*$18*	*$66*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$83*
Right of Way - Staff	*$53*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$83*
Construction Mgmt - Consultant	*$0*	*$70*	*$10*	*$0*	*$0*	*$0*	*$0*	*$0*	*$80*
Construction Mgmt - Staff	*$0*	*$75*	*$10*	*$0*	*$0*	*$0*	*$0*	*$0*	*$85*
Direct Construction Costs	*$0*	*$900*	*$150*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,050*
Total	*$485*	*$1,257*	*$170*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,912*

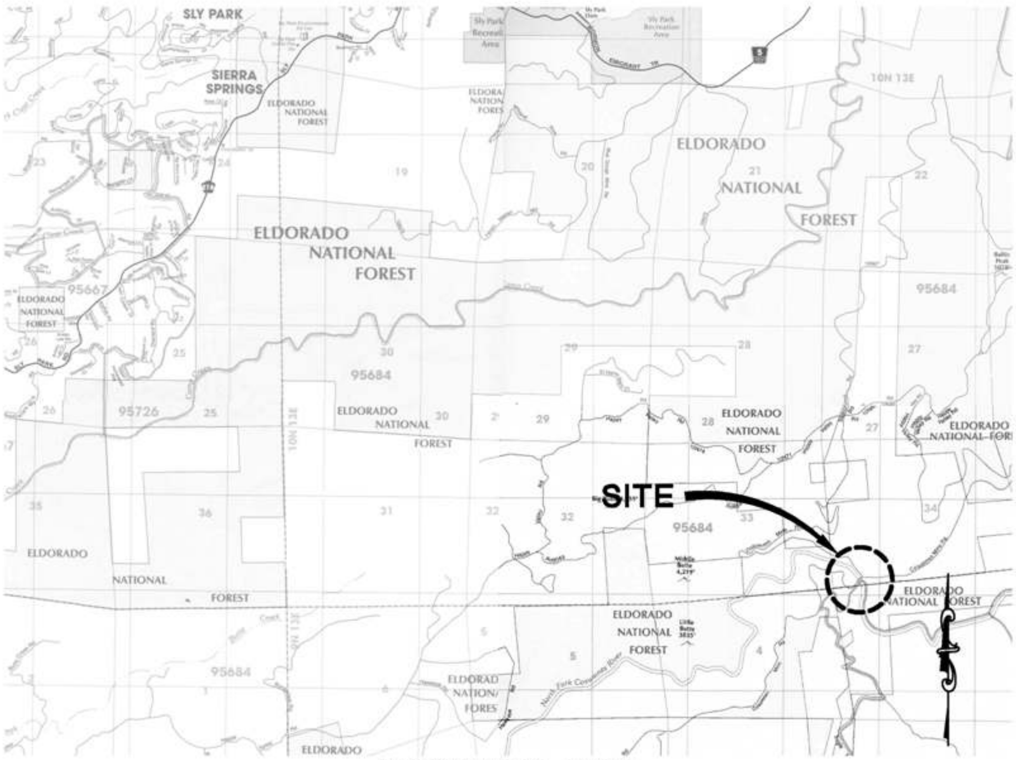


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cosumnes Mine Road at North Fork Cosumnes River - Bridge Maintenance Project

CIP Project Summary

Project No: 77133 **Type: Bridge** **Supervisor District(s) 5**



LOCATION MAP
COSUMNES MINE RD AT NORTH FORK COSUMNES RIVER
BRIDGE NO. 25C0102
NOT TO SCALE

Project Description:

Project includes maintenance work on bridge deck, joints and paint.

Original Budget: $267,500 Expenditures thru 6/30/2013: $11,904 Project Initiation Date: 05/08/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cosumnes Mine Road at North Fork Cosumnes River - Bridge Maintenance Project

Financing Plan & Tentative Schedule

Project No: 77133 **Type: Bridge** **Supervisor District(s) 5**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$40	$86	$0	$0	$0	$0	$0	$0	$126
Road Fund/Discretionary	$5	$11	$0	$0	$0	$0	$0	$0	$17
Total	$45	$98	$0	$0	$0	$0	$0	$0	$143

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$6	$0	$0	$0	$0	$0	$0	$0	$6
Design - Staff	$29	$0	$0	$0	$0	$0	$0	$0	$29
Construction Mgmt - Staff	$10	$63	$0	$0	$0	$0	$0	$0	$73
Direct Construction Costs	$0	$35	$0	$0	$0	$0	$0	$0	$35
Total	$45	$98	$0	$0	$0	$0	$0	$0	$143

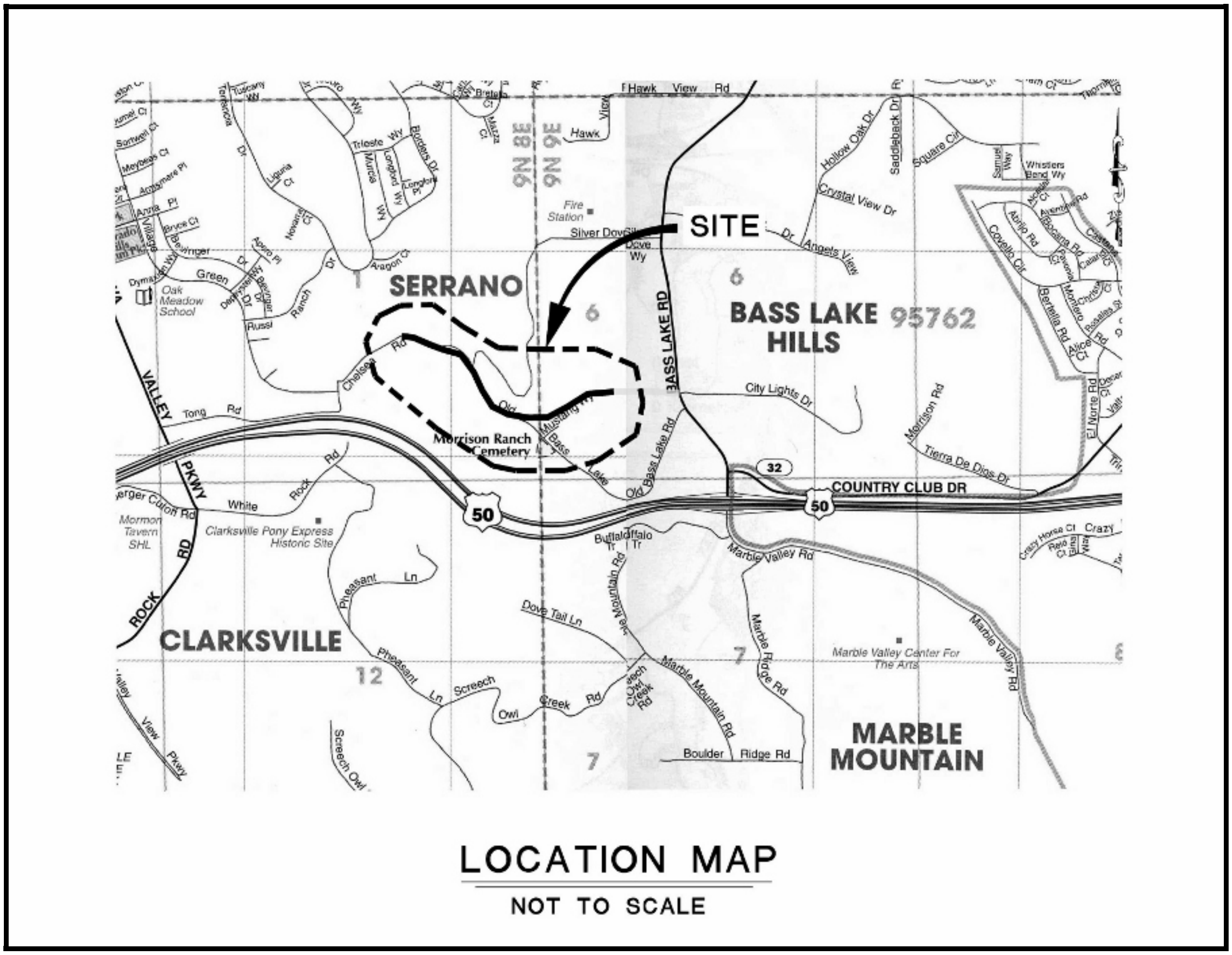
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Country Club Drive Ext. - West Bass Lake Hills SP Boundary to Silver Dove Rd

CIP Project Summary

Project No: GP125 **Type: Roadway** **Supervisor District(s) 1**



Project Description:

Construct new two-lane extension of Country Club Drive from west end of Bass Lake Hills specific plan boundary to Silver Dove Road for future connection to Silva Valley Parkway. Work includes 6-foot paved shoulders. Part of the Bass Lake Hills Specific Plan (PFFP).

Original Budget: $5,400,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Country Club Drive Ext. - West Bass Lake Hills SP Boundary to Silver Dove Rd

Financing Plan & Tentative Schedule

Project No: GP125 | **Type: Roadway** | **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Developer Advance - EDH TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,413*	*$5,413*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,413*	*$5,413*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$289*	*$289*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,120*	*$1,120*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$467*	*$467*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$20*	*$20*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$18*	*$18*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$700*	*$700*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,799*	*$2,799*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,413*	*$5,413*

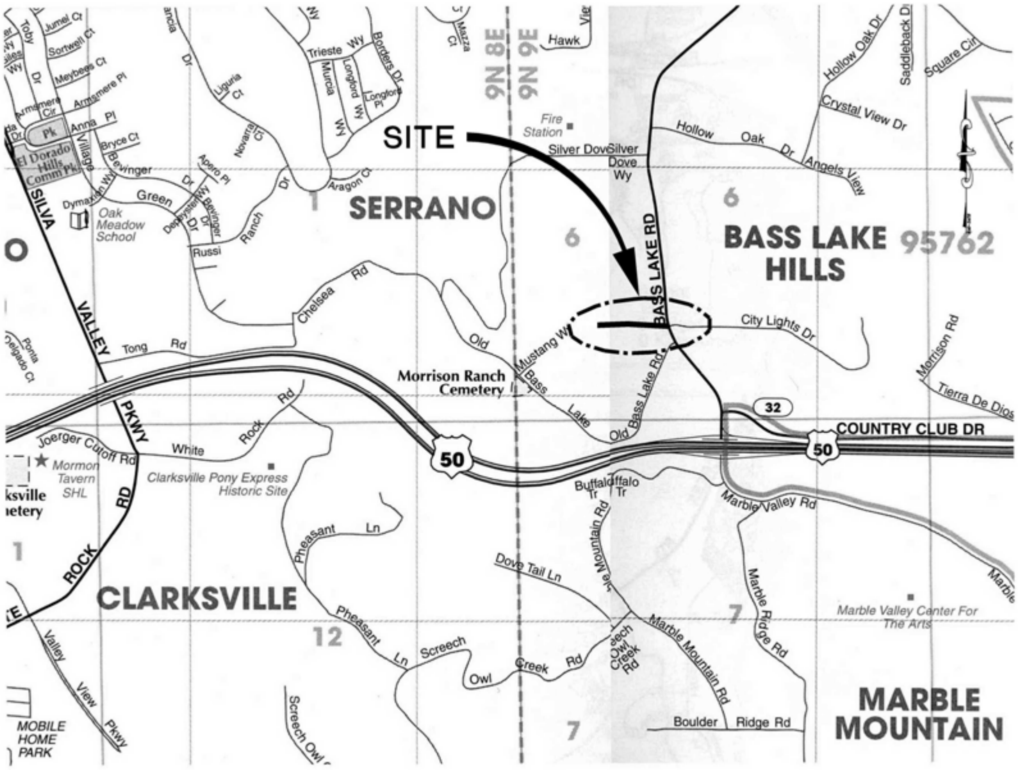
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Country Club Drive Extension - Silver Dove Road to Bass Lake Road

CIP Project Summary

Project No: GP124 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Construct new two-lane extension of Country Club Drive from Silver Dove Road to Bass Lake Road, with 6-foot paved shoulders, and new intersection at Bass Lake Road. Located within the Bass Lake Hills Specific Plan Area.

Original Budget: $1,107,500 Expenditures thru 6/30/2013: $0 Project Initiation Date: 09/12/05

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Country Club Drive Extension - Silver Dove Road to Bass Lake Road

Financing Plan & Tentative Schedule

Project No: GP124 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Developer Advance - EDH TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$1,111*	*$1,121*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$1,111*	*$1,121*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$16*	*$26*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$134*	*$134*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$17*	*$17*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$72*	*$72*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$95*	*$95*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$777*	*$777*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$1,111*	*$1,121*

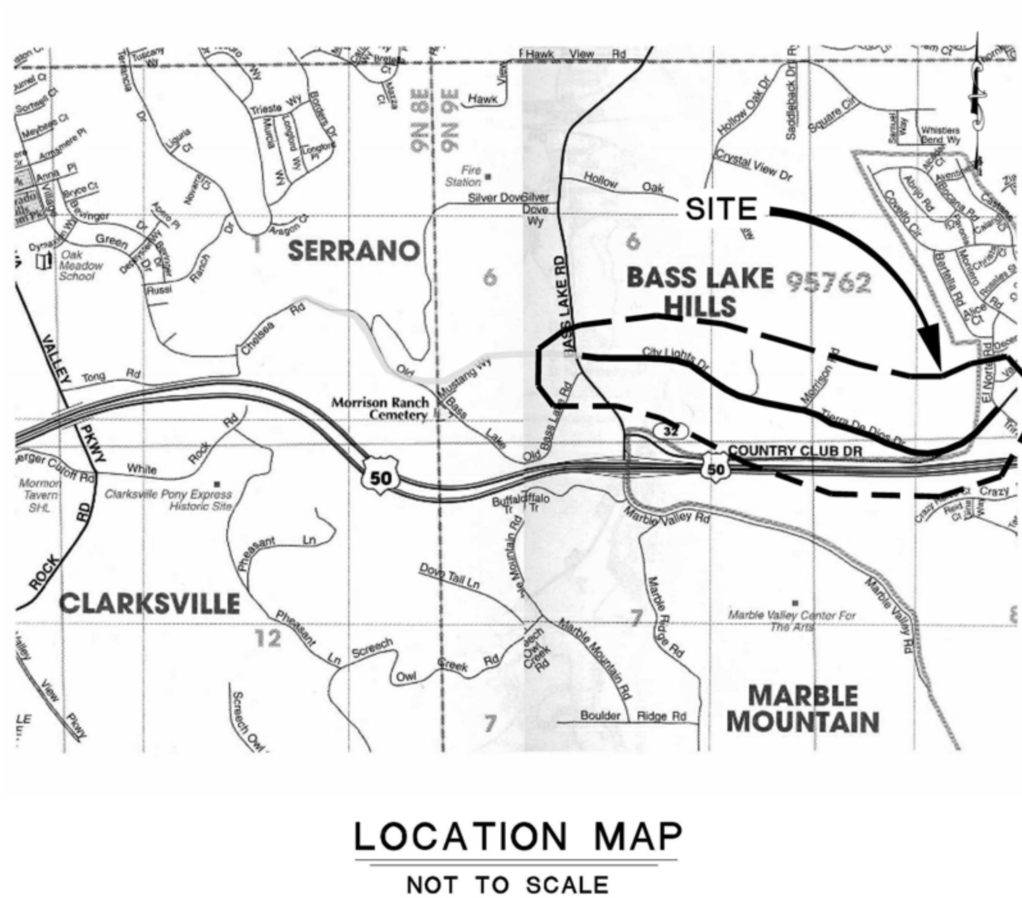
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Country Club Drive Realignment - Bass Lake Road to east Bass Lake Hills Specific Plan Boundary

CIP Project Summary

Project No: GP126 | **Type: Roadway** | **Supervisor District(s) 1**



Project Description:

Realign Country Club Drive from Bass Lake Road to east end of Bass Lake Hills specific plan boundary. Work includes constructing a two-lane road with 6-foot paved shoulders. Part of the Bass Lake Hills Specific Plan (PFFP).

Original Budget: $4,800,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Country Club Drive Realignment - Bass Lake Road to east Bass Lake Hills Specific Plan Boundary

Financing Plan & Tentative Schedule

Project No: GP126 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Developer Advance TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,043*	*$5,043*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,043*	*$5,043*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$36*	*$36*
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$175*	*$175*
Design - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$490*	*$490*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$376*	*$376*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$36*	*$36*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$31*	*$31*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$82*	*$82*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$366*	*$366*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,451*	*$3,451*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,043*	*$5,043*

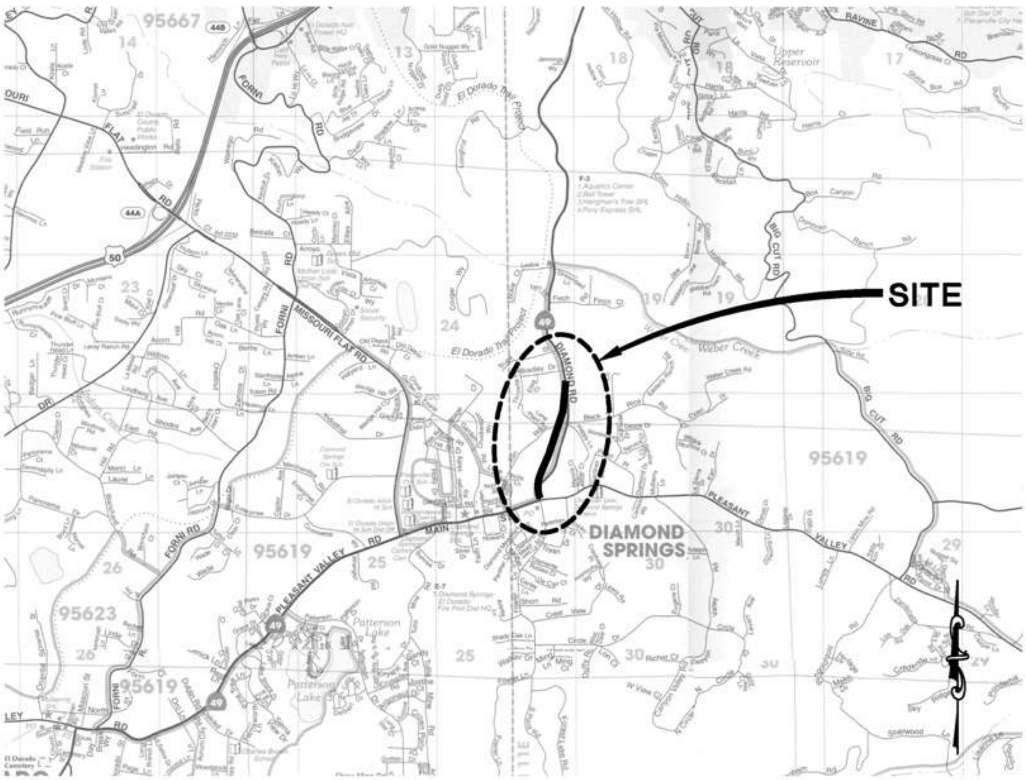
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	**FY 24/25-33/34**	
Planning / Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Diamond Springs Parkway - Phase 1A - SR-49 Realignment

CIP Project Summary

Project No: 72375 **Type: Roadway** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Project realigns SR-49/Diamond Road from Pleasant Valley Road to north of Lime Kiln. Project realigns SR-49/Diamond Road to the west to create frontage road for residences along the east. SR-49/Diamond Road will be improved with two 12-foot lanes and 8-foot shoulders. Project includes signal modifications at Pleasant Valley Road/SR-49 intersection and potential underground utility district.

Original Budget: $5,800,000 Expenditures thru 6/30/2013: $463,463 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Diamond Springs Parkway - Phase 1A - SR-49 Realignment

Financing Plan & Tentative Schedule

Project No: 72375 **Type: Roadway** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$182	$364	$0	$0	$0	$0	$0	$0	$546
Local Funds - Tribe	$0	$0	$2,836	$0	$0	$0	$0	$0	$2,836
Master Circulation & Funding Plan Financing	$643	$87	$0	$0	$0	$0	$0	$0	$729
Road Fund/Discretionary	($1)	$0	$0	$0	$0	$0	$0	$0	($1)
Traffic Impact Mitigation Fee (West Slope)	$0	$905	$2,749	$0	$0	$0	$0	$0	$3,654
Utility Agencies	$0	$0	$2,065	$0	$0	$0	$0	$0	$2,065
Total	$823	$1,355	$7,650	$0	$0	$0	$0	$0	$9,828

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$163	$0	$0	$0	$0	$0	$0	$0	$163
Design - Consultant	$17	$55	$20	$0	$0	$0	$0	$0	$92
Design - Staff	$560	$175	$40	$0	$0	$0	$0	$0	$775
Right of Way - Acquisition	$0	$870	$0	$0	$0	$0	$0	$0	$870
Right of Way - Consultant	$10	$95	$0	$0	$0	$0	$0	$0	$105
Right of Way - Staff	$74	$160	$20	$0	$0	$0	$0	$0	$254
Construction Mgmt - Consultant	$0	$0	$20	$0	$0	$0	$0	$0	$20
Construction Mgmt - Staff	$0	$0	$985	$0	$0	$0	$0	$0	$985
Direct Construction Costs	$0	$0	$6,565	$0	$0	$0	$0	$0	$6,565
Total	$823	$1,355	$7,650	$0	$0	$0	$0	$0	$9,828

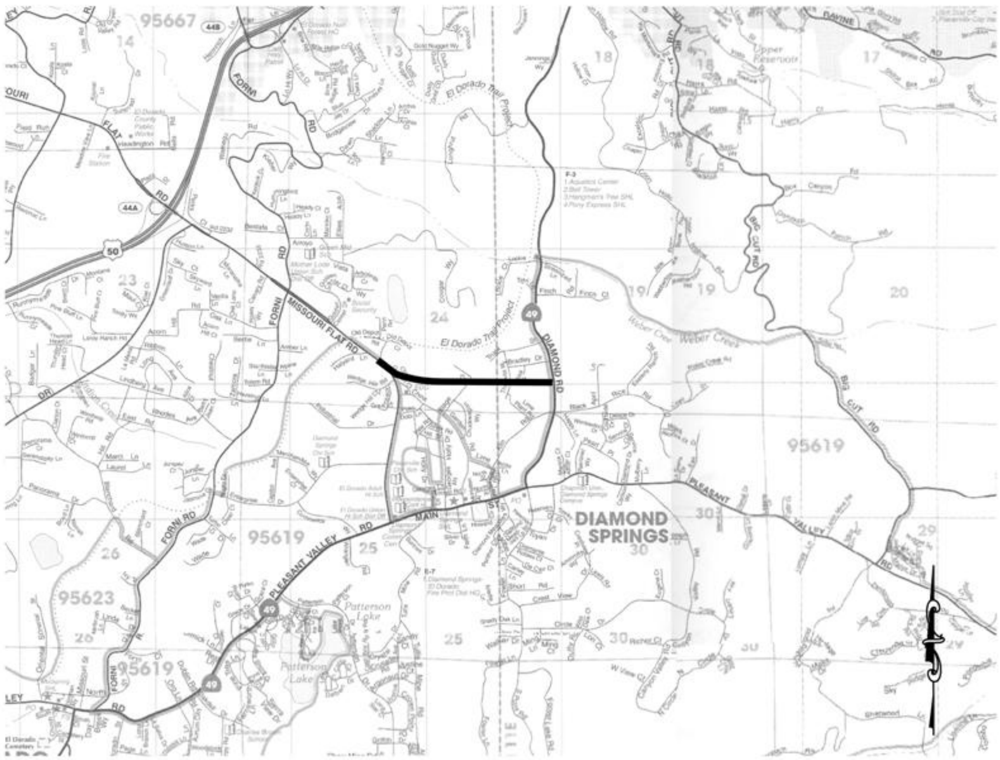
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Diamond Springs Parkway - Phase 1B

CIP Project Summary

Project No: 72334 **Type: Roadway** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Project provides a new four-lane arterial roadway with concrete curb, gutter and sidewalk from Missouri Flat Road east of Golden Center Drive to a new T-intersection with SR-49 south of Bradley Drive. The project also includes widening and improvements to SR-49/Diamond Road from the new roadway intersection to Pleasant Valley Road and signalization of multiple intersections. This project also includes a sidewalk on the east side of SR-49. Formerly Missouri Flat Road - Pleasant Valley Road Connector Phase 1. This project now split into 72375 and 72334. Project 72368, Diamond Springs Parkway Phase 2, has been incorporated into this project.

Original Budget: $29,405,781 Expenditures thru 6/30/2013: $2,440,595 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Diamond Springs Parkway - Phase 1B

Financing Plan & Tentative Schedule

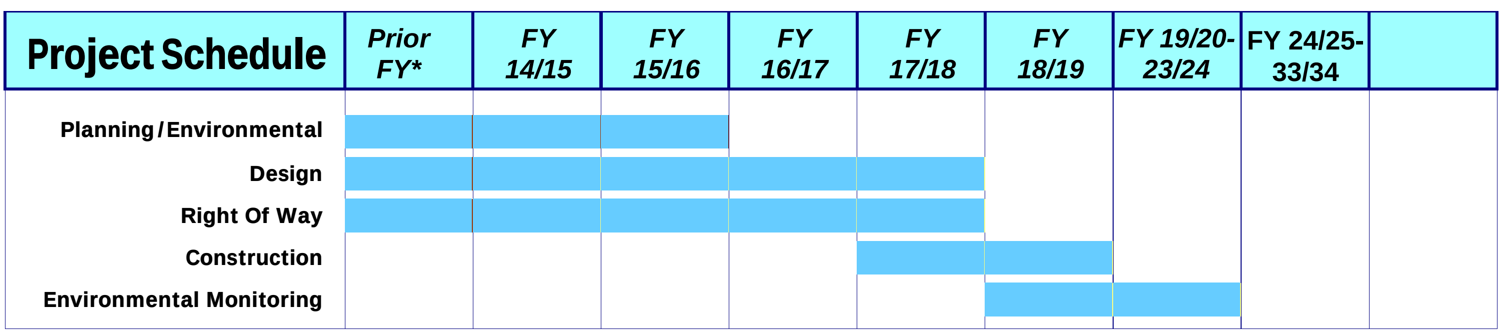
Project No: 72334 | **Type: Roadway** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	*$1,745*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,745*
Congestion Mitigation and Air Quality Program	*$0*	*$100*	*$200*	*$200*	*$108*	*$0*	*$0*	*$0*	*$608*
Local Funds - Tribe	*$0*	*$0*	*$1,775*	*$3,745*	*$8,638*	*$5,520*	*$0*	*$0*	*$19,678*
Master Circulation & Funding Plan Financing	*$941*	*$390*	*$1,000*	*$1,000*	*$2,318*	*$1,000*	*$20*	*$0*	*$6,669*
Utility Agencies	*$0*	*$0*	*$0*	*$0*	*$3,832*	*$0*	*$0*	*$0*	*$3,832*
Total	*$2,686*	*$490*	*$2,975*	*$4,945*	*$14,897*	*$6,520*	*$20*	*$0*	*$32,532*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$740*	*$200*	*$100*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,040*
Planning/Env - Staff	*$853*	*$100*	*$70*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,023*
Design - Consultant	*$632*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$632*
Design - Staff	*$405*	*$150*	*$230*	*$200*	*$100*	*$0*	*$0*	*$0*	*$1,085*
Right of Way - Acquisition	*$0*	*$0*	*$2,250*	*$4,500*	*$2,250*	*$0*	*$0*	*$0*	*$9,000*
Right of Way - Consultant	*$4*	*$0*	*$150*	*$70*	*$50*	*$0*	*$0*	*$0*	*$274*
Right of Way - Staff	*$51*	*$40*	*$175*	*$175*	*$75*	*$0*	*$0*	*$0*	*$516*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$1,100*	*$1,100*	*$0*	*$0*	*$2,200*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$11,322*	*$5,400*	*$0*	*$0*	*$16,722*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$15*	*$10*	*$0*	*$25*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$5*	*$10*	*$0*	*$15*
Total	*$2,686*	*$490*	*$2,975*	*$4,945*	*$14,897*	*$6,520*	*$20*	*$0*	*$32,532*

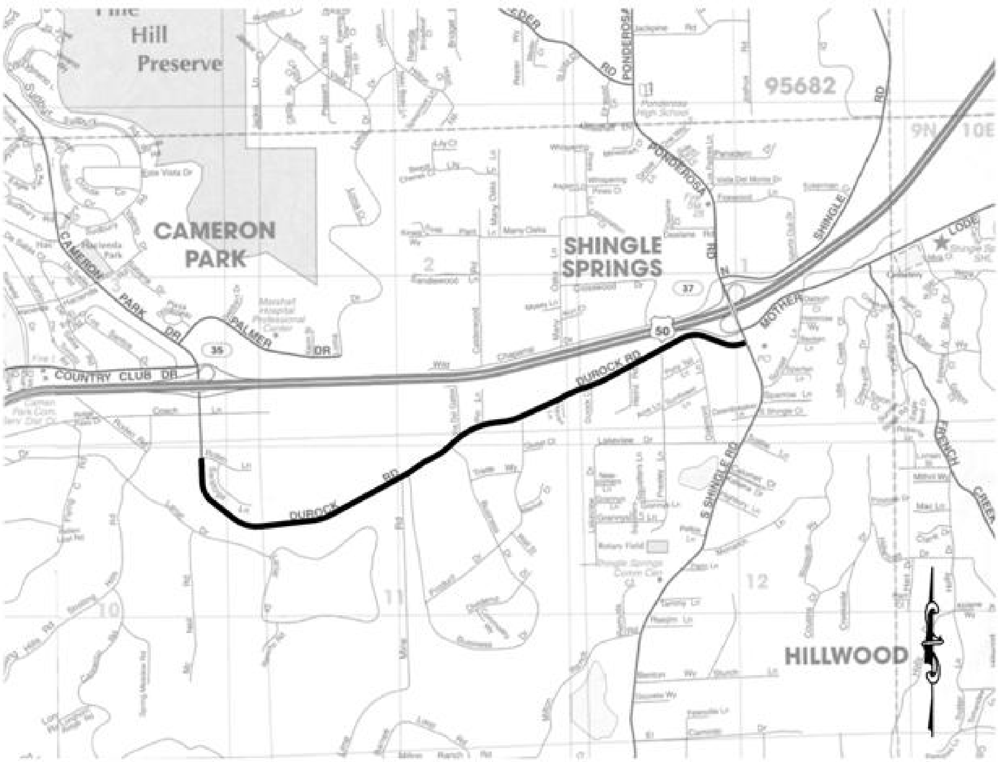


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Durock Road Widening - Robin Lane to South Shingle Road

CIP Project Summary

Project No: GP171 **Type: Roadway** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Widening of Durock Road from Robin Lane to South Shingle Road. Work includes widening the roadway to accommodate a two-way left turn lane.

Original Budget: $1,600,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Durock Road Widening - Robin Lane to South Shingle Road

Financing Plan & Tentative Schedule

Project No: GP171 **Type: Roadway** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$7,210	$7,210
Total	$0	$0	$0	$0	$0	$0	$0	$7,210	$7,210

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$300	$300
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$640	$640
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$1,680	$1,680
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$25	$25
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$65	$65
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$750	$750
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$3,750	$3,750
Total	$0	$0	$0	$0	$0	$0	$0	$7,210	$7,210

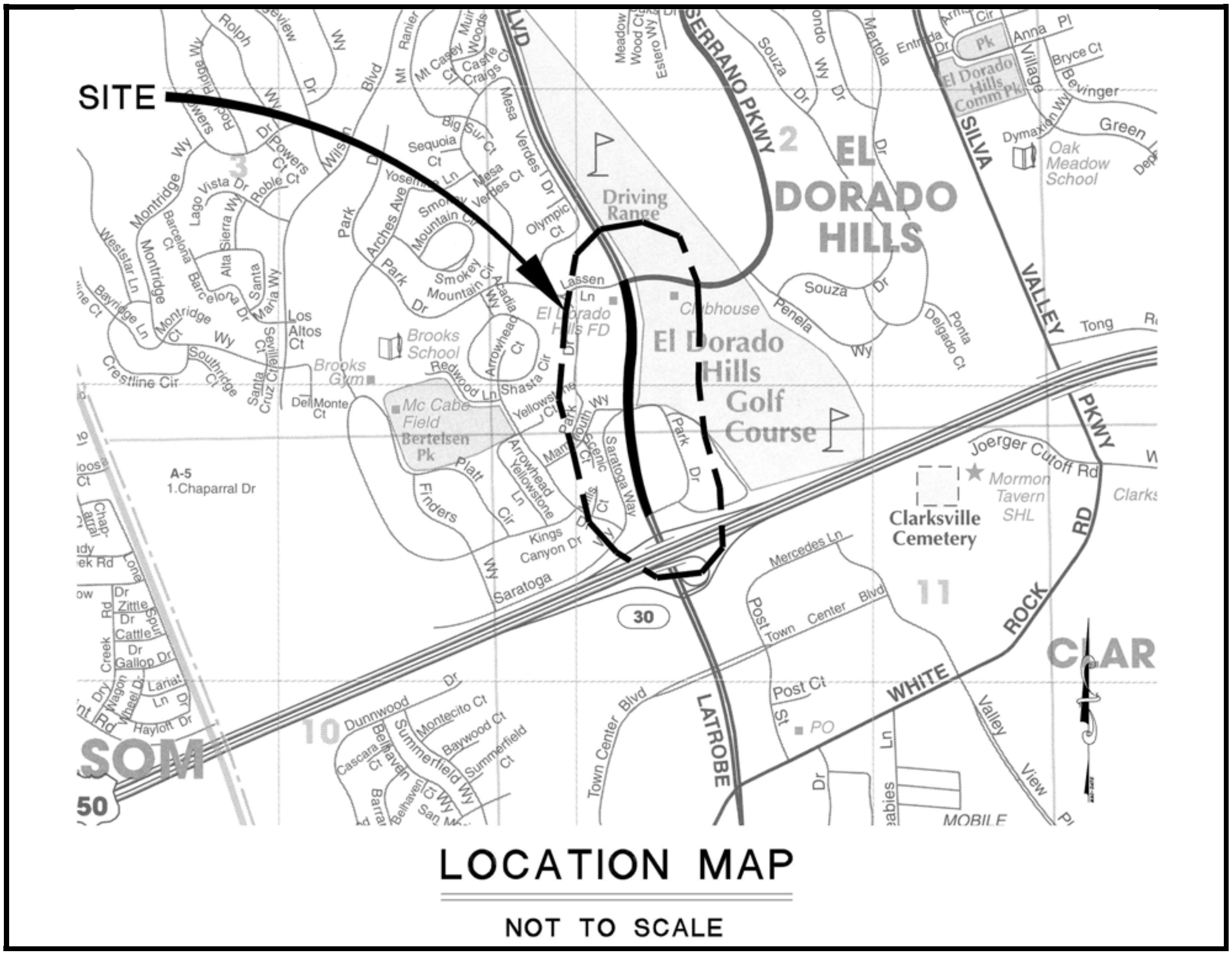
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Hills Boulevard Widening - Lassen Lane to Park Drive

CIP Project Summary

Project No: GP183 **Type: Roadway** **Supervisor District(s) 1**



Project Description:

Widen El Dorado Hills Boulevard southbound from Lassen Lane to Park Drive. Project involves adding a third southbound lane and curb, gutter and sidewalk.

Original Budget: $1,500,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Hills Boulevard Widening - Lassen Lane to Park Drive

Financing Plan & Tentative Schedule

Project No: GP183 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$178*	*$918*	*$1,096*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$178*	*$918*	*$1,096*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$37*	*$0*	*$37*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$141*	*$0*	*$141*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$70*	*$70*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*	*$6*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*	*$6*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$76*	*$76*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$760*	*$760*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$178*	*$918*	*$1,096*

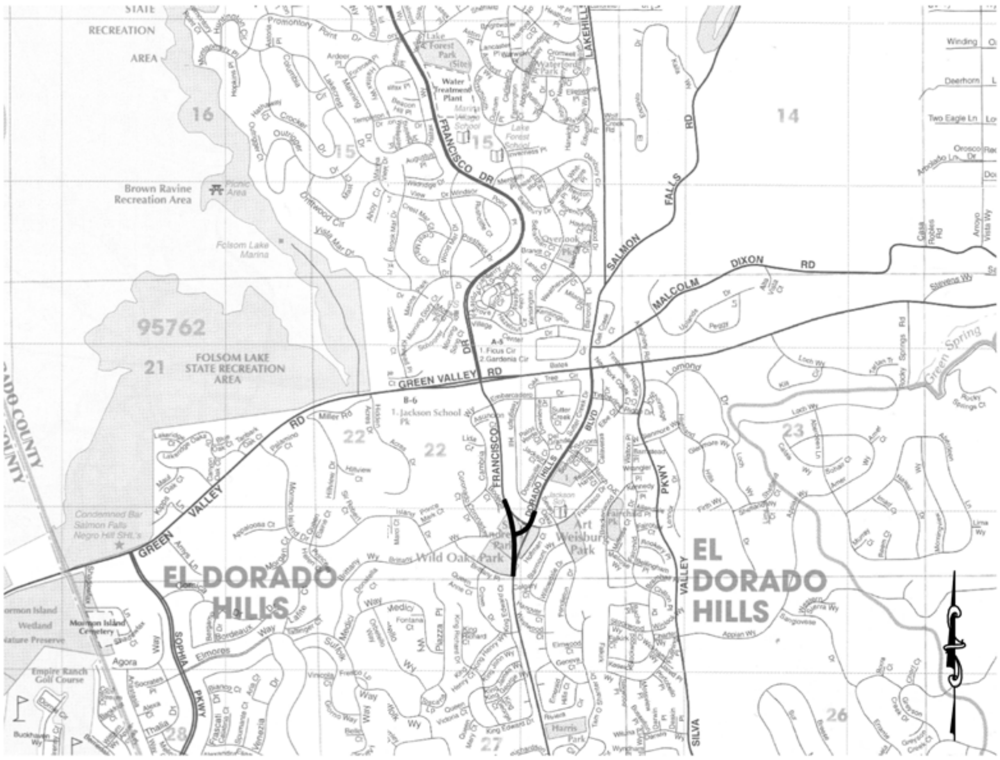
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning / Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Hills Boulevard/Francisco Drive Intersection Alignment

CIP Project Summary

Project No: 72332 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Realignment of existing El Dorado Hills Boulevard/Francisco Drive and Brittany Way intersection and approach roadways resulting in a new 4-way intersection with extensions and signal installation. The northern portion of El Dorado Hills Boulevard (at this intersection) will become the new minor traffic way, and the current Francisco Drive between El Dorado Hills Boulevard and Green Valley Road will become the new major traffic way. This project also anticipates sidewalk along Francisco Drive from El Dorado Hills Blvd to Jackson School for which an in-lieu fee payment was made by the developer of the homes across from Hoffman Court.

Original Budget: $6,900,000 Expenditures thru 6/30/2013: $1,006,238 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Hills Boulevard/Francisco Drive Intersection Alignment

Financing Plan & Tentative Schedule

Project No: 72332 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$1,006*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$8,445*	*$9,452*
Total	*$1,006*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$8,445*	*$9,452*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$44*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$44*
Planning/Env - Staff	*$249*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$249*
Design - Consultant	*$1*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$40*	*$41*
Design - Staff	*$394*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$389*	*$783*
Right of Way - Acquisition	*$301*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$301*
Right of Way - Consultant	*$1*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$15*	*$16*
Right of Way - Staff	*$10*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$26*	*$36*
Construction Mgmt - Staff	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,200*	*$1,206*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6,776*	*$6,776*
Total	*$1,006*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$8,445*	*$9,452*

Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

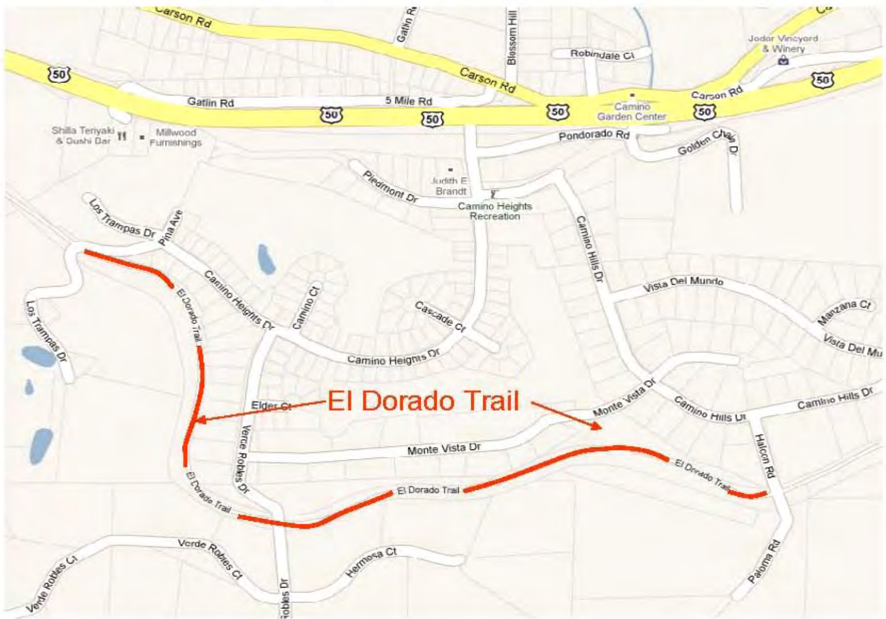
*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Trail - Los Trampas to Halcon

CIP Project Summary

Project No: 97012 | **Type: Parks & Trails** | **Supervisor District(s) 3**

Project No. 97012
El Dorado Trail – Los Trampas Drive to Halcon Road



LOCATION MAP
NOT TO SCALE

Project Description:

Design and construct an extension of the El Dorado Trail from its current terminus at Los Trampas Drive (a private road) to Halcon Road. This project is dependent on receiving grant funding.

Original Budget: $520,431 | Expenditures thru 6/30/2013: $12,888 | Project Initiation Date: 04/27/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Trail - Los Trampas to Halcon

Financing Plan & Tentative Schedule

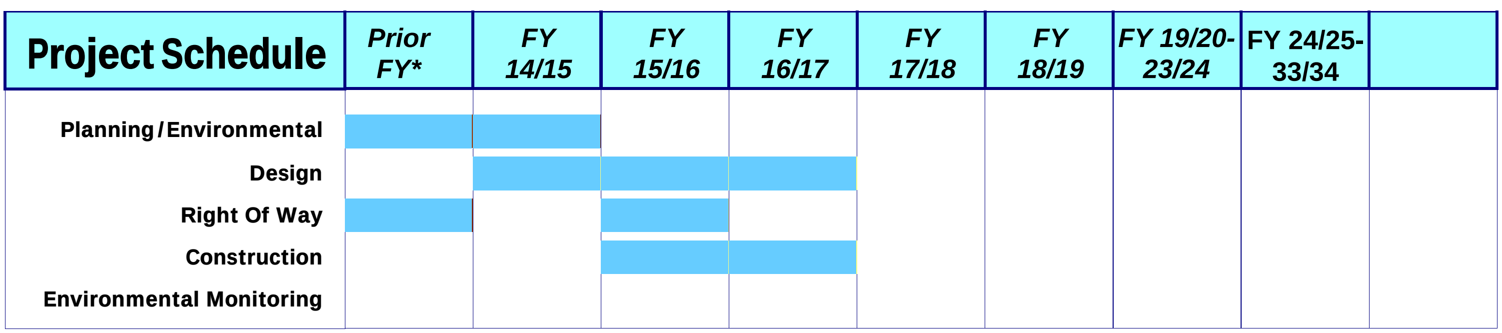
Project No: 97012 **Type: Parks & Trails** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
ACO-Accumulative Capital Outlay-Parks	*$13*	*$0*	*$0*	*$78*	*$0*	*$0*	*$0*	*$0*	*$91*
Congestion Mitigation and Air Quality Program	*$0*	*$55*	*$31*	*$315*	*$0*	*$0*	*$0*	*$0*	*$401*
Pollock Pines/Camino Park (ZOB)	*$33*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$33*
State Parks-Recreational Trails Program (RTP)	*$12*	*$55*	*$146*	*$245*	*$0*	*$0*	*$0*	*$0*	*$458*
Trails Now Grant	*$0*	*$0*	*$0*	*$5*	*$0*	*$0*	*$0*	*$0*	*$5*
Transportation Development Act (TDA)	*$11*	*$4*	*$21*	*$27*	*$0*	*$0*	*$0*	*$0*	*$62*
Total	*$69*	*$114*	*$198*	*$669*	*$0*	*$0*	*$0*	*$0*	*$1,050*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	*$12*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$27*
Planning/Env - Staff	*$55*	*$7*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$62*
Design - Consultant	*$0*	*$12*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$12*
Design - Staff	*$0*	*$79*	*$60*	*$76*	*$0*	*$0*	*$0*	*$0*	*$215*
Right of Way - Staff	*$3*	*$0*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$7*
Construction Mgmt - Consultant	*$0*	*$0*	*$6*	*$19*	*$0*	*$0*	*$0*	*$0*	*$25*
Construction Mgmt - Staff	*$0*	*$0*	*$27*	*$80*	*$0*	*$0*	*$0*	*$0*	*$107*
Direct Construction Costs	*$0*	*$0*	*$100*	*$495*	*$0*	*$0*	*$0*	*$0*	*$595*
Total	*$69*	*$114*	*$198*	*$669*	*$0*	*$0*	*$0*	*$0*	*$1,050*

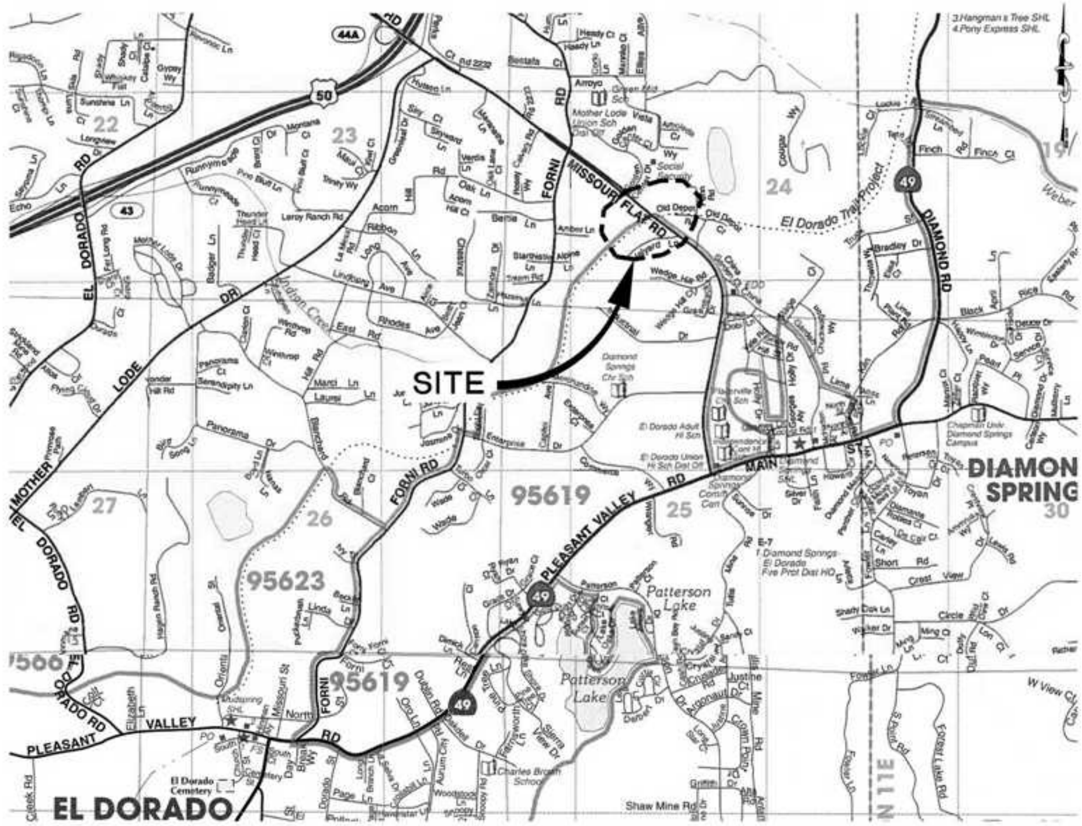


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Trail - Missouri Flat Road Bike/Pedestrain Overcrossing

CIP Project Summary

Project No: 97015 **Type:** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Construct a bicycle/pedestrian overcrossing as part of the El Dorado Trail at Missouri Flat Road

Original Budget: $2,705,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: TBD

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Trail - Missouri Flat Road Bike/Pedestrain Overcrossing

Financing Plan & Tentative Schedule

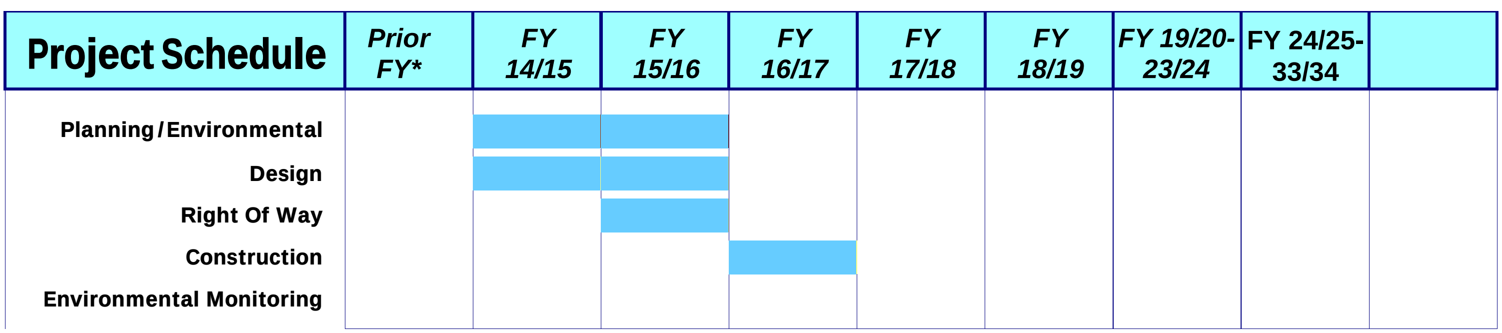
Project No: 97015 **Type:** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Anticipated Grant	*$0*	*$0*	*$0*	*$2,197*	*$0*	*$0*	*$0*	*$0*	*$2,197*
Congestion Mitigation and Air Quality Program	*$0*	*$193*	*$315*	*$0*	*$0*	*$0*	*$0*	*$0*	*$508*
Total	*$0*	*$193*	*$315*	*$2,197*	*$0*	*$0*	*$0*	*$0*	*$2,705*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$0*	*$70*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$100*
Planning/Env - Staff	*$0*	*$13*	*$10*	*$0*	*$0*	*$0*	*$0*	*$0*	*$23*
Design - Consultant	*$0*	*$90*	*$210*	*$0*	*$0*	*$0*	*$0*	*$0*	*$300*
Design - Staff	*$0*	*$20*	*$55*	*$0*	*$0*	*$0*	*$0*	*$0*	*$75*
Right of Way - Staff	*$0*	*$0*	*$10*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$190*	*$0*	*$0*	*$0*	*$0*	*$190*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$82*	*$0*	*$0*	*$0*	*$0*	*$82*
Direct Construction Costs	*$0*	*$0*	*$0*	*$1,925*	*$0*	*$0*	*$0*	*$0*	*$1,925*
Total	*$0*	*$193*	*$315*	*$2,197*	*$0*	*$0*	*$0*	*$0*	*$2,705*

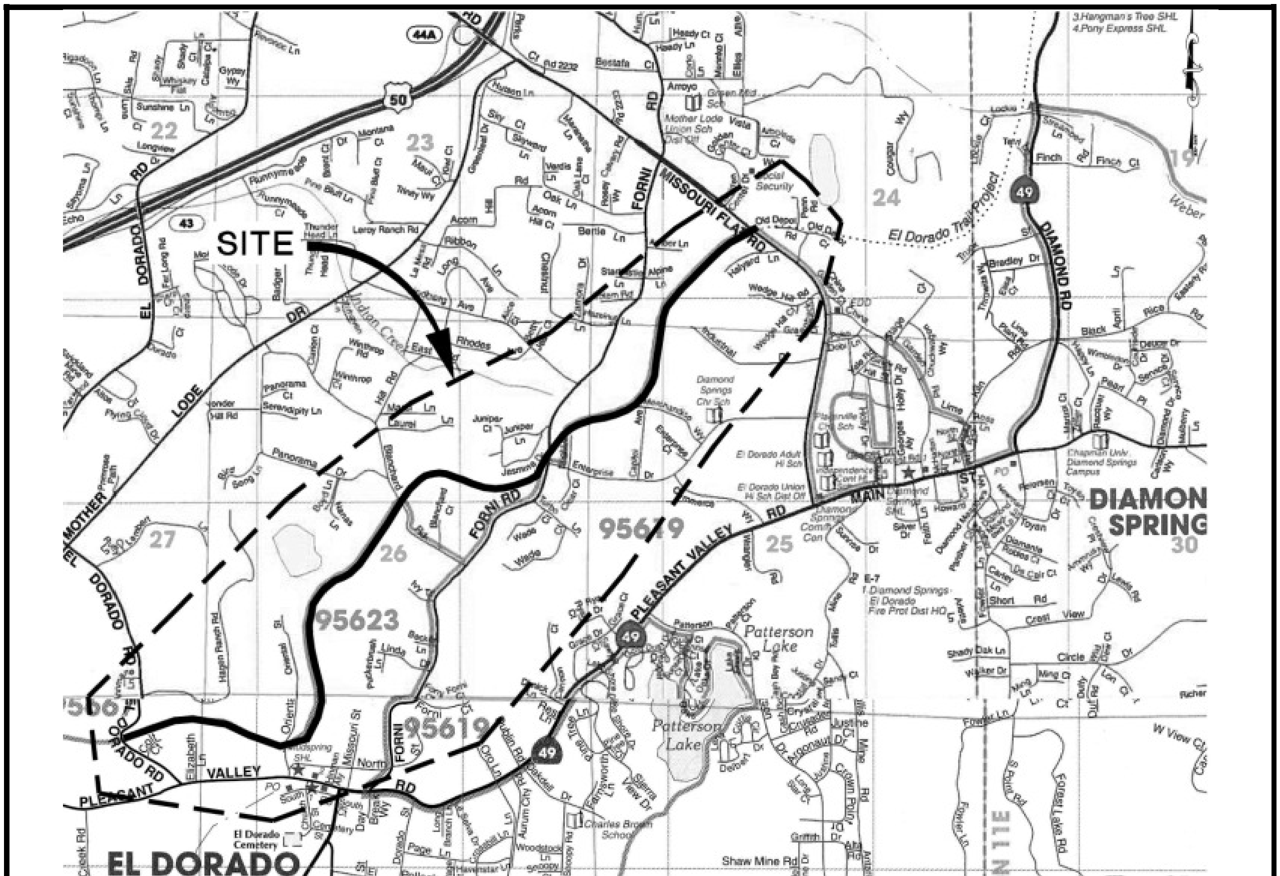


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Trail - Missouri Flat Road to El Dorado Road

CIP Project Summary

Project No: 97014 **Type:** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Extend the existing El Dorado Trail from its current terminus at Missouri Flat Road in Placerville, west to El Dorado Road. A small parking facility may be included at Oriental Road in the town of El Dorado.

Original Budget: $4,165,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 03/18/14

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

El Dorado Trail - Missouri Flat Road to El Dorado Road

Financing Plan & Tentative Schedule

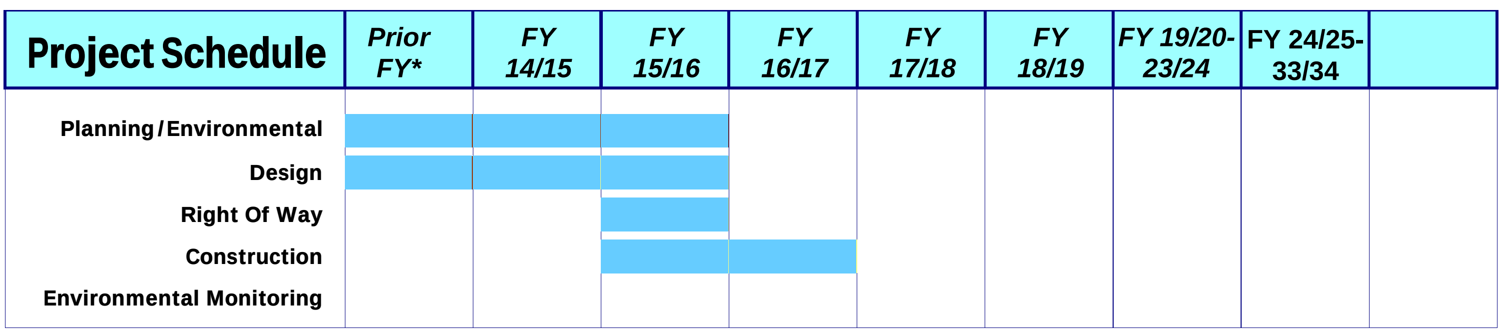
Project No: 97014 **Type:** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Anticipated Grant	$0	$0	$55	$3,350	$0	$0	$0	$0	$3,405
Congestion Mitigation and Air Quality Program	$50	$180	$480	$50	$0	$0	$0	$0	$760
Total	$50	$180	$535	$3,400	$0	$0	$0	$0	$4,165

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$50	$15	$0	$0	$0	$0	$0	$65
Planning/Env - Staff	$20	$10	$5	$0	$0	$0	$0	$0	$35
Design - Staff	$30	$120	$450	$0	$0	$0	$0	$0	$600
Right of Way - Staff	$0	$0	$15	$0	$0	$0	$0	$0	$15
Construction Mgmt - Staff	$0	$0	$20	$400	$0	$0	$0	$0	$420
Direct Construction Costs	$0	$0	$30	$3,000	$0	$0	$0	$0	$3,030
Total	$50	$180	$535	$3,400	$0	$0	$0	$0	$4,165

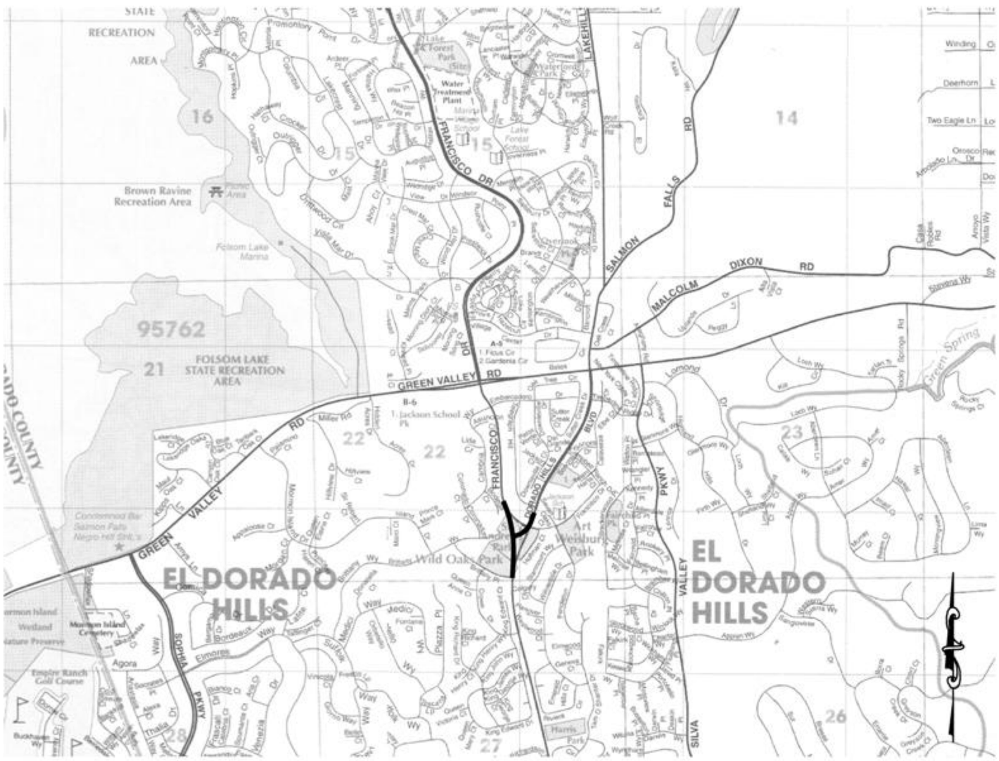


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Francisco Drive Right-Turn Pocket

CIP Project Summary

Project No: 71358 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Francisco Drive Right-Turn Pocket.

Original Budget: $240,000 Expenditures thru 6/30/2013: $41,314 Project Initiation Date: 06/04/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Francisco Drive Right-Turn Pocket

Financing Plan & Tentative Schedule

Project No: 71358 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Congestion Mitigation and Air Quality Program	$0	$508	$0	$0	$0	$0	$0	$0	$508
RSTP Exchange Funds-Caltrans	$2	$0	$0	$0	$0	$0	$0	$0	$2
RSTP Federal Funds-Urban	$95	$307	$0	$0	$0	$0	$0	$0	$402
Transportation Enhancement Activities	$30	$70	$0	$0	$0	$0	$0	$0	$100
Total	$128	$885	$0	$0	$0	$0	$0	$0	$1,013

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$4	$0	$0	$0	$0	$0	$0	$0	$4
Planning/Env - Staff	$38	$0	$0	$0	$0	$0	$0	$0	$38
Design - Staff	$86	$20	$0	$0	$0	$0	$0	$0	$106
Construction Mgmt - Staff	$0	$100	$0	$0	$0	$0	$0	$0	$100
Direct Construction Costs	$0	$765	$0	$0	$0	$0	$0	$0	$765
Total	$127	$885	$0	$0	$0	$0	$0	$0	$1,012

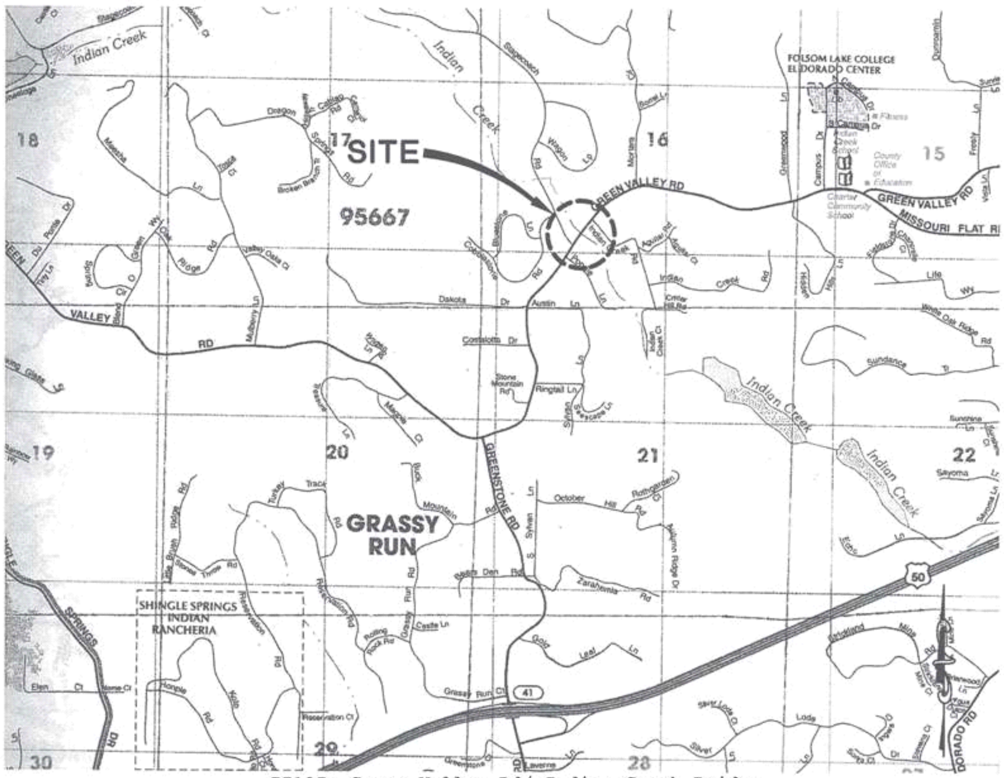
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Indian Creek - Bridge Replacement

CIP Project Summary

Project No: 77127 | **Type: Bridge** | **Supervisor District(s) 3, 4**



77127: Green Valley Rd/ Indian Creek Bridge

LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge at the Indian Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $4,500,000 Expenditures thru 6/30/2013: $54,408 Project Initiation Date: 05/08/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Indian Creek - Bridge Replacement

Financing Plan & Tentative Schedule

Project No: 77127 **Type: Bridge** **Supervisor District(s) 3, 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$191*	*$186*	*$168*	*$117*	*$0*	*$0*	*$3,238*	*$0*	*$3,901*
RSTP Exchange Funds-Caltrans	*$26*	*$20*	*$22*	*$109*	*$0*	*$0*	*$419*	*$0*	*$596*
RSTP Exchange Funds-Rural-EDCTC	*$0*	*$4*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4*
Total	*$217*	*$211*	*$190*	*$226*	*$0*	*$0*	*$3,657*	*$0*	*$4,500*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$84*	*$94*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$178*
Planning/Env - Staff	*$131*	*$7*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$138*
Design - Consultant	*$0*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$30*
Design - Staff	*$1*	*$80*	*$125*	*$130*	*$0*	*$0*	*$65*	*$0*	*$401*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$20*	*$0*	*$0*	*$30*	*$0*	*$50*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$28*	*$0*	*$0*	*$0*	*$0*	*$28*
Right of Way - Staff	*$0*	*$0*	*$65*	*$48*	*$0*	*$0*	*$25*	*$0*	*$138*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$25*	*$0*	*$25*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$485*	*$0*	*$485*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,997*	*$0*	*$2,997*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$25*	*$0*	*$25*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5*	*$0*	*$5*
Total	*$216*	*$211*	*$190*	*$226*	*$0*	*$0*	*$3,657*	*$0*	*$4,500*

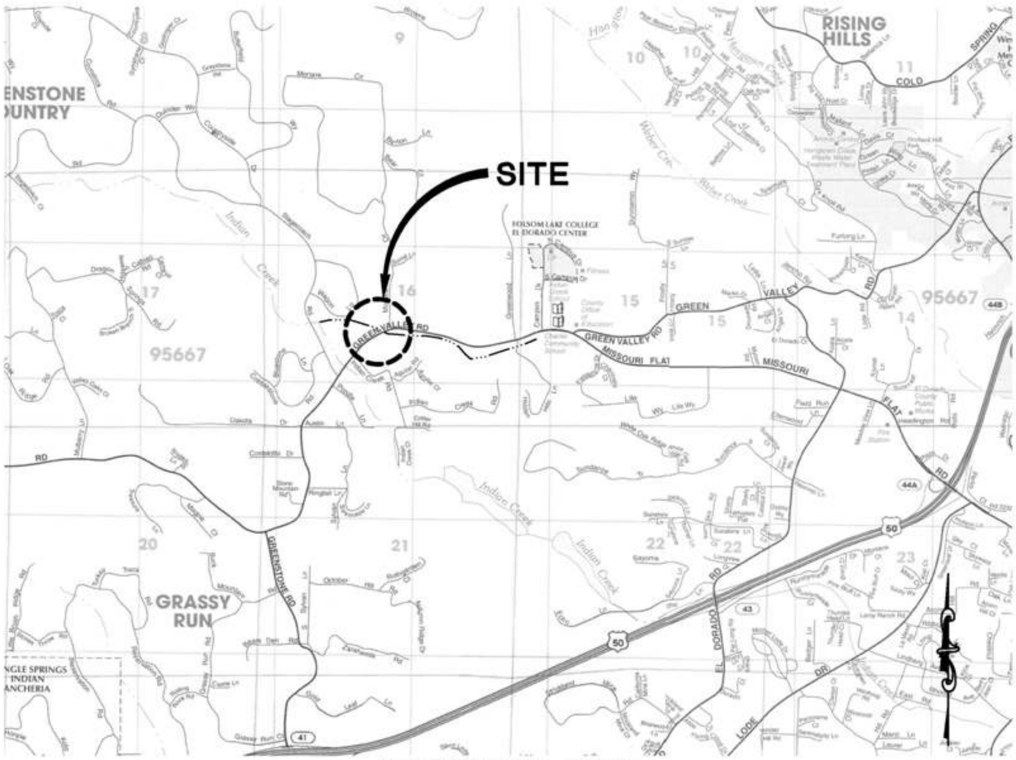
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Mound Springs Creek - Bridge Replacement

CIP Project Summary

Project No: 77136 | **Type: Bridge** | **Supervisor District(s) 4**



LOCATION MAP
GREEN VALLEY RD AT MOUND SPRINGS CREEK
BRIDGE NO. 25C0041
NOT TO SCALE

Project Description:

Project includes replacement of the bridge at the Mound Springs Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $4,504,000 | Expenditures thru 6/30/2013: $48,628 | Project Initiation Date: 05/08/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Mound Springs Creek - Bridge Replacement

Financing Plan & Tentative Schedule

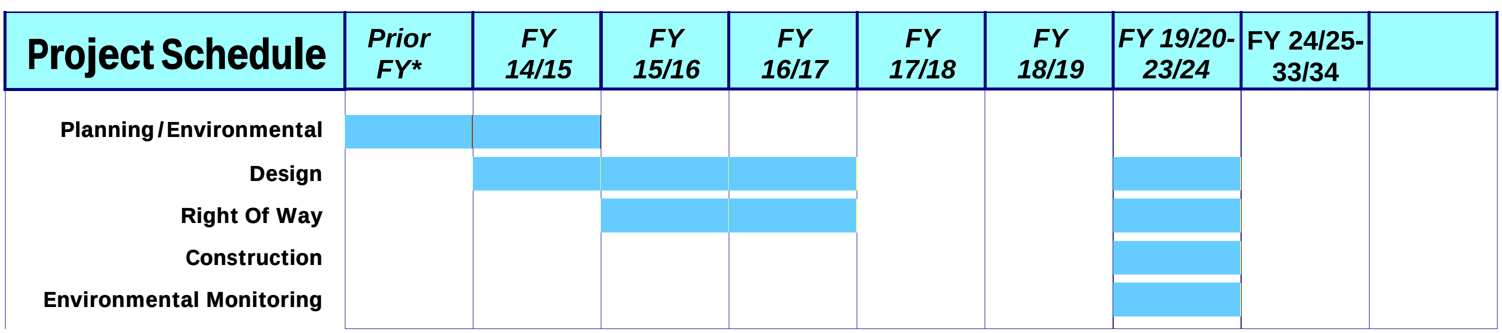
Project No: 77136 **Type: Bridge** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$186	$226	$159	$91	$0	$0	$3,207	$0	$3,870
RSTP Exchange Funds-Caltrans	$24	$29	$21	$145	$0	$0	$415	$0	$634
Total	$211	$255	$180	$236	$0	$0	$3,622	$0	$4,504

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$84	$94	$0	$0	$0	$0	$0	$0	$178
Planning/Env - Staff	$126	$11	$0	$0	$0	$0	$0	$0	$137
Design - Consultant	$0	$75	$25	$0	$0	$0	$0	$0	$100
Design - Staff	$0	$75	$80	$80	$0	$0	$40	$0	$275
Right of Way - Acquisition	$0	$0	$0	$30	$0	$0	$20	$0	$50
Right of Way - Consultant	$0	$0	$50	$78	$0	$0	$0	$0	$128
Right of Way - Staff	$0	$0	$25	$48	$0	$0	$25	$0	$98
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$485	$0	$485
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$2,997	$0	$2,997
Env Monitoring - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Env Monitoring - Staff	$0	$0	$0	$0	$0	$0	$5	$0	$5
Total	$211	$255	$180	$236	$0	$0	$3,622	$0	$4,504

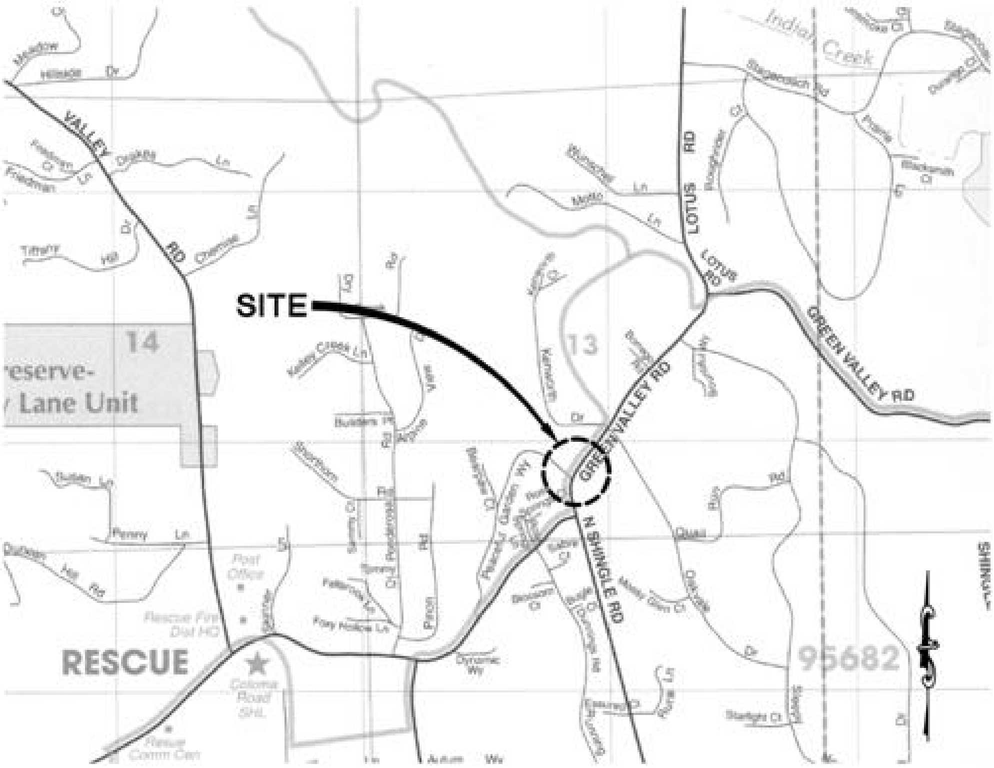


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Tennessee Creek - Bridge Replacement

CIP Project Summary

Project No: 77109 | **Type: Bridge** | **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge at Tennessee Creek, widening and realignment of Green Valley Road including a two-way left turn lane, and a traffic signal at Green Valley Road/North Shingle Road.

Original Budget: $7,606,705   Expenditures thru 6/30/2013: $5,858,326   Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Tennessee Creek - Bridge Replacement

Financing Plan & Tentative Schedule

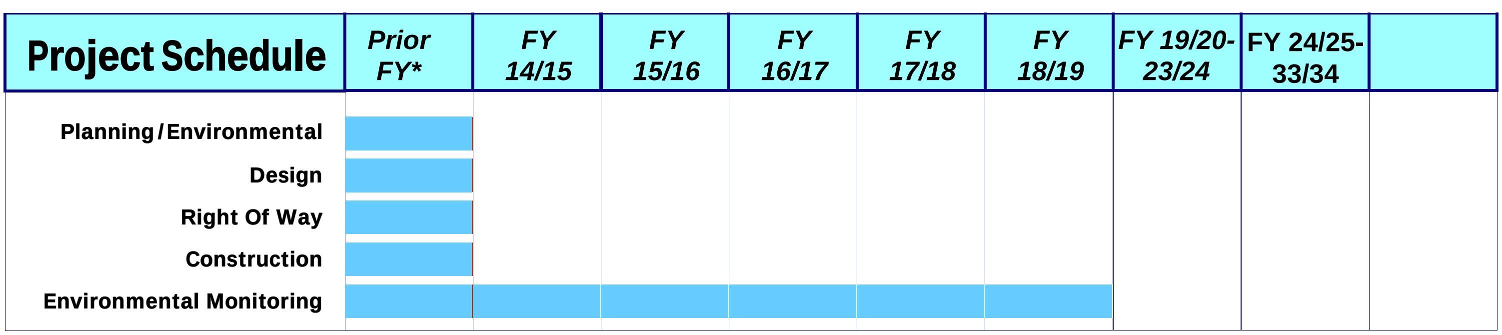
Project No: 77109 | **Type: Bridge** | **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	$461	$0	$0	$0	$0	$0	$0	$0	$461
Highway Bridge Program	$3,343	$14	$6	$6	$6	$10	$0	$0	$3,386
Highway Safety Improvement Program	$937	$0	$0	$0	$0	$0	$0	$0	$937
Road Fund/Discretionary	($2)	$0	$0	$0	$0	$0	$0	$0	($2)
RSTP Exchange Funds-Caltrans	$610	$2	$1	$1	$1	$1	$0	$0	$615
RSTP Exchange Funds-Rural-EDCTC	$117	$0	$0	$0	$0	$0	$0	$0	$117
Traffic Impact Mitigation Fee (West Slope)	$44	$0	$0	$0	$0	$0	$0	$0	$44
Transportation Community & System Preservation (TCSP)	$154	$0	$0	$0	$0	$0	$0	$0	$154
Utility Agency - EID	$212	$0	$0	$0	$0	$0	$0	$0	$212
Total	$5,877	$16	$7	$7	$7	$11	$0	$0	$5,925

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$87	$0	$0	$0	$0	$0	$0	$0	$87
Planning/Env - Staff	$249	$0	$0	$0	$0	$0	$0	$0	$249
Design - Consultant	$432	$0	$0	$0	$0	$0	$0	$0	$432
Design - Staff	$733	$0	$0	$0	$0	$0	$0	$0	$733
Right of Way - Acquisition	$85	$0	$0	$0	$0	$0	$0	$0	$85
Right of Way - Consultant	$56	$0	$0	$0	$0	$0	$0	$0	$56
Right of Way - Staff	$197	$0	$0	$0	$0	$0	$0	$0	$197
Construction Mgmt - Consultant	$37	$0	$0	$0	$0	$0	$0	$0	$37
Construction Mgmt - Staff	$1,003	$0	$0	$0	$0	$0	$0	$0	$1,003
Direct Construction Costs	$2,998	$0	$0	$0	$0	$0	$0	$0	$2,998
Env Monitoring - Consultant	$0	$10	$5	$5	$5	$5	$0	$0	$30
Env Monitoring - Staff	$1	$6	$2	$2	$2	$6	$0	$0	$19
Total	$5,877	$16	$7	$7	$7	$11	$0	$0	$5,925

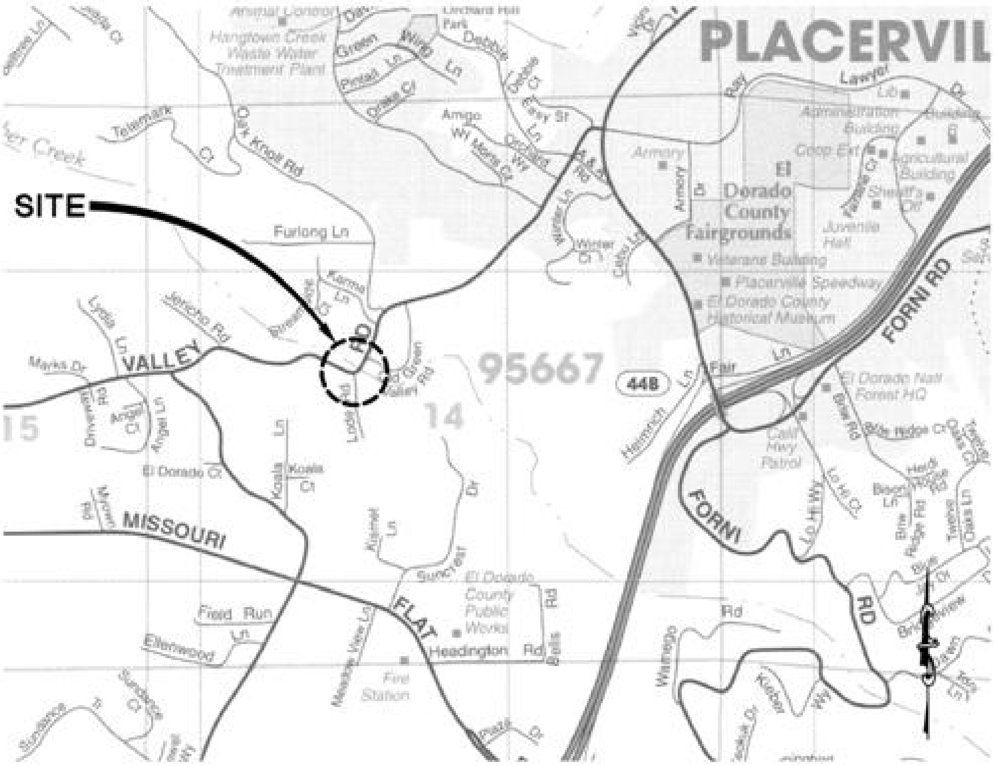


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Weber Creek - Bridge Replacement

CIP Project Summary

Project No: 77114 | **Type: Bridge** | **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge at Weber Creek, widening and realignment of Green Valley Road to the new bridge approaches, and improvements to the drainage along Green Valley Road. A new access road has been added, resulting in a cost reduction for the road approach work.

Original Budget: $10,573,000 Expenditures thru 6/30/2013: $1,585,334 Project Initiation Date: 04/17/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road at Weber Creek - Bridge Replacement

Financing Plan & Tentative Schedule

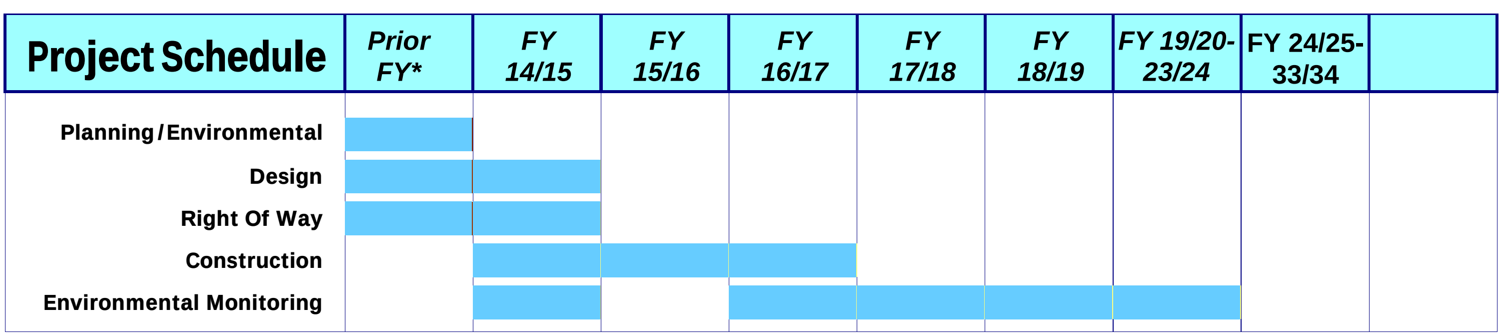
Project No: 77114 | **Type: Bridge** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$22	$0	$0	$0	$0	$0	$0	$0	$22
Highway Bridge Program	$1,646	$1,987	$1,859	$3,495	$22	$13	$22	$0	$9,046
Road Fund/Discretionary	($8)	$0	$0	$0	$0	$0	$0	$0	($8)
RSTP Exchange Funds-Caltrans	$78	$0	$0	$0	$0	$0	$0	$0	$78
RSTP Exchange Funds-Urban-EDCTC	$171	$258	$241	$453	$3	$2	$3	$0	$1,130
Traffic Impact Mitigation Fee (West Slope)	$68	$0	$0	$0	$0	$0	$0	$0	$68
Total	$1,978	$2,245	$2,100	$3,948	$25	$15	$25	$0	$10,336

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$238	$0	$0	$0	$0	$0	$0	$0	$238
Planning/Env - Staff	$533	$0	$0	$0	$0	$0	$0	$0	$533
Design - Consultant	$447	$80	$0	$0	$0	$0	$0	$0	$527
Design - Staff	$286	$40	$0	$0	$0	$0	$0	$0	$326
Right of Way - Acquisition	$233	$5	$0	$0	$0	$0	$0	$0	$238
Right of Way - Consultant	$38	$0	$0	$0	$0	$0	$0	$0	$38
Right of Way - Staff	$203	$5	$0	$0	$0	$0	$0	$0	$208
Construction Mgmt - Consultant	$0	$160	$180	$350	$0	$0	$0	$0	$690
Construction Mgmt - Staff	$0	$105	$120	$230	$0	$0	$0	$0	$455
Direct Construction Costs	$0	$1,600	$1,800	$3,350	$0	$0	$0	$0	$6,750
Env Monitoring - Consultant	$0	$250	$0	$10	$20	$10	$10	$0	$300
Env Monitoring - Staff	$0	$0	$0	$8	$5	$5	$15	$0	$33
Total	$1,978	$2,245	$2,100	$3,948	$25	$15	$25	$0	$10,336



*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Traffic Signal Interconnect

CIP Project Summary

Project No: 73151 **Type: Intersection** **Supervisor District(s) 1**

LOCATION MAP

NOT TO SCALE

Project Description:

Install traffic signal interconnect to coordinate three traffic signals on Green Valley Road at the intersections of Francisco Drive, El Dorado Hills Boulevard, and Silva Valley Parkway.

Original Budget: $270,000 Expenditures thru 6/30/2013: $17,810 Project Initiation Date: 01/30/13

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Traffic Signal Interconnect

Financing Plan & Tentative Schedule

Project No: 73151 **Type: Intersection** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Safety Improvement Program	$60	$182	$0	$0	$0	$0	$0	$0	$242
RSTP Exchange Funds-Caltrans	$7	$37	$0	$0	$0	$0	$0	$0	$45
Total	$67	$220	$0	$0	$0	$0	$0	$0	$287

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$5	$0	$0	$0	$0	$0	$0	$0	$5
Design - Staff	$50	$10	$0	$0	$0	$0	$0	$0	$60
Construction Mgmt - Staff	$2	$27	$0	$0	$0	$0	$0	$0	$29
Direct Construction Costs	$10	$183	$0	$0	$0	$0	$0	$0	$193
Total	$67	$220	$0	$0	$0	$0	$0	$0	$287

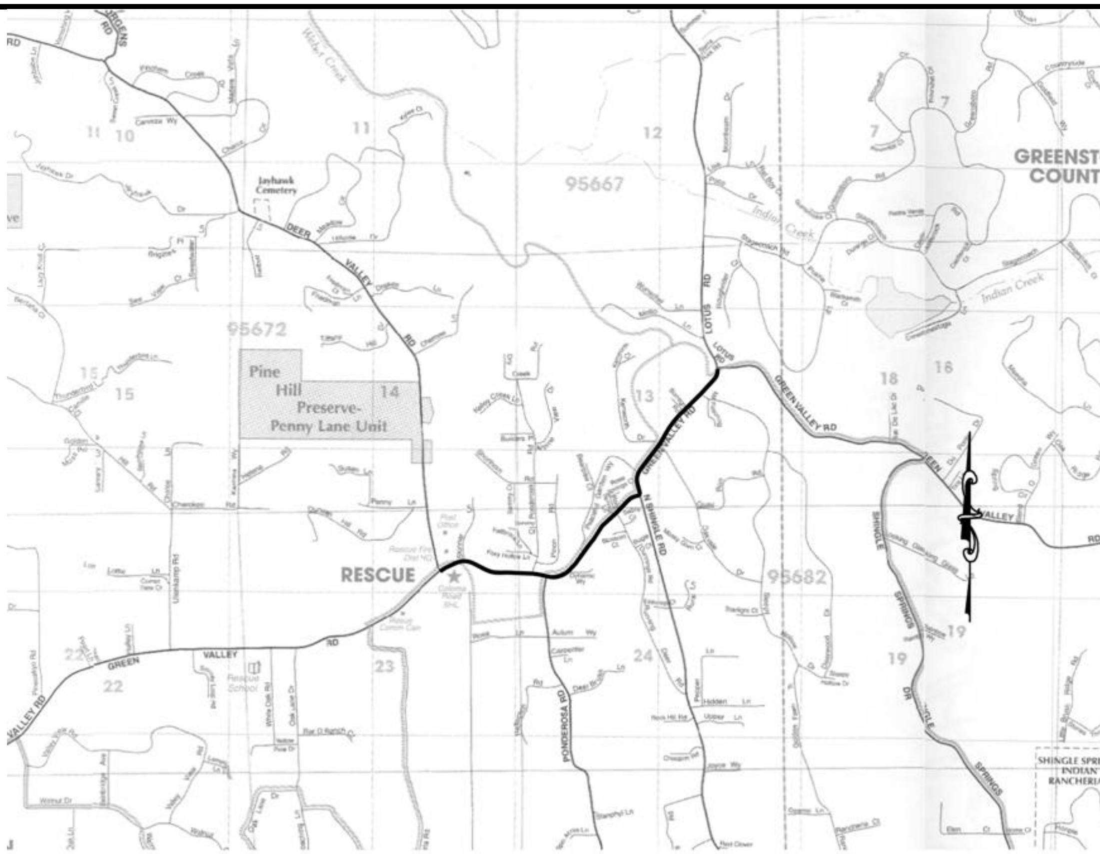
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental	X								
Design	X	X							
Right Of Way									
Construction	X	X							
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Widening - Deer Valley Road East to Lotus Road

CIP Project Summary

Project No: GP179 **Type: Roadway** **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen existing Green Valley Road from Deer Valley Road East to Lotus Road. This project consists of widening existing road to two 12-foot lanes with paved shoulders and adding six left-turn pockets.

Original Budget: $4,300,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Widening - Deer Valley Road East to Lotus Road

Financing Plan & Tentative Schedule

Project No: GP179 **Type: Roadway** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,784*	*$4,784*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,784*	*$4,784*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$160*	*$160*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$620*	*$620*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$350*	*$350*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$25*	*$25*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$55*	*$55*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$340*	*$340*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,234*	*$3,234*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,784*	*$4,784*

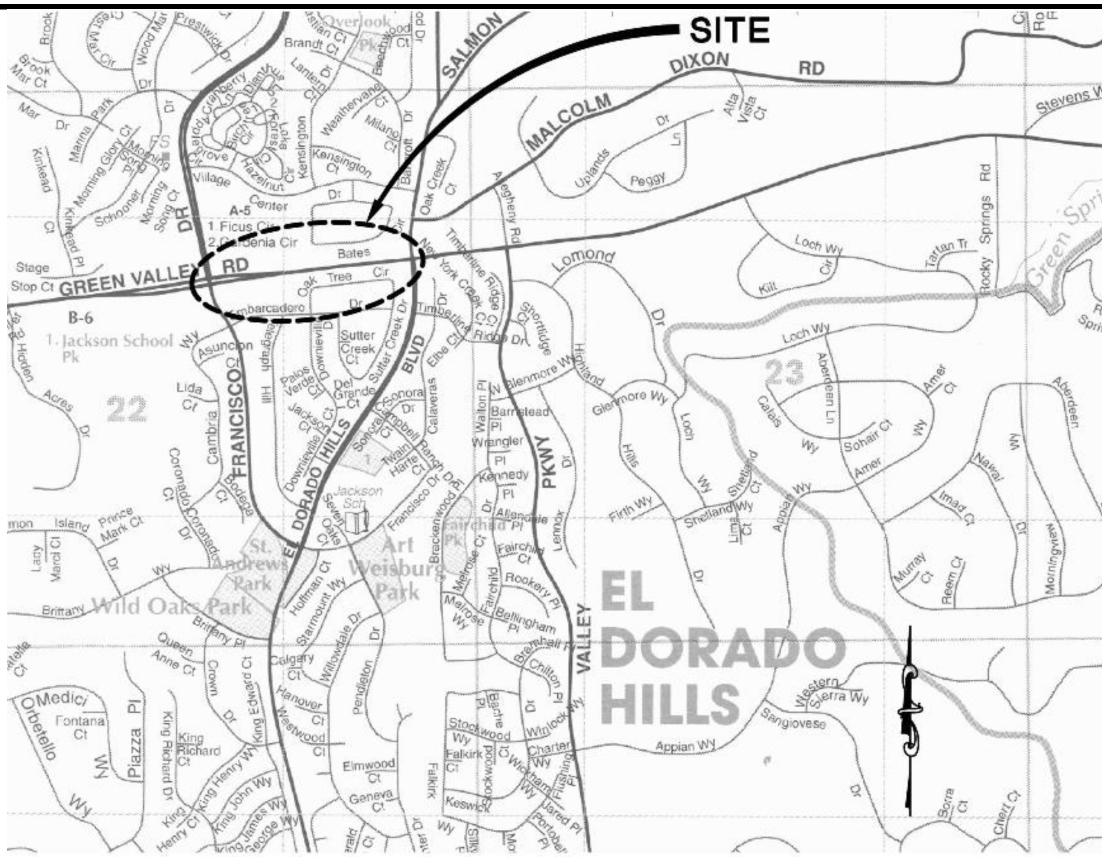
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Widening - Francisco to Salmon Falls Road

CIP Project Summary

Project No: GP178 | **Type: Roadway** | **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen existing Green Valley Road from Francisco Drive to Salmon Falls Road from two to four lanes, undivided; includes curb, gutter and sidewalk.

Original Budget: $2,900,000   Expenditures thru 6/30/2013: $0   Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Widening - Francisco to Salmon Falls Road

Financing Plan & Tentative Schedule

Project No: GP178 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$0	$1,898	$1,898
Total	$0	$0	$0	$0	$0	$0	$0	$1,898	$1,898

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$55	$55
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$210	$210
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$455	$455
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$10	$10
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$8	$8
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$110	$110
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$1,050	$1,050
Total	$0	$0	$0	$0	$0	$0	$0	$1,898	$1,898

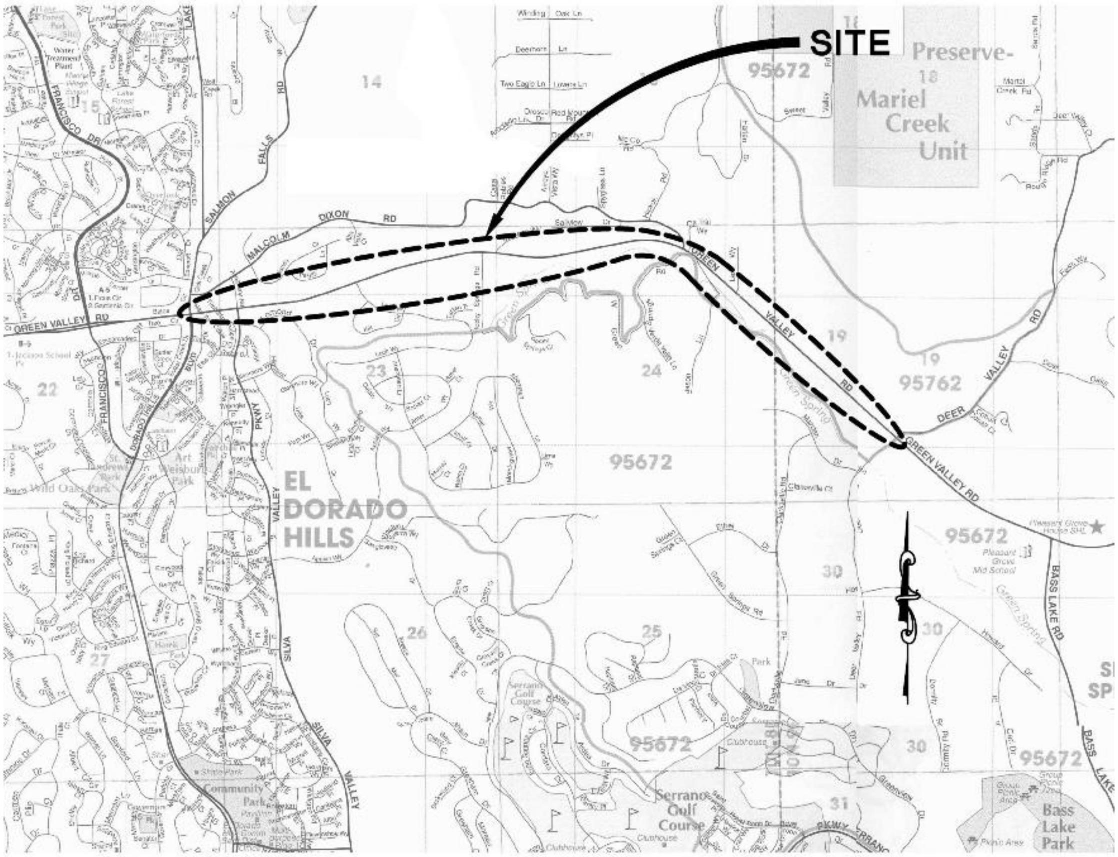
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Widening from Salmon Falls Road to Deer Valley Road

CIP Project Summary

Project No: GP159 **Type: Roadway** **Supervisor District(s) 1, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

This project consists of widening Green Valley Road from 2-lane undivided roadway to 4-lane undivided arterial from Salmon Falls Road to Deer Valley Road.

Original Budget: $14,600,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road Widening from Salmon Falls Road to Deer Valley Road

Financing Plan & Tentative Schedule

Project No: GP159 **Type: Roadway** **Supervisor District(s) 1, 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$1,860	$10,718	$12,578
Total	$0	$0	$0	$0	$0	$0	$1,860	$10,718	$12,578

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$380	$0	$380
Design - Staff	$0	$0	$0	$0	$0	$0	$1,480	$0	$1,480
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$2,030	$2,030
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$40	$40
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$126	$126
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$780	$780
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$7,742	$7,742
Total	$0	$0	$0	$0	$0	$0	$1,860	$10,718	$12,578

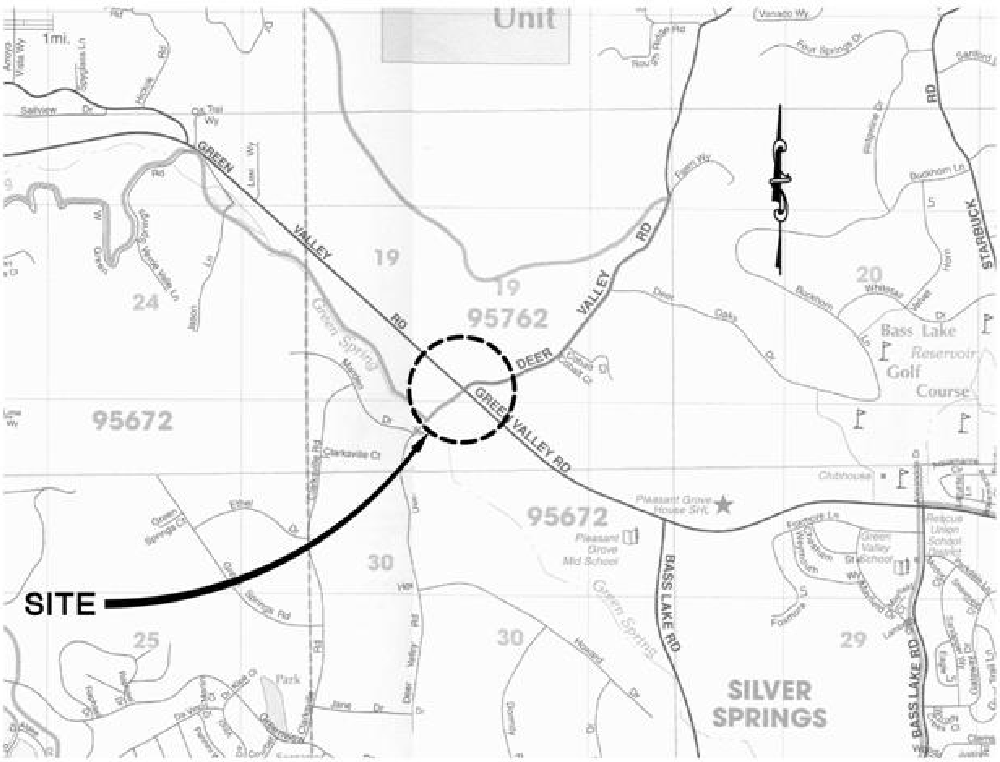
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road/Deer Valley Road West Intersection Improvements

CIP Project Summary

Project No: 76114 **Type: Intersection** **Supervisor District(s) 1, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Construct turn lanes on Green Valley Road at the intersection with Deer Valley Road West.

Original Budget: $1,095,433 Expenditures thru 6/30/2013: $368,016 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Green Valley Road/Deer Valley Road West Intersection Improvements

Financing Plan & Tentative Schedule

Project No: 76114 **Type: Intersection** **Supervisor District(s) 1, 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Developer Advance TIM	*$398*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$398*
Developer Funded	*$350*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$350*
Road Fund/Discretionary	*$133*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$133*
Traffic Impact Mitigation Fee (West Slope)	*$299*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$329*
Total	*$1,180*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,210*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3*
Planning/Env - Staff	*$9*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$9*
Design - Consultant	*$12*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$12*
Design - Staff	*$213*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$213*
Developer Advanced Design	*$113*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$113*
Right of Way - Staff	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$15*
Construction Mgmt - Consultant	*$61*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$61*
Construction Mgmt - Staff	*$54*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$84*
Direct Construction Costs	*$700*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$700*
Total	*$1,179*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,209*

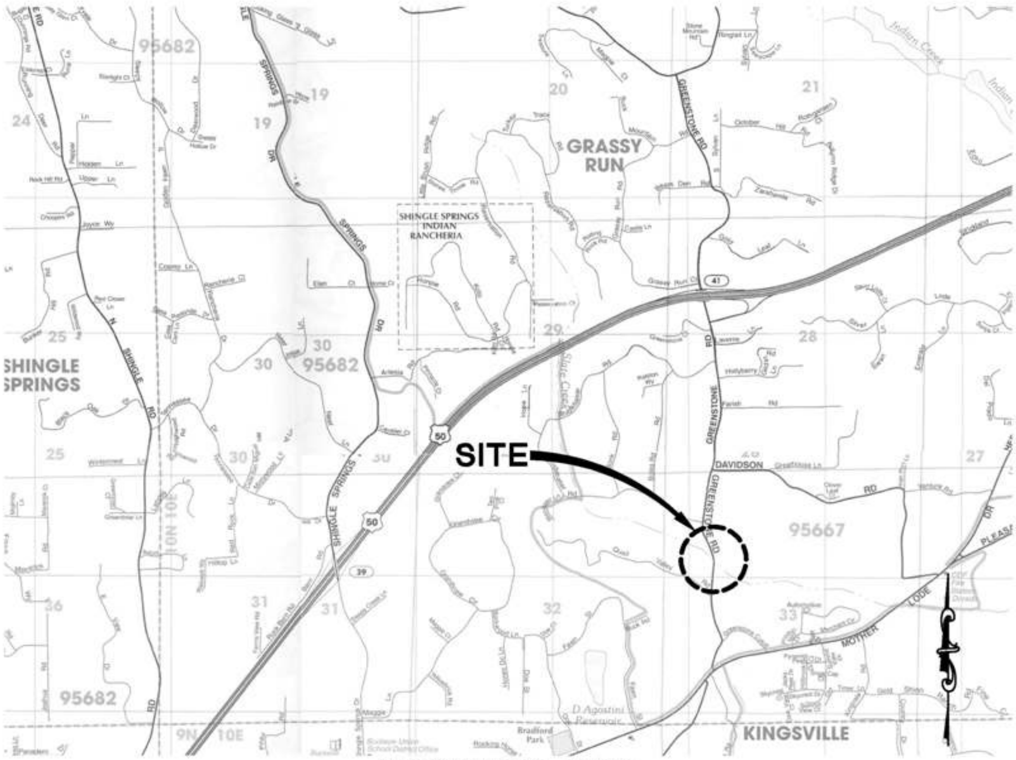
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	**FY 24/25-33/34**	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Greenstone Road at Slate Creek - Bridge Replacement

CIP Project Summary

Project No: 77137 | **Type: Bridge** | **Supervisor District(s) 3, 4**



LOCATION MAP
GREENSTONE RD AT SLATE CREEK
BRIDGE NO. 25C0087
NOT TO SCALE

Project Description:

Project includes replacement or rehabilitation of the bridge at the Slate Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $3,512,875 Expenditures thru 6/30/2013: $4,254 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Greenstone Road at Slate Creek - Bridge Replacement

Financing Plan & Tentative Schedule

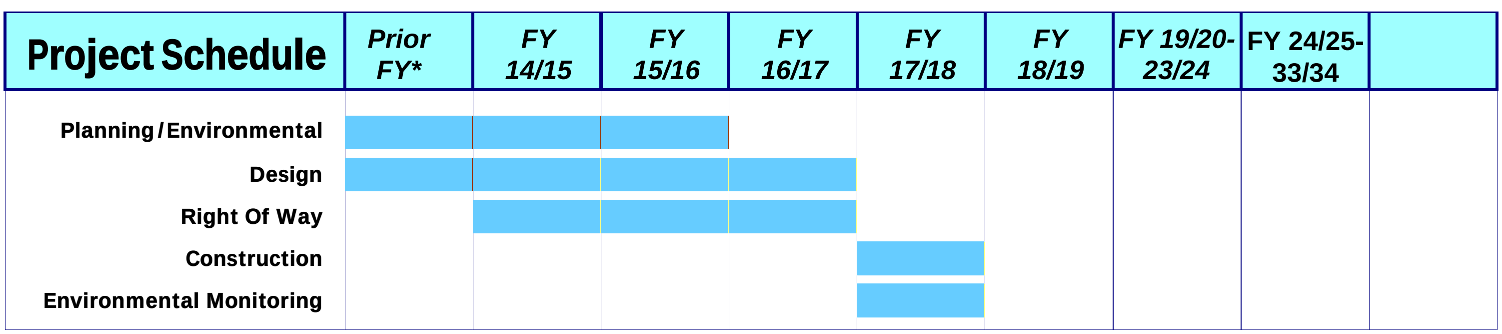
Project No: 77137 | **Type: Bridge** | **Supervisor District(s) 3, 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$72*	*$308*	*$206*	*$157*	*$2,765*	*$0*	*$0*	*$0*	*$3,508*
Total	*$72*	*$308*	*$206*	*$157*	*$2,765*	*$0*	*$0*	*$0*	*$3,508*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$0*	*$93*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$98*
Planning/Env - Staff	*$33*	*$15*	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$50*
Design - Consultant	*$0*	*$60*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$75*
Design - Staff	*$40*	*$126*	*$120*	*$70*	*$0*	*$0*	*$0*	*$0*	*$356*
Right of Way - Acquisition	*$0*	*$0*	*$10*	*$40*	*$0*	*$0*	*$0*	*$0*	*$50*
Right of Way - Consultant	*$0*	*$8*	*$38*	*$32*	*$0*	*$0*	*$0*	*$0*	*$78*
Right of Way - Staff	*$0*	*$6*	*$15*	*$15*	*$0*	*$0*	*$0*	*$0*	*$36*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$25*	*$0*	*$0*	*$0*	*$25*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$372*	*$0*	*$0*	*$0*	*$372*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$2,338*	*$0*	*$0*	*$0*	*$2,338*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$25*	*$0*	*$0*	*$0*	*$25*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$5*	*$0*	*$0*	*$0*	*$5*
Total	*$73*	*$308*	*$206*	*$157*	*$2,765*	*$0*	*$0*	*$0*	*$3,508*

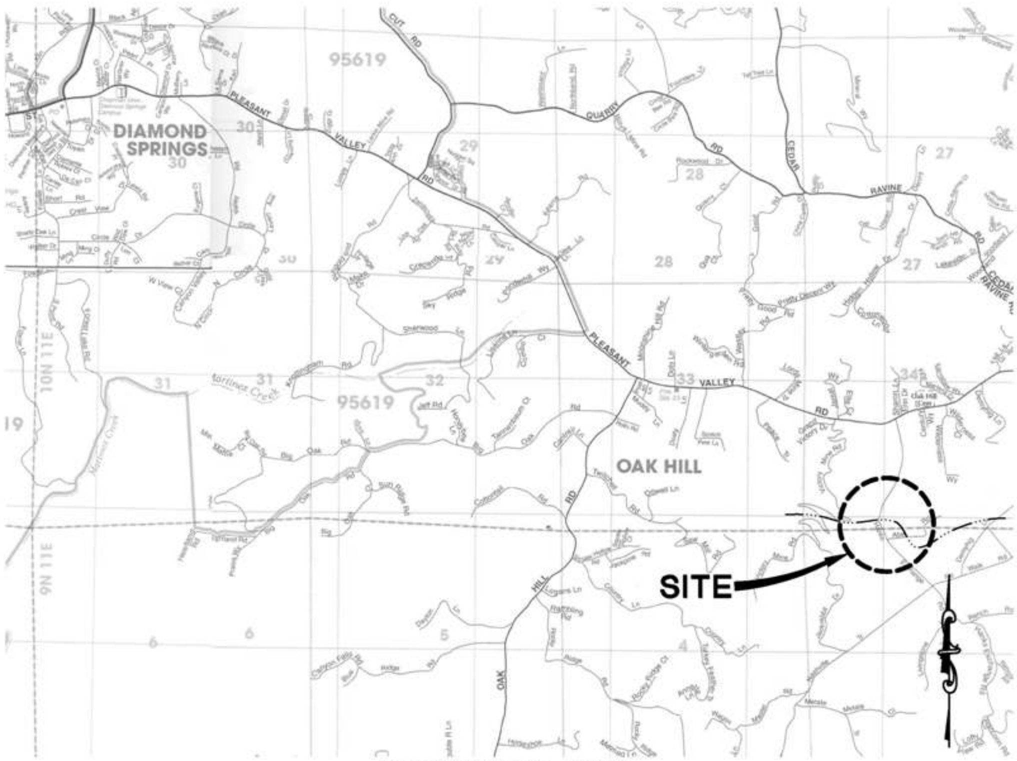


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Hanks Exchange at Squaw Hollow Creek - Bridge Replacement

CIP Project Summary

Project No: 77135 **Type: Bridge** **Supervisor District(s) 2, 3**



LOCATION MAP
HANKS EXCHANGE RD AT SQUAW HOLLOW CREEK
BRIDGE NO. 25C0053
NOT TO SCALE

Project Description:

Project includes replacement or rehabilitation of the bridge at the Squaw Hollow Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $3,917,250 Expenditures thru 6/30/2013: $4,076 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Hanks Exchange at Squaw Hollow Creek - Bridge Replacement

Financing Plan & Tentative Schedule

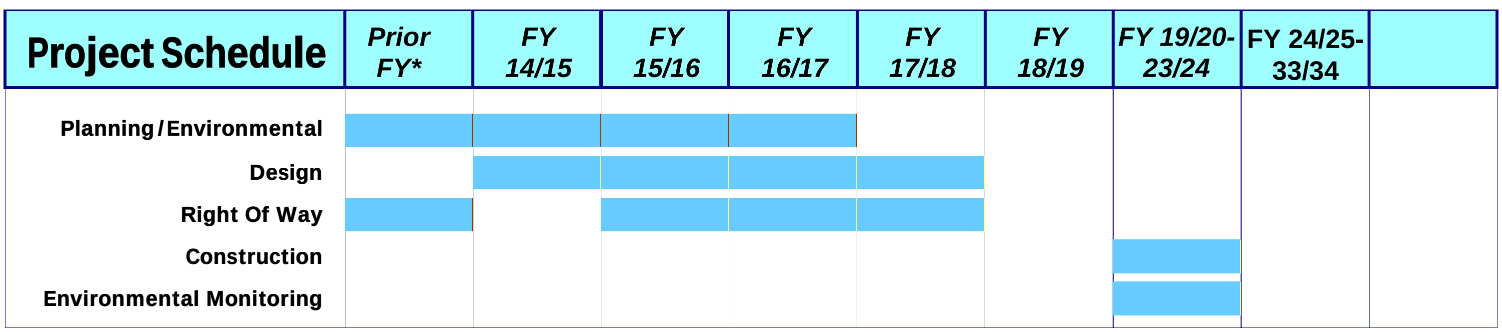
Project No: 77135 | **Type: Bridge** | **Supervisor District(s) 2, 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$44	$174	$208	$233	$158	$0	$3,100	$0	$3,917
Total	$44	$174	$208	$233	$158	$0	$3,100	$0	$3,917

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$10	$45	$40	$5	$0	$0	$0	$0	$100
Planning/Env - Staff	$24	$19	$5	$2	$0	$0	$0	$0	$50
Design - Consultant	$0	$10	$50	$15	$0	$0	$0	$0	$75
Design - Staff	$0	$100	$101	$160	$70	$0	$0	$0	$431
Right of Way - Acquisition	$0	$0	$0	$20	$65	$0	$0	$0	$85
Right of Way - Consultant	$0	$0	$6	$26	$20	$0	$0	$0	$52
Right of Way - Staff	$10	$0	$6	$5	$3	$0	$0	$0	$24
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$420	$0	$420
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$2,625	$0	$2,625
Env Monitoring - Consultant	$0	$0	$0	$0	$0	$0	$25	$0	$25
Env Monitoring - Staff	$0	$0	$0	$0	$0	$0	$5	$0	$5
Total	$44	$174	$208	$233	$158	$0	$3,100	$0	$3,917

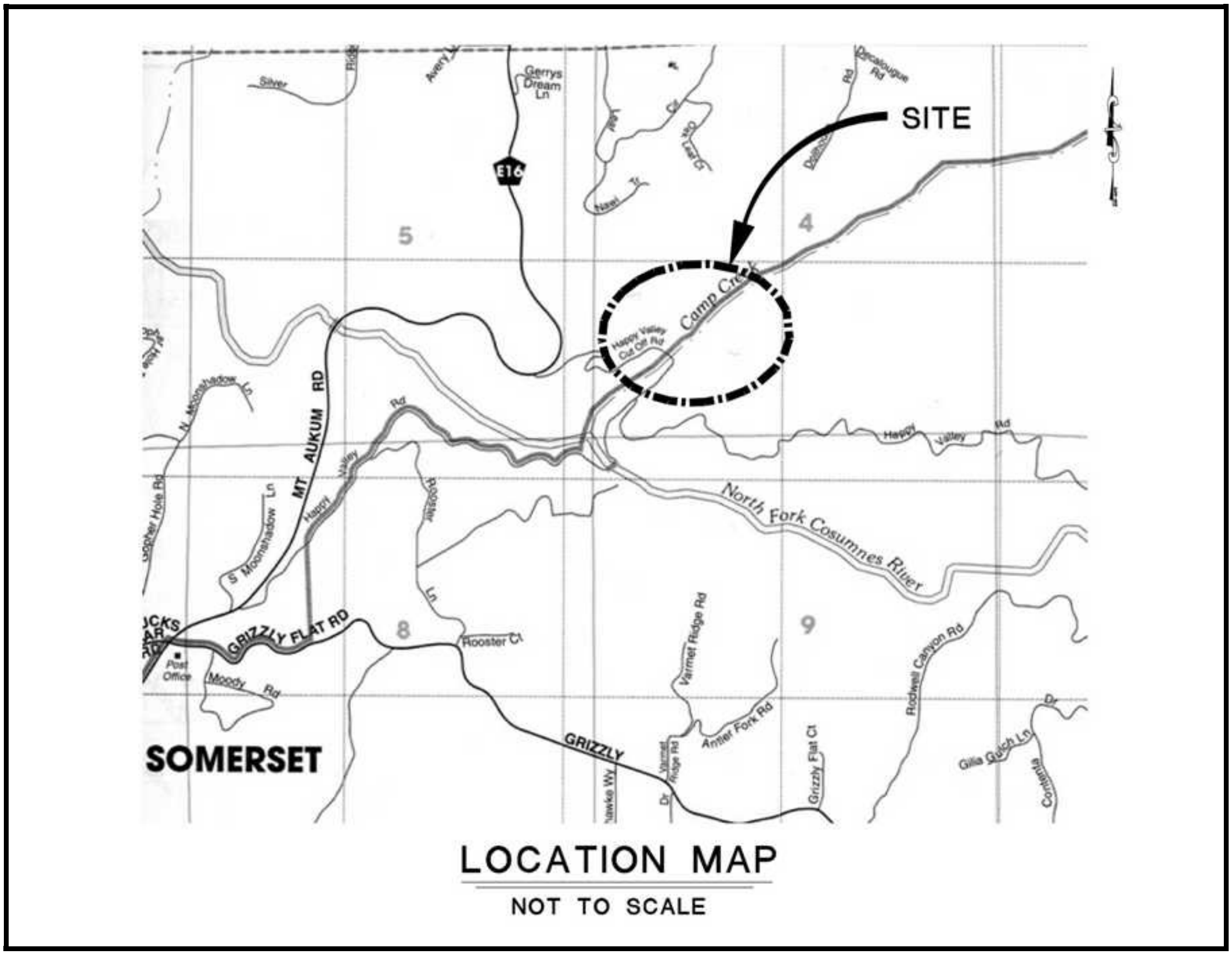


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Happy Valley Cutoff Road at Camp Creek - Bridge Maintenance Project

CIP Project Summary

Project No: 77140 **Type: Bridge** **Supervisor District(s) 2**



Project Description:

Project includes preventative maintenance work on bridge

Original Budget: $190,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Happy Valley Cutoff Road at Camp Creek - Bridge Maintenance Project

Financing Plan & Tentative Schedule

Project No: 77140 **Type: Bridge** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$4	$173	$0	$0	$0	$0	$0	$0	$177
Road Fund/Discretionary	$1	$22	$0	$0	$0	$0	$0	$0	$23
Total	$5	$195	$0	$0	$0	$0	$0	$0	$200

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$5	$5	$0	$0	$0	$0	$0	$0	$10
Design - Staff	$0	$40	$0	$0	$0	$0	$0	$0	$40
Construction Mgmt - Staff	$0	$15	$0	$0	$0	$0	$0	$0	$15
Direct Construction Costs	$0	$135	$0	$0	$0	$0	$0	$0	$135
Total	$5	$195	$0	$0	$0	$0	$0	$0	$200

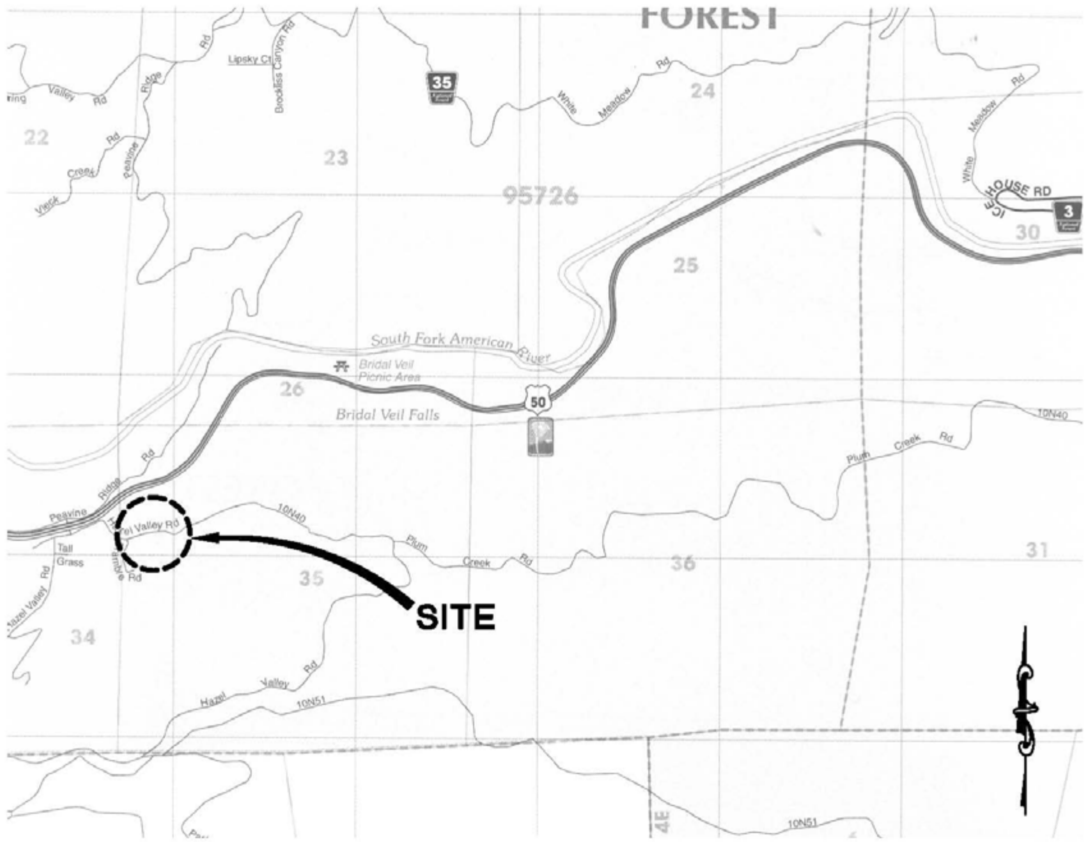
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Hazel Valley Road at EID Canal - Bridge Replacement

CIP Project Summary

Project No: 77125 | **Type: Bridge** | **Supervisor District(s) 5**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge at the EID canal crossing, widening and minor improvements at the bridge approaches.

Original Budget: $2,604,000 | Expenditures thru 6/30/2013: $71,066 | Project Initiation Date: 12/16/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Hazel Valley Road at EID Canal - Bridge Replacement

Financing Plan & Tentative Schedule

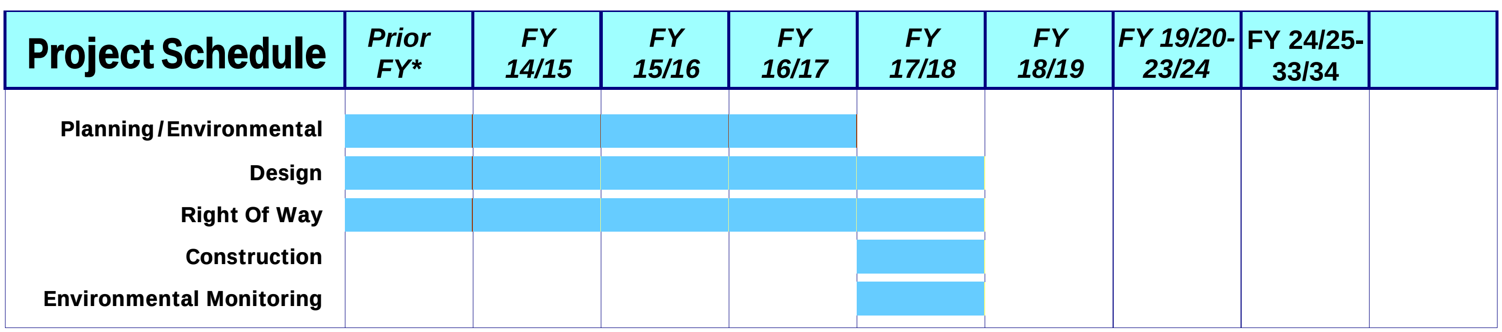
Project No: 77125 | **Type: Bridge** | **Supervisor District(s) 5**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$122*	*$208*	*$180*	*$87*	*$1,715*	*$0*	*$0*	*$0*	*$2,311*
Total	*$122*	*$208*	*$180*	*$87*	*$1,715*	*$0*	*$0*	*$0*	*$2,311*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$55*	*$73*	*$44*	*$10*	*$0*	*$0*	*$0*	*$0*	*$182*
Planning/Env - Staff	*$54*	*$78*	*$2*	*$2*	*$0*	*$0*	*$0*	*$0*	*$136*
Design - Consultant	*$0*	*$39*	*$5*	*$15*	*$0*	*$0*	*$0*	*$0*	*$59*
Design - Staff	*$11*	*$16*	*$96*	*$41*	*$34*	*$0*	*$0*	*$0*	*$198*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$50*	*$0*	*$0*	*$0*	*$50*
Right of Way - Consultant	*$0*	*$0*	*$13*	*$0*	*$0*	*$0*	*$0*	*$0*	*$13*
Right of Way - Staff	*$2*	*$2*	*$20*	*$19*	*$2*	*$0*	*$0*	*$0*	*$45*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$15*	*$0*	*$0*	*$0*	*$15*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$280*	*$0*	*$0*	*$0*	*$280*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$1,300*	*$0*	*$0*	*$0*	*$1,300*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$29*	*$0*	*$0*	*$0*	*$29*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$5*	*$0*	*$0*	*$0*	*$5*
Total	*$122*	*$208*	*$180*	*$87*	*$1,715*	*$0*	*$0*	*$0*	*$2,311*

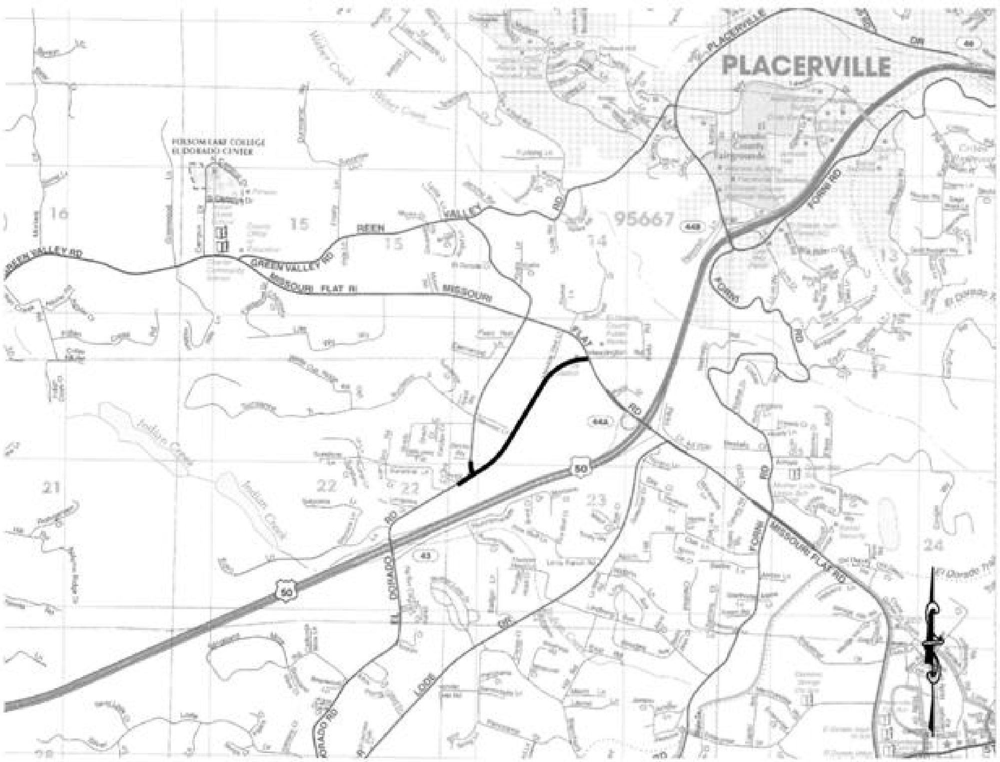


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Headington Road Extension - Missouri Flat Road to El Dorado Road

CIP Project Summary

Project No: 71375 | **Type: Roadway** | **Supervisor District(s) 3, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Extension of Headington Road northwesterly from Missouri Flat Road to El Dorado Road. The new road will be a 2-lane arterial with median. Does not include curb, gutter or sidewalk. R/W to be dedicated as a condition of development; therefore, no R/W acquistion costs have been included.

Original Budget: $9,878,000 Expenditures thru 6/30/2013: $654,304 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Headington Road Extension - Missouri Flat Road to El Dorado Road

Financing Plan & Tentative Schedule

Project No: 71375 **Type: Roadway** **Supervisor District(s) 3, 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	*$654*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$9,763*	*$10,416*
Total	*$654*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$9,763*	*$10,416*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$96*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$100*	*$196*
Planning/Env - Staff	*$137*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$34*	*$171*
Design - Consultant	*$58*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$164*	*$222*
Design - Staff	*$350*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$153*	*$503*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$60*	*$60*
Right of Way - Staff	*$11*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$115*	*$126*
Construction Mgmt - Staff	*$1*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,377*	*$1,378*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$7,700*	*$7,700*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$50*	*$50*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$10*
Total	*$654*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$9,763*	*$10,417*

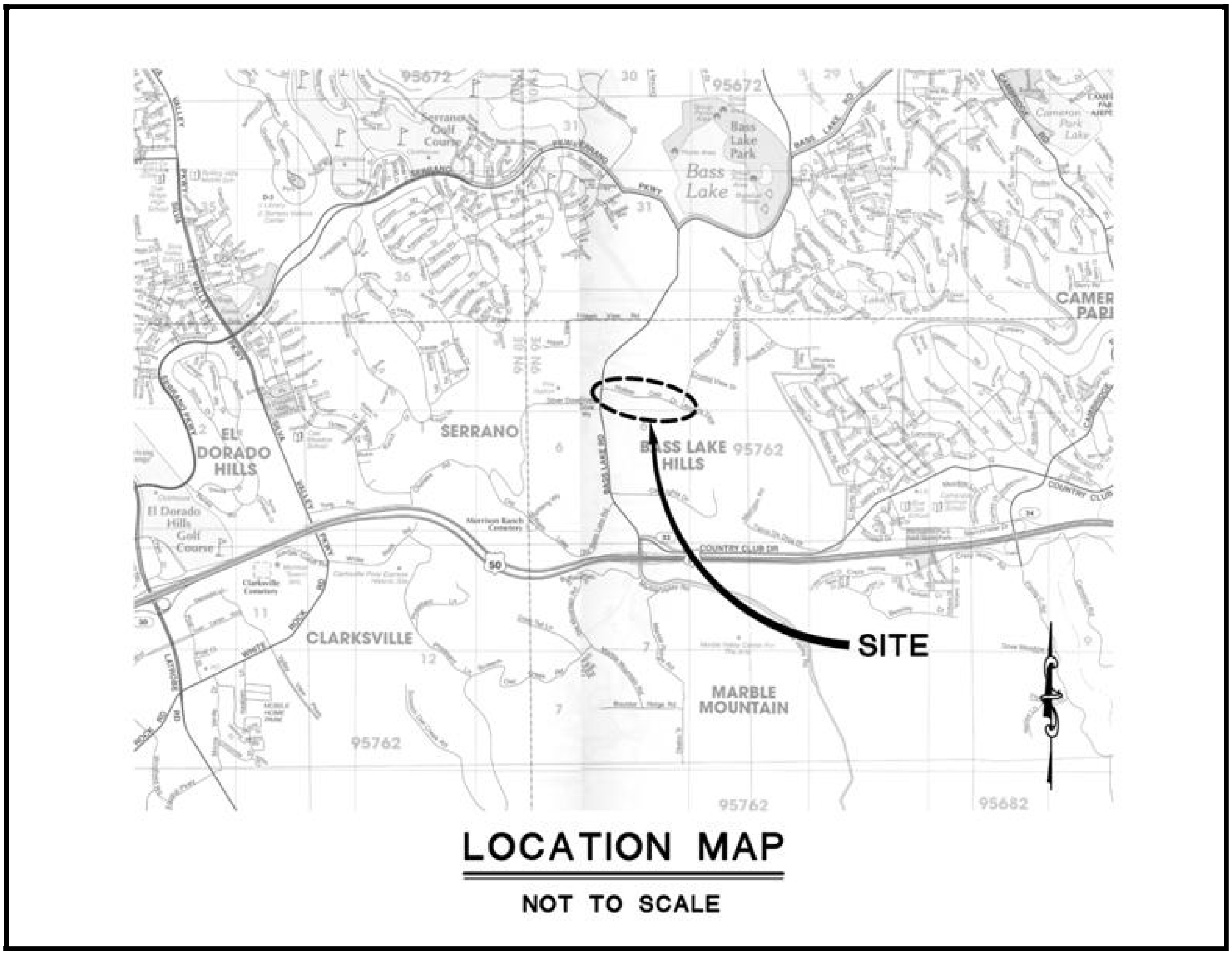
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Hollow Oak Road Drainage

CIP Project Summary

Project No: 72369 **Type: Drainage** **Supervisor District(s) 1**



Project Description:

Drainage mitigation and repair on Hollow Oak Road. Requires advancement of culvert under Bass Lake Road which is being advanced under 66109.

Original Budget: $345,000 Expenditures thru 6/30/2013: $154,667 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Hollow Oak Road Drainage

Financing Plan & Tentative Schedule

Project No: 72369 **Type: Drainage** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Bass Lake Hills PFFP	*$261*	*$438*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$700*
RSTP Exchange Funds-Caltrans	*$0*	*$277*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$278*
Total	*$261*	*$716*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$977*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3*
Design - Staff	*$169*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$169*
Right of Way - Acquisition	*$23*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$23*
Right of Way - Staff	*$45*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$45*
Construction Mgmt - Staff	*$21*	*$139*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$160*
Direct Construction Costs	*$0*	*$576*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$576*
Total	*$261*	*$716*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$977*

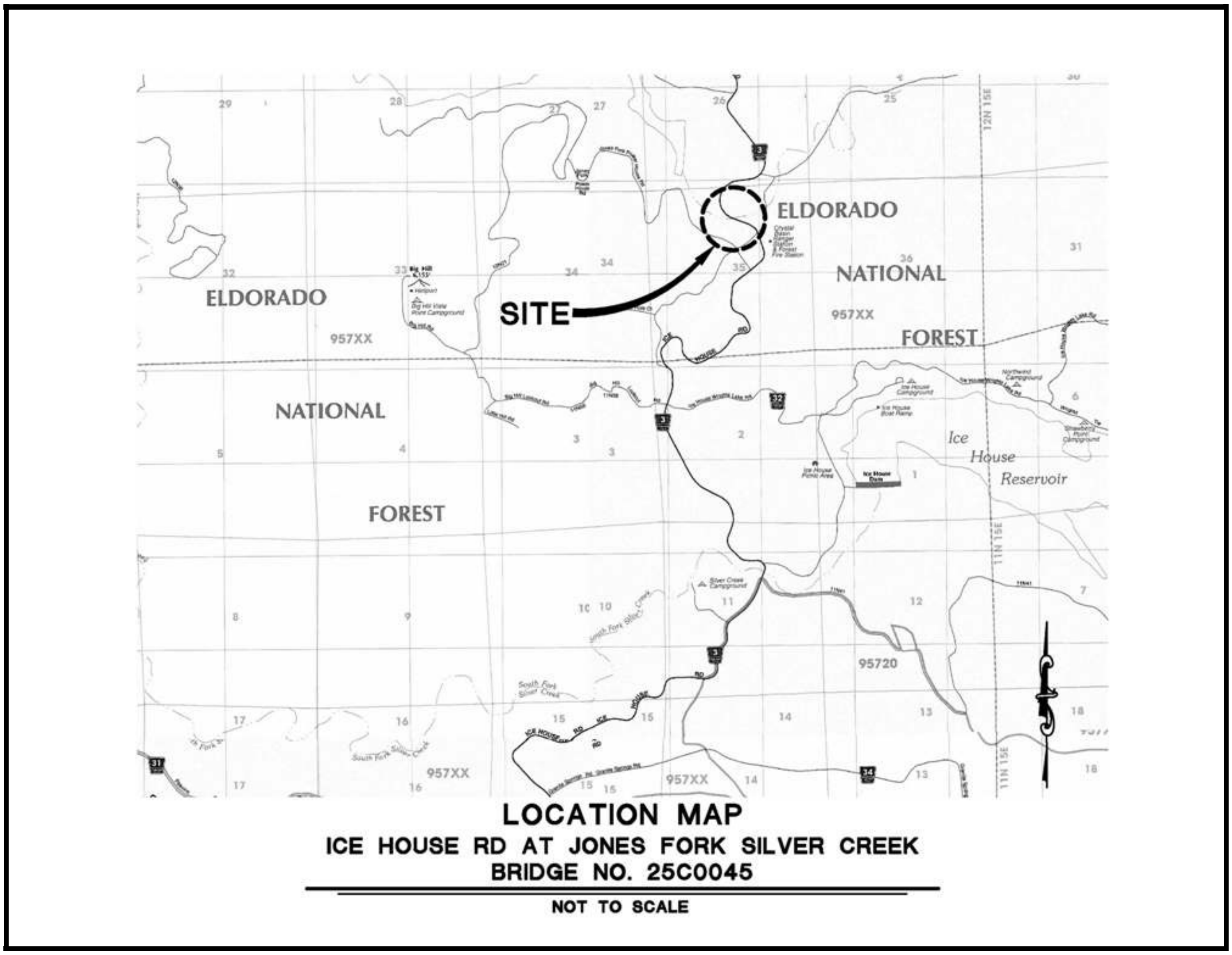
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Ice House Road at Jones Fork Silver Creek - Bridge Maintenance Project

CIP Project Summary

Project No: 77131 **Type: Bridge** **Supervisor District(s) 4**



Project Description:

Project includes joint and paint maintenance work and replacement of the bridge bearings.

Original Budget: $761,000 Expenditures thru 6/30/2013: $1,561 Project Initiation Date: 05/08/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Ice House Road at Jones Fork Silver Creek - Bridge Maintenance Project

Financing Plan & Tentative Schedule

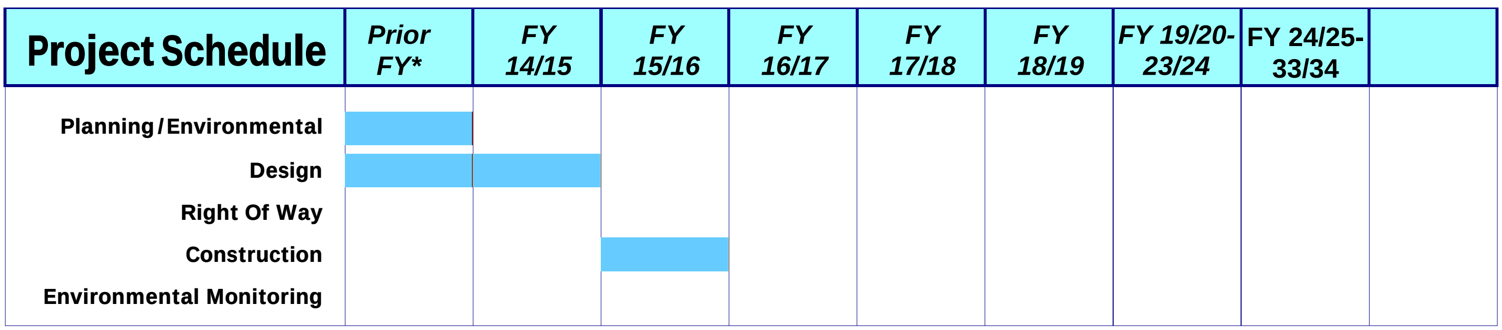
Project No: 77131 **Type: Bridge** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$54	$75	$545	$0	$0	$0	$0	$0	$674
SMUD Upper American River Project Coop Agreement	$7	$10	$71	$0	$0	$0	$0	$0	$87
Total	$61	$84	$616	$0	$0	$0	$0	$0	$761

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$6	$0	$0	$0	$0	$0	$0	$0	$6
Design - Consultant	$4	$4	$0	$0	$0	$0	$0	$0	$8
Design - Staff	$50	$80	$0	$0	$0	$0	$0	$0	$131
Construction Mgmt - Staff	$0	$0	$103	$0	$0	$0	$0	$0	$103
Direct Construction Costs	$0	$0	$513	$0	$0	$0	$0	$0	$513
Total	$61	$84	$616	$0	$0	$0	$0	$0	$761

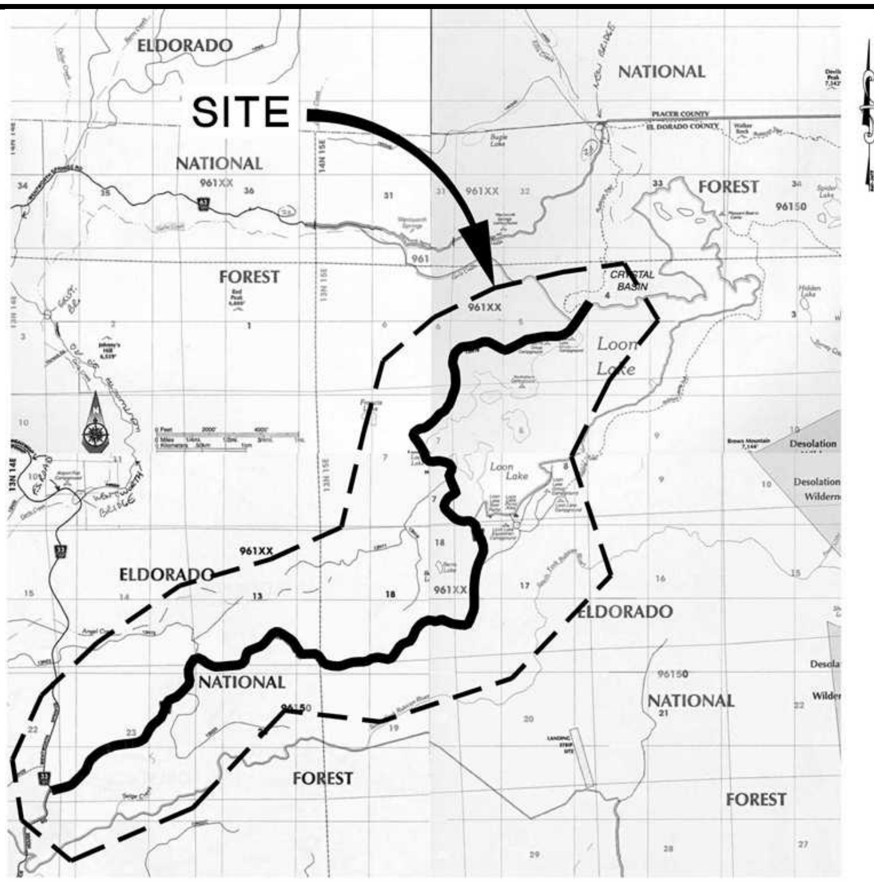


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Ice House Road Rehabilitation

CIP Project Summary

Project No: 72187 **Type: Roadway** **Supervisor District(s) 5**



LOCATION MAP

NOT TO SCALE

Project Description:

The County is working with the Federal Highway Administration on design and construction for asphalt concrete rehabilitation of 7.1 miles of Ice House Road from Wentworth Springs Road near MP 23.94 to Loon Lake near MP 31.06.

Original Budget: $34,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 09/16/13

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Ice House Road Rehabilitation

Financing Plan & Tentative Schedule

Project No: 72187 **Type: Roadway** **Supervisor District(s) 5**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Federal Lands Access Program (FLAP)	$64	$1,300	$2,835	$0	$0	$0	$0	$0	$4,198
SMUD Upper American River Project Coop Agreement	$28	$218	$374	$0	$0	$0	$0	$0	$621
Total	$92	$1,518	$3,209	$0	$0	$0	$0	$0	$4,819

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$79	$0	$0	$0	$0	$0	$0	$0	$79
Planning/Env - Staff	$13	$0	$0	$0	$0	$0	$0	$0	$13
Design - Consultant	$0	$300	$0	$0	$0	$0	$0	$0	$300
Design - Staff	$0	$42	$0	$0	$0	$0	$0	$0	$42
Construction Mgmt - Consultant	$0	$169	$200	$0	$0	$0	$0	$0	$369
Construction Mgmt - Staff	$0	$7	$8	$0	$0	$0	$0	$0	$15
Direct Construction Costs	$0	$1,000	$3,001	$0	$0	$0	$0	$0	$4,001
Total	$92	$1,518	$3,209	$0	$0	$0	$0	$0	$4,819

Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Intelligent Transportation System (ITS) Improvements

CIP Project Summary

Project No: 31202 **Type: Miscellaneous** **Supervisor District(s) 1, 2, 3, 4, 5**

Project Description:

Various ITS improvements along US 50 and regionally significant corridors in the County; projects may include upgrading controllers, building the communications infrastructure, adding Closed Circuit Television (CCTV's), adding Dynamic Message Sign (DMS), connecting all the signals to a centralized location, creating coordinated signal timing plans, building a Traffic Operation Center (TOC), connecting to another TOC, etc. These improvements should both improve signal timing between signals and help alert drivers to traffic conditions in advance, thereby relieving congestion and improving safety.

Original Budget: $5,833 Expenditures thru 6/30/2013: $143,210 Project Initiation Date: 09/25/07

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Anticipated Grant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,690*	*$5,690*
El Dorado County Transportation Commission	*$89*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$89*
Road Fund/Discretionary	*$55*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$55*
Total	*$143*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,690*	*$5,833*

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	*$91*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$50*	*$141*
Planning/Env - Staff	*$41*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$41*
Design - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$300*	*$300*
Design - Staff	*$11*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$170*	*$181*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$100*	*$100*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$10*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$132*	*$132*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$528*	*$528*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,400*	*$4,400*
Total	*$143*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,690*	*$5,833*

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

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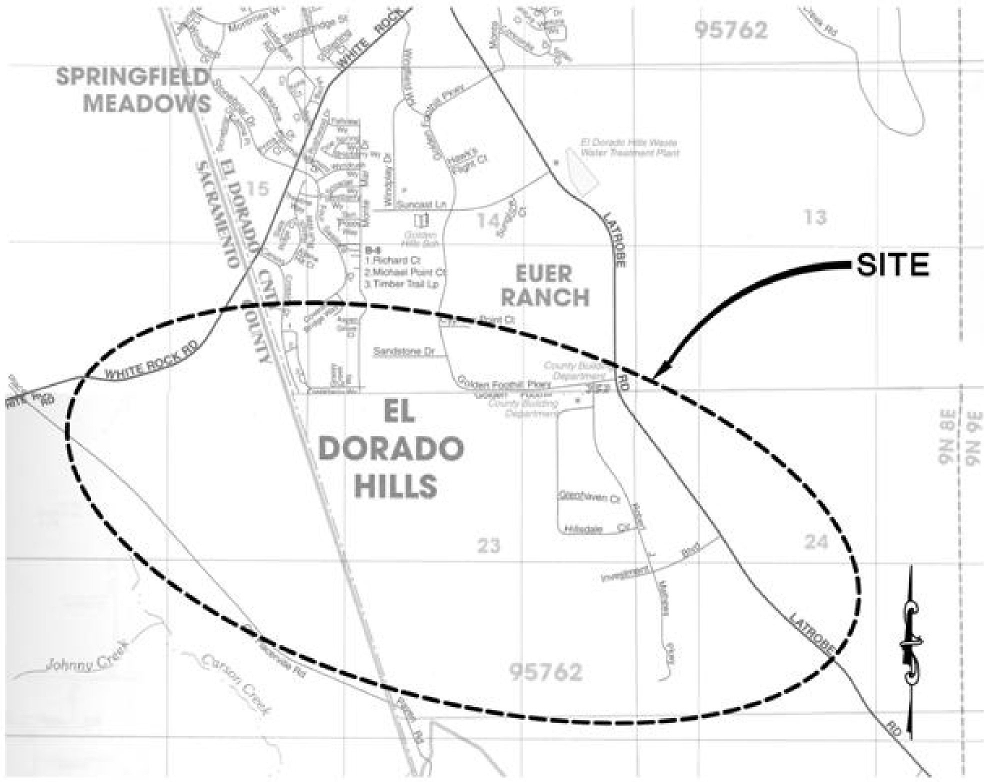
Latrobe Connection

CIP Project Summary

Project No: 66116 **Type: Roadway** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

This project is to identify, design and construct a new road from the El Dorado Hills Business Park to White Rock Road west of the Four Seasons / Stonebriar Intersection. Possible connections include Carson Crossing Drive, Old Placerville Road, Payen Road, Investment Boulevard or Golden Foothill Parkway. The ultimate for all alignment alternatives extends into Sacramento County and the Folsom sphere of influence. The initial work is to perform a route alignment study and begin the route adoption process. Subsequent work includes Environmental, Design and Construction (to be accomplished in future years). Project may require coordination with Sacramento County, the City of Folsom, the Southeast Connector JPA and area developers.

Original Budget: $22,645,001 Expenditures thru 6/30/2013: $78,123 Project Initiation Date: 02/13/07

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Latrobe Connection

Financing Plan & Tentative Schedule

Project No: 66116 **Type: Roadway** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP EDH TIM Blackstone Prepayment	$16	$0	$0	$0	$0	$0	$0	$0	$16
2004 GP El Dorado Hills TIM	$80	$0	$0	$0	$0	$0	$0	$19,078	$19,158
Developer Advance - EDH TIM	$250	$0	$0	$0	$0	$0	$0	$0	$250
Miscellaneous Reimbursement	$15	$0	$0	$0	$0	$0	$0	$0	$15
Road Fund/Discretionary	$5	$0	$0	$0	$0	$0	$0	$0	$5
Total	$367	$0	$0	$0	$0	$0	$0	$19,078	$19,445

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Developer Advanced Planning	$250	$0	$0	$0	$0	$0	$0	$0	$250
Planning/Env - Staff	$113	$0	$0	$0	$0	$0	$0	$0	$113
Design - Consultant	$3	$0	$0	$0	$0	$0	$0	$99	$102
Design - Staff	$1	$0	$0	$0	$0	$0	$0	$1,879	$1,881
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$4,900	$4,900
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$100	$100
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$100	$100
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$300	$300
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$1,300	$1,300
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$10,400	$10,400
Total	$367	$0	$0	$0	$0	$0	$0	$19,078	$19,445

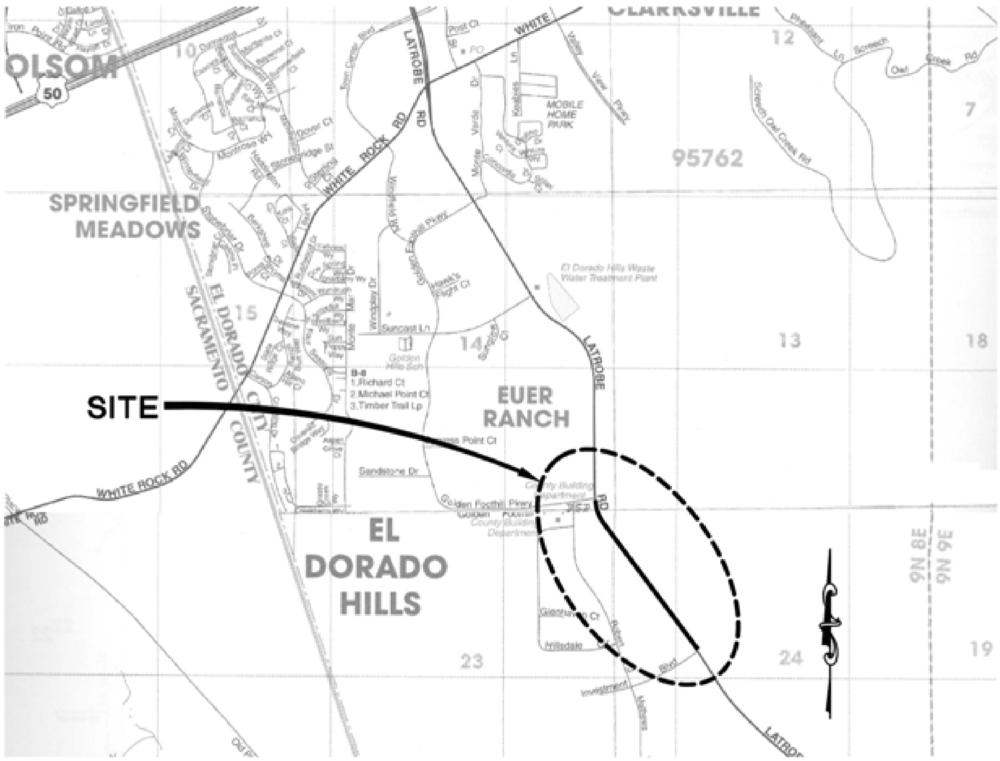
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Latrobe Road Widening (2 to 4 lanes) - Golden Foothill Parkway (south) to Investment Boulevard

CIP Project Summary

Project No: 72350 | **Type: Roadway** | **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen Latrobe Road from Golden Foothill Parkway (south) to Investment Boulevard (a two-lane undivided road to a four-lane divided road with curb and gutter and Class II Bike Lanes). Modify signal at Investment Blvd. (Note: Class 1 Bike Lane on east side to be built by developer, as a development condition.)

Original Budget: $8,100,000 Expenditures thru 6/30/2013: $208,891 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Latrobe Road Widening (2 to 4 lanes) - Golden Foothill Parkway (south) to Investment Boulevard

Financing Plan & Tentative Schedule

Project No: 72350 **Type: Roadway** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$209*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$308*	*$516*
EDH Business Park Assessment District	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,000*	*$3,000*
Total	*$209*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,308*	*$3,516*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$25*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$25*
Design - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$10*
Design - Staff	*$179*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$262*	*$441*
Right of Way - Staff	*$2*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$25*	*$27*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$20*	*$20*
Construction Mgmt - Staff	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$335*	*$338*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,656*	*$2,656*
Total	*$209*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,308*	*$3,516*

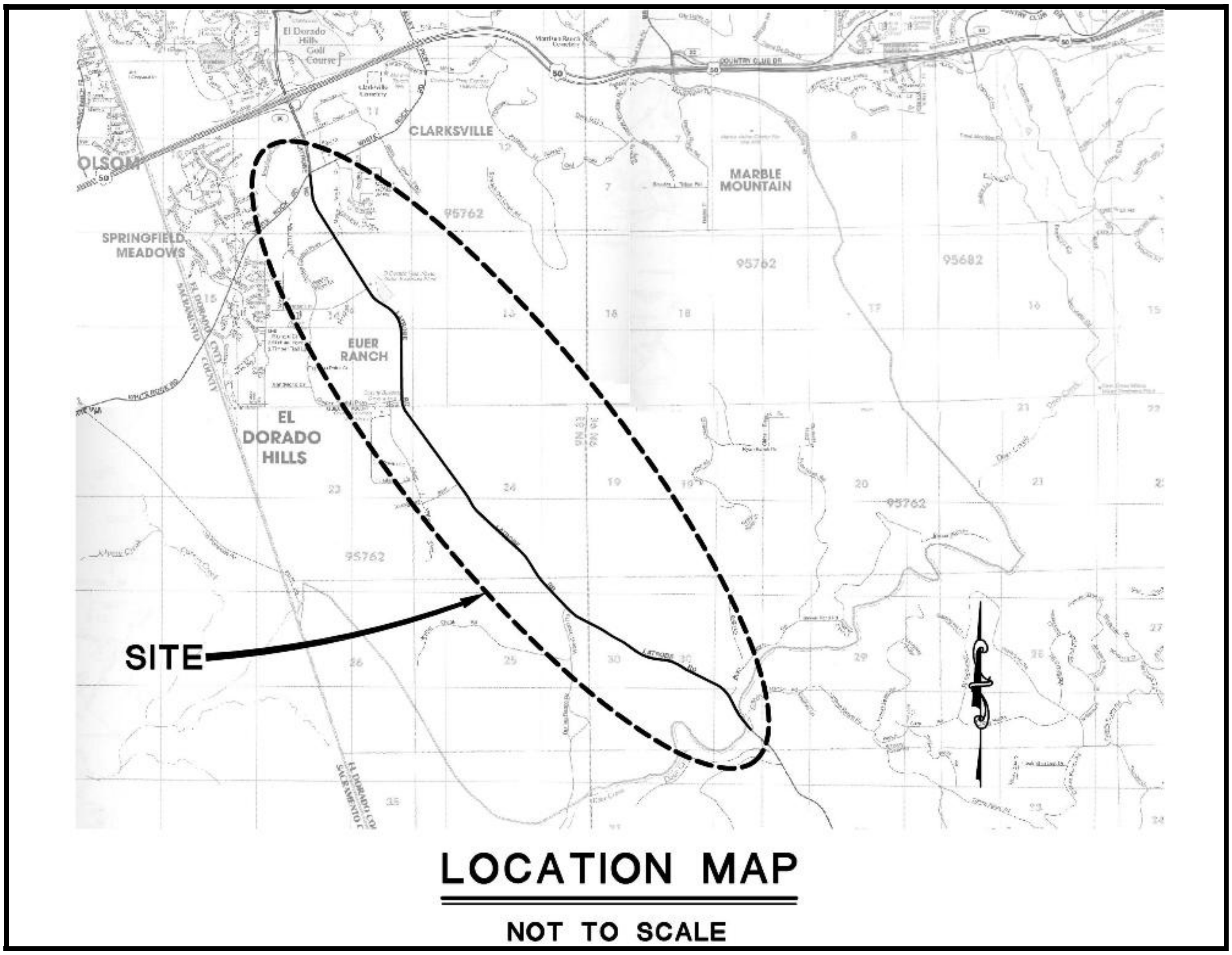
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning / Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Latrobe Road Widening (4 to 6 lanes) - White Rock Road to Carson Creek (Suncast Lane)

CIP Project Summary

Project No: GP154 | **Type: Roadway** | **Supervisor District(s) 1**



Project Description:

Widen Latrobe Road from White Rock Road to Carson Creek (Suncast Lane) from four to six lanes, divided, with six-foot shoulders.

Original Budget: $8,987,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Latrobe Road Widening (4 to 6 lanes) - White Rock Road to Carson Creek (Suncast Lane)

Financing Plan & Tentative Schedule

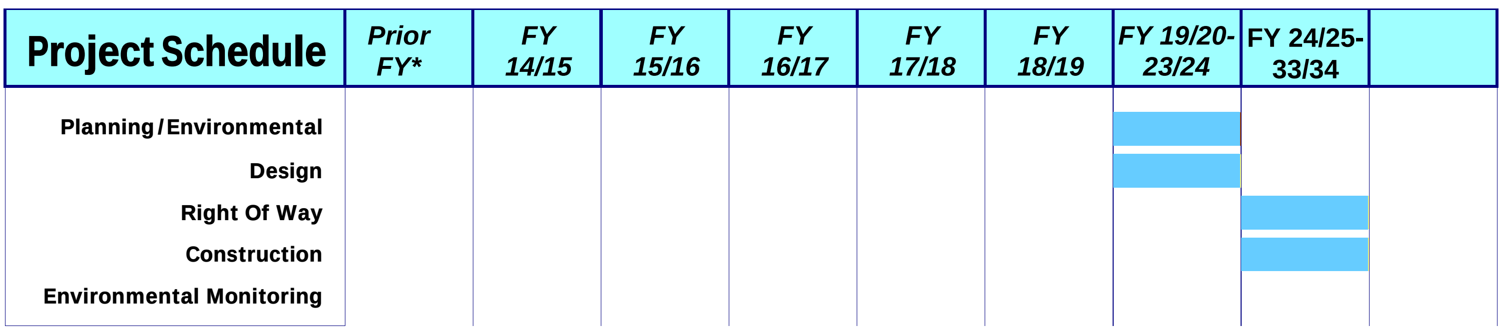
Project No: GP154 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$1,250	$7,737	$8,987
Total	$0	$0	$0	$0	$0	$0	$1,250	$7,737	$8,987

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$260	$0	$260
Design - Staff	$0	$0	$0	$0	$0	$0	$990	$0	$990
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$1,750	$1,750
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$40	$40
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$47	$47
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$540	$540
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$5,360	$5,360
Total	$0	$0	$0	$0	$0	$0	$1,250	$7,737	$8,987

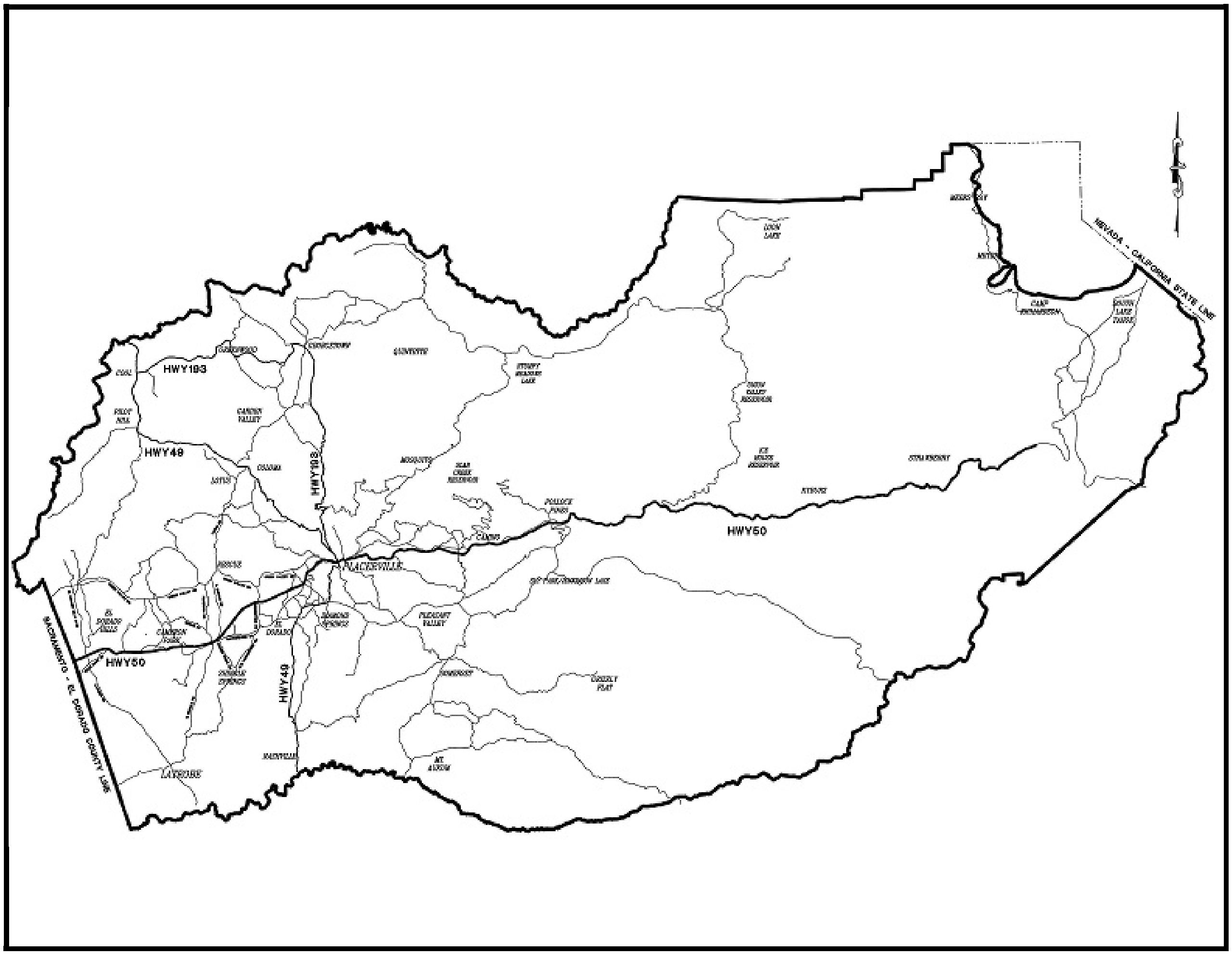


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Metal Beam Guardrail Installation - Various Locations

CIP Project Summary

Project No: OP005 **Type: Roadway** **Supervisor District(s) 1, 2, 3, 4, 5**



Project Description:

Construction/reconstruction of guardrail at various locations throughout the County. Listed locations are those most in need and for which FHWA HSIP grant funds are anticipated to be available. As funding permits, additional locations will be identified.

Original Budget: $771,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 09/14/04

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Metal Beam Guardrail Installation - Various Locations

Financing Plan & Tentative Schedule

Project No: OP005 | **Type: Roadway** | **Supervisor District(s) 1, 2, 3, 4, 5**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Anticipated Grant	$0	$0	$0	$0	$0	$0	$50	$555	$605
RSTP Exchange Funds-Caltrans	$0	$0	$0	$0	$0	$0	$6	$61	$67
Total	$0	$0	$0	$0	$0	$0	$56	$616	$672

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Design - Staff	$0	$0	$0	$0	$0	$0	$56	$0	$56
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$56	$56
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$560	$560
Total	$0	$0	$0	$0	$0	$0	$56	$616	$672

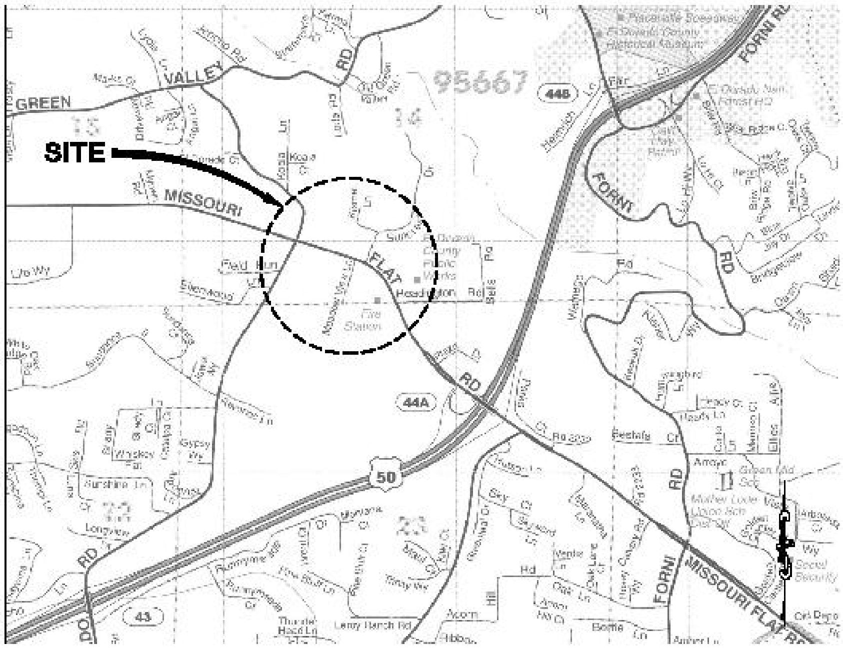
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Missouri Flat Rd Two-Way Left Turn Lane - El Dorado Rd to Headington Rd

CIP Project Summary

Project No: GP163 **Type: Roadway** **Supervisor District(s) 3, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Add two-way left turn lane on Missouri Flat Road from El Dorado Road to Headington Road. No curb, gutter or sidewalk.

Original Budget: $1,200,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Missouri Flat Rd Two-Way Left Turn Lane - El Dorado Rd to Headington Rd

Financing Plan & Tentative Schedule

Project No: GP163 **Type: Roadway** **Supervisor District(s) 3, 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,202*	*$1,202*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,202*	*$1,202*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$39*	*$39*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$150*	*$150*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$140*	*$140*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*	*$6*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$7*	*$7*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$80*	*$80*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$780*	*$780*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,202*	*$1,202*

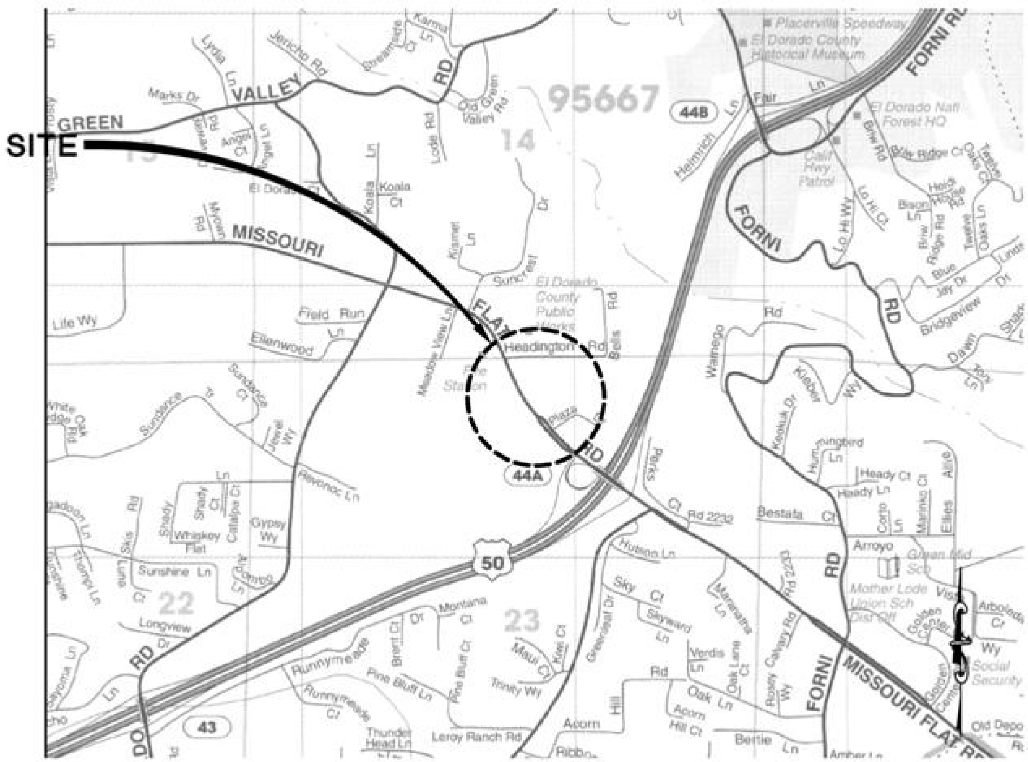
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Missouri Flat Road Widening, Headington Road to Prospector's Plaza

CIP Project Summary

Project No: GP165 | **Type: Roadway** | **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen Missouri Flat Road to five-lane cross-section (two lanes in each direction with center two-way left turn lane) from Headington Road to Prospector's Plaza north driveway. Project to be developer funded.

Original Budget: $1,613,800 | Expenditures thru 6/30/2013: $0 | Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Missouri Flat Road Widening, Headington Road to Prospector's Plaza

Financing Plan & Tentative Schedule

Project No: GP165 **Type: Roadway** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Developer Funded	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,299*	*$1,299*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,299*	*$1,299*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$47*	*$47*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$180*	*$180*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$58*	*$58*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*	*$6*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$12*	*$12*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$96*	*$96*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$900*	*$900*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,299*	*$1,299*

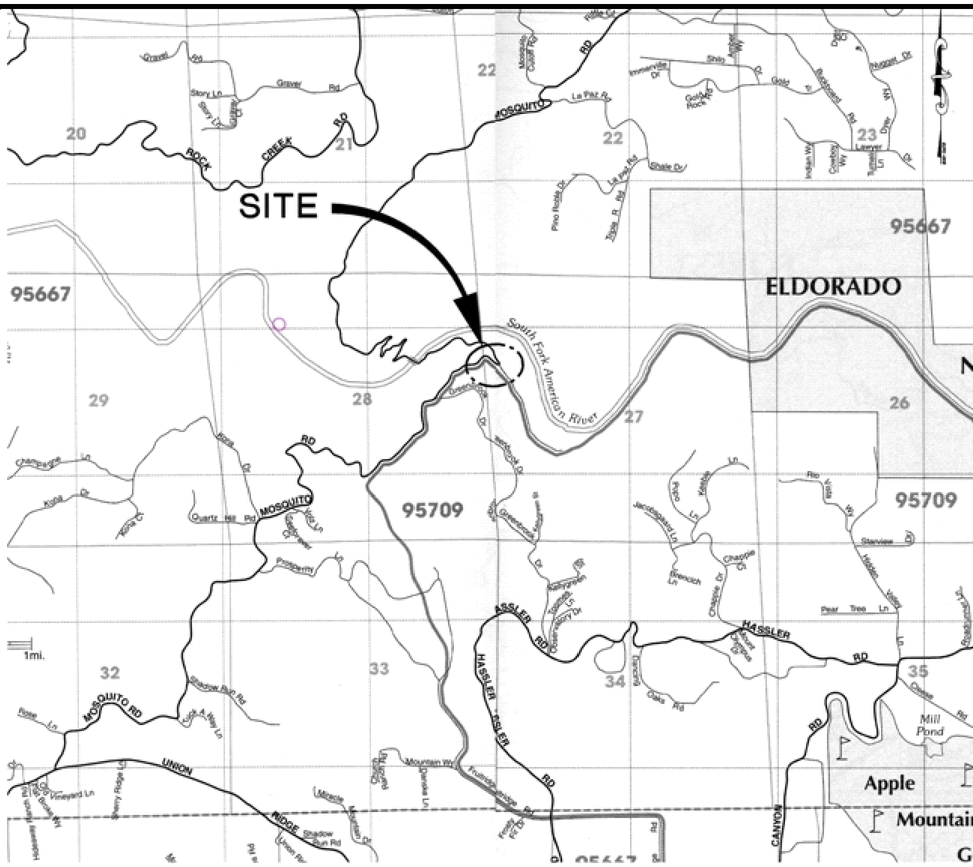
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mosquito Road at South Fork American River - Bridge Maintenance Project

CIP Project Summary

Project No: 77141 **Type: Bridge** **Supervisor District(s) 3, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes preventative maintenance work on bridge.

Original Budget: $206,800 Expenditures thru 6/30/2013: $0 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mosquito Road at South Fork American River - Bridge Maintenance Project

Financing Plan & Tentative Schedule

Project No: 77141 **Type: Bridge** **Supervisor District(s) 3, 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$4*	*$179*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$183*
Road Fund/Discretionary	*$1*	*$23*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$24*
Total	*$5*	*$202*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$207*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$5*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*
Design - Staff	*$0*	*$40*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$40*
Construction Mgmt - Staff	*$0*	*$17*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$17*
Direct Construction Costs	*$0*	*$140*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$140*
Total	*$5*	*$202*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$207*

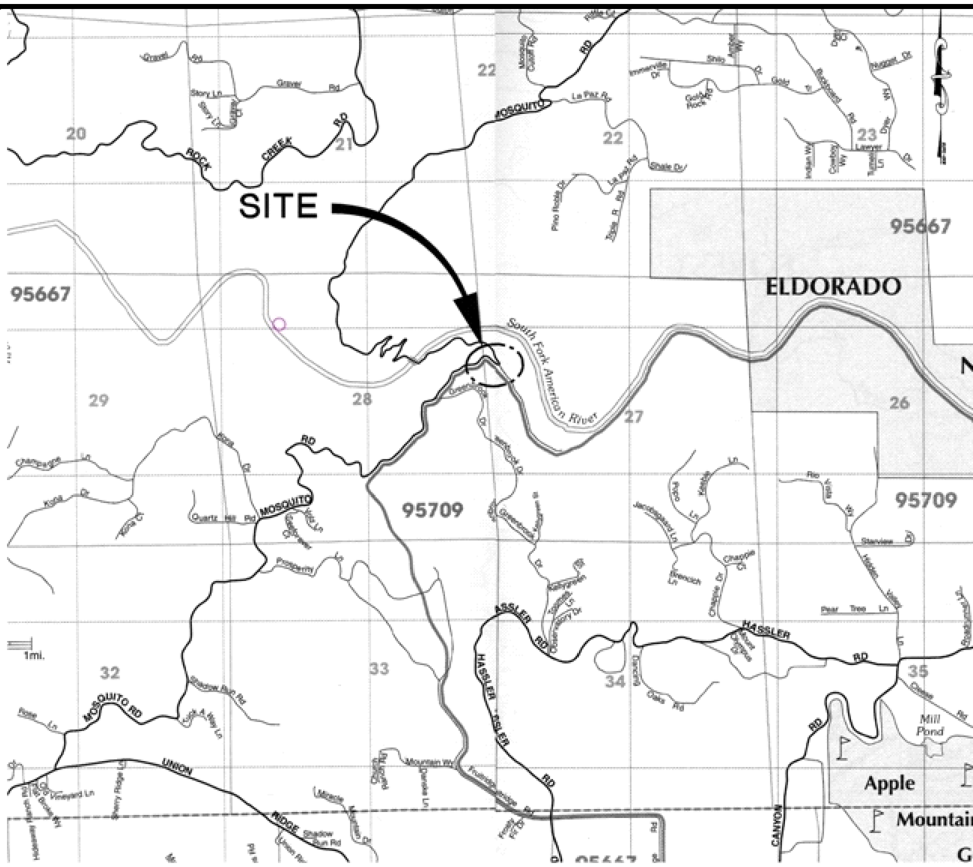
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mosquito Road Bridge at South Fork American River

CIP Project Summary

Project No: 77126 **Type: Bridge** **Supervisor District(s) 3, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge at the South Fork American River crossing, widening and realignment at the bridge approaches.

Original Budget: $30,555,000 Expenditures thru 6/30/2013: $77,560 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mosquito Road Bridge at South Fork American River

Financing Plan & Tentative Schedule

Project No: 77126 **Type: Bridge** **Supervisor District(s) 3, 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$726	$2,208	$3,049	$1,600	$0	$0	$23,000	$0	$30,583
Road Fund/Discretionary	$2	$0	$0	$0	$0	$0	$0	$0	$2
Total	$728	$2,208	$3,049	$1,600	$0	$0	$23,000	$0	$30,584

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$550	$750	$388	$0	$0	$0	$0	$0	$1,688
Planning/Env - Staff	$175	$85	$81	$0	$0	$0	$0	$0	$341
Design - Consultant	$0	$1,000	$2,000	$175	$0	$0	$0	$0	$3,175
Design - Staff	$2	$373	$580	$200	$0	$0	$0	$0	$1,155
Right of Way - Acquisition	$0	$0	$0	$400	$0	$0	$0	$0	$400
Right of Way - Consultant	$0	$0	$0	$275	$0	$0	$0	$0	$275
Right of Way - Staff	$0	$0	$0	$550	$0	$0	$0	$0	$550
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$1,500	$0	$1,500
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$1,500	$0	$1,500
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$20,000	$0	$20,000
Total	$728	$2,208	$3,049	$1,600	$0	$0	$23,000	$0	$30,584

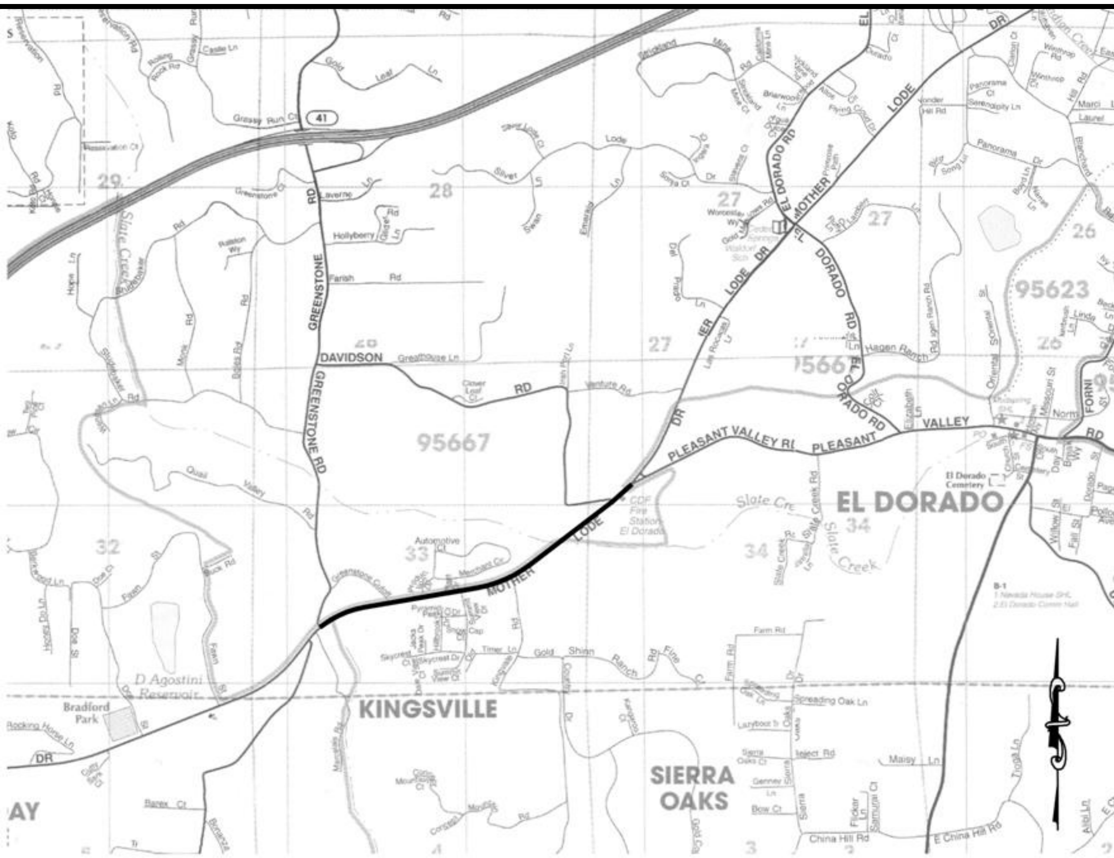
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mother Lode Drive - Greenstone Road to Pleasant Valley Road

CIP Project Summary

Project No: GP155 | **Type: Roadway** | **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Improve Mother Lode Drive from Greenstone Road to Pleasant Valley Road. Improvements include adding a two-way left turn lane and widening the road to accommodate the left turn lane. No curb, gutter or sidewalk.

Original Budget: $5,100,000 | Expenditures thru 6/30/2013: $0 | Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mother Lode Drive - Greenstone Road to Pleasant Valley Road

Financing Plan & Tentative Schedule

Project No: GP155 | **Type: Roadway** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$3,893	$3,893
Total	$0	$0	$0	$0	$0	$0	$0	$3,893	$3,893

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$140	$140
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$550	$550
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$70	$70
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$10	$10
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$48	$48
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$300	$300
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$2,775	$2,775
Total	$0	$0	$0	$0	$0	$0	$0	$3,893	$3,893

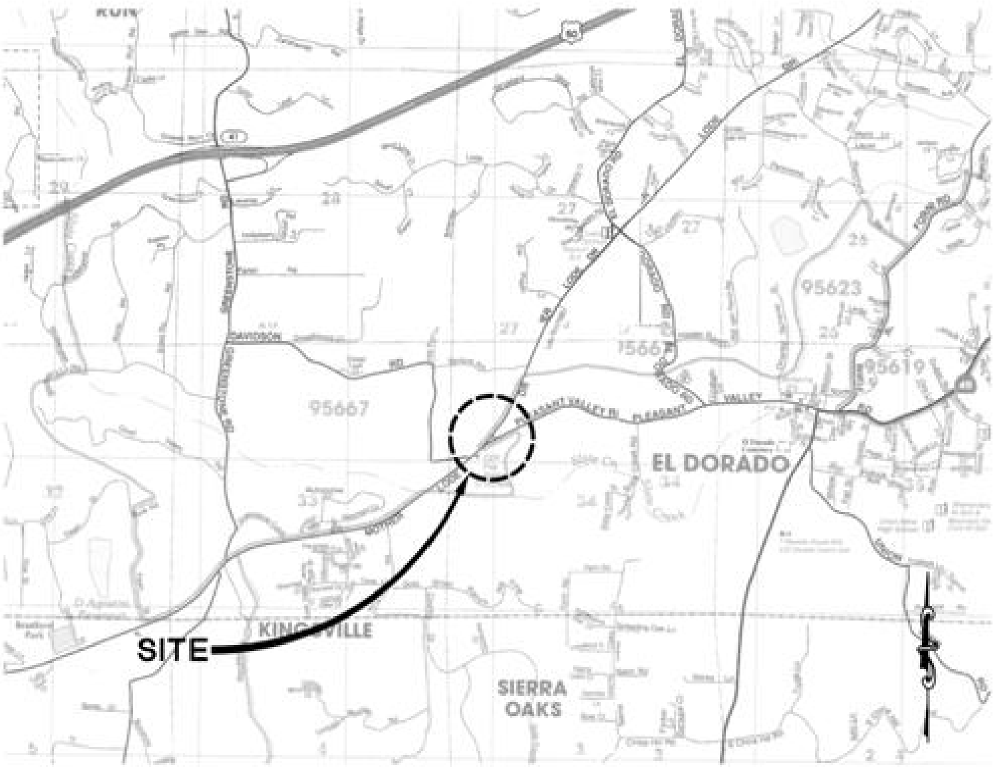
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mother Lode Drive/Pleasant Valley Road Intersection Improvements

CIP Project Summary

Project No: 73307 **Type: Intersection** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Intersection all-way stop was installed in 2006. Potential future improvements include reconfiguration of existing "y" intersection to a signalized "T" intersection, including turn pockets and shoulder improvements. This project to be funded out of the TIM Fee Program line item for intersection signalization and safety improvements.

Original Budget: $7,782,420 Expenditures thru 6/30/2013: $78,620 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mother Lode Drive/Pleasant Valley Road Intersection Improvements

Financing Plan & Tentative Schedule

Project No: 73307 **Type: Intersection** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	$79	$0	$0	$0	$0	$0	$0	$7,704	$7,782
Total	$79	$0	$0	$0	$0	$0	$0	$7,704	$7,782

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	$20	$0	$0	$0	$0	$0	$0	$34	$54
Design - Staff	$40	$0	$0	$0	$0	$0	$0	$1,300	$1,340
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$350	$350
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$53	$53
Right of Way - Staff	$5	$0	$0	$0	$0	$0	$0	$67	$72
Construction Mgmt - Staff	$14	$0	$0	$0	$0	$0	$0	$1,100	$1,114
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$4,800	$4,800
Total	$79	$0	$0	$0	$0	$0	$0	$7,704	$7,782

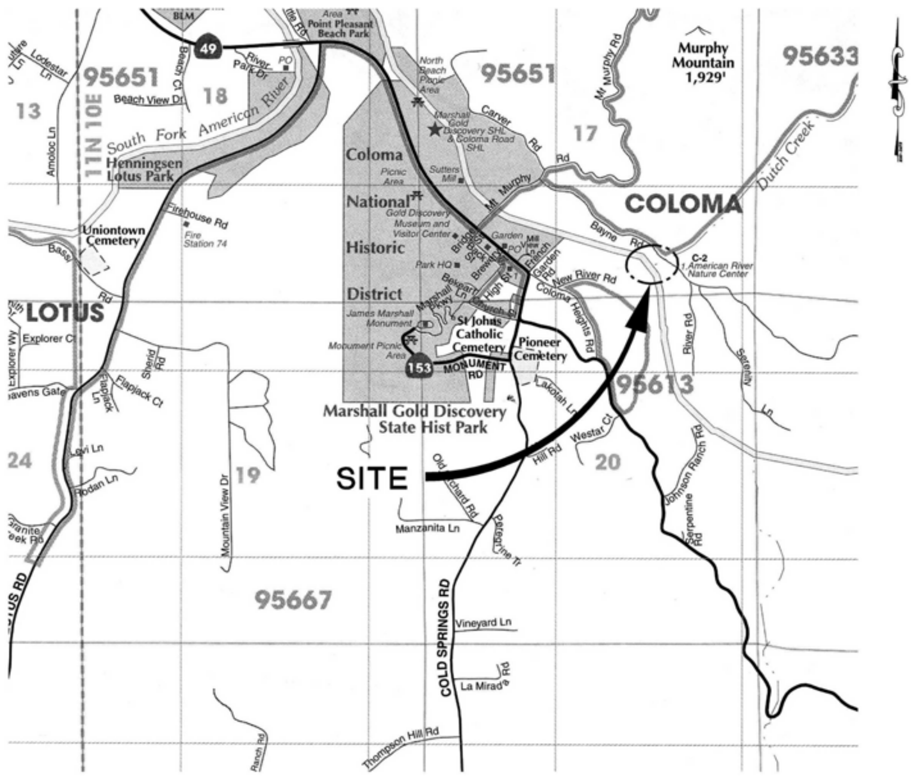
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mount Murphy Road at South Fork American River - Bridge Replacement

CIP Project Summary

Project No: 77129 **Type: Bridge** **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement or rehabilitation of the bridge at Mount Murphy Road at the South Fork American River crossing, widening and potential realignment at the bridge approaches.

Original Budget: $8,065,000 Expenditures thru 6/30/2013: $77,329 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Mount Murphy Road at South Fork American River - Bridge Replacement

Financing Plan & Tentative Schedule

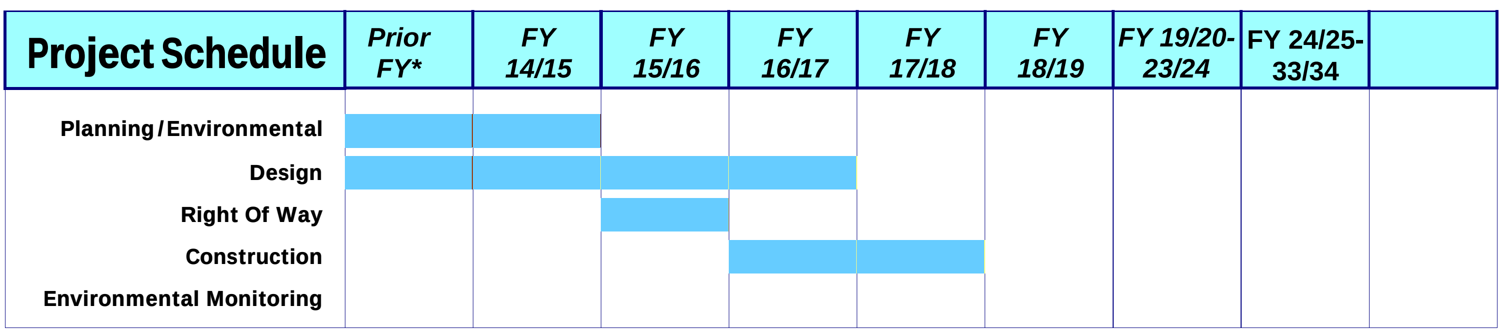
Project No: 77129 **Type: Bridge** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$476	$772	$1,160	$6,930	$11,200	$0	$0	$0	$20,538
Road Fund/Discretionary	$1	$0	$0	$0	$0	$0	$0	$0	$1
Total	$477	$772	$1,160	$6,930	$11,200	$0	$0	$0	$20,539

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$320	$250	$0	$0	$0	$0	$0	$0	$570
Planning/Env - Staff	$154	$80	$0	$0	$0	$0	$0	$0	$234
Design - Consultant	$0	$345	$600	$450	$0	$0	$0	$0	$1,395
Design - Staff	$3	$97	$120	$130	$0	$0	$0	$0	$350
Right of Way - Acquisition	$0	$0	$140	$0	$0	$0	$0	$0	$140
Right of Way - Consultant	$0	$0	$150	$0	$0	$0	$0	$0	$150
Right of Way - Staff	$0	$0	$150	$0	$0	$0	$0	$0	$150
Construction Mgmt - Consultant	$0	$0	$0	$450	$600	$0	$0	$0	$1,050
Construction Mgmt - Staff	$0	$0	$0	$400	$600	$0	$0	$0	$1,000
Direct Construction Costs	$0	$0	$0	$5,500	$10,000	$0	$0	$0	$15,500
Total	$477	$772	$1,160	$6,930	$11,200	$0	$0	$0	$20,539



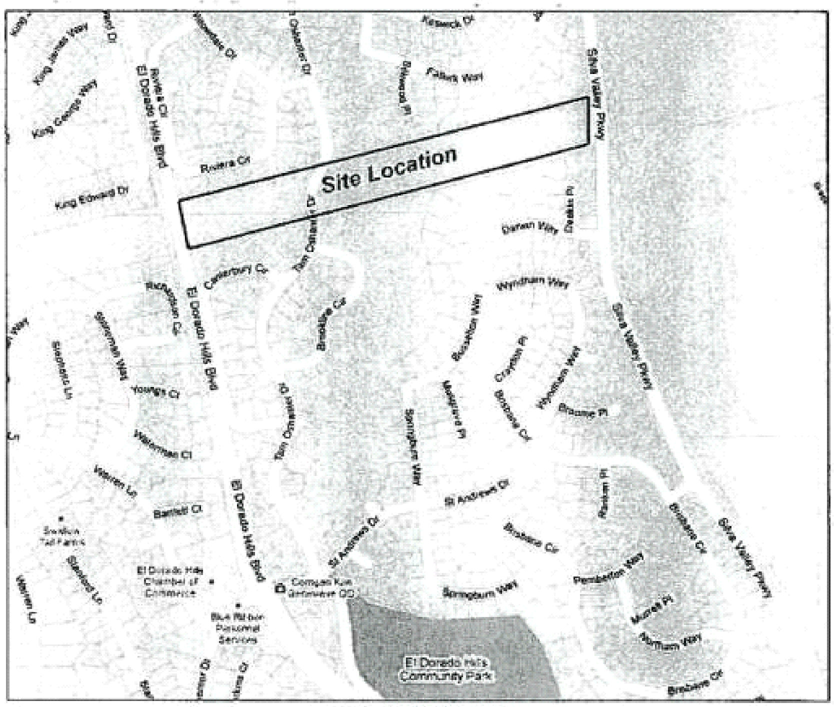
*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

New York Creek Trail East - Phase 2

CIP Project Summary

Project No: 72308 | **Type: Parks & Trails** | **Supervisor District(s) 1**

Project No. 72308
New York Creek Trail (East) Phase 2



LOCATION MAP
NOT TO SCALE

Project Description:

Phase 2 of a project to construct a trail within the El Dorado Hills Community Service District property from Steven Harris Park at Tam Oshanter Drive/El Dorado Hills Boulevard east to Silva Valley Parkway. This phase completes the bike trail from Tam Oshanter Drive east accross the New York Creek to the New York Creek Trail.

Original Budget: $784,600 | Expenditures thru 6/30/2013: $0 | Project Initiation Date: 05/25/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

New York Creek Trail East - Phase 2

Financing Plan & Tentative Schedule

Project No: 72308 **Type: Parks & Trails** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Congestion Mitigation and Air Quality Program	*$0*	*$141*	*$529*	*$331*	*$0*	*$0*	*$0*	*$0*	*$1,000*
Total	*$0*	*$141*	*$529*	*$331*	*$0*	*$0*	*$0*	*$0*	*$1,000*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	*$0*	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*
Design - Consultant	*$0*	*$19*	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$25*
Design - Staff	*$0*	*$108*	*$36*	*$0*	*$0*	*$0*	*$0*	*$0*	*$143*
Right of Way - Staff	*$0*	*$9*	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$12*
Construction Mgmt - Staff	*$0*	*$0*	*$83*	*$56*	*$0*	*$0*	*$0*	*$0*	*$139*
Direct Construction Costs	*$0*	*$0*	*$400*	*$275*	*$0*	*$0*	*$0*	*$0*	*$675*
Total	*$0*	*$141*	*$529*	*$331*	*$0*	*$0*	*$0*	*$0*	*$1,000*

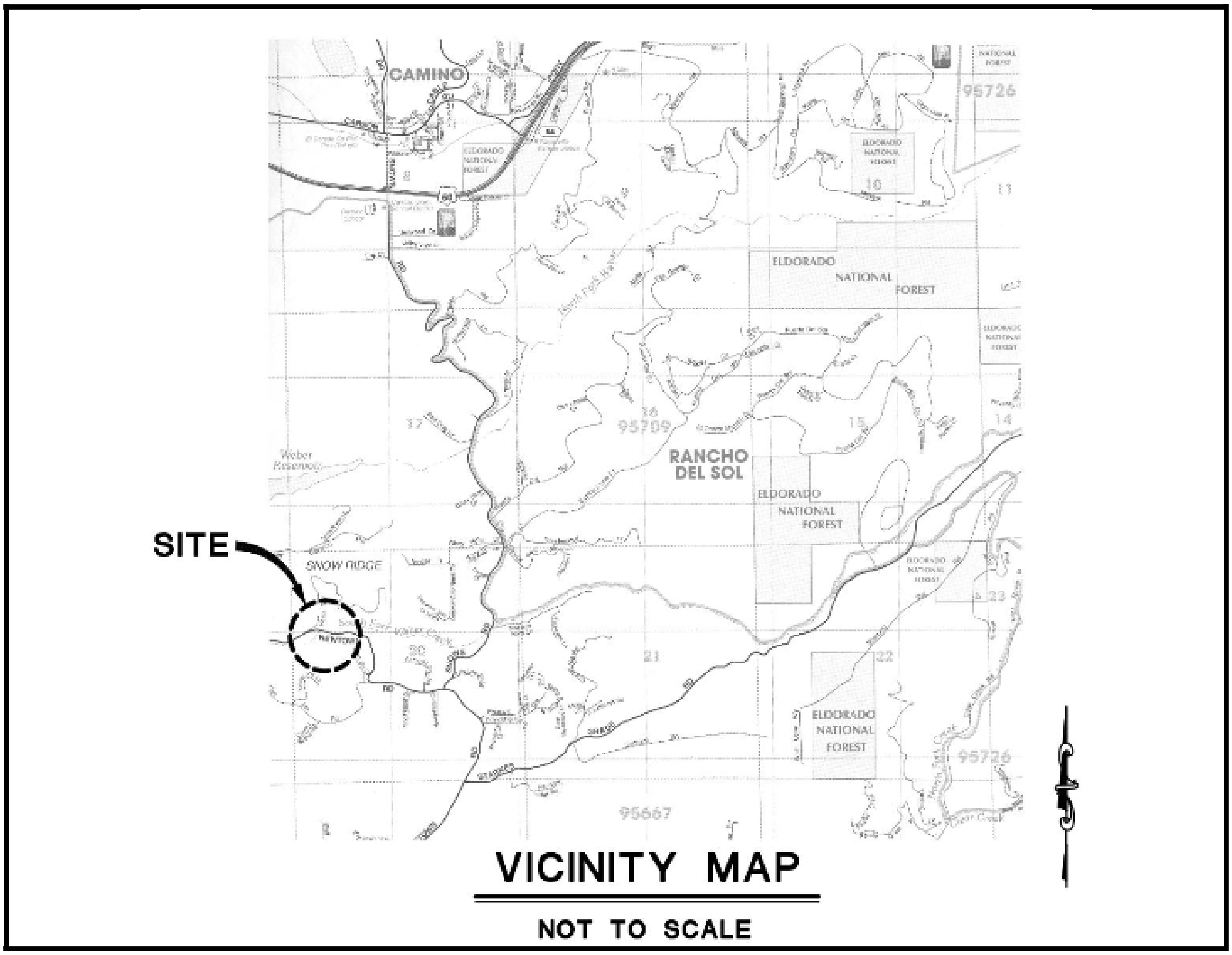
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Newtown Road at South Fork of Weber Creek - Bridge Replacement

CIP Project Summary

Project No: 77122 **Type: Bridge** **Supervisor District(s) 3**



Project Description:

Project includes bridge replacement at the South Fork Weber Creek (Bridge No. 25C0033, PM 4.4), widening improvements with horizontal and vertical realignment of Newtown Road at each bridge approach side, safety railing, improvements to roadway drainage and retaining walls. Advanced planning study has demonstrated a need for a substantial increase in the size of the retaining walls.

Original Budget: $3,177,000 Expenditures thru 6/30/2013: $386,969 Project Initiation Date: 04/27/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Newtown Road at South Fork of Weber Creek - Bridge Replacement

Financing Plan & Tentative Schedule

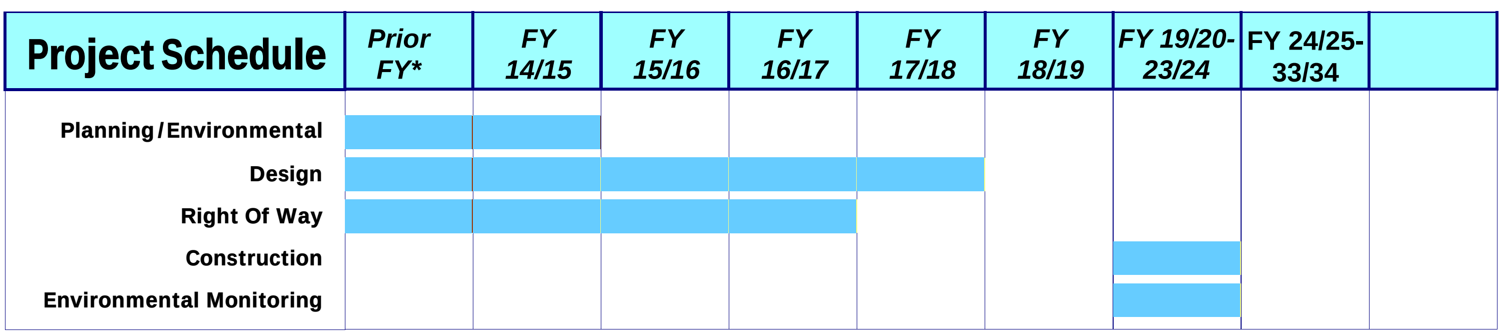
Project No: 77122 | **Type: Bridge** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$466*	*$238*	*$53*	*$0*	*$0*	*$0*	*$2,202*	*$0*	*$2,959*
Road Fund/Discretionary	*($2)*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*($2)*
RSTP Exchange Funds-Caltrans	*$0*	*$0*	*$342*	*$98*	*$93*	*$0*	*$928*	*$0*	*$1,461*
RSTP Match Funds-Caltrans	*$79*	*$28*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$107*
Total	*$543*	*$266*	*$395*	*$98*	*$93*	*$0*	*$3,130*	*$0*	*$4,525*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$173*	*$24*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$197*
Planning/Env - Staff	*$325*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$330*
Design - Consultant	*$0*	*$50*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$50*
Design - Staff	*$39*	*$185*	*$185*	*$93*	*$93*	*$0*	*$0*	*$0*	*$595*
Right of Way - Acquisition	*$0*	*$0*	*$75*	*$0*	*$0*	*$0*	*$0*	*$0*	*$75*
Right of Way - Consultant	*$0*	*$0*	*$32*	*$0*	*$0*	*$0*	*$0*	*$0*	*$32*
Right of Way - Staff	*$7*	*$2*	*$103*	*$5*	*$0*	*$0*	*$0*	*$0*	*$117*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$50*	*$0*	*$50*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$480*	*$0*	*$480*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,540*	*$0*	*$2,540*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$40*	*$0*	*$40*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$20*	*$0*	*$20*
Total	*$543*	*$266*	*$395*	*$98*	*$93*	*$0*	*$3,130*	*$0*	*$4,525*

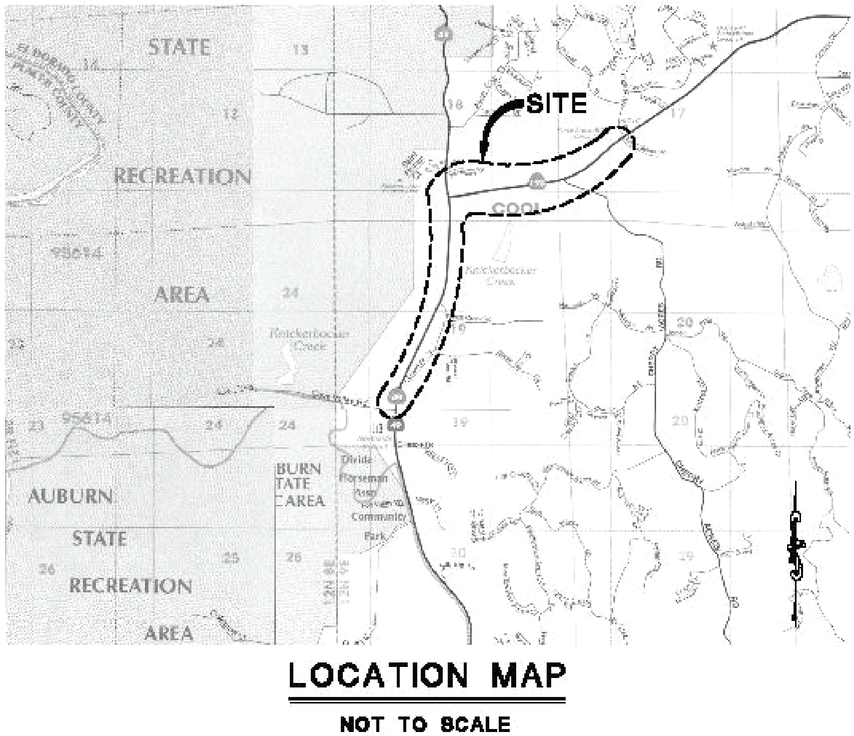


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Northside School Class I Bike Path - Phase 1 (SR193)

CIP Project Summary

Project No: 72304 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 4**



Project Description:

This first phase provides a Class 1 bike path along the north side of SR-193 from SR-49 to Auburn Lake Trails. See Project 72306 for Phase 2.

Original Budget: $1,067,001 Expenditures thru 6/30/2013: $940,581 Project Initiation Date: 02/13/07

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Northside School Class I Bike Path - Phase 1 (SR193)

Financing Plan & Tentative Schedule

Project No: 72304 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Congestion Mitigation and Air Quality Program	*$36*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$36*
Public Lands Highway Discretionary (PLHD)	*$70*	*$140*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$210*
Road Fund/Discretionary	*$42*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$42*
RSTP Exchange Funds-Caltrans	*$193*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$193*
RSTP Exchange Funds-Rural-EDCTC	*$300*	*$32*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$332*
Safe Routes to School - Federal	*$460*	*$540*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,000*
Transportation Enhancement Activities	*$242*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$242*
Total	*$1,341*	*$713*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,053*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	*$94*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$94*
Planning/Env - Staff	*$185*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$185*
Design - Consultant	*$12*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$12*
Design - Staff	*$552*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$552*
Right of Way - Acquisition	*$18*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$18*
Right of Way - Consultant	*$46*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$46*
Right of Way - Staff	*$78*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$78*
Construction Mgmt - Consultant	*$44*	*$87*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$131*
Construction Mgmt - Staff	*$48*	*$95*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$143*
Direct Construction Costs	*$265*	*$530*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$795*
Total	*$1,341*	*$713*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,053*

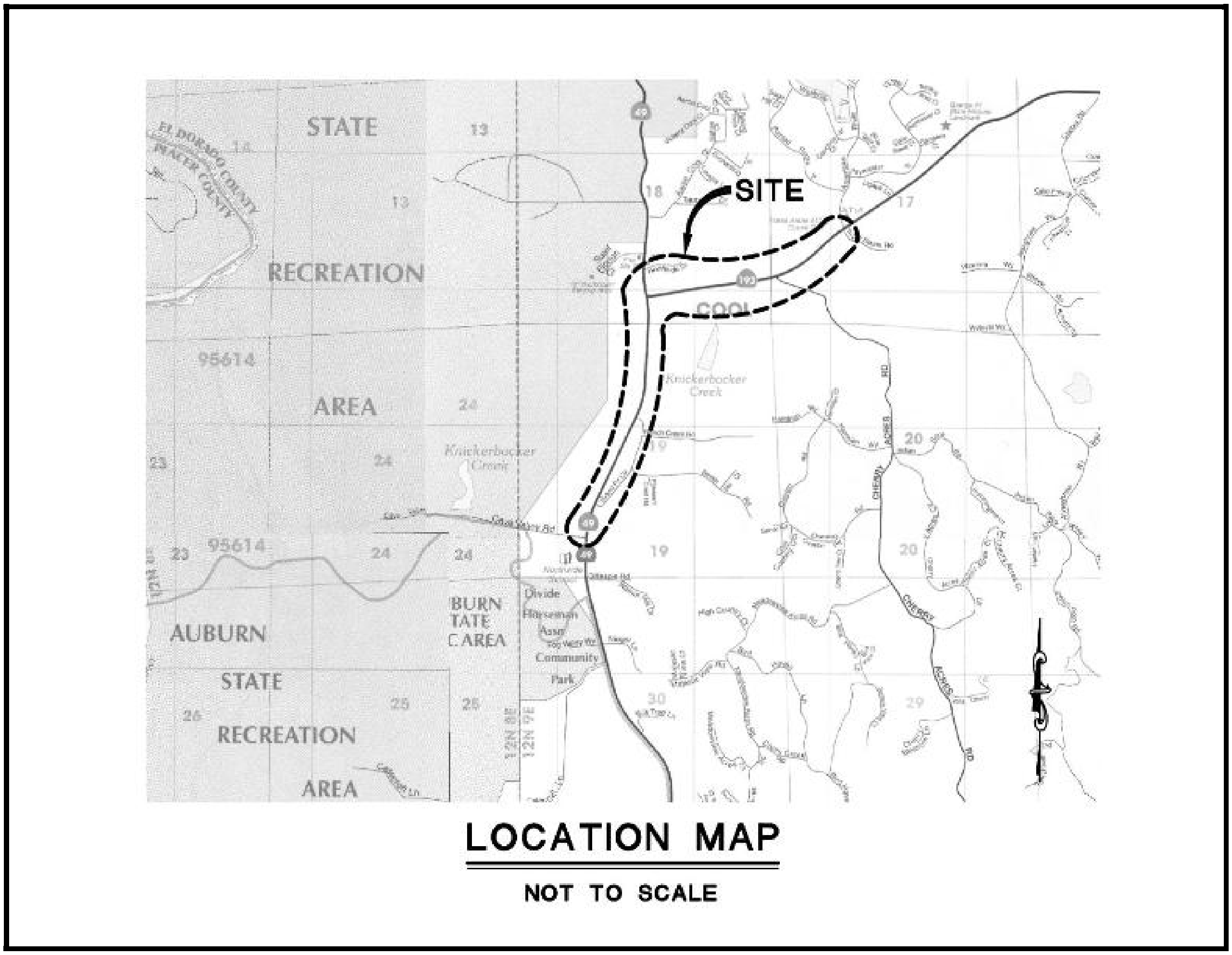
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning / Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Northside School Class I Bike Path - Phase 2 (SR49)

CIP Project Summary

Project No: 72306 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 4**



Project Description:

This second phase provides a Class 1 Bike Path along the west side of SR-49 from Northside School (Cave Valley Road) to SR-193. See project 72304 for Phase 1.

Original Budget: $1,385,000 Expenditures thru 6/30/2013: $607,760 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Northside School Class I Bike Path - Phase 2 (SR49)

Financing Plan & Tentative Schedule

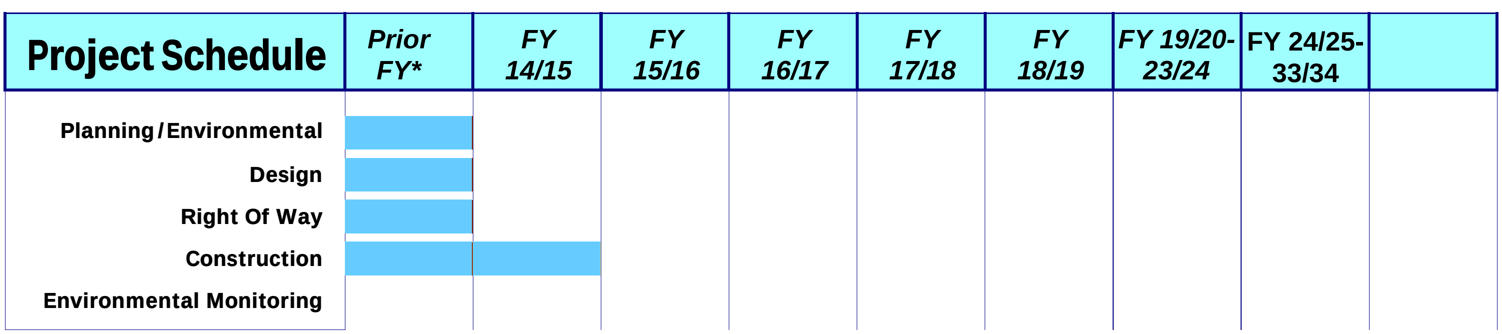
Project No: 72306 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Congestion Mitigation and Air Quality Program	$203	$406	$0	$0	$0	$0	$0	$0	$610
Public Lands Highway Discretionary (PLHD)	$30	$60	$0	$0	$0	$0	$0	$0	$90
RSTP Exchange Funds-Caltrans	$38	$0	$0	$0	$0	$0	$0	$0	$38
RSTP Exchange Funds-Rural-EDCTC	$129	$31	$0	$0	$0	$0	$0	$0	$160
Safe Routes to School - State	$537	$363	$0	$0	$0	$0	$0	$0	$900
Transportation Development Act (TDA)	$135	$5	$0	$0	$0	$0	$0	$0	$140
Total	$1,071	$865	$0	$0	$0	$0	$0	$0	$1,937

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$37	$0	$0	$0	$0	$0	$0	$0	$37
Planning/Env - Staff	$3	$0	$0	$0	$0	$0	$0	$0	$3
Design - Consultant	$49	$0	$0	$0	$0	$0	$0	$0	$49
Design - Staff	$426	$0	$0	$0	$0	$0	$0	$0	$426
Right of Way - Acquisition	$23	$0	$0	$0	$0	$0	$0	$0	$23
Right of Way - Consultant	$23	$0	$0	$0	$0	$0	$0	$0	$23
Right of Way - Staff	$78	$0	$0	$0	$0	$0	$0	$0	$78
Construction Mgmt - Consultant	$35	$70	$0	$0	$0	$0	$0	$0	$105
Construction Mgmt - Staff	$39	$78	$0	$0	$0	$0	$0	$0	$117
Direct Construction Costs	$359	$718	$0	$0	$0	$0	$0	$0	$1,076
Total	$1,072	$865	$0	$0	$0	$0	$0	$0	$1,937

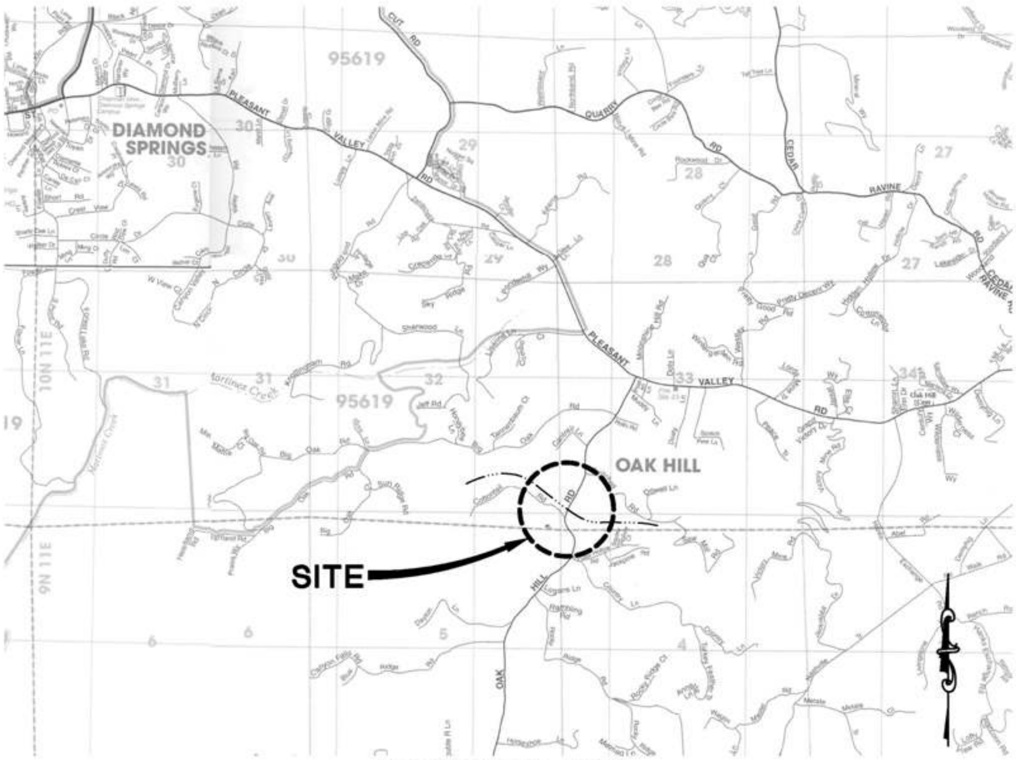


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Oak Hill Road at Squaw Hollow Creek - Bridge Replacement

CIP Project Summary

Project No: 77134 **Type: Bridge** **Supervisor District(s) 3**



LOCATION MAP
OAK HILL RD AT SQUAW HOLLOW CREEK
BRIDGE NO. 25C0096
NOT TO SCALE

Project Description:

Project includes replacement or rehabilitation of the bridge at the Squaw Hollow Creek crossing, widening and improvements at the bridge approaches.

Original Budget: $3,960,250 Expenditures thru 6/30/2013: $4,521 Project Initiation Date: 04/17/12

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Oak Hill Road at Squaw Hollow Creek - Bridge Replacement

Financing Plan & Tentative Schedule

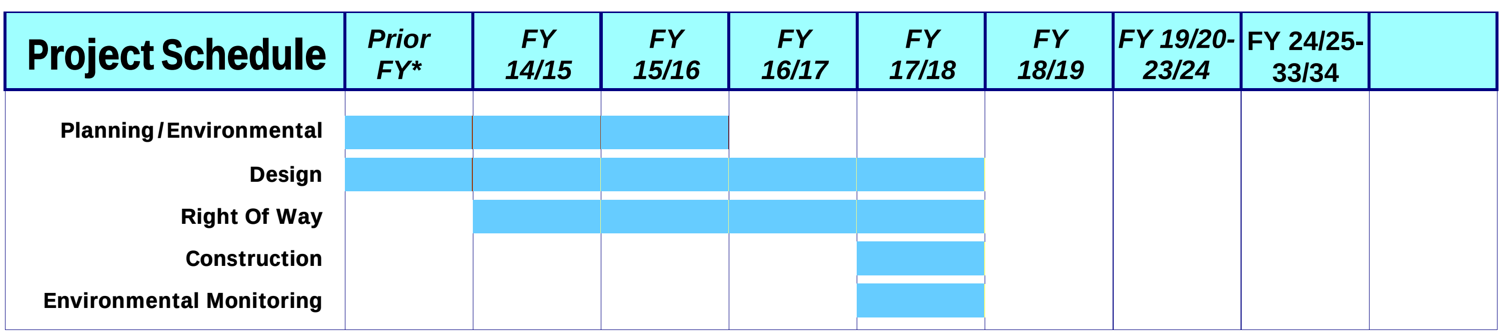
Project No: 77134 **Type: Bridge** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$82*	*$339*	*$263*	*$87*	*$3,189*	*$0*	*$0*	*$0*	*$3,960*
Total	*$82*	*$339*	*$263*	*$87*	*$3,189*	*$0*	*$0*	*$0*	*$3,960*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$0*	*$95*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$100*
Planning/Env - Staff	*$33*	*$15*	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$50*
Design - Consultant	*$0*	*$60*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$75*
Design - Staff	*$50*	*$151*	*$160*	*$35*	*$35*	*$0*	*$0*	*$0*	*$431*
Right of Way - Acquisition	*$0*	*$0*	*$10*	*$20*	*$20*	*$0*	*$0*	*$0*	*$50*
Right of Way - Consultant	*$0*	*$10*	*$50*	*$22*	*$22*	*$0*	*$0*	*$0*	*$104*
Right of Way - Staff	*$0*	*$8*	*$20*	*$10*	*$10*	*$0*	*$0*	*$0*	*$48*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$25*	*$0*	*$0*	*$0*	*$25*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$422*	*$0*	*$0*	*$0*	*$422*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$2,625*	*$0*	*$0*	*$0*	*$2,625*
Env Monitoring - Consultant	*$0*	*$0*	*$0*	*$0*	*$25*	*$0*	*$0*	*$0*	*$25*
Env Monitoring - Staff	*$0*	*$0*	*$0*	*$0*	*$5*	*$0*	*$0*	*$0*	*$5*
Total	*$83*	*$339*	*$263*	*$87*	*$3,189*	*$0*	*$0*	*$0*	*$3,960*

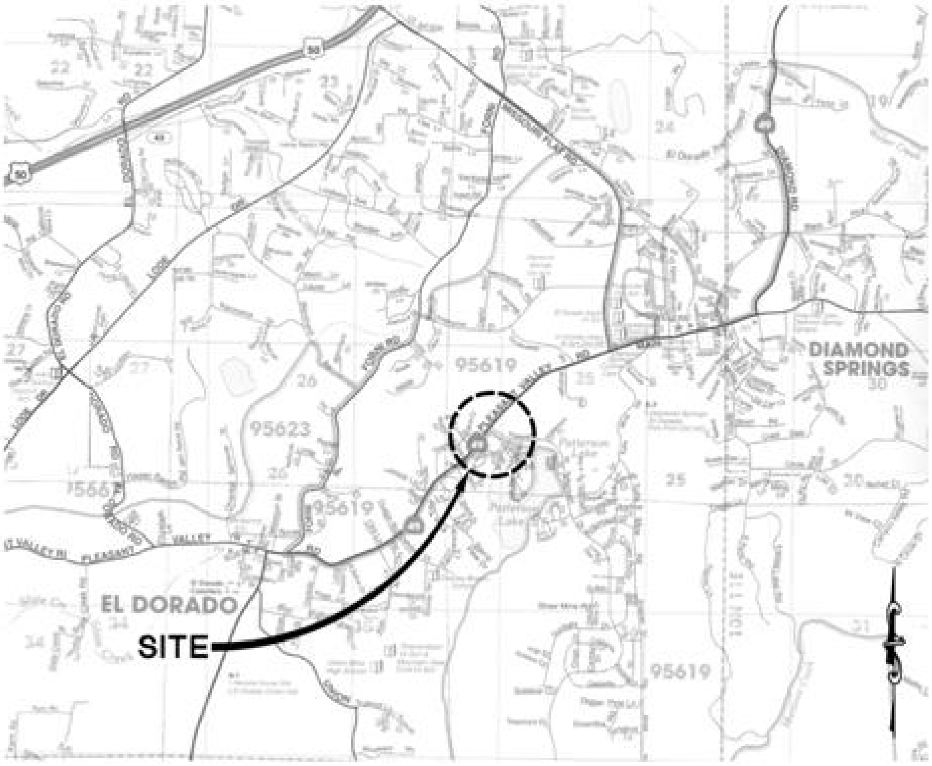


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road (SR 49)/Patterson Drive Intersection Signalization

CIP Project Summary

Project No: 73320 | **Type: Intersection** | **Supervisor District(s) 3**



Project Description:

Signalize intersection including channelization and construction of associated improvements. County requested Caltrans participation on two SR 49 legs as operational and safety improvement project. Caltrans agrees to fund $1M in Minor B SHOPP Funds. Future industrial development proposes to build 4th leg of intersection. Project is currently in design phase.

Original Budget: $6,557,966 Expenditures thru 6/30/2013: $1,789,609 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road (SR 49)/Patterson Drive Intersection Signalization

Financing Plan & Tentative Schedule

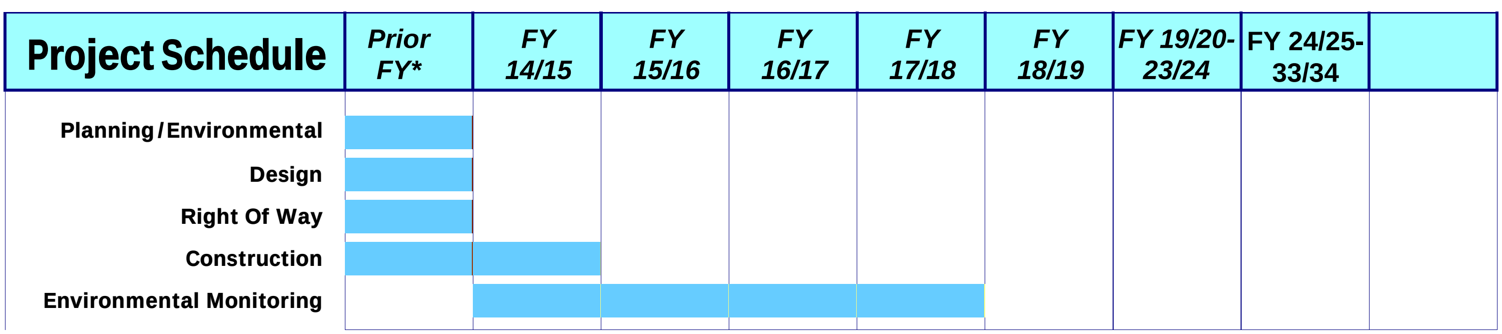
Project No: 73320 | **Type: Intersection** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Developer In-Lieu Fees	$150	$0	$0	$0	$0	$0	$0	$0	$150
RIF - El Dorado / Diamond Springs	$139	$0	$0	$0	$0	$0	$0	$0	$139
Road Fund/Discretionary	$75	$0	$0	$0	$0	$0	$0	$0	$75
SHOPP Funds	$1,000	$0	$0	$0	$0	$0	$0	$0	$1,000
State Transportation Impact Mitigation Fee	$25	$0	$0	$0	$0	$0	$0	$0	$25
State-Local Partnership Program (SLPP)	$550	$0	$0	$0	$0	$0	$0	$0	$550
Traffic Impact Mitigation Fee (West Slope)	$1,930	$1,026	$5	$5	$10	$0	$0	$0	$2,974
Total	$3,869	$1,026	$5	$5	$10	$0	$0	$0	$4,913

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$94	$0	$0	$0	$0	$0	$0	$0	$94
Planning/Env - Staff	$256	$0	$0	$0	$0	$0	$0	$0	$256
Design - Consultant	$26	$0	$0	$0	$0	$0	$0	$0	$26
Design - Staff	$917	$0	$0	$0	$0	$0	$0	$0	$917
Right of Way - Acquisition	$250	$0	$0	$0	$0	$0	$0	$0	$250
Right of Way - Consultant	$164	$0	$0	$0	$0	$0	$0	$0	$164
Right of Way - Staff	$301	$0	$0	$0	$0	$0	$0	$0	$301
Construction Mgmt - Consultant	$127	$100	$0	$0	$0	$0	$0	$0	$227
Construction Mgmt - Staff	$135	$106	$0	$0	$0	$0	$0	$0	$241
Direct Construction Costs	$1,600	$816	$0	$0	$0	$0	$0	$0	$2,416
Env Monitoring - Consultant	$0	$2	$4	$4	$8	$0	$0	$0	$18
Env Monitoring - Staff	$0	$2	$1	$1	$2	$0	$0	$0	$5
Total	$3,869	$1,026	$5	$5	$10	$0	$0	$0	$4,913

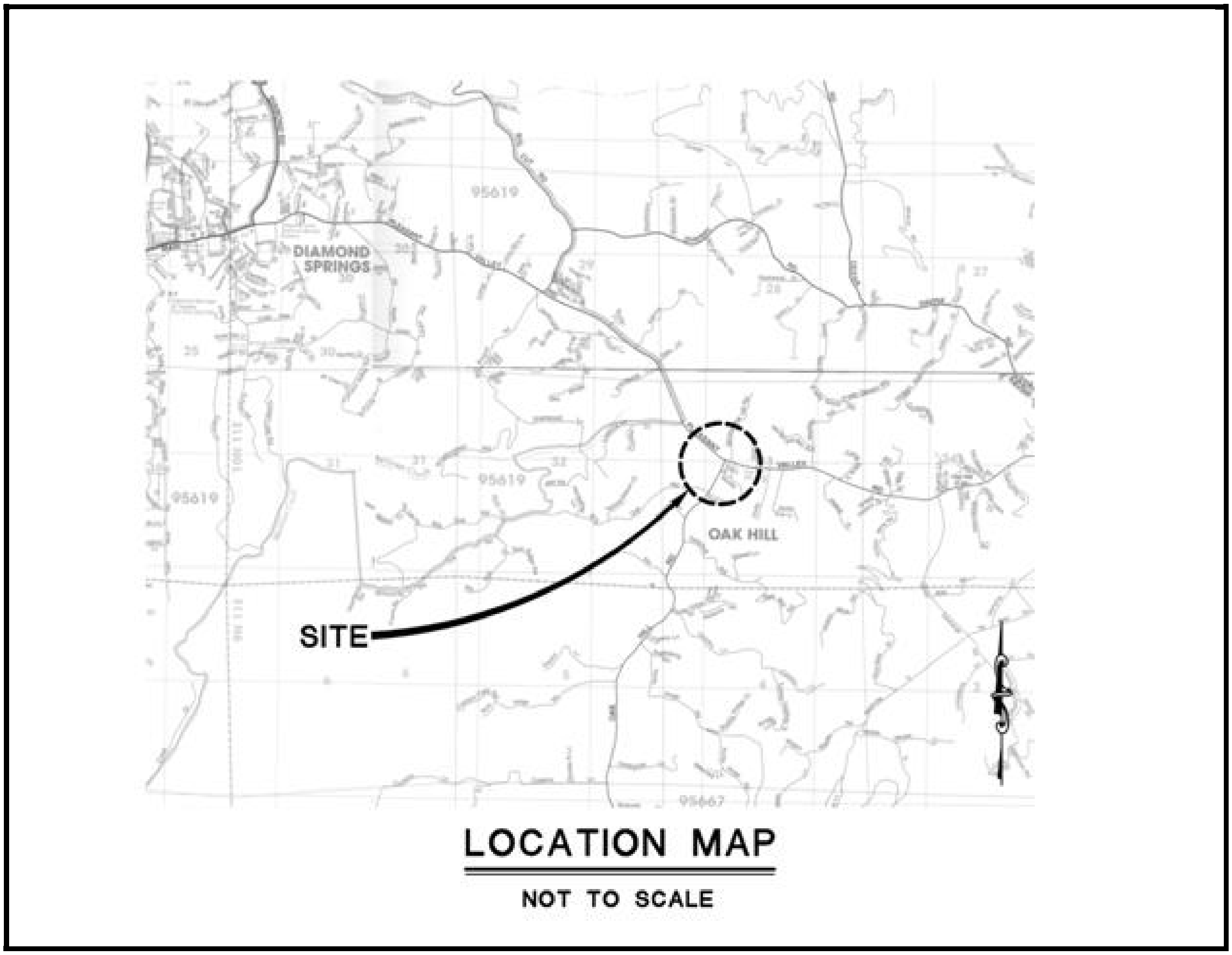


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road at Oak Hill Road Intersection Improvements

CIP Project Summary

Project No: 73358 **Type: Intersection** **Supervisor District(s) 3**



Project Description:

Intersection improvements including alignment improvements, widened shoulders on the north side and additional turn lanes.

Original Budget: $1,081,000 Expenditures thru 6/30/2013: $404,062 Project Initiation Date: 04/27/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road at Oak Hill Road Intersection Improvements

Financing Plan & Tentative Schedule

Project No: 73358 | **Type: Intersection** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Safety Improvement Program	$383	$517	$0	$0	$0	$0	$0	$0	$900
Road Fund/Discretionary	($12)	$0	$0	$0	$0	$0	$0	$0	($12)
RSTP Exchange Funds-Caltrans	$43	$0	$0	$0	$0	$0	$0	$0	$43
RSTP Exchange Funds-Rural-EDCTC	$0	$58	$0	$0	$0	$0	$0	$0	$58
Traffic Impact Mitigation Fee (West Slope)	$65	$142	$0	$0	$0	$0	$0	$0	$207
Total	$478	$717	$0	$0	$0	$0	$0	$0	$1,195

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$8	$0	$0	$0	$0	$0	$0	$0	$8
Planning/Env - Staff	$74	$0	$0	$0	$0	$0	$0	$0	$74
Design - Consultant	$4	$0	$0	$0	$0	$0	$0	$0	$4
Design - Staff	$225	$10	$0	$0	$0	$0	$0	$0	$235
Right of Way - Acquisition	$12	$0	$0	$0	$0	$0	$0	$0	$12
Right of Way - Consultant	$12	$0	$0	$0	$0	$0	$0	$0	$12
Right of Way - Staff	$83	$0	$0	$0	$0	$0	$0	$0	$83
Construction Mgmt - Consultant	$0	$23	$0	$0	$0	$0	$0	$0	$23
Construction Mgmt - Staff	$9	$74	$0	$0	$0	$0	$0	$0	$83
Direct Construction Costs	$50	$610	$0	$0	$0	$0	$0	$0	$660
Total	$478	$717	$0	$0	$0	$0	$0	$0	$1,195

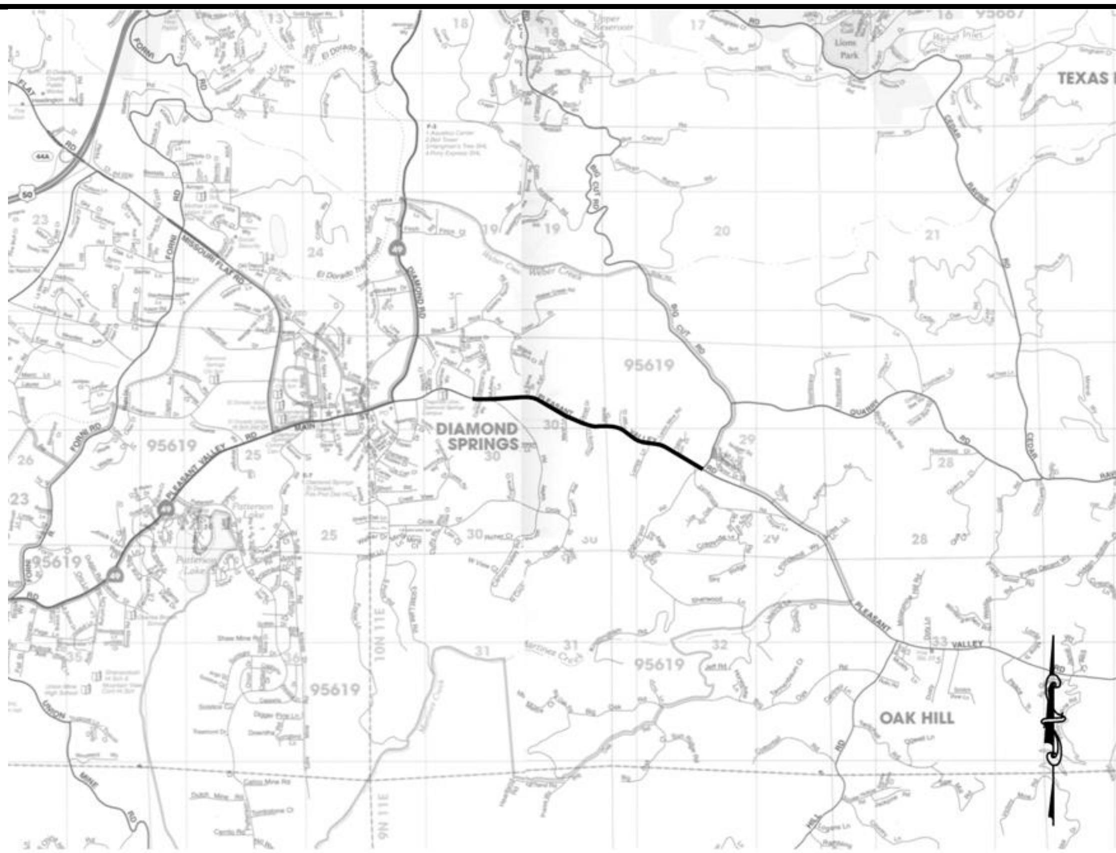
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental	■								
Design	■	■							
Right Of Way	■								
Construction	■	■							
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road Widening - Pearl Place to Big Cut Road in Diamond Springs

CIP Project Summary

Project No: GP173 | **Type: Roadway** | **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

In Diamond Springs, widening of Pleasant Valley Road to accommodate three left-turn pockets, 0.5 miles of 2-way left turn lane and shoulder widening. Part of this project was completed in project 73318.

Original Budget: $2,200,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road Widening - Pearl Place to Big Cut Road in Diamond Springs

Financing Plan & Tentative Schedule

Project No: GP173 **Type: Roadway** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$2,710	$2,710
Total	$0	$0	$0	$0	$0	$0	$0	$2,710	$2,710

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$86	$86
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$330	$330
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$420	$420
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$29	$29
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$180	$180
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$1,650	$1,650
Total	$0	$0	$0	$0	$0	$0	$0	$2,710	$2,710

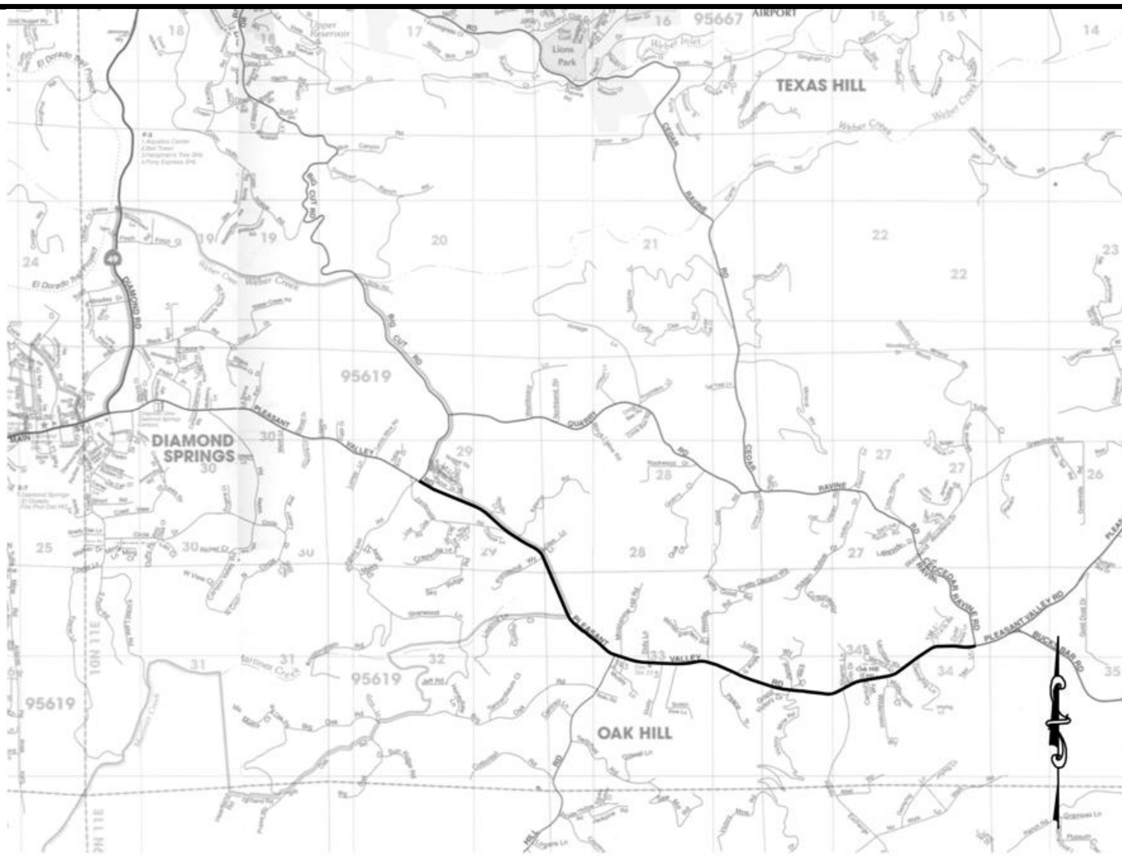
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road Widening from Big Cut Road to Cedar Ravine Road

CIP Project Summary

Project No: GP174 | **Type: Roadway** | **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Widening of Pleasant Valley Road from Big Cut Road to Cedar Ravine Road to accommodate seven left-turn pockets.

Original Budget: $3,700,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road Widening from Big Cut Road to Cedar Ravine Road

Financing Plan & Tentative Schedule

Project No: GP174 **Type: Roadway** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$2,291	$2,291
Total	$0	$0	$0	$0	$0	$0	$0	$2,291	$2,291

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$82	$82
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$310	$310
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$70	$70
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$27	$27
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$170	$170
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$1,617	$1,617
Total	$0	$0	$0	$0	$0	$0	$0	$2,291	$2,291

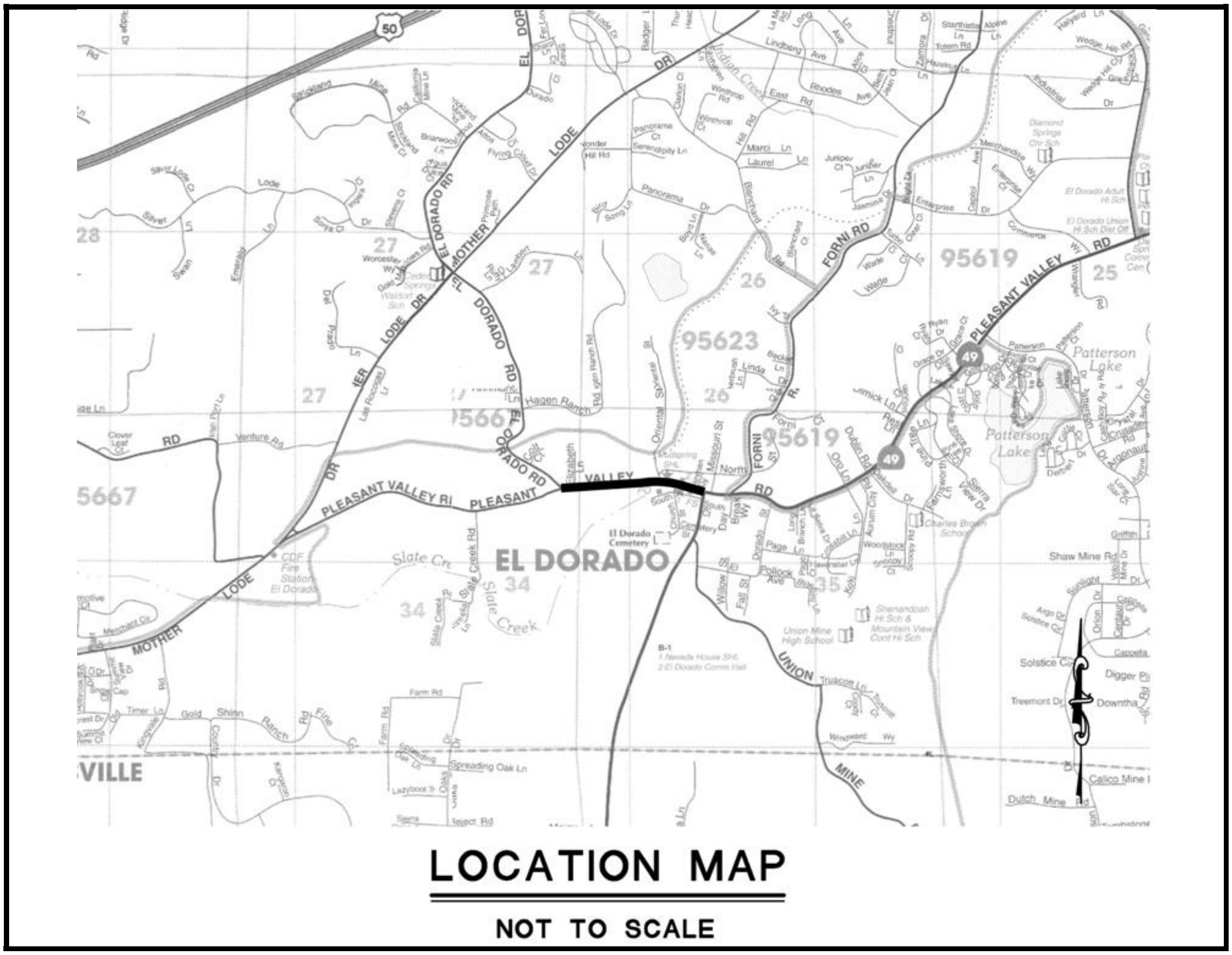
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road Widening from El Dorado Road to State Route 49

CIP Project Summary

Project No: GP160 | **Type: Roadway** | **Supervisor District(s) 3**



Project Description:

In the town of El Dorado, widen Pleasant Valley Road from El Dorado Road east to State Route 49 to accommodate 0.25 miles of two-way left turn lane at the west end and widening shoulders throughout.

Original Budget: $1,300,000   Expenditures thru 6/30/2013: $0   Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Pleasant Valley Road Widening from El Dorado Road to State Route 49

Financing Plan & Tentative Schedule

Project No: GP160 | **Type: Roadway** | **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,099*	*$1,099*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,099*	*$1,099*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$31*	*$31*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$120*	*$120*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$210*	*$210*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5*	*$5*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$10*	*$10*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$63*	*$63*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$660*	*$660*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,099*	*$1,099*

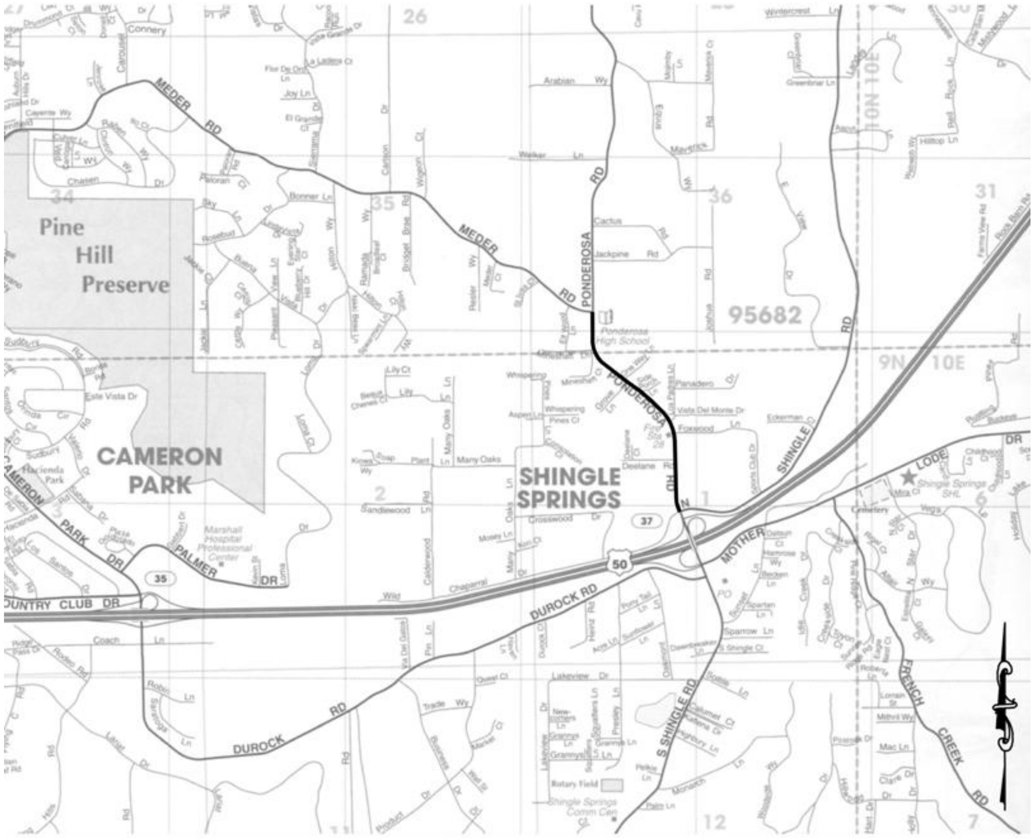
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Ponderosa Road Widening from North Shingle Road to Meder Road

CIP Project Summary

Project No: GP175 **Type: Roadway** **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Widening of Ponderosa Road from North Shingle Road to Meder Road to accommodate four left-turn pockets and 0.3 miles of dual left turn lane as well as shoulder repair and widening.

Original Budget: $3,700,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Ponderosa Road Widening from North Shingle Road to Meder Road

Financing Plan & Tentative Schedule

Project No: GP175 **Type: Roadway** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$2,798	$2,798
Total	$0	$0	$0	$0	$0	$0	$0	$2,798	$2,798

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$86	$86
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$330	$330
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$420	$420
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$29	$29
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$180	$180
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$1,738	$1,738
Total	$0	$0	$0	$0	$0	$0	$0	$2,798	$2,798

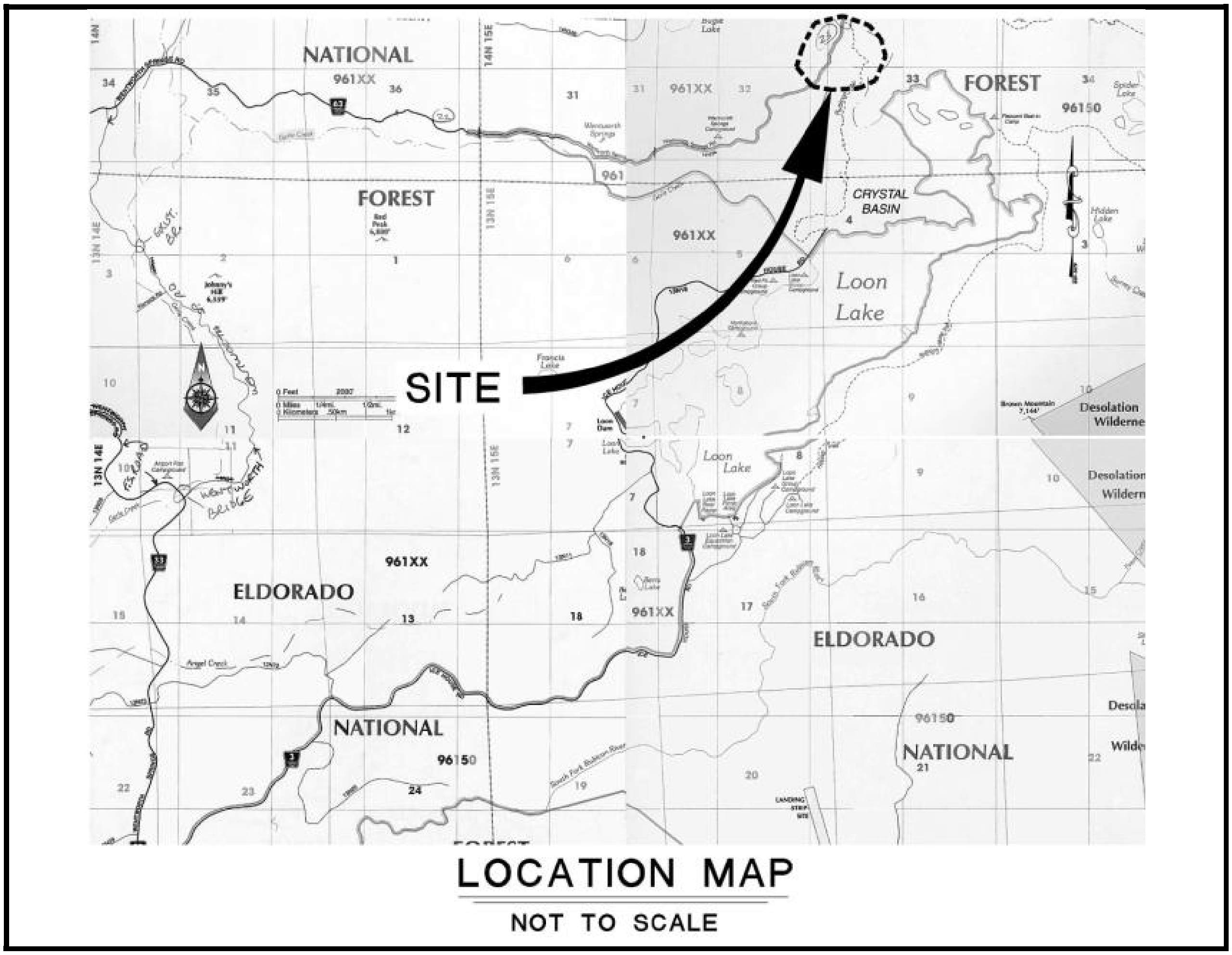
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Rubicon Trail at Ellis Creek - Bridge Replacement

CIP Project Summary

Project No: 77117 | **Type: Bridge** | **Supervisor District(s) 4**



Project Description:

Project includes replacement of a low water crossing at Ellis Creek with a new bridge, minor realignment of the Rubicon Trail at the bridge approaches, erosion control along the trail and restoration work at the existing low water crossing.

Original Budget: $963,000 Expenditures thru 6/30/2013: $435,528 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Rubicon Trail at Ellis Creek - Bridge Replacement

Financing Plan & Tentative Schedule

Project No: 77117 **Type: Bridge** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Highway Bridge Program	*$978*	*$29*	*$29*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,036*
Off Highway Vehicle Grant	*$93*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$93*
RSTP Exchange Funds-Caltrans	*$91*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$91*
SMUD Upper American River Project Coop Agreement	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$30*
Total	*$1,191*	*$29*	*$29*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,249*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$121*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$121*
Planning/Env - Staff	*$167*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$167*
Design - Consultant	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5*
Design - Staff	*$116*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$116*
Right of Way - Staff	*$2*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2*
Construction Mgmt - Staff	*$80*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$80*
Direct Construction Costs	*$701*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$701*
Env Monitoring - Consultant	*$0*	*$23*	*$23*	*$0*	*$0*	*$0*	*$0*	*$0*	*$46*
Env Monitoring - Staff	*$0*	*$6*	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$12*
Total	*$1,191*	*$29*	*$29*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,249*

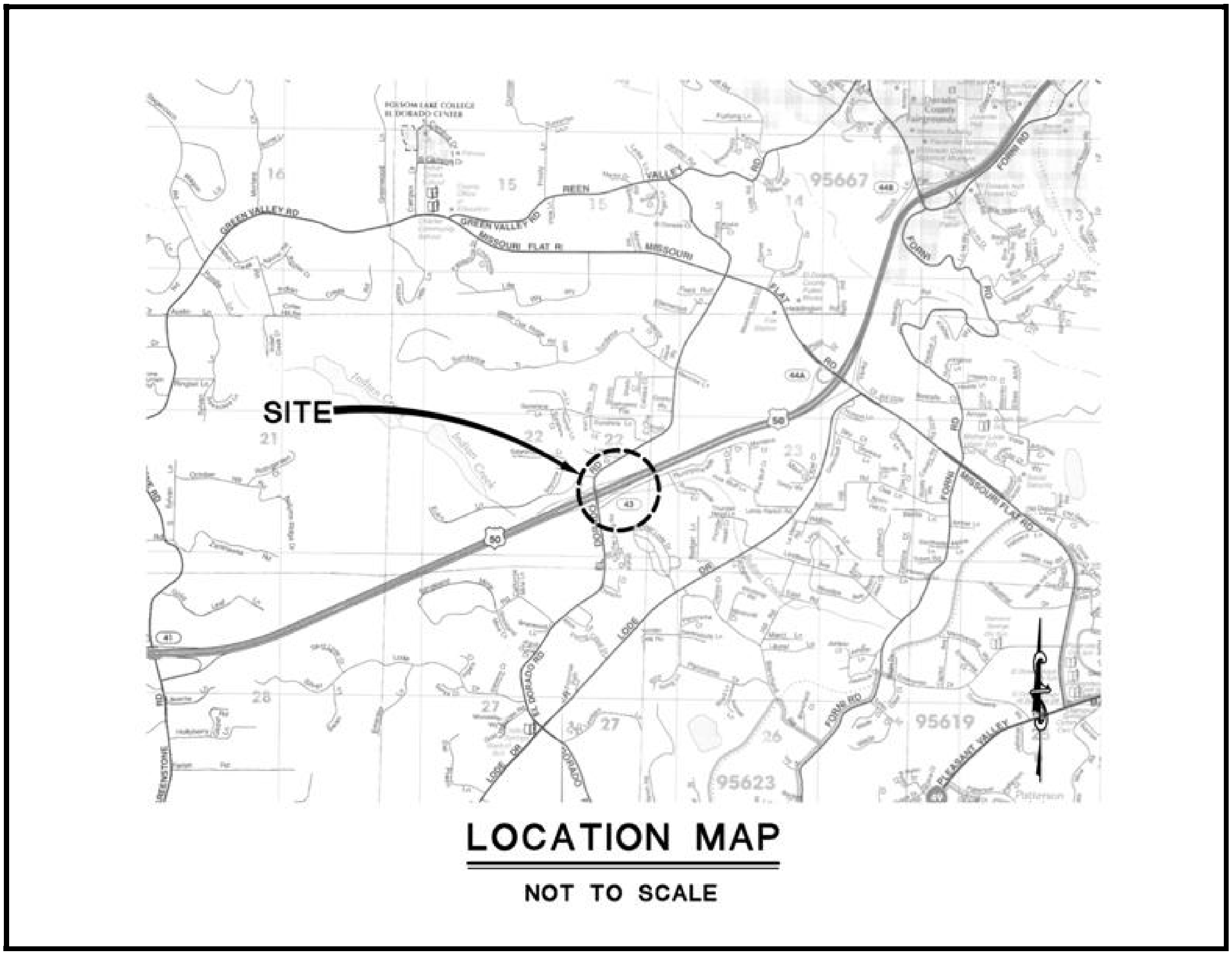
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Runnymeade Drive Realignment at El Dorado Road

CIP Project Summary

Project No: GP130 | **Type: Roadway** | **Supervisor District(s) 3**



Project Description:

This project will relocate the intersection of Runnymeade Drive and El Dorado Road. Construction will consist of realigning 1000 linear feet of Runnymeade so that it is 500 feet south of U.S. 50.

Original Budget: $2,200,000   Expenditures thru 6/30/2013: $0   Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Runnymeade Drive Realignment at El Dorado Road

Financing Plan & Tentative Schedule

Project No: GP130 **Type: Roadway** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,902*	*$1,902*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,902*	*$1,902*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$296*	*$296*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$160*	*$160*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,446*	*$1,446*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,902*	*$1,902*

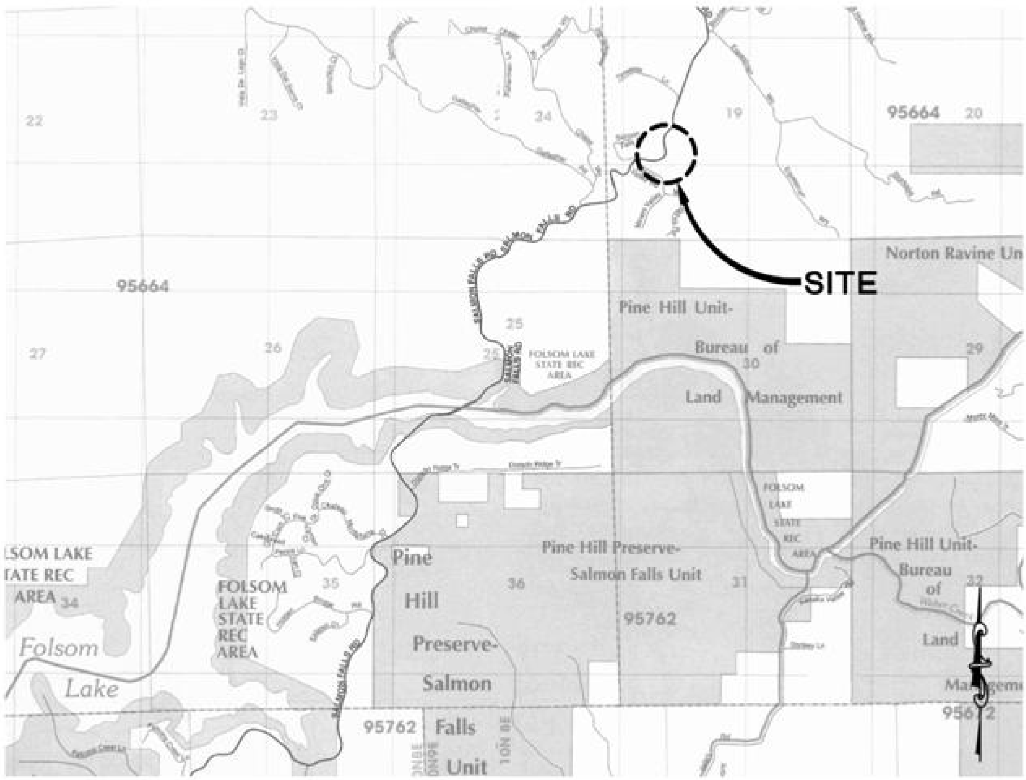
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	**FY 24/25-33/34**	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Salmon Falls Road South of Glenesk Lane Realignment

CIP Project Summary

Project No: 73362 | **Type: Roadway** | **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Realign horizontal and vertical curves between mile posts 7.79 and 7.89, widen the roadway, add shoulders, superelevate the curve, improve drainage, and add flashing beacon warning signs and rumble strips.

Original Budget: $1,133,000 Expenditures thru 6/30/2013: $310,172 Project Initiation Date: 04/27/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Salmon Falls Road South of Glenesk Lane Realignment

Financing Plan & Tentative Schedule

Project No: 73362 **Type: Roadway** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Safety Improvement Program	$233	$671	$0	$0	$0	$0	$0	$0	$904
RSTP Exchange Funds-Caltrans	$199	$369	$0	$0	$0	$0	$0	$0	$568
Total	$432	$1,040	$0	$0	$0	$0	$0	$0	$1,472

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$56	$0	$0	$0	$0	$0	$0	$0	$56
Planning/Env - Staff	$136	$0	$0	$0	$0	$0	$0	$0	$136
Design - Consultant	$15	$0	$0	$0	$0	$0	$0	$0	$15
Design - Staff	$130	$35	$0	$0	$0	$0	$0	$0	$165
Right of Way - Acquisition	$5	$5	$0	$0	$0	$0	$0	$0	$10
Right of Way - Consultant	$34	$2	$0	$0	$0	$0	$0	$0	$36
Right of Way - Staff	$57	$5	$0	$0	$0	$0	$0	$0	$62
Construction Mgmt - Consultant	$0	$80	$0	$0	$0	$0	$0	$0	$80
Construction Mgmt - Staff	$0	$50	$0	$0	$0	$0	$0	$0	$50
Direct Construction Costs	$0	$863	$0	$0	$0	$0	$0	$0	$863
Total	$432	$1,040	$0	$0	$0	$0	$0	$0	$1,472

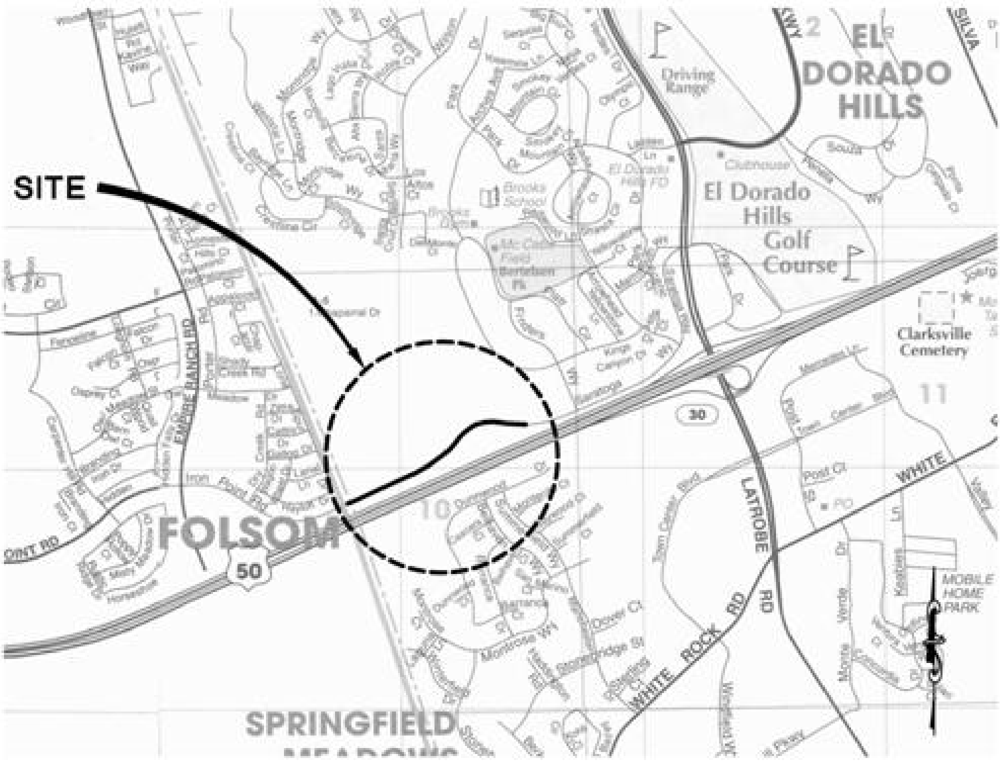
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Saratoga Way Extension - Phase 1

CIP Project Summary

Project No: 71324 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Phase 1 will construct a new two-lane (including median and standard 6 foot shoulders) arterial road to extend Saratoga Way from the current terminus at the Sacramento County Line to Finders Way. Other improvements include grading for the ultimate project, a two-way left lane from Finders Way to Arrowhead, installing asphalt concrete path at north side of the roadway and drainage systems for the ultimate project. Project will environmentally clear and secure ROW for future four-lane road from County Line to El Dorado Hills Boulevard.

Original Budget: $14,960,000 Expenditures thru 6/30/2013: $1,088,397 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Saratoga Way Extension - Phase 1

Financing Plan & Tentative Schedule

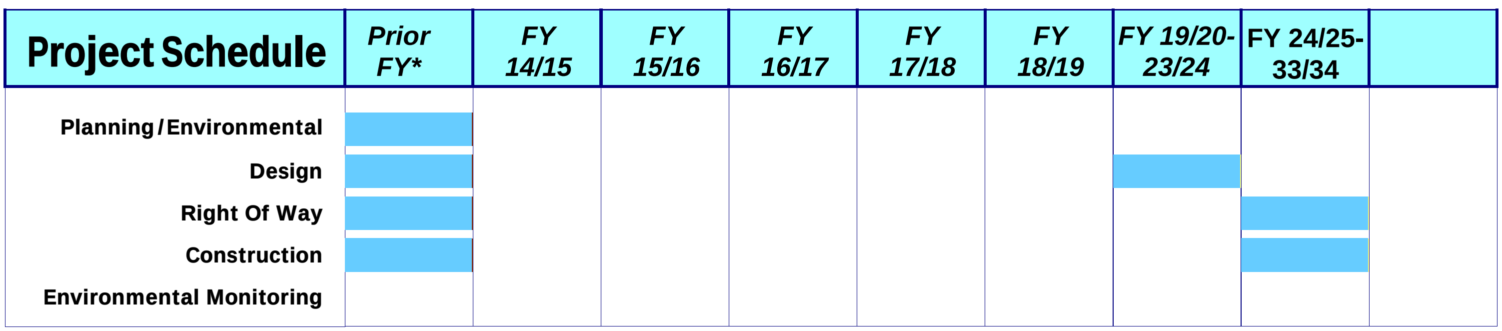
Project No: 71324 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$1,088*	*$0*	*$0*	*$0*	*$0*	*$0*	*$358*	*$10,095*	*$11,541*
Total	*$1,088*	*$0*	*$0*	*$0*	*$0*	*$0*	*$358*	*$10,095*	*$11,541*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$339*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$339*
Planning/Env - Staff	*$333*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$333*
Design - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$28*	*$0*	*$28*
Design - Staff	*$398*	*$0*	*$0*	*$0*	*$0*	*$0*	*$330*	*$0*	*$728*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,300*	*$4,300*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$30*	*$30*
Right of Way - Staff	*$14*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$40*	*$54*
Construction Mgmt - Consultant	*$4*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$100*	*$104*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$600*	*$600*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,025*	*$5,025*
Total	*$1,088*	*$0*	*$0*	*$0*	*$0*	*$0*	*$358*	*$10,095*	*$11,541*

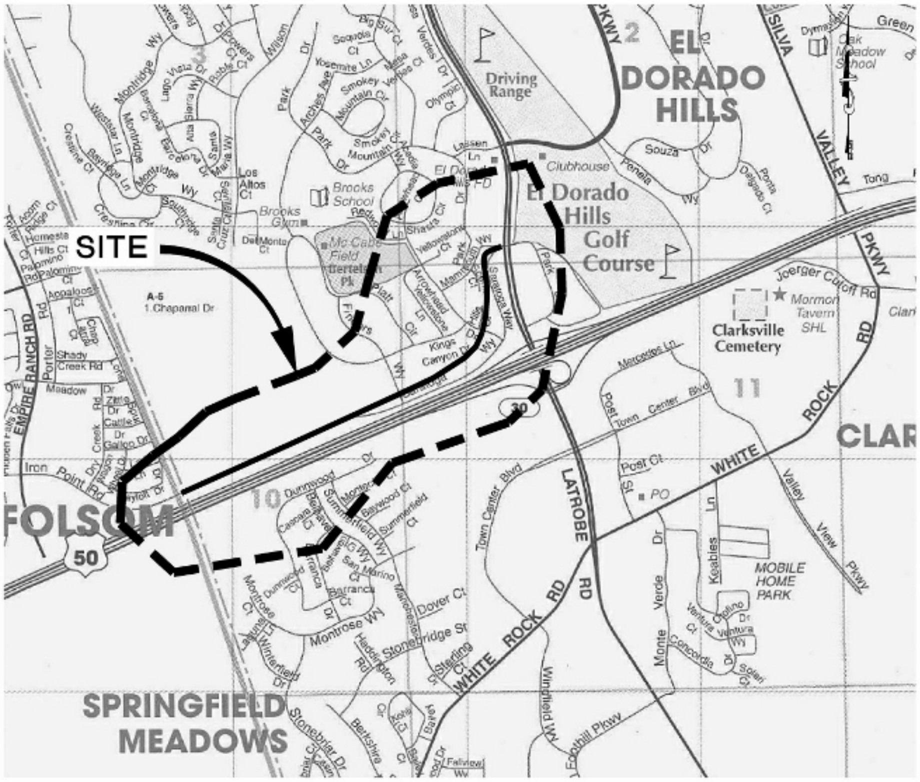


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Saratoga Way Extension - Phase 2

CIP Project Summary

Project No: GP147 | **Type: Roadway** | **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Phase 2 will widen the existing two-lane road to four-lanes from the Sacramento County line to El Dorado Hills Boulevard with full curb, gutter and sidewalk. Environmental clearance and preliminary engineering will be completed under Phase 1 project CIP#71324.

Original Budget: $5,100,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Saratoga Way Extension - Phase 2

Financing Plan & Tentative Schedule

Project No: GP147 | **Type: Roadway** | **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,638*	*$4,638*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,638*	*$4,638*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$133*	*$133*
Design - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$503*	*$503*
Right of Way - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$44*	*$44*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$546*	*$546*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,412*	*$3,412*
Total	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,638*	*$4,638*

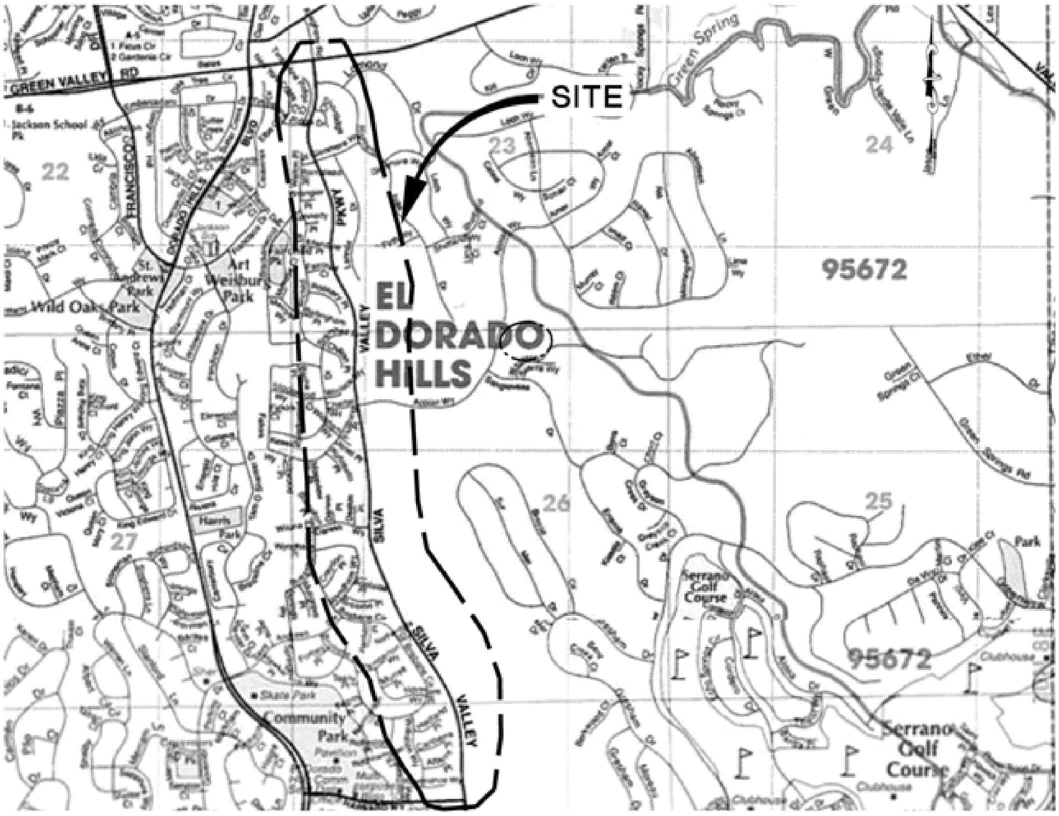
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silva Valley Parkway Class 1 and Class 2 Bike Lanes (Harvard to Green Valley)

CIP Project Summary

Project No: 72310 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Design and construct 1.1 miles of Class I Bike Path east of Silva Valley Parkway, from Harvard Way to the Appian Way intersection at Silva Valley Parkway. The project would also construct approximately 0.9 miles of Class II Bike Lane along northbound and southbound Silva Valley Parkway from the Appian Way intersection to Green Valley Road. The project would include a Class II bike lane along southbound Silva Valley Parkway from Appian Way to Harvard Way.

Original Budget: $1,678,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 03/18/14

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silva Valley Parkway Class 1 and Class 2 Bike Lanes (Harvard to Green Valley)

Financing Plan & Tentative Schedule

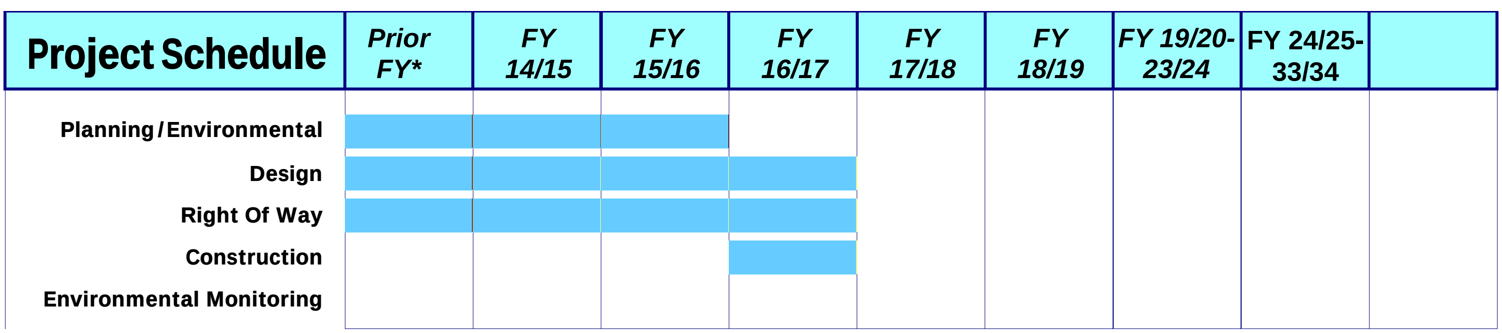
Project No: 72310 | **Type: Pedestrian Way and Bike Path** | **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Congestion Mitigation and Air Quality Program	*$91*	*$163*	*$96*	*$1,135*	*$0*	*$0*	*$0*	*$0*	*$1,486*
To Be Determined	*$12*	*$21*	*$13*	*$147*	*$0*	*$0*	*$0*	*$0*	*$192*
Total	*$103*	*$184*	*$109*	*$1,282*	*$0*	*$0*	*$0*	*$0*	*$1,678*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$58*	*$47*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$105*
Planning/Env - Staff	*$22*	*$53*	*$22*	*$0*	*$0*	*$0*	*$0*	*$0*	*$97*
Design - Staff	*$18*	*$41*	*$41*	*$23*	*$0*	*$0*	*$0*	*$0*	*$123*
Right of Way - Acquisition	*$0*	*$5*	*$27*	*$0*	*$0*	*$0*	*$0*	*$0*	*$32*
Right of Way - Consultant	*$0*	*$12*	*$7*	*$0*	*$0*	*$0*	*$0*	*$0*	*$19*
Right of Way - Staff	*$5*	*$26*	*$12*	*$14*	*$0*	*$0*	*$0*	*$0*	*$57*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$143*	*$0*	*$0*	*$0*	*$0*	*$143*
Direct Construction Costs	*$0*	*$0*	*$0*	*$1,102*	*$0*	*$0*	*$0*	*$0*	*$1,102*
Total	*$103*	*$184*	*$109*	*$1,282*	*$0*	*$0*	*$0*	*$0*	*$1,678*

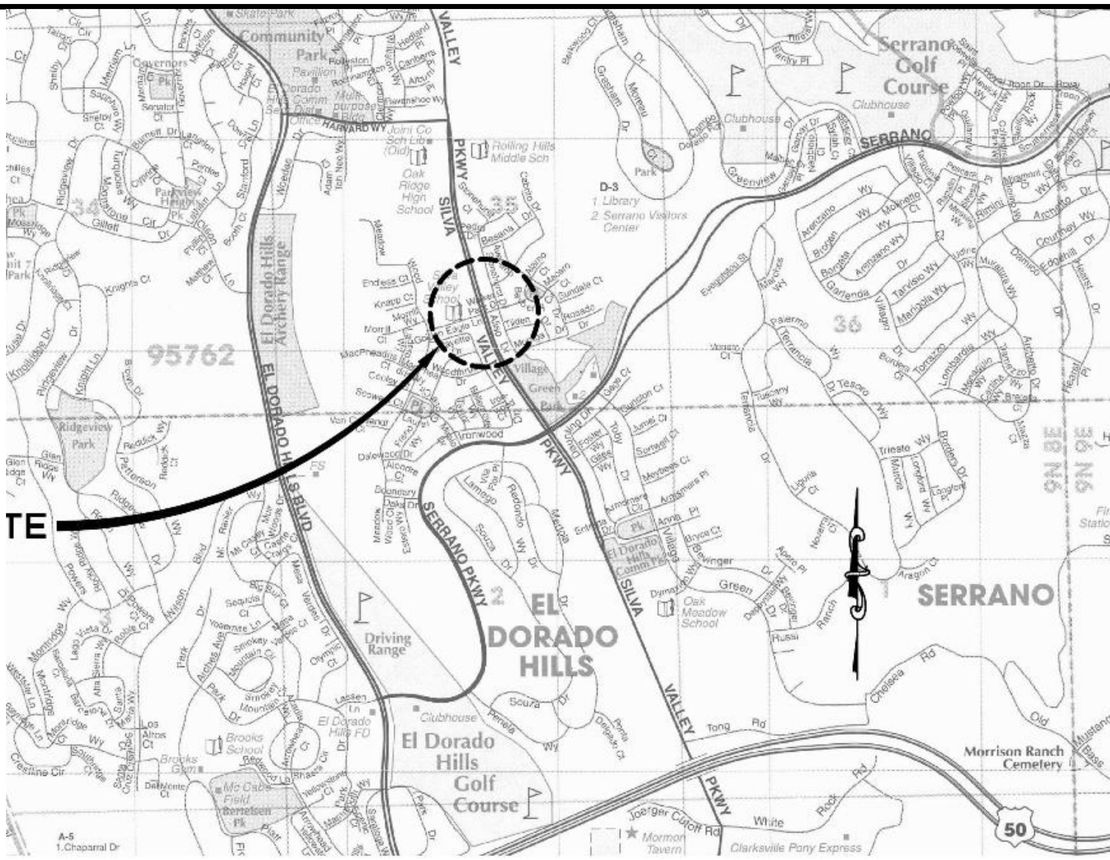


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silva Valley Parkway/Golden Eagle Lane Intersection Signalization

CIP Project Summary

Project No: GP182 | **Type: Intersection** | **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Signalize intersection at Silva Valley Parkway and Golden Eagle Lane. Project timing will need to be coordinated with school on-site improvements. This Project to be funded out of the TIM Fee Program line item for intersection signalization and safety improvements.

Original Budget: $768,000 | Expenditures thru 6/30/2013: $0 | Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silva Valley Parkway/Golden Eagle Lane Intersection Signalization

Financing Plan & Tentative Schedule

Project No: GP182 **Type: Intersection** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$0	$768	$768
Total	$0	$0	$0	$0	$0	$0	$0	$768	$768

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$25	$25
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$10	$10
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$90	$90
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$100	$100
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$10	$10
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$50	$50
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$10	$10
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$58	$58
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$400	$400
Total	$0	$0	$0	$0	$0	$0	$0	$768	$768

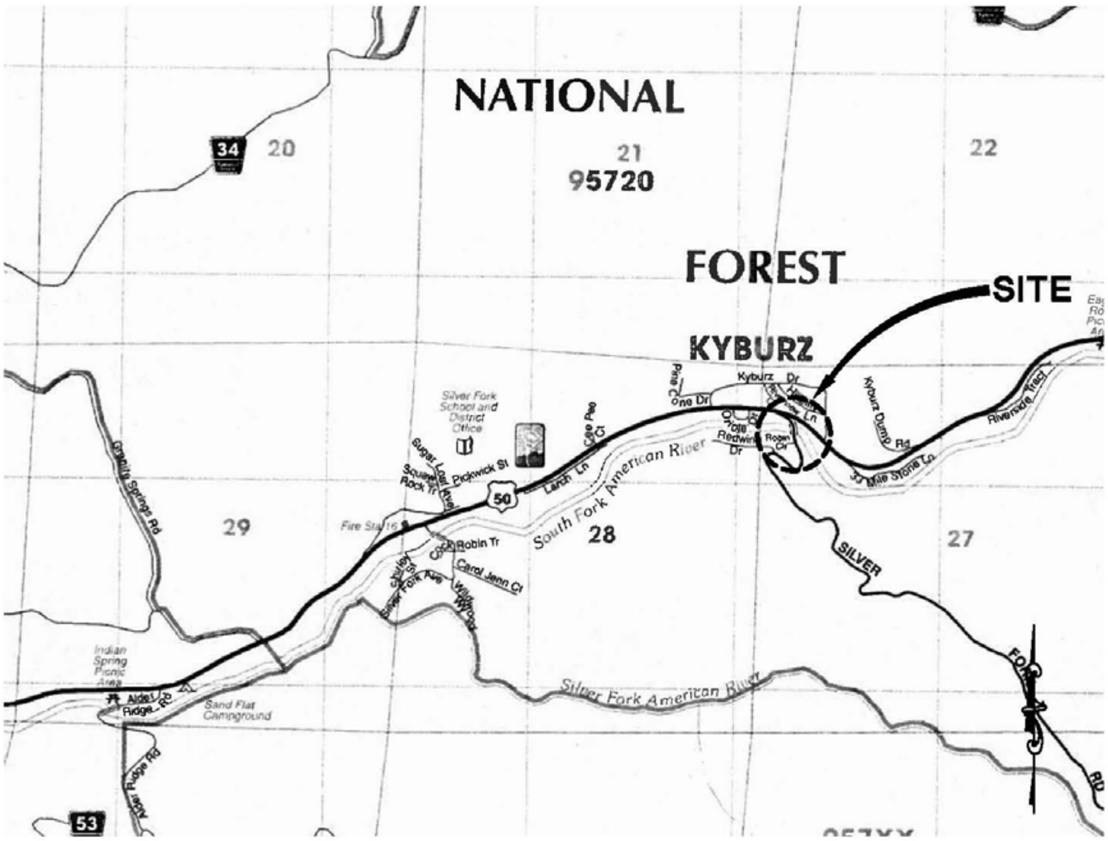
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silver Fork Road at South Fork American River - Bridge Rehabilitation

CIP Project Summary

Project No: 77124 | **Type: Bridge** | **Supervisor District(s) 5**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes rehabilitation of the bridge at the South Fork American River, including replacing the deck with a wider deck.

Original Budget: $4,275,000 | Expenditures thru 6/30/2013: $117,936 | Project Initiation Date: 12/16/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silver Fork Road at South Fork American River - Bridge Rehabilitation

Financing Plan & Tentative Schedule

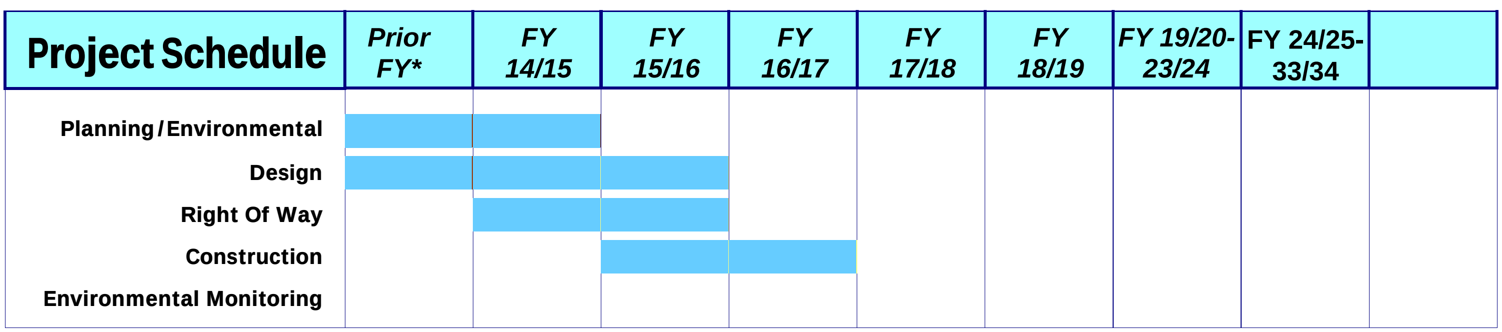
Project No: 77124 | **Type: Bridge** | **Supervisor District(s) 5**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$400	$228	$458	$1,164	$0	$0	$0	$0	$2,250
Utility Agencies	$10	$10	$13	$65	$0	$0	$0	$0	$97
Total	$409	$238	$471	$1,229	$0	$0	$0	$0	$2,347

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$164	$22	$0	$0	$0	$0	$0	$0	$186
Planning/Env - Staff	$130	$33	$0	$0	$0	$0	$0	$0	$163
Design - Consultant	$69	$80	$80	$0	$0	$0	$0	$0	$228
Design - Staff	$46	$31	$92	$0	$0	$0	$0	$0	$168
Right of Way - Acquisition	$0	$0	$6	$0	$0	$0	$0	$0	$6
Right of Way - Consultant	$0	$8	$0	$0	$0	$0	$0	$0	$8
Right of Way - Staff	$0	$65	$29	$0	$0	$0	$0	$0	$94
Construction Mgmt - Consultant	$0	$0	$21	$21	$0	$0	$0	$0	$42
Construction Mgmt - Staff	$0	$0	$38	$179	$0	$0	$0	$0	$217
Direct Construction Costs	$0	$0	$206	$1,030	$0	$0	$0	$0	$1,235
Total	$409	$238	$471	$1,229	$0	$0	$0	$0	$2,347

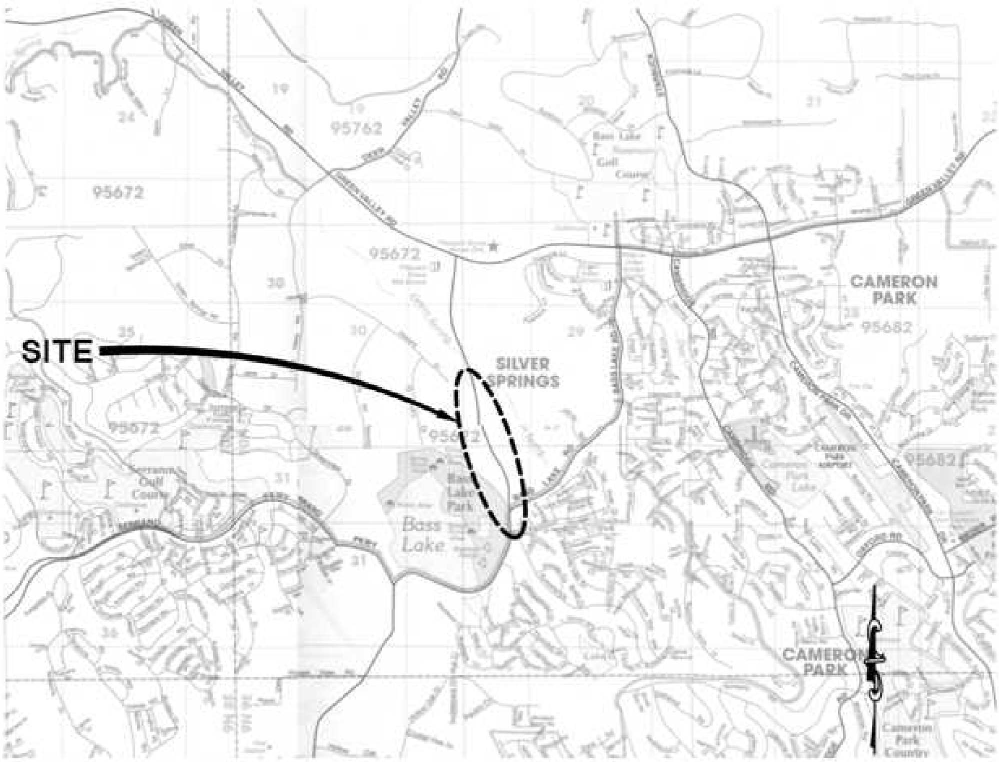


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silver Springs Pkwy to Bass Lake Rd (south segment)

CIP Project Summary

Project No: 76108 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Realign Bass Lake Road south of Green Valley Road through the proposed Silver Springs Subdivision, which is west of the existing Bass Lake Road. The new road is named Silver Springs Parkway. The Silver Springs Subdivision is responsible for building Silver Springs Parkway through the Subdivision. Silver Springs Parkway will be a two-lane standard divided roadway with shoulders.

Original Budget: $6,283,606 Expenditures thru 6/30/2013: $1,241,903 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silver Springs Pkwy to Bass Lake Rd (south segment)

Financing Plan & Tentative Schedule

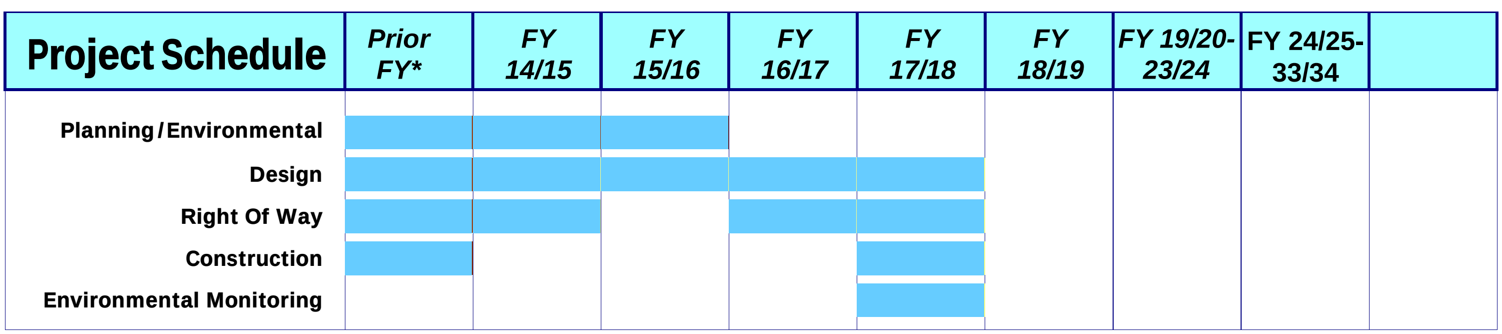
Project No: 76108 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP TIM	$0	$0	$0	$0	$1,400	$0	$0	$0	$1,400
Developer Advance TIM	$188	$0	$0	$0	$3,736	$0	$0	$0	$3,924
Developer Funded	$907	$0	$0	$0	$1,660	$0	$0	$0	$2,567
Road Fund/Discretionary	$1	$0	$0	$0	$0	$0	$0	$0	$1
Traffic Impact Mitigation Fee (West Slope)	$212	$203	$63	$187	$16	$0	$0	$0	$681
Total	$1,308	$203	$63	$187	$6,812	$0	$0	$0	$8,573

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$23	$154	$49	$0	$0	$0	$0	$0	$226
Planning/Env - Staff	$68	$39	$11	$0	$0	$0	$0	$0	$118
Design - Consultant	$14	$0	$0	$14	$0	$0	$0	$0	$28
Design - Staff	$164	$2	$3	$77	$88	$0	$0	$0	$334
Developer Advanced Design	$907	$0	$0	$0	$0	$0	$0	$0	$907
Right of Way - Acquisition	$1	$0	$0	$0	$960	$0	$0	$0	$961
Right of Way - Consultant	$51	$8	$0	$20	$0	$0	$0	$0	$79
Right of Way - Staff	$74	$0	$0	$76	$149	$0	$0	$0	$299
Construction Mgmt - Consultant	$0	$0	$0	$0	$350	$0	$0	$0	$350
Construction Mgmt - Staff	$8	$0	$0	$0	$400	$0	$0	$0	$408
Direct Construction Costs	$0	$0	$0	$0	$4,650	$0	$0	$0	$4,650
Env Monitoring - Consultant	$0	$0	$0	$0	$10	$0	$0	$0	$10
Env Monitoring - Staff	$0	$0	$0	$0	$205	$0	$0	$0	$205
Total	$1,308	$203	$63	$187	$6,812	$0	$0	$0	$8,573

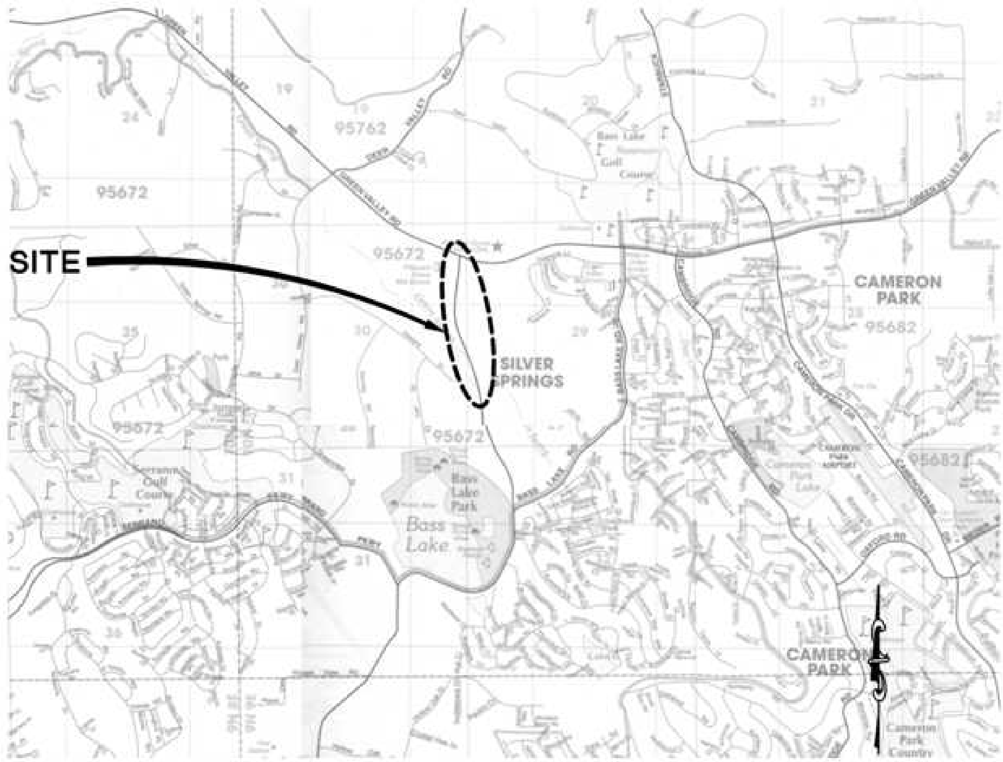


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silver Springs Pkwy to Green Valley Rd (north segment)/Green Vly Rd Intersection Signalization

CIP Project Summary

Project No: 76107 **Type: Roadway** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Construct new Silver Springs Parkway through the future proposed Silver Springs Development from Bass Lake Road to Green Valley Road and install signal at Silver Springs Parkway and Green Valley Road intersection. Future phase connects to realigned Bass Lake Road (see project 76108). Coordinate with project 76108.

Original Budget: $8,167,939 Expenditures thru 6/30/2013: $1,528,346 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Silver Springs Pkwy to Green Valley Rd (north segment)/Green Vly Rd Intersection Signalization

Financing Plan & Tentative Schedule

Project No: 76107 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Developer Advance TIM	*$2,883*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$2,883*
Developer Funded	*$3,979*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,979*
Road Fund/Discretionary	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$6*
Traffic Impact Mitigation Fee (West Slope)	*$813*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$843*
Total	*$7,681*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$7,711*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$9*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$9*
Design - Consultant	*$38*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$38*
Design - Staff	*$471*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$471*
Developer Advanced Design	*$981*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$981*
Right of Way - Staff	*$23*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$23*
Construction Mgmt - Consultant	*$616*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$616*
Construction Mgmt - Staff	*$231*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$261*
Direct Construction Costs	*$5,311*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,311*
Total	*$7,680*	*$30*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$7,710*

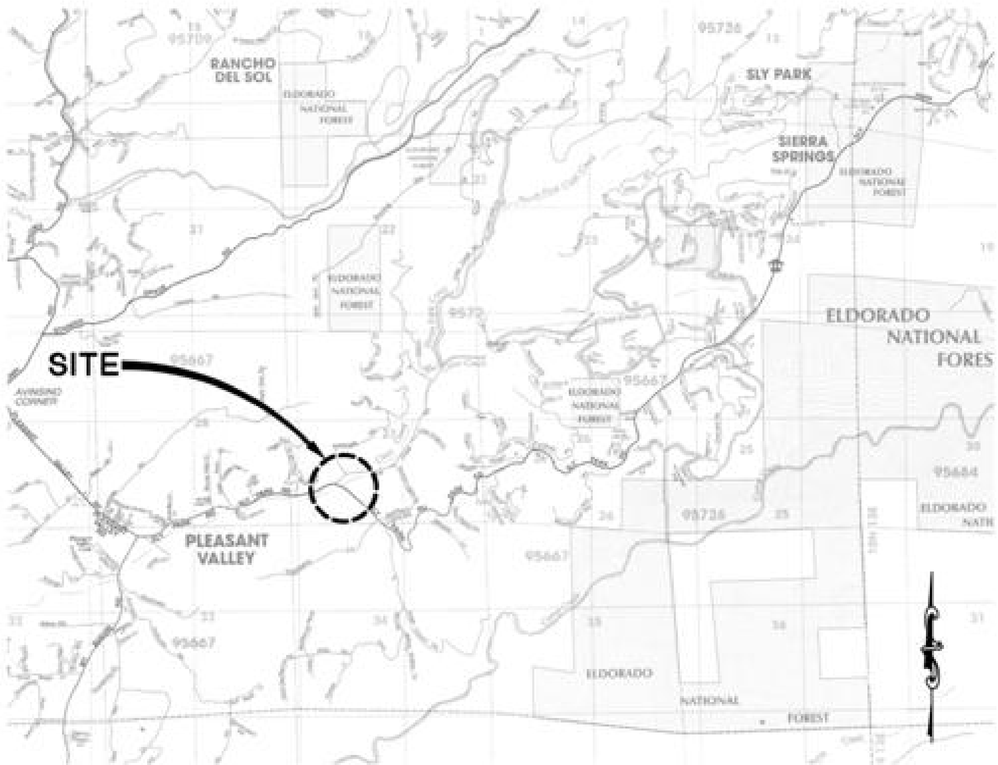
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	**FY 24/25-33/34**	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Sly Park Road at Clear Creek Crossing - Bridge Replacement

CIP Project Summary

Project No: 77115 **Type: Bridge** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Project includes replacement of the bridge at Clear Creek, widening and realignment of Sly Park Road at the bridge approaches and at the entrance to Clear Creek Road, and improvements to the drainage along Sly Park Road.

Original Budget: $5,391,000 Expenditures thru 6/30/2013: $863,051 Project Initiation Date: 04/17/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Sly Park Road at Clear Creek Crossing - Bridge Replacement

Financing Plan & Tentative Schedule

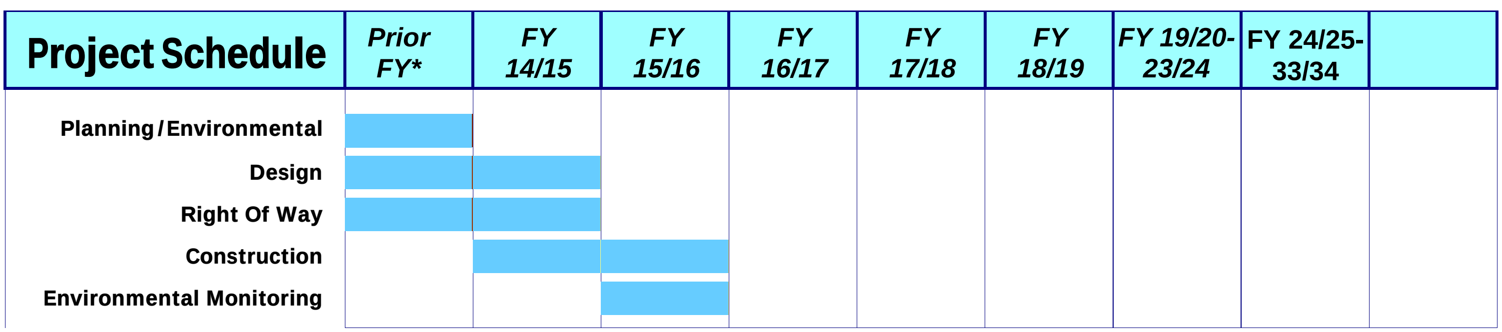
Project No: 77115 | **Type: Bridge** | **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	*$203*	*$214*	*$466*	*$0*	*$0*	*$0*	*$0*	*$0*	*$883*
Highway Bridge Program	*$849*	*$470*	*$3,464*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,783*
RSTP Exchange Funds-Caltrans	*$84*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$84*
Total	*$1,135*	*$684*	*$3,930*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,749*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	*$133*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$133*
Planning/Env - Staff	*$184*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$184*
Design - Consultant	*$57*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$57*
Design - Staff	*$500*	*$92*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$592*
Right of Way - Acquisition	*$0*	*$128*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$128*
Right of Way - Consultant	*$117*	*$219*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$336*
Right of Way - Staff	*$144*	*$35*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$179*
Construction Mgmt - Consultant	*$0*	*$0*	*$210*	*$0*	*$0*	*$0*	*$0*	*$0*	*$210*
Construction Mgmt - Staff	*$0*	*$25*	*$350*	*$0*	*$0*	*$0*	*$0*	*$0*	*$375*
Direct Construction Costs	*$0*	*$185*	*$3,365*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3,550*
Env Monitoring - Consultant	*$0*	*$0*	*$5*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5*
Total	*$1,135*	*$684*	*$3,930*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,749*

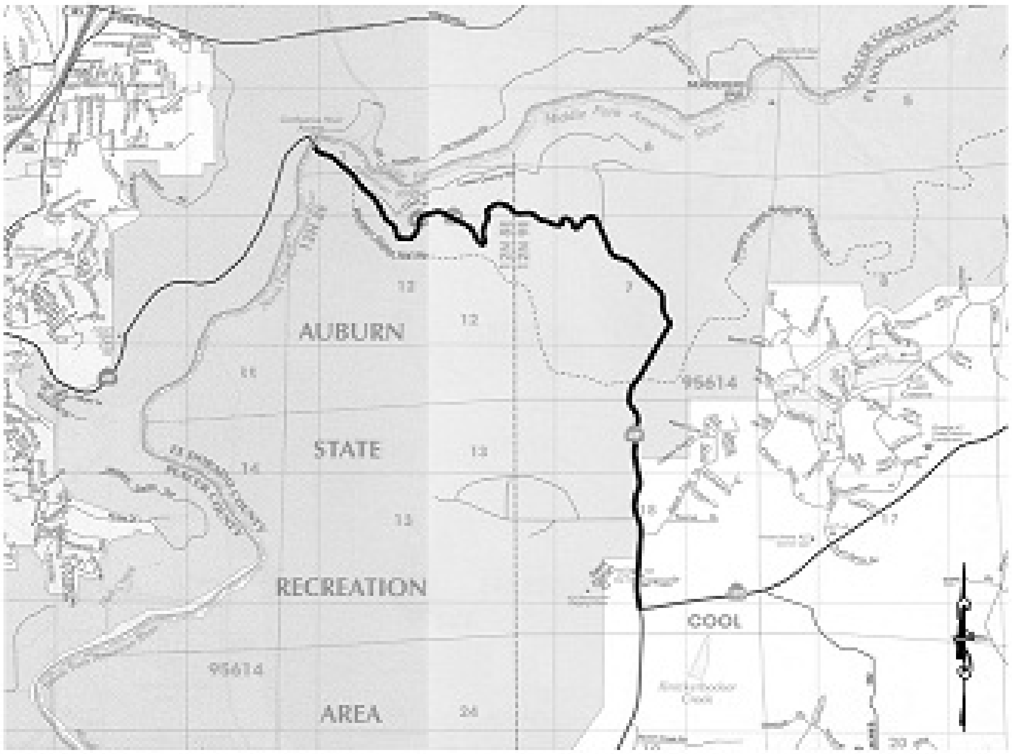


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

State Route 49 Passing Lanes from SR193 (in Cool) to the northern County Line

CIP Project Summary

Project No: GP177 **Type: Roadway** **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

In Cool, add two passing lanes on SR49 from SR193 to the northern County Line.

Original Budget: $3,800,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

State Route 49 Passing Lanes from SR193 (in Cool) to the northern County Line

Financing Plan & Tentative Schedule

Project No: GP177 **Type: Roadway** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$3,482	$3,482
Total	$0	$0	$0	$0	$0	$0	$0	$3,482	$3,482

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$120	$120
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$460	$460
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$210	$210
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$40	$40
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$250	$250
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$2,387	$2,387
Total	$0	$0	$0	$0	$0	$0	$0	$3,482	$3,482

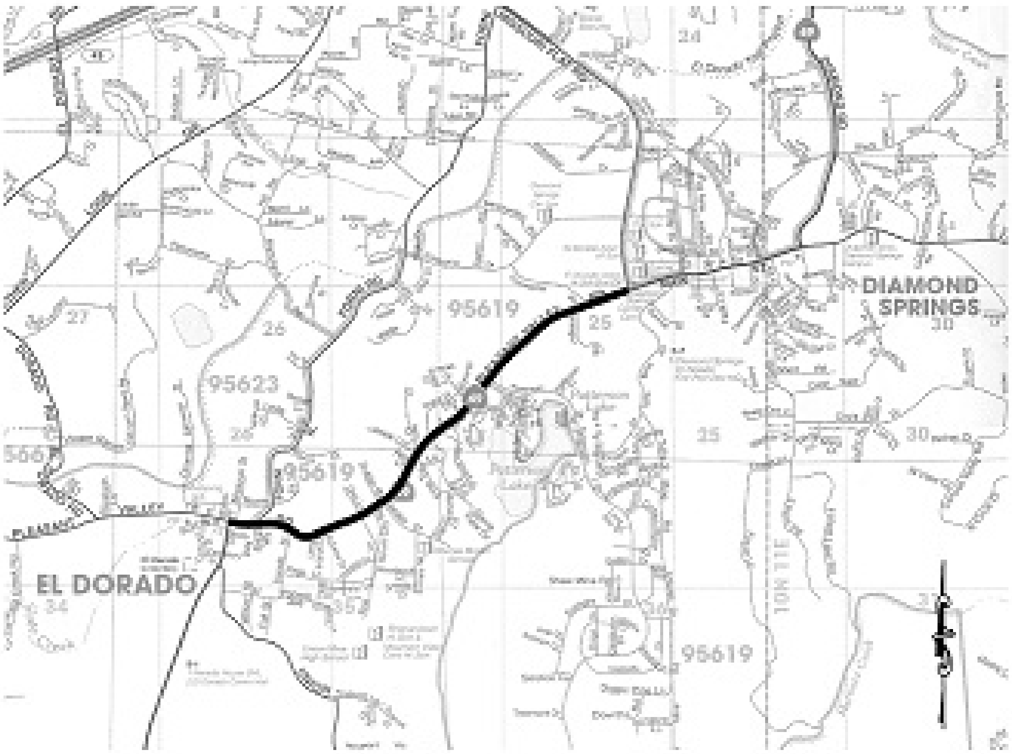
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning / Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

State Route 49 Widening from Pleasant Valley Road to Missouri Flat Road

CIP Project Summary

Project No: GP176 **Type: Roadway** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

In the business district of Diamond Springs, widening of State Route 49 from Pleasant Valley Road to Missouri Flat Road to accommodate a two-way left-turn lane and shoulder work.

Original Budget: $8,200,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

State Route 49 Widening from Pleasant Valley Road to Missouri Flat Road

Financing Plan & Tentative Schedule

Project No: GP176 **Type: Roadway** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$7,879	$7,879
Total	$0	$0	$0	$0	$0	$0	$0	$7,879	$7,879

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$210	$210
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$780	$780
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$2,030	$2,030
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$30	$30
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$63	$63
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$420	$420
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$4,346	$4,346
Total	$0	$0	$0	$0	$0	$0	$0	$7,879	$7,879

Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

TIM Fee Program Projects

CIP Project Summary

Project No: TIM Prog | **Type: Miscellaneous** | **Supervisor District(s) 1, 2, 3, 4, 5**

Project Description:

This project is for TIM Fee Program Development and Updates. Work includes initial development, annual updates and one major update every five years. The project also includes travel demand model updates.

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$823	$86	$27	$28	$28	$24	$240	$1,070	$2,327
2004 GP Hwy 50 TIM	$697	$71	$22	$23	$23	$20	$197	$879	$1,932
2004 GP Silva Valley Interchange Set Aside	$371	$37	$12	$12	$12	$10	$103	$459	$1,015
2004 GP TIM	$1,138	$114	$36	$37	$37	$32	$317	$1,414	$3,125
Total	$3,030	$307	$97	$99	$100	$87	$857	$3,822	$8,400

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Aggregate	$3,030	$307	$97	$99	$100	$87	$857	$3,822	$8,400
Total	$3,030	$307	$97	$99	$100	$87	$857	$3,822	$8,400

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

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Traffic Signal and Intersection Operational Improvements

CIP Project Summary

Project No: Traffic Signals/Inter **Type: Miscellaneous** **Supervisor District(s) 1, 2, 3, 4**

Project Description:

Unprogrammed CIP projects from TIM Fee Program Exhibit B for Traffic Signal and Intersection Operational Improvements. Example projects: Construct new or upgrade existing Traffic Signals, seed funding Intelligent Transportation Systems (ITS) projects, local match funding for safety improvements proportional to new development's impacts.

Original Budget: $57,400,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 02/05/13

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$0	$25,361	$25,361
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$27,253	$27,253
Total	$0	$0	$0	$0	$0	$0	$0	$52,615	$52,615

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Aggregate	$0	$0	$0	$0	$0	$0	$0	$52,615	$52,615
Total	$0	$0	$0	$0	$0	$0	$0	$52,615	$52,615

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

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Transit Service Improvements

CIP Project Summary

Project No: 53118 **Type: Miscellaneous** **Supervisor District(s) 1, 2, 3, 4, 5**

Project Description:

Work may include bus fleet expansion and new Park and Ride facilities. Five commuter buses were purchased for El Dorado County Transit Authority in fiscal year 05/06.

Under state law, the fee program can only fund capital expenditures, not operating cost.

Original Budget: $10,500,000 Expenditures thru 6/30/2013: $1,284,620 Project Initiation Date: 08/22/06

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$0	$0	$0	$0	$0	$0	$0	$9,215	$9,215
Interim Highway 50 Variable TIM Fee	$1,285	$0	$0	$0	$0	$0	$0	$0	$1,285
Total	$1,285	$0	$0	$0	$0	$0	$0	$9,215	$10,500

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Construction Mgmt - Consultant	$1,285	$0	$0	$0	$0	$0	$0	$9,215	$10,500
Total	$1,285	$0	$0	$0	$0	$0	$0	$9,215	$10,500

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

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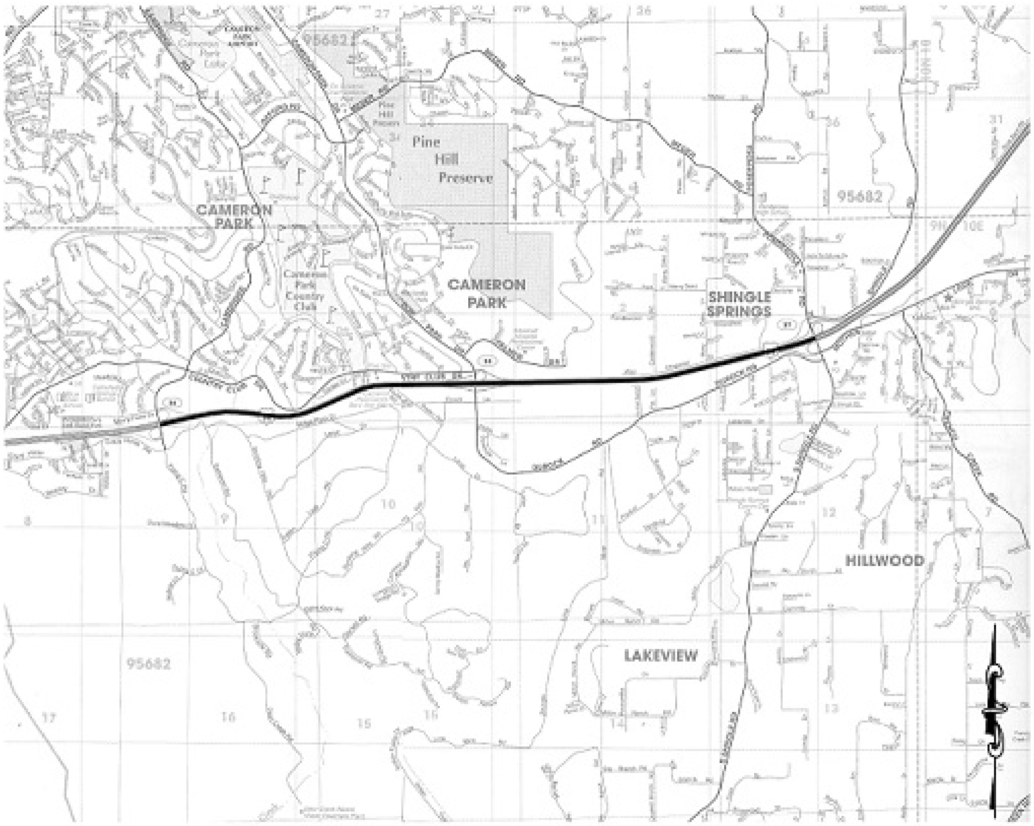
U.S. 50 Auxiliary Lane Eastbound - Cambridge to Ponderosa

CIP Project Summary

Project No: GP150 | **Type: Interchange** | **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Project provides eastbound continuous auxiliary lane from Cambridge Road to Ponderosa Road as determined necessary in the US 50/Cameron Park Drive PSR/PDS dated October 2008.

Original Budget: $10,350,000   Expenditures thru 6/30/2013: $0   Project Initiation Date: 12/15/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 Auxiliary Lane Eastbound - Cambridge to Ponderosa

Financing Plan & Tentative Schedule

Project No: GP150 **Type: Interchange** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$0	$0	$0	$0	$0	$0	$0	$5,175	$5,175
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$5,175	$5,175
Total	$0	$0	$0	$0	$0	$0	$0	$10,350	$10,350

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$0	$500	$500
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$150	$150
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$250	$250
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$1,250	$1,250
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$250	$250
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$35	$35
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$15	$15
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$1,000	$1,000
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$6,900	$6,900
Total	$0	$0	$0	$0	$0	$0	$0	$10,350	$10,350

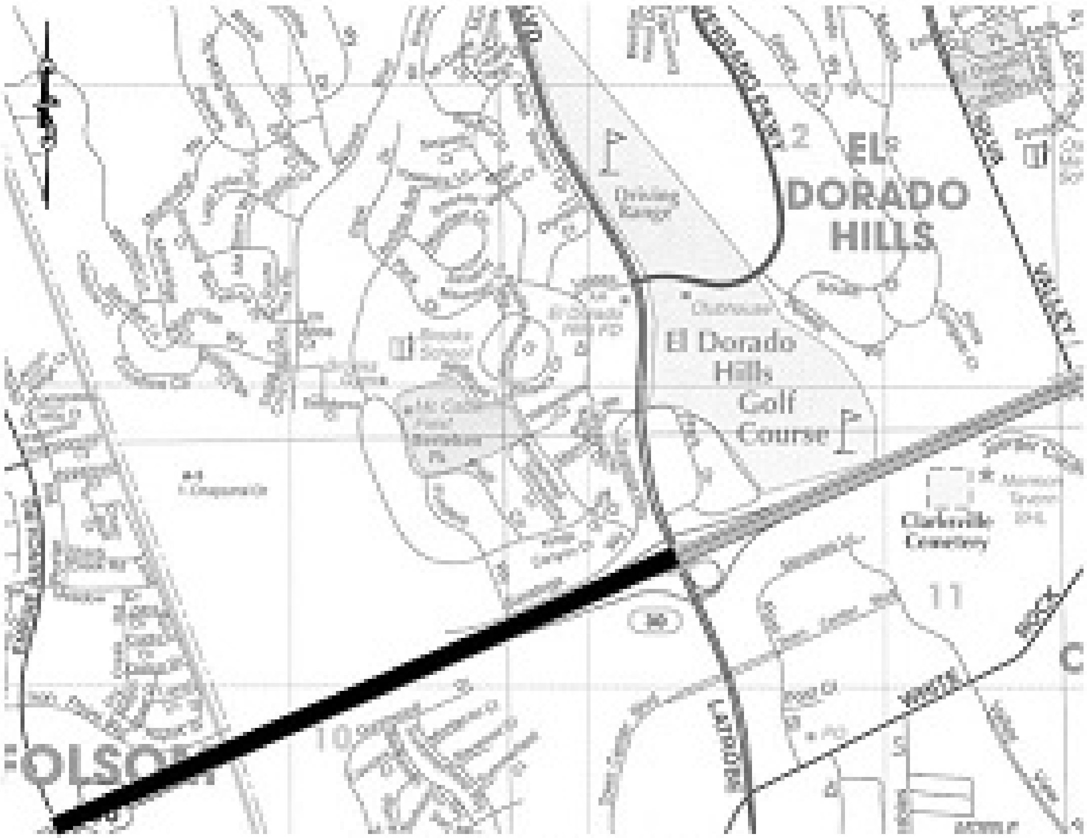
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 Auxiliary Lane Westbound - El Dorado Hills Boulevard to Empire Ranch Road

CIP Project Summary

Project No: 53115 | **Type: Roadway** | **Supervisor District(s) 1, 2**



LOCATION MAP

NOT TO SCALE

Project Description:

This project consists of widening US 50 and adding an auxiliary lane to westbound US 50 connecting the El Dorado Hills Boulevard/Latrobe Road interchange and the proposed Empire Ranch Road interchange. The project assumes the City of Folsom, as a part of the Empire Ranch Road Interchange, will construct the eastbound auxiliary lane. Timing of construction to be concurrent with or after the El Dorado Hills Blvd Interchange (71323) or Empire Ranch Interchange. CEQA/NEPA cleared through the Empire Ranch Interchange document.

Original Budget: $2,809,337 | Expenditures thru 6/30/2013: $8,337 | Project Initiation Date: 06/08/10

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 Auxiliary Lane Westbound - El Dorado Hills Boulevard to Empire Ranch Road

Financing Plan & Tentative Schedule

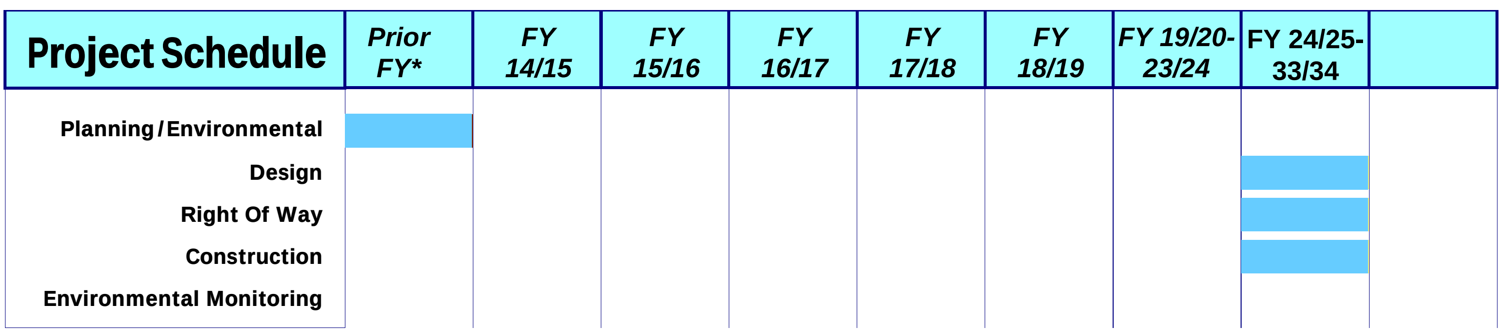
Project No: 53115 **Type: Roadway** **Supervisor District(s) 1, 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
04 GP Hwy 50 TIM-Blackstone	$8	$0	$0	$0	$0	$0	$0	$2,801	$2,809
Total	$8	$0	$0	$0	$0	$0	$0	$2,801	$2,809

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$8	$0	$0	$0	$0	$0	$0	$0	$8
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$300	$300
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$50	$50
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$20	$20
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$30	$30
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$50	$50
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$300	$300
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$2,051	$2,051
Total	$8	$0	$0	$0	$0	$0	$0	$2,801	$2,809



*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 HOV Lanes (Phase 3) - Ponderosa Road to Greenstone Road

CIP Project Summary

Project No: 53116 **Type: Roadway** **Supervisor District(s) 2, 4**

LOCATION MAP

NOT TO SCALE

Project Description:

This is a joint project between the County and Caltrans and part of a larger plan to add HOV lanes to US 50 from El Dorado Hills to Shingle Springs. This project includes a design study and the construction of HOV lanes from Ponderosa Road to Greenstone Road. The need for this project will be determined during the Major 5-Year CIP update.

Original Budget: $19,057,500 Expenditures thru 6/30/2013: $0 Project Initiation Date: 02/13/07

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 HOV Lanes (Phase 3) - Ponderosa Road to Greenstone Road

Financing Plan & Tentative Schedule

Project No: 53116 **Type: Roadway** **Supervisor District(s) 2, 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Local Funds - Tribe	$0	$615	$0	$0	$0	$0	$0	$0	$615
Total	$0	$615	$0	$0	$0	$0	$0	$0	$615

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Design - Consultant	$0	$600	$0	$0	$0	$0	$0	$0	$600
Design - Staff	$0	$15	$0	$0	$0	$0	$0	$0	$15
Total	$0	$615	$0	$0	$0	$0	$0	$0	$615

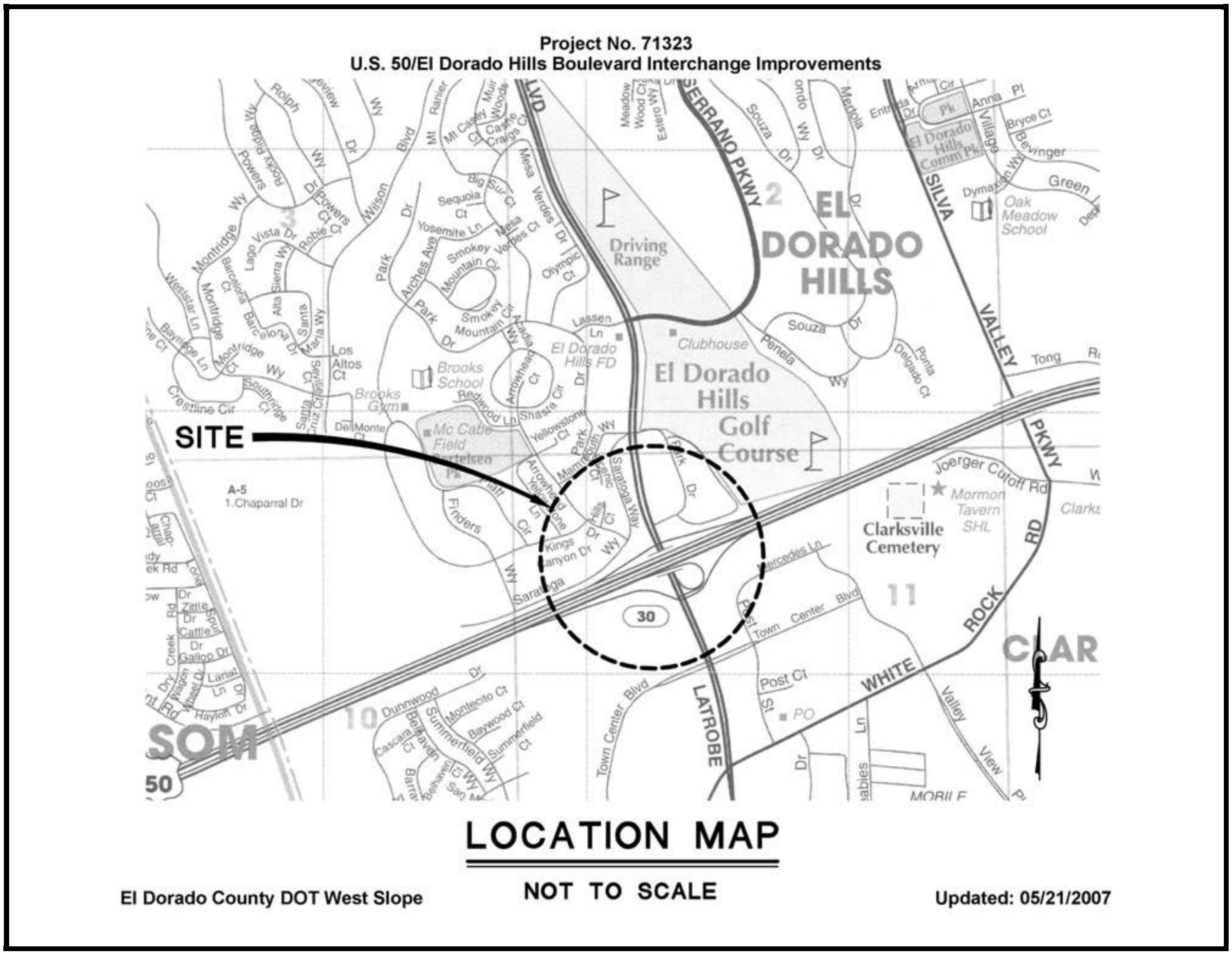
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design		■							
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 HOV Lanes Phase 0

CIP Project Summary

Project No: 53124 | **Type: Interchange** | **Supervisor District(s) 1**



Project Description:

Part of a larger project to reconstruct the interchange and provide US 50 and El Dorado Hills Interchange with HOV lanes and ramp metering. Complete reconstruction of this interchange is being phased to align improvement needs, construction staging within the US 50 corridor, and available funding. This Phase improves the on-ramp and off-ramp for westbound US 50. Project includes roadwork, ramp metering, bridge structure, retaining walls, barrier, and traffic signal modifications.

Original Budget: $19,700,000 Expenditures thru 6/30/2013: $8,176,338 Project Initiation Date: 08/01/11

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 HOV Lanes Phase 0

Financing Plan & Tentative Schedule

Project No: 53124 **Type: Interchange** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Corridor Mobility Improvement Account	$13,880	$1,620	$0	$0	$0	$0	$0	$0	$15,500
Local Funds - Tribe	$3,219	$5	$0	$0	$0	$0	$0	$0	$3,224
Road Fund/Discretionary	$14	$0	$0	$0	$0	$0	$0	$0	$14
Total	$17,113	$1,625	$0	$0	$0	$0	$0	$0	$18,738

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$479	$0	$0	$0	$0	$0	$0	$0	$479
Planning/Env - Staff	$21	$0	$0	$0	$0	$0	$0	$0	$21
Design - Consultant	$1,096	$0	$0	$0	$0	$0	$0	$0	$1,096
Design - Staff	$228	$0	$0	$0	$0	$0	$0	$0	$228
Right of Way - Acquisition	$25	$0	$0	$0	$0	$0	$0	$0	$25
Right of Way - Consultant	$19	$0	$0	$0	$0	$0	$0	$0	$19
Right of Way - Staff	$10	$0	$0	$0	$0	$0	$0	$0	$10
Construction Mgmt - Consultant	$1,380	$100	$0	$0	$0	$0	$0	$0	$1,480
Construction Mgmt - Staff	$730	$25	$0	$0	$0	$0	$0	$0	$755
Direct Construction Costs	$13,125	$1,500	$0	$0	$0	$0	$0	$0	$14,625
Total	$17,113	$1,625	$0	$0	$0	$0	$0	$0	$18,738

Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 Mainline Widening at El Dorado Hills

CIP Project Summary

Project No: 53120 **Type: Roadway** **Supervisor District(s) 1**

LOCATION MAP

NOT TO SCALE

Project Description:

Part of a larger project along US 50 in El Dorado Hills area which is phased to align the improvement needs, staged construction and available funding. This project will construct a new westbound auxiliary lane on US 50 between the Silva Valley Interchange and the Empire Ranch Interchange. The new lane would utilize some existing excess median/shoulder width (re-stripe) as well as an exterior sliver widening in the vicinity of the HOV CHP enforcement area. Between the El Dorado Hills Interchange and the County Line the new lane would utilize existing excess median/shoulder width (re-stripe only). Project requires coordination with the Silva Valley Interchange Phase 2 (71345), Empire Ranch Interchange and El Dorado Hills Blvd. Interchange (71323). Construction should be concurrent with the Silva Valley Interchange and/or Empire Ranch Interchange.

Original Budget: $2,950,333 Expenditures thru 6/30/2013: $687,594 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50 Mainline Widening at El Dorado Hills

Financing Plan & Tentative Schedule

Project No: 53120 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP Hwy 50 TIM	$688	$0	$0	$0	$0	$0	$0	$1,473	$2,161
Total	$688	$0	$0	$0	$0	$0	$0	$1,473	$2,161

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	$27	$0	$0	$0	$0	$0	$0	$90	$117
Planning/Env - Staff	$2	$0	$0	$0	$0	$0	$0	$9	$10
Design - Consultant	$657	$0	$0	$0	$0	$0	$0	$318	$975
Design - Staff	$3	$0	$0	$0	$0	$0	$0	$73	$76
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$21	$21
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$6	$6
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$16	$16
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$20	$20
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$150	$150
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$770	$770
Total	$688	$0	$0	$0	$0	$0	$0	$1,473	$2,161

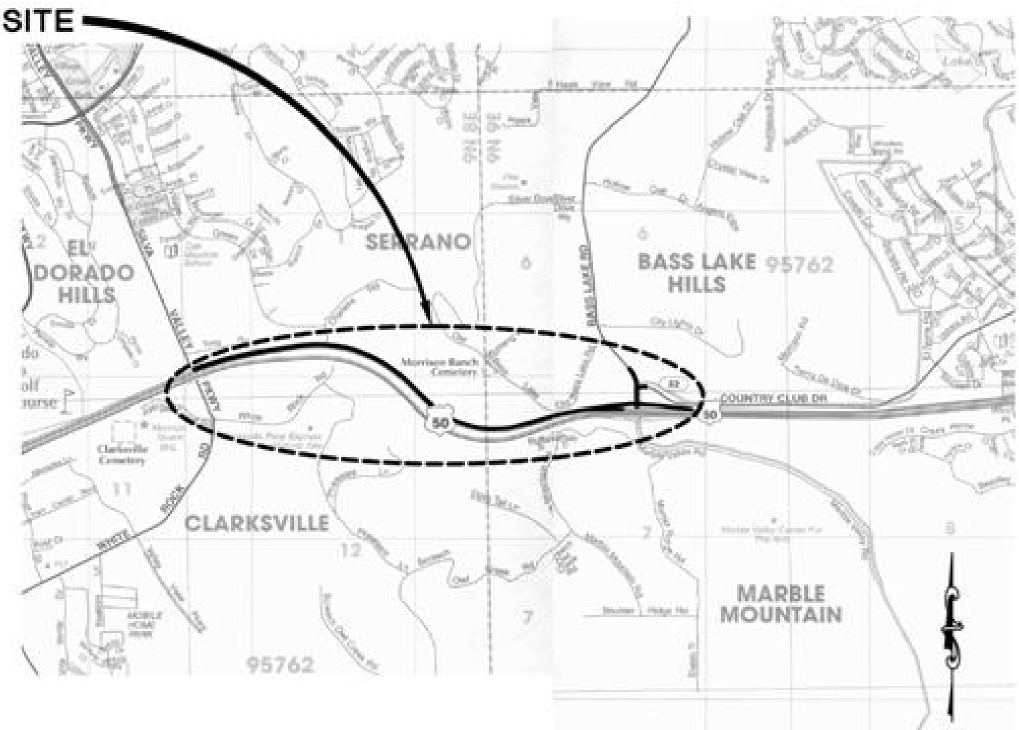
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Bass Lake Road Interchange Improvements - Phase 1

CIP Project Summary

Project No: 71330 **Type: Interchange** **Supervisor District(s) 1, 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Phase 1 of a larger project for the complete reconstruction of the Bass Lake Rd interchange. Phase 1 of this project includes a detailed study to determine the complete improvements needed. Phase 1 is assumed to include ramp widenings, road widening, signals, and the WB auxiliary lane between Bass Lake and Silva Valley interchanges. Phase 1 assumes bridge replacement. Phase 2 (GP148) is assumed to include additional ramp and road widenings and an eastbound auxiliary lane between Bass Lake and Cambridge Road interchanges.

Original Budget: $9,000,000 Expenditures thru 6/30/2013: $22,164 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Bass Lake Road Interchange Improvements - Phase 1

Financing Plan & Tentative Schedule

Project No: 71330 | **Type: Interchange** | **Supervisor District(s) 1, 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$5	$0	$0	$0	$0	$0	$206	$3,484	$3,695
2004 GP Hwy 50 TIM	$10	$0	$0	$0	$0	$0	$413	$6,968	$7,390
2004 GP TIM	$5	$0	$0	$0	$0	$0	$206	$3,484	$3,695
Developer Advance BLHPFFP	$0	$0	$0	$0	$0	$0	$0	$1,750	$1,750
Interim Highway 50 Variable TIM Fee	$1	$0	$0	$0	$0	$0	$0	$0	$1
Total	$22	$0	$0	$0	$0	$0	$825	$15,685	$16,532

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$325	$0	$325
Planning/Env - Staff	$21	$0	$0	$0	$0	$0	$500	$0	$521
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$662	$662
Design - Staff	$1	$0	$0	$0	$0	$0	$0	$662	$663
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$700	$700
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$85	$85
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$278	$278
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$66	$66
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$1,245	$1,245
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$11,987	$11,987
Total	$22	$0	$0	$0	$0	$0	$825	$15,685	$16,532

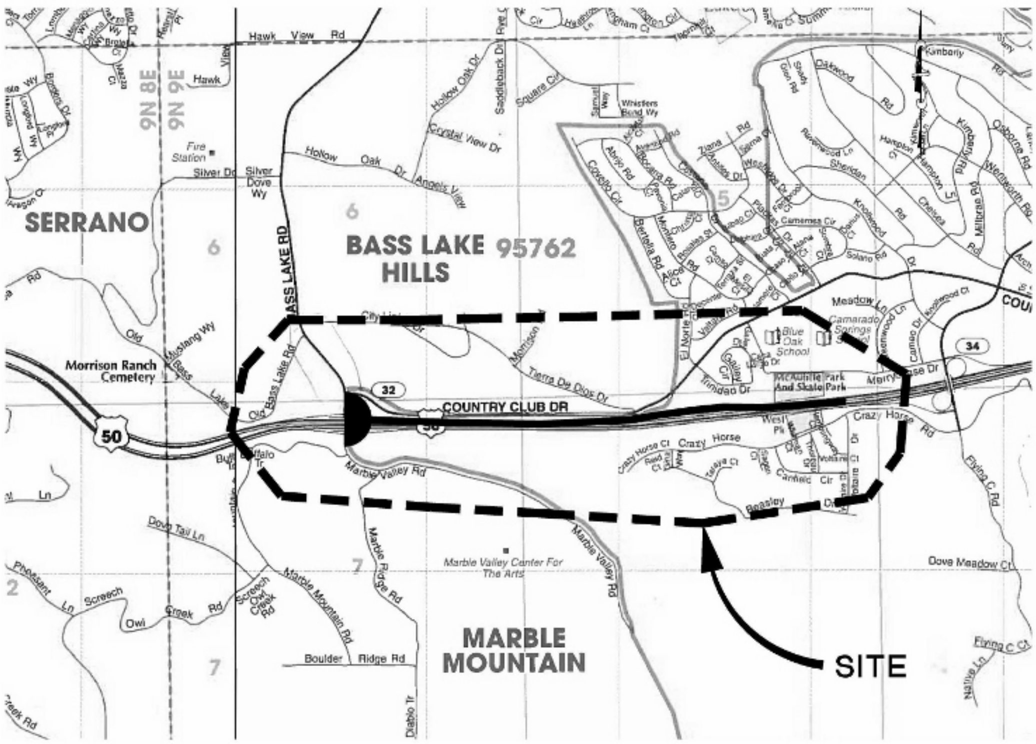
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Bass Lake Road Interchange Improvements - Phase 2

CIP Project Summary

Project No: GP148 **Type: Interchange** **Supervisor District(s) 1, 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Phase 2 Improvements to Bass Lake Road Interchange. Phase 1 (See 71330) studies will determine the actual needed improvements. Phase 2 is assumed to include additional ramp and road widenings; east bound auxiliary lanes from Bass Lake Road to Cambridge Road interchanges; and widening of a portion of the west bound auxiliary lane at the west bound off ramp. Assumed ramp widenings include adding a second westbound off ramp lane, additional eastbound off ramp turning lane, and adding an eastbound on ramp HOV bypass lane.

Original Budget: $11,250,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Bass Lake Road Interchange Improvements - Phase 2

Financing Plan & Tentative Schedule

Project No: GP148 **Type: Interchange** **Supervisor District(s) 1, 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$0	$4,766	$4,766
2004 GP Hwy 50 TIM	$0	$0	$0	$0	$0	$0	$0	$9,532	$9,532
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$4,766	$4,766
Total	$0	$0	$0	$0	$0	$0	$0	$19,063	$19,063

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$0	$870	$870
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$410	$410
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$1,600	$1,600
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$750	$750
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$700	$700
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$170	$170
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$190	$190
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$670	$670
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$870	$870
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$12,833	$12,833
Total	$0	$0	$0	$0	$0	$0	$0	$19,063	$19,063

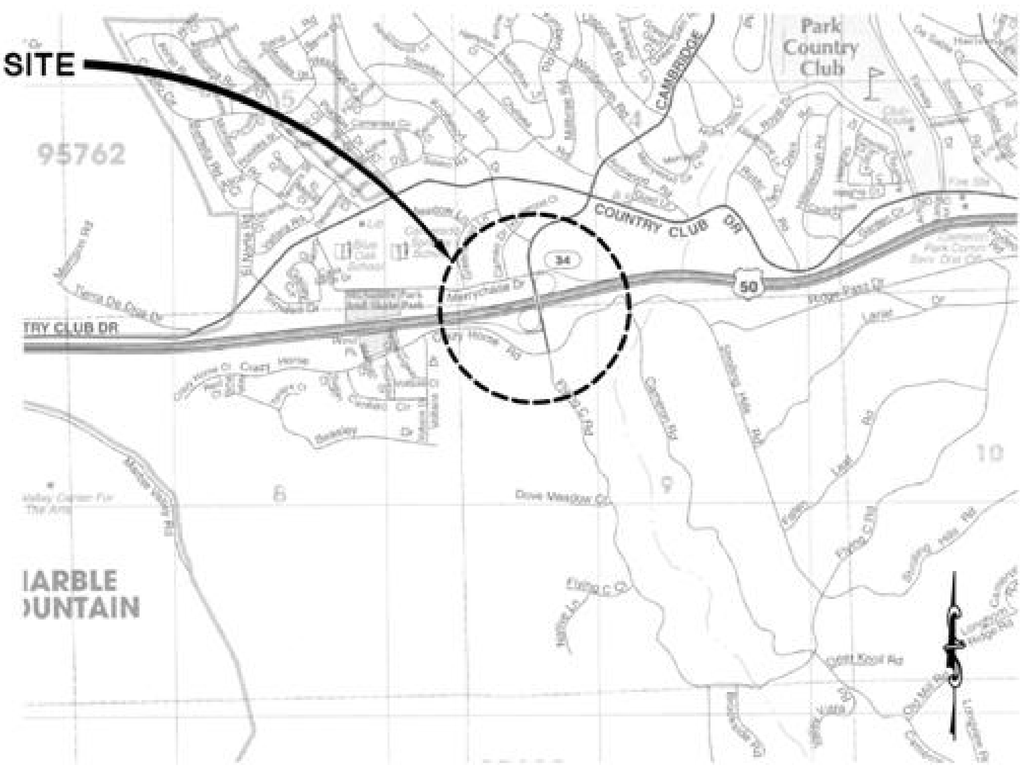
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Cambridge Road Interchange Improvements - Phase 1

CIP Project Summary

Project No: 71332 **Type: Interchange** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Phase 1 Improvements to Cambridge Road interchange. Phase I project consists of widening the existing EB and WB off-ramps; addition of new WB on-ramp from SB Cambridge Road; reconstruction of the local intersections to provide for additional capacity, both turning and through; and the installation of traffic signals at EB ramp terminal intersection. Also includes preliminary engineering for Phase 2 improvements to Cambridge Interchange (GP149).

Original Budget: $7,430,000 Expenditures thru 6/30/2013: $38,722 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Cambridge Road Interchange Improvements - Phase 1

Financing Plan & Tentative Schedule

Project No: 71332 **Type: Interchange** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$38	$0	$0	$0	$0	$0	$163	$3,739	$3,940
2004 GP TIM	$1	$0	$0	$0	$0	$0	$163	$3,739	$3,903
Total	$38	$0	$0	$0	$0	$0	$326	$7,478	$7,842

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$25	$0	$0	$0	$0	$0	$261	$0	$286
Planning/Env - Staff	$8	$0	$0	$0	$0	$0	$65	$0	$73
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$570	$570
Design - Staff	$6	$0	$0	$0	$0	$0	$0	$142	$148
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$1,899	$1,899
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$59	$59
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$59	$59
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$119	$119
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$475	$475
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$4,155	$4,155
Total	$39	$0	$0	$0	$0	$0	$326	$7,478	$7,843

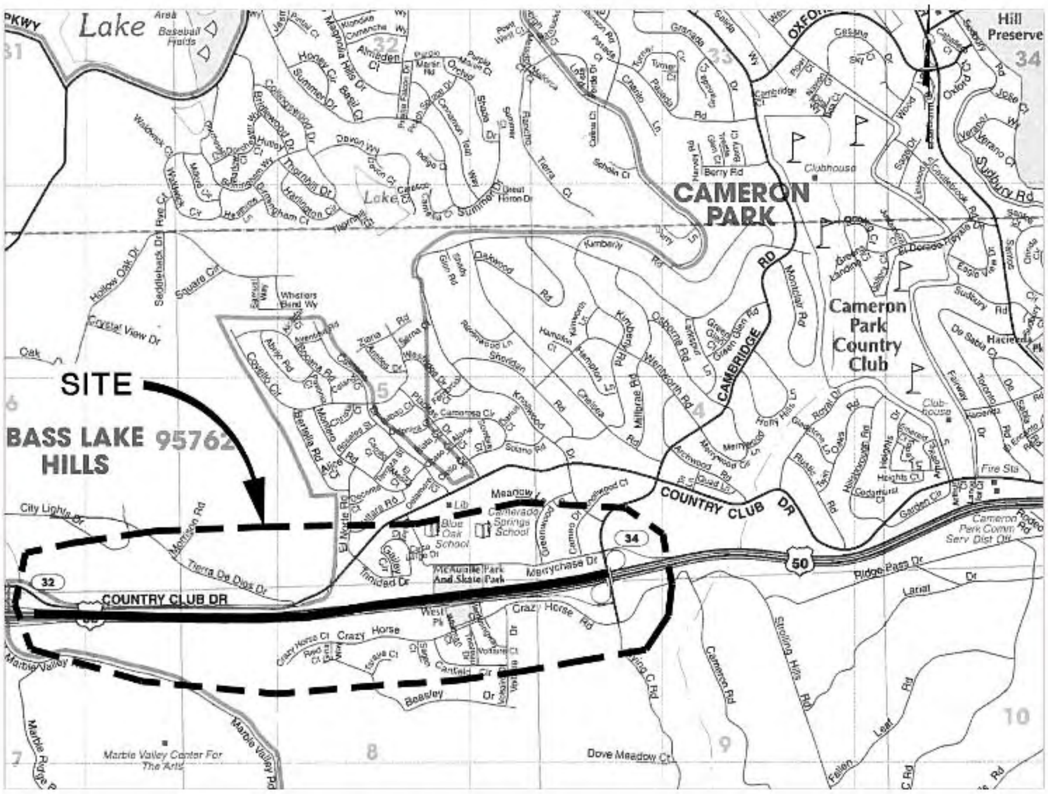
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental	■						■		
Design	■							■	
Right Of Way								■	
Construction								■	
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Cambridge Road Interchange Improvements - Phase 2

CIP Project Summary

Project No: GP149 **Type: Interchange** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Phase 2 Improvements to Cambridge Road Interchange. Phase 2 project consists of bridge widening to add lanes, widen ramps, and construct WB auxiliary lane from the Bass Lake Road Interchange to Cambridge Road Interchange. Preliminary engineering for Phase 2 to be performed with Phase I project (71332).

Original Budget: $14,130,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Cambridge Road Interchange Improvements - Phase 2

Financing Plan & Tentative Schedule

Project No: GP149 **Type: Interchange** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$0	$0	$0	$0	$0	$0	$0	$5,968	$5,968
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$5,968	$5,968
Total	$0	$0	$0	$0	$0	$0	$0	$11,935	$11,935

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$0	$580	$580
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$270	$270
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$1,100	$1,100
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$500	$500
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$325	$325
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$110	$110
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$120	$120
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$440	$440
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$580	$580
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$7,910	$7,910
Total	$0	$0	$0	$0	$0	$0	$0	$11,935	$11,935

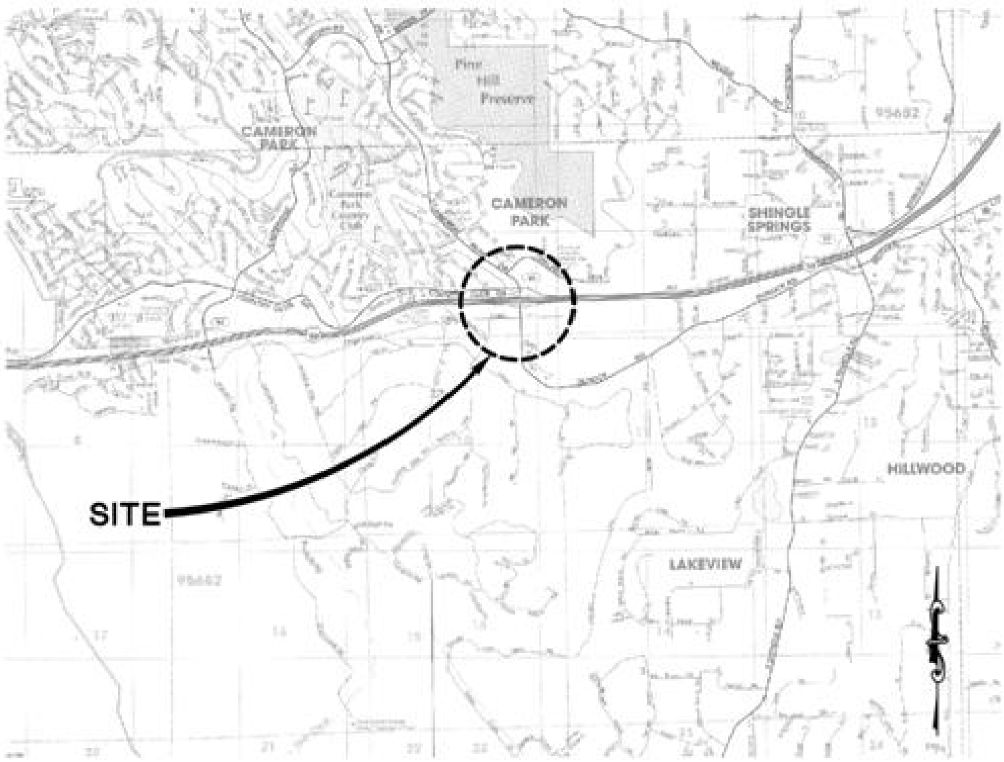
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Cameron Park Drive Interchange Improvements

CIP Project Summary

Project No: 72361 | **Type: Interchange** | **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project provides capacity improvements to the interchange. The project includes a detailed study to identify alternatives and selection of the preferred alternative. The preferred alternative has not been selected. For budgeting purposes, the project assumes construction of Alternative 1 in US 50/Cameron Park Drive PSR/PDS dated October 2008 consisting of reconstruction of the existing US50 bridges to widen Cameron Park Drive to eight lanes under the undercrossing for a 20-year design life. The project includes widening Cameron Park Drive to 3 through lanes each direction at Palmer and widening all ramps to 2 lanes. The project requires construction of Cameron Park Drive Widening from Durock Road to Coach Lane (Project 72367). It will be coordinated with US50 HOV Lanes, Phase 2B (Project 53122) and US50 Eastbound Auxiliary Lanes from Cambridge Road to Ponderosa Road (GP150).

Original Budget: $23,700,000 Expenditures thru 6/30/2013: $1,140,650 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Cameron Park Drive Interchange Improvements

Financing Plan & Tentative Schedule

Project No: 72361 | **Type: Interchange** | **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	*$570*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$23,243*	*$23,813*
2004 GP TIM	*$570*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$23,243*	*$23,813*
Total	*$1,141*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$46,485*	*$47,626*

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	*$730*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$242*	*$972*
Planning/Env - Staff	*$343*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$503*	*$846*
Design - Consultant	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,000*	*$1,006*
Design - Staff	*$55*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$5,400*	*$5,455*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,100*	*$4,100*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$500*	*$500*
Right of Way - Staff	*$7*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$200*	*$207*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,000*	*$4,000*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$30,540*	*$30,540*
Total	*$1,141*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$46,485*	*$47,626*

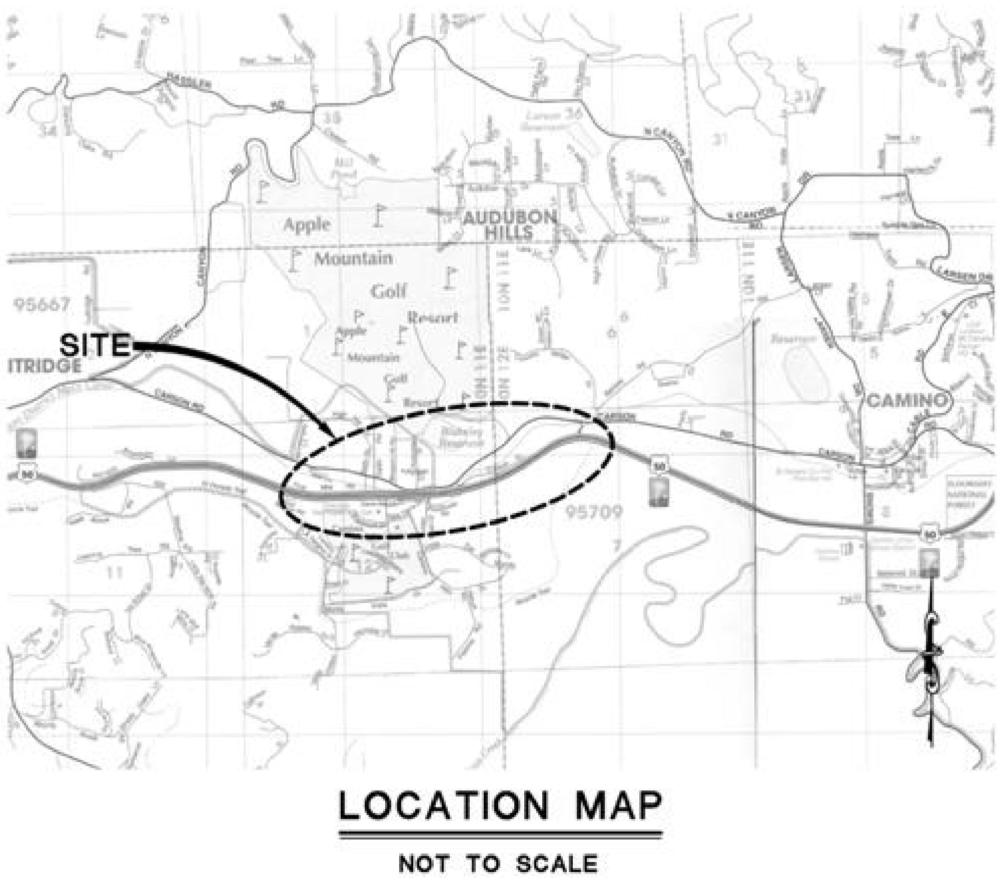
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Camino Area Parallel Capacity/Safety Study

CIP Project Summary

Project No: 71319 **Type: Interchange** **Supervisor District(s) 3**



Project Description:

The current goal of the US 50 Camino corridor safety improvement project is to improve access and reduce accidents. A preliminary study completed and approved by Caltrans in 2010 looked at alternatives and recommended limiting at grade crossings, improve parallel capacity and suggested extending Pondorado Road north to a future US 50 undercrossing. Caltrans is the lead agency on this project and is working on a final Project Study Report and Environmental document that can lead to a design and construction phase if funding is available. The County is providing oversight for this Caltrans project and possible portions of future local road construction.

Original Budget: $4,269,044 Expenditures thru 6/30/2013: $598,736 Project Initiation Date: 06/30/97

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Camino Area Parallel Capacity/Safety Study

Financing Plan & Tentative Schedule

Project No: 71319 **Type: Interchange** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP Hwy 50 TIM	*$392*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,376*	*$1,783*
RSTP Exchange Funds-Rural-EDCTC	*$217*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$217*
Total	*$609*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,376*	*$2,000*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$580*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$580*
Planning/Env - Staff	*$27*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$27*
Design - Staff	*$1*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$200*	*$216*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$176*	*$176*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,000*	*$1,000*
Total	*$609*	*$15*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,376*	*$2,000*

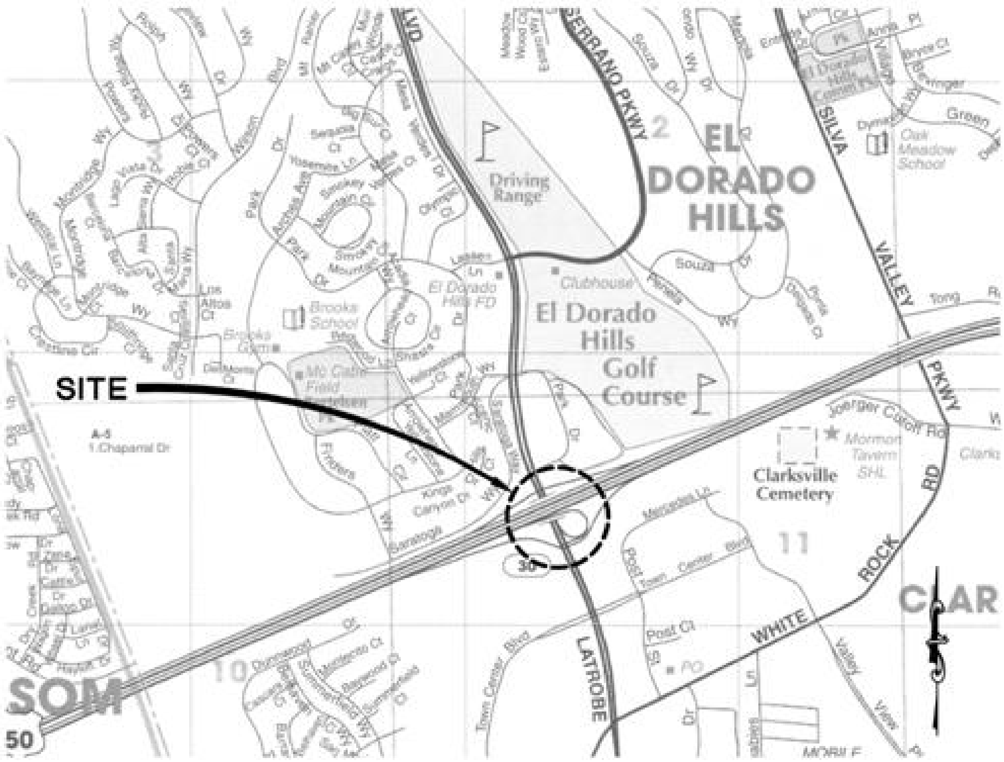
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	**FY 24/25-33/34**	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Hills Blvd Interchange - Pedestrian Overcrossing

CIP Project Summary

Project No: 71340 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

The project includes a 12-foot wide pedestrian overcrossing over US 50 just east of El Dorado Hills Boulevard interchange between the eastbound and westbound ramps. The project also includes a class 3 mixed use path, 10-foot wide along northbound Latrobe Rd from Town Center Blvd to the east bound ramps and along northbound El Dorado Hills Blvd from the west bound ramps to Park Drive. This crossing will divert pedestrian and bicycle traffic from the complex, high volume roadway traffic in the interchange and allow for a better configuration for traffic through the interchange. This crossing also provides pedestrian and bicycle connectivity between the activity centers north and south of US 50. The project and timing of construction are to be coordinated with the phased reconstruction of the interchange. Construction and ROW acquisition for the 10-foot sidewalk and adjacent retaining walls, barriers, railings, and landscape replacement have been included with project 71323 (construction cost +/- $1,000,000 and ROW cost +/- $300,000) to take advantage of construction cost efficiencies.

Original Budget: $5,512,580 Expenditures thru 6/30/2013: $418,167 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Hills Blvd Interchange - Pedestrian Overcrossing

Financing Plan & Tentative Schedule

Project No: 71340 **Type: Pedestrian Way and Bike Path** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$187*	*$0*	*$0*	*$0*	*$0*	*$0*	*$700*	*$5,665*	*$6,552*
Air Pollution Control District Grant	*$35*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$35*
Road Fund/Discretionary	*($4)*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*($4)*
Transportation Enhancement Activities	*$200*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$200*
Total	*$418*	*$0*	*$0*	*$0*	*$0*	*$0*	*$700*	*$5,665*	*$6,783*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Consultant	*$268*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$268*
Planning/Env - Staff	*$87*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$87*
Design - Consultant	*$57*	*$0*	*$0*	*$0*	*$0*	*$0*	*$350*	*$0*	*$407*
Design - Staff	*$6*	*$0*	*$0*	*$0*	*$0*	*$0*	*$350*	*$0*	*$355*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$75*	*$75*
Right of Way - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$20*	*$20*
Right of Way - Staff	*$1*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$30*	*$31*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$100*	*$100*
Construction Mgmt - Staff	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$750*	*$750*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,690*	*$4,690*
Total	*$418*	*$0*	*$0*	*$0*	*$0*	*$0*	*$700*	*$5,665*	*$6,783*

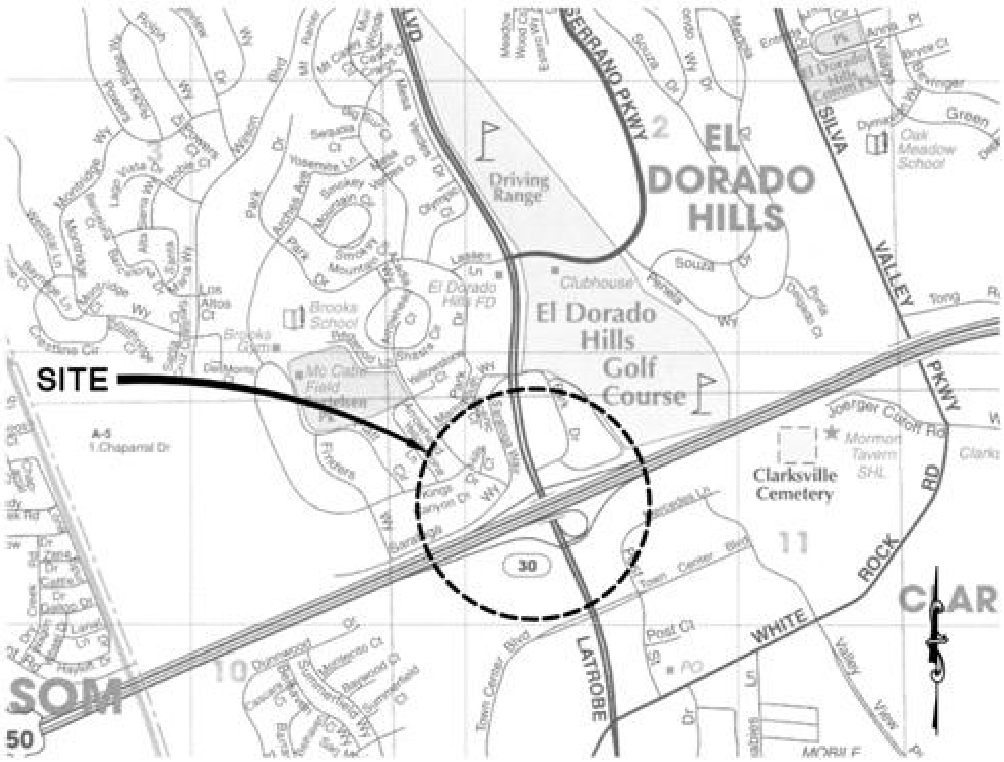
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Hills Boulevard Interchange Improvements - Phase 2B

CIP Project Summary

Project No: 71323 **Type: Interchange** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Part of larger project to reconstruct the interchange and widen Latrobe Rd/El Dorado Hills Boulevard. Complete reconstruction is being phased to align improvement needs, construction staging within US 50 corridor, and available funding. This phase improves on-/off-ramps for eastbound US 50 and widens Latrobe Road/El Dorado Hills Boulevard. Design to be coordinated with Mainline Widening (53120), Westbound Auxilliary Lane (53115) and Pedestrian Overcrossing (71340). This phase may also be broken into phases to take advantage of available grant funding.

Original Budget: $21,870,797 Expenditures thru 6/30/2013: $279,434 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Hills Boulevard Interchange Improvements - Phase 2B

Financing Plan & Tentative Schedule

Project No: 71323 **Type: Interchange** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
2004 GP El Dorado Hills TIM	*$279*	*$0*	*$0*	*$0*	*$0*	*$0*	*$720*	*$5,905*	*$6,904*
Total	*$279*	*$0*	*$0*	*$0*	*$0*	*$0*	*$720*	*$5,905*	*$6,904*

All Figures in Thousands

Expenditures	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	*Total*
Planning/Env - Staff	*$3*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$3*
Design - Consultant	*$194*	*$0*	*$0*	*$0*	*$0*	*$0*	*$470*	*$0*	*$664*
Design - Staff	*$72*	*$0*	*$0*	*$0*	*$0*	*$0*	*$250*	*$0*	*$322*
Right of Way - Acquisition	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$75*	*$75*
Right of Way - Consultant	*$2*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$1,030*	*$1,032*
Right of Way - Staff	*$7*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$30*	*$37*
Construction Mgmt - Consultant	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$490*	*$490*
Construction Mgmt - Staff	*$1*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$200*	*$201*
Direct Construction Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$4,080*	*$4,080*
Total	*$279*	*$0*	*$0*	*$0*	*$0*	*$0*	*$720*	*$5,905*	*$6,904*

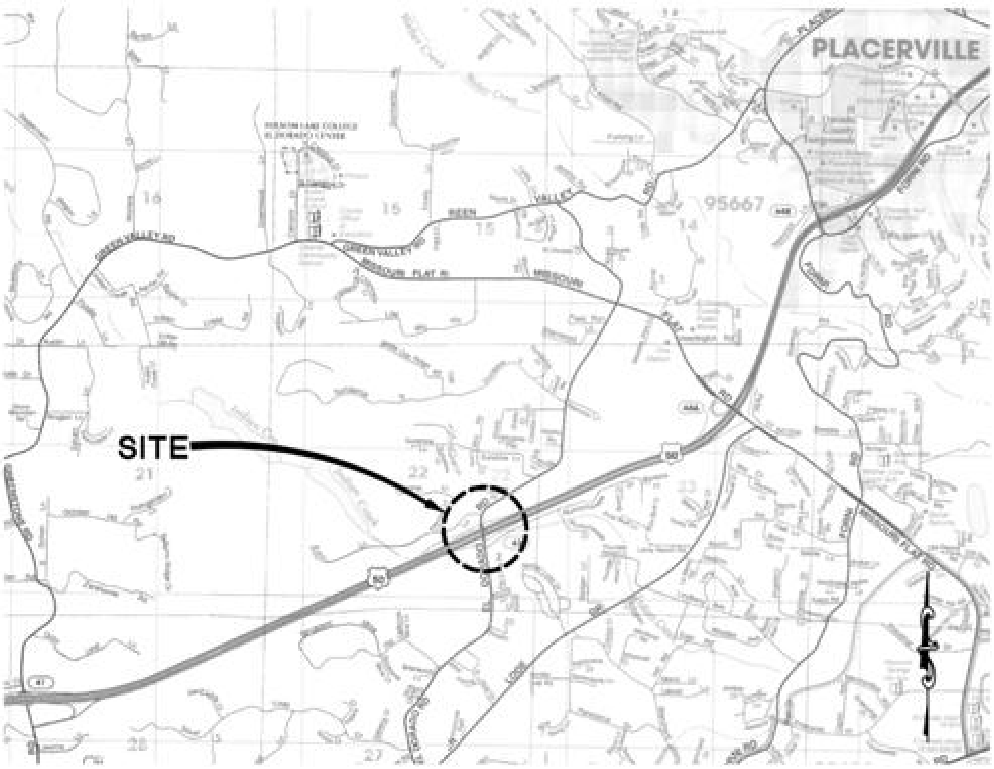
Project Schedule	*Prior FY**	*FY 14/15*	*FY 15/16*	*FY 16/17*	*FY 17/18*	*FY 18/19*	*FY 19/20-23/24*	*FY 24/25-33/34*	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Road Interchange Improvements - Phase 1

CIP Project Summary

Project No: 71347 | **Type: Interchange** | **Supervisor District(s) 3**



Project Description:

Phase 1 project includes signalization and widening of existing ramps and minor widening / lane adustments on El Dorado Road. See also, Phase 2 Project #71376.

Original Budget: $2,910,000   Expenditures thru 6/30/2013: $181,532   Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Road Interchange Improvements - Phase 1

Financing Plan & Tentative Schedule

Project No: 71347 **Type: Interchange** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$29	$0	$0	$0	$0	$0	$199	$1,156	$1,384
2004 GP TIM	$29	$0	$0	$0	$0	$0	$199	$1,156	$1,384
RSTP Exchange Funds-Rural-EDCTC	$124	$0	$0	$0	$0	$0	$0	$0	$124
Total	$182	$0	$0	$0	$0	$0	$398	$2,312	$2,892

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$136	$0	$0	$0	$0	$0	$70	$0	$206
Planning/Env - Staff	$14	$0	$0	$0	$0	$0	$26	$0	$40
Design - Consultant	$0	$0	$0	$0	$0	$0	$30	$0	$30
Design - Staff	$31	$0	$0	$0	$0	$0	$272	$0	$303
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$62	$62
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Right of Way - Staff	$1	$0	$0	$0	$0	$0	$0	$20	$21
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$400	$400
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$1,815	$1,815
Total	$182	$0	$0	$0	$0	$0	$398	$2,312	$2,892

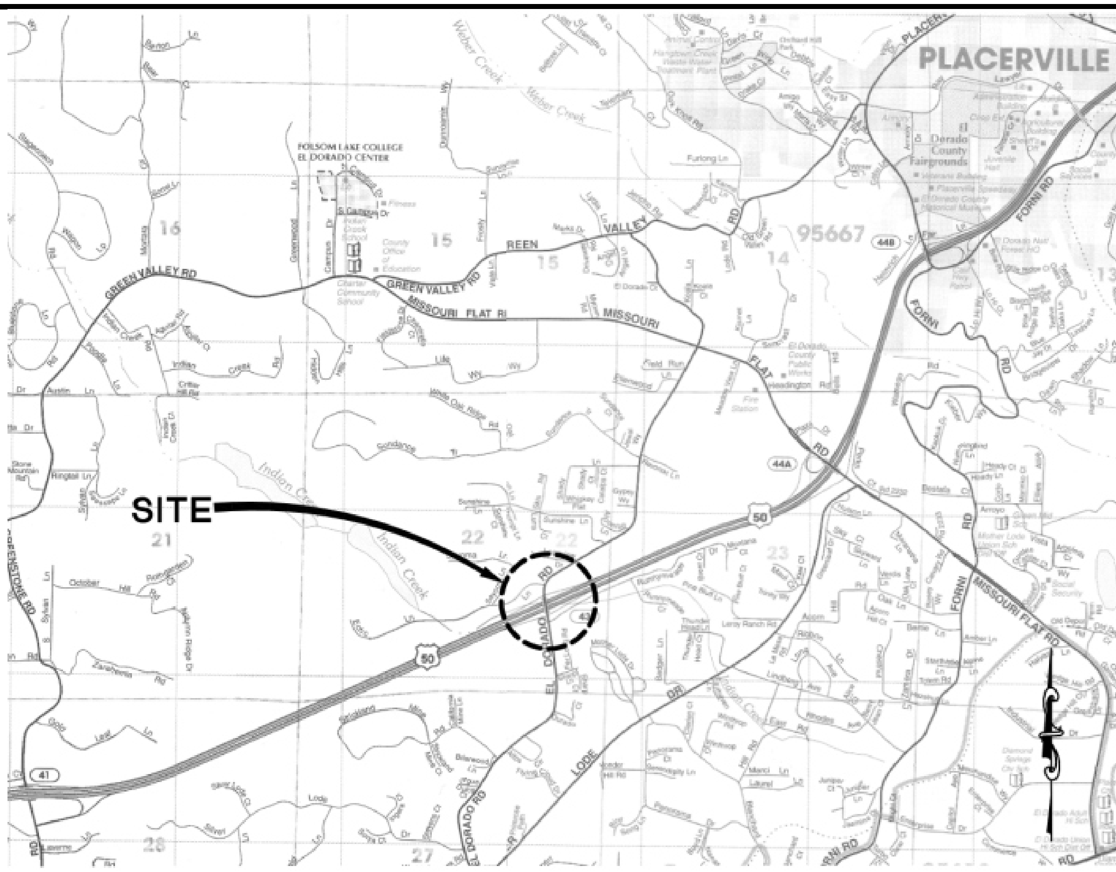
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Road Interchange Phase 2

CIP Project Summary

Project No: 71376 | **Type: Interchange** | **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project would involve construction of left and right turn lanes and additional through traffic lanes as follows: north/southbound El Dorado Road, and east/westbound on-/off-ramps for US 50. Will require either widening of the existing El Dorado Road/US 50 overcrossing structure and/or construction of a new adjacent structure. Refer to 2000 PSR. See Project No 71347 for Phase 1 improvements.

Original Budget: $21,690,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/El Dorado Road Interchange Phase 2

Financing Plan & Tentative Schedule

Project No: 71376 **Type: Interchange** **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$0	$0	$0	$0	$0	$0	$0	$2,935	$2,935
2004 GP TIM	$0	$0	$0	$0	$0	$0	$0	$2,935	$2,935
Total	$0	$0	$0	$0	$0	$0	$0	$5,870	$5,870

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$0	$280	$280
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$130	$130
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$500	$500
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$240	$240
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$67	$67
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$54	$54
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$59	$59
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$210	$210
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$280	$280
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$4,050	$4,050
Total	$0	$0	$0	$0	$0	$0	$0	$5,870	$5,870

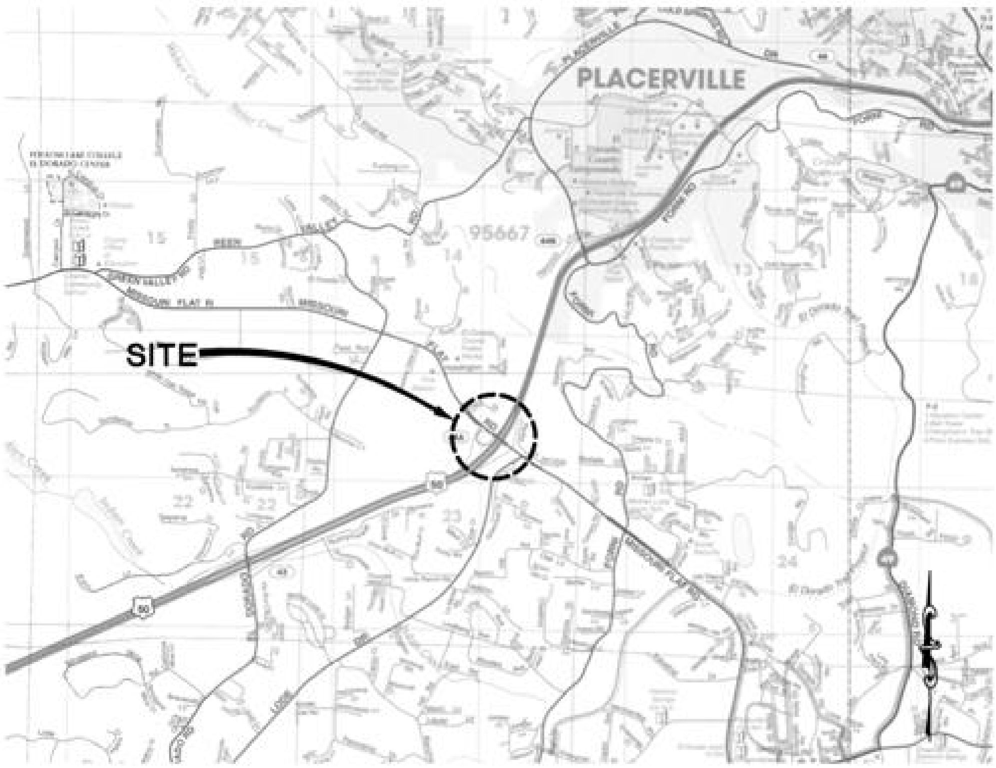
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Missouri Flat Road Interchange Improvements - Phase 1B

CIP Project Summary

Project No: 71336 | **Type: Interchange** | **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

Project Phase 1B is the second of three phases to construct the Phase 1 option addressed in the FEIR for the US 50/Missouri Flat Road Interchange. In October 2010, the project scope was increased to include items not originally in the PSR, but that were a part of the Western Placerville Drive Interchange project at Forni Road in Placerville. With this added scope, additional STIP grant funds were programmed. The phase 1B project includes: reconfiguration of the interchange to a four-lane tight diamond interchange, construction of auxiliary lanes between the interchange and the Forni Road/Western Placerville Drive Interchange; widening and seismic retrofitting of the Weber Creek bridges on US 50; addition of a bike/pedestrian facility between Missouri Flat Road and Placerville Drive. Cost increase due to added scope from Western Placerville Interchange and the bike path over Weber Creek.

Original Budget: $37,859,000 | Expenditures thru 6/30/2013: $38,664,582 | Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Missouri Flat Road Interchange Improvements - Phase 1B

Financing Plan & Tentative Schedule

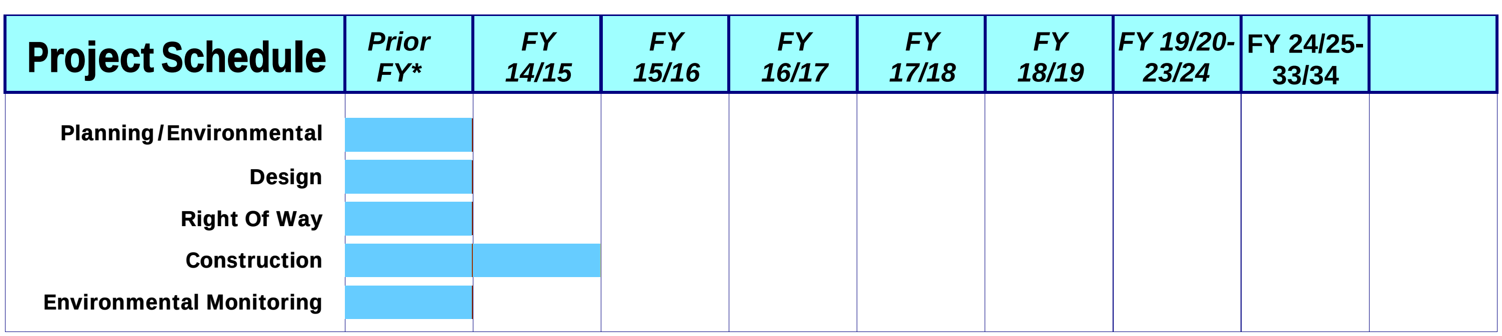
Project No: 71336 **Type: Interchange** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$1,004	$0	$0	$0	$0	$0	$0	$0	$1,004
2004 GP TIM	$1,004	$0	$0	$0	$0	$0	$0	$0	$1,004
American Recovery & Reinvestment Act (ARRA)	$5,174	$0	$0	$0	$0	$0	$0	$0	$5,174
Master Circulation & Funding Plan Financing	$3,278	$120	$0	$0	$0	$0	$0	$0	$3,398
Proposition 1B	$5,034	$0	$0	$0	$0	$0	$0	$0	$5,034
Regional Improvement Program	$21,874	$400	$0	$0	$0	$0	$0	$0	$22,274
Road Fund/Discretionary	($314)	$0	$0	$0	$0	$0	$0	$0	($314)
SHOPP Funds	$2,950	$0	$0	$0	$0	$0	$0	$0	$2,950
Transportation Community & System Preservation (TCSP)	$534	$0	$0	$0	$0	$0	$0	$0	$534
Total	$40,536	$520	$0	$0	$0	$0	$0	$0	$41,056

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$145	$0	$0	$0	$0	$0	$0	$0	$145
Planning/Env - Staff	$24	$0	$0	$0	$0	$0	$0	$0	$24
Design - Consultant	$1,587	$0	$0	$0	$0	$0	$0	$0	$1,587
Design - Staff	$618	$0	$0	$0	$0	$0	$0	$0	$618
Right of Way - Acquisition	$164	$0	$0	$0	$0	$0	$0	$0	$164
Right of Way - Consultant	$11	$0	$0	$0	$0	$0	$0	$0	$11
Right of Way - Staff	$135	$0	$0	$0	$0	$0	$0	$0	$135
Construction Mgmt - Consultant	$3,886	$80	$0	$0	$0	$0	$0	$0	$3,966
Construction Mgmt - Staff	$4,186	$40	$0	$0	$0	$0	$0	$0	$4,226
Direct Construction Costs	$29,765	$400	$0	$0	$0	$0	$0	$0	$30,165
Env Monitoring - Consultant	$14	$0	$0	$0	$0	$0	$0	$0	$14
Total	$40,536	$520	$0	$0	$0	$0	$0	$0	$41,056

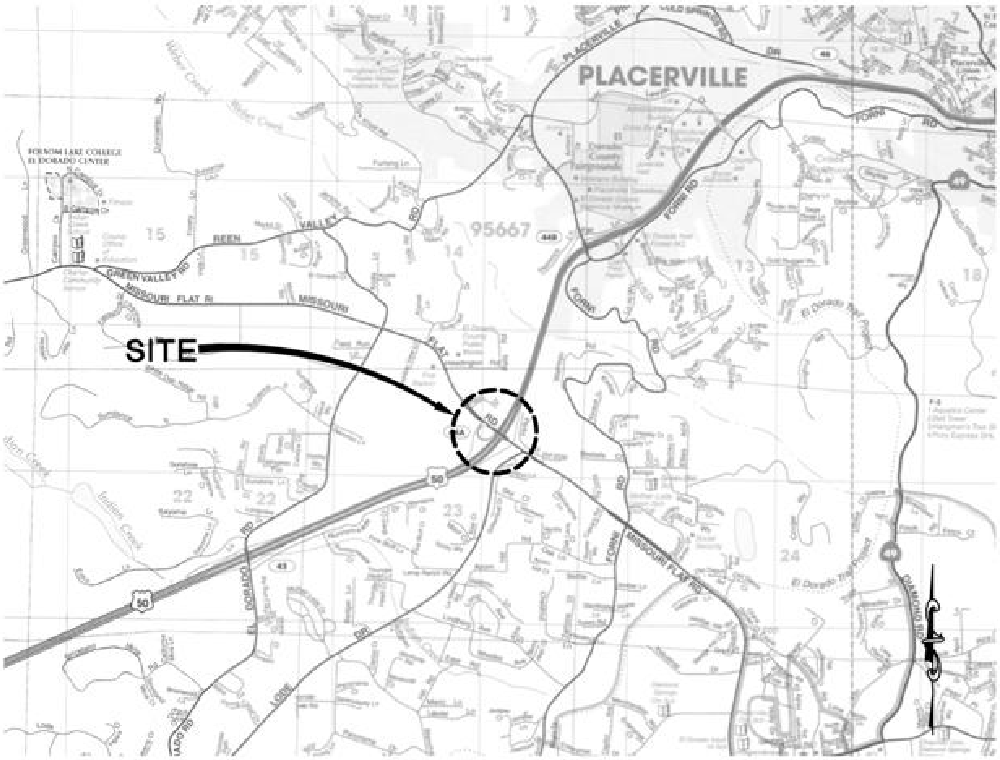


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Missouri Flat Road Interchange Improvements - Phase 1C Riparian Restoration

CIP Project Summary

Project No: 71346 **Type: Interchange** **Supervisor District(s) 3**



LOCATION MAP

NOT TO SCALE

Project Description:

This project, Phase 1C, is the third of three phases to construct the Phase 1 option addressed in the FEIR for the "US 50/Missouri Flat Road Interchange". See the Phase 1A project, 71317 for costs prior to FY 07/08 as they include costs for Phases 1A, 1B and 1C.

The Phase 1C project is proposed to include riparian restoration and landscape improvements as required by the PR & FEIR for the project. The project will include the design, specifications, an implementation plan, maintenance plan, maintenance requirements and a monitoring program for the restoration of native riparian vegetation and trees that are or have been removed as a part of the overall Phase 1 project construction.

Original Budget: $1,586,000 Expenditures thru 6/30/2013: $22,756 Project Initiation Date: 05/05/09

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Missouri Flat Road Interchange Improvements - Phase 1C Riparian Restoration

Financing Plan & Tentative Schedule

Project No: 71346 **Type: Interchange** **Supervisor District(s) 3**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Master Circulation & Funding Plan Financing	$194	$1,438	$34	$34	$68	$0	$0	$0	$1,768
Total	$194	$1,438	$34	$34	$68	$0	$0	$0	$1,768

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Design - Consultant	$68	$5	$0	$0	$0	$0	$0	$0	$73
Design - Staff	$61	$21	$0	$0	$0	$0	$0	$0	$82
Right of Way - Consultant	$60	$0	$0	$0	$0	$0	$0	$0	$60
Right of Way - Staff	$5	$0	$0	$0	$0	$0	$0	$0	$5
Construction Mgmt - Consultant	$0	$50	$0	$0	$0	$0	$0	$0	$50
Construction Mgmt - Staff	$0	$128	$0	$0	$0	$0	$0	$0	$128
Direct Construction Costs	$0	$1,200	$0	$0	$0	$0	$0	$0	$1,200
Env Monitoring - Consultant	$0	$30	$30	$30	$60	$0	$0	$0	$150
Env Monitoring - Staff	$0	$4	$4	$4	$8	$0	$0	$0	$20
Total	$194	$1,438	$34	$34	$68	$0	$0	$0	$1,768

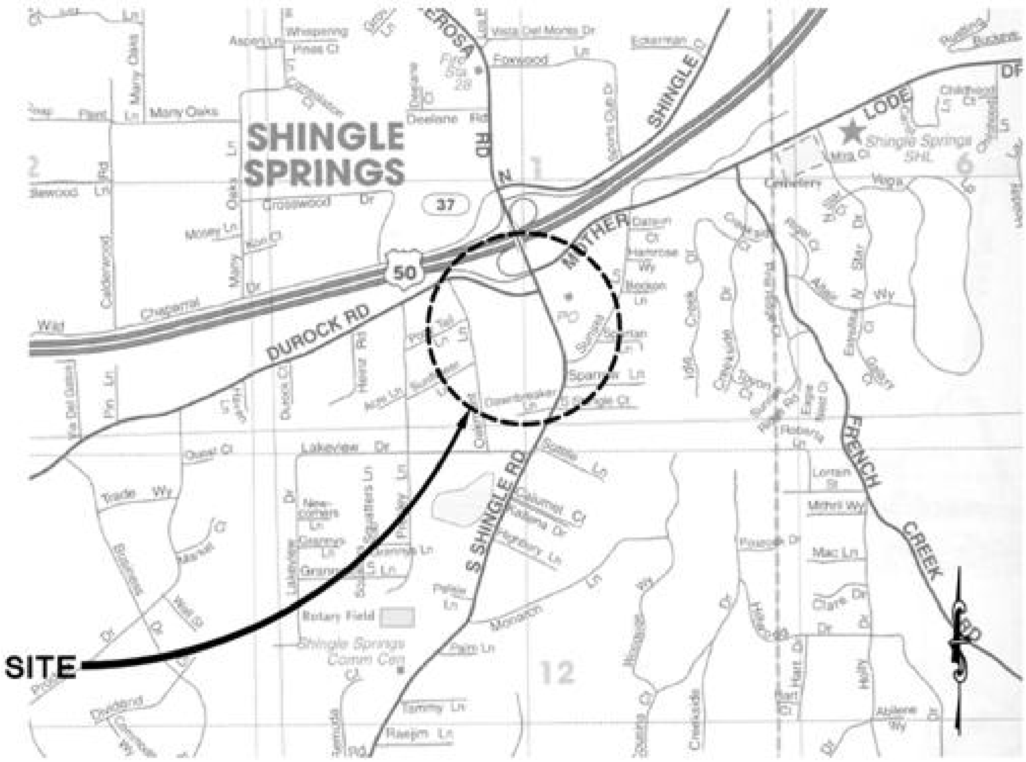
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Ponderosa Rd Interchange - Durock Rd Realignment

CIP Project Summary

Project No: 71338 **Type: Interchange** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

This project includes realignment of approximately 1/4 mile of Durock Road to South Shingle Road/Sunset Lane and signalization of the new intersection. Durock Road will be two through lanes with turn pockets at the intersection. This project is part of a larger project, US 50/Ponderosa Road/South Shingle Road interchange (project 71333). Preliminary engineering shall be performed under the interchange project. Work needs to be coordinated with US 50/Ponderosa Road/South Shingle Road Interchange (project 71333), US 50/Ponderosa Road Interchange - N. Shingle Road Realignment (project 71339) and Durock Road Widening - South Shingle Road to Robin Lane (project GP171).

Original Budget: $8,105,000 Expenditures thru 6/30/2013: $14,600 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Ponderosa Rd Interchange - Durock Rd Realignment

Financing Plan & Tentative Schedule

Project No: 71338 **Type: Interchange** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$7	$0	$0	$0	$0	$0	$375	$3,194	$3,576
2004 GP TIM	$7	$0	$0	$0	$0	$0	$375	$3,194	$3,576
Total	$15	$0	$0	$0	$0	$0	$750	$6,387	$7,152

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$9	$0	$0	$0	$0	$0	$0	$0	$9
Design - Consultant	$0	$0	$0	$0	$0	$0	$50	$0	$50
Design - Staff	$4	$0	$0	$0	$0	$0	$700	$0	$704
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$1,900	$1,900
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$50	$50
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$40	$40
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$675	$675
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$3,700	$3,700
Env Monitoring - Consultant	$0	$0	$0	$0	$0	$0	$0	$20	$20
Env Monitoring - Staff	$1	$0	$0	$0	$0	$0	$0	$2	$3
Total	$15	$0	$0	$0	$0	$0	$750	$6,387	$7,152

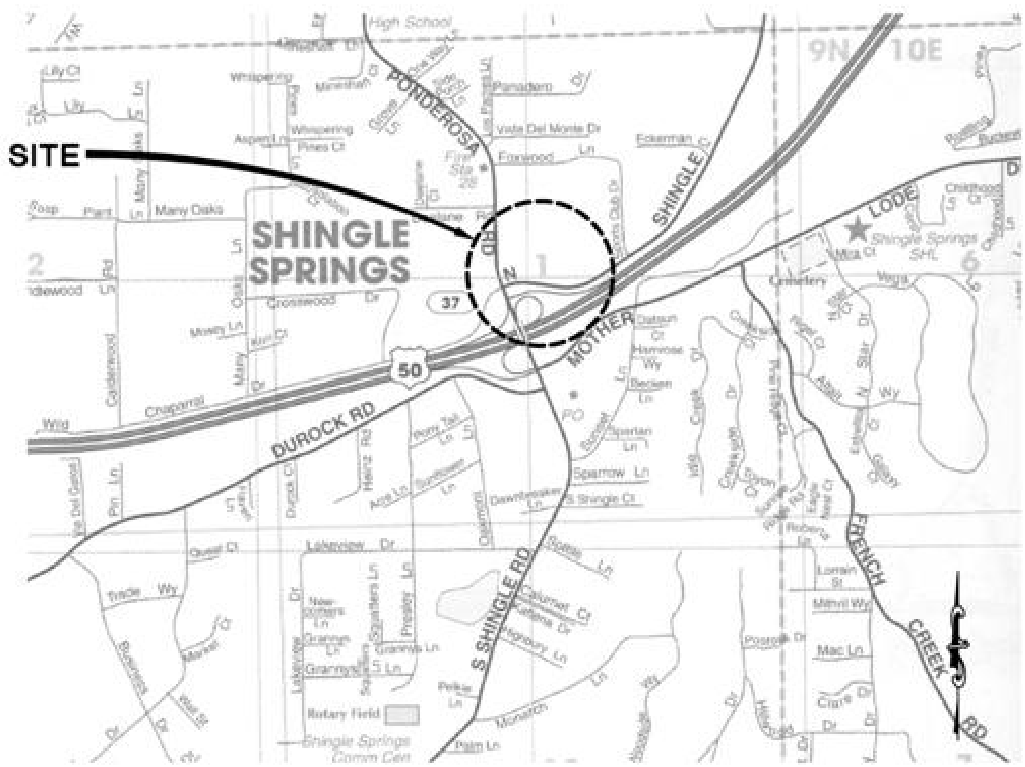
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Ponderosa Rd Interchange - N. Shingle Rd Realignment

CIP Project Summary

Project No: 71339 | **Type: Interchange** | **Supervisor District(s) 4**



LOCATION MAP

NOT TO SCALE

Project Description:

This project includes: realignment of about 1/4 mile of North Shingle Road to about 600 feet north on Ponderosa Road; realignment of the westbound off-ramp to align with Wild Chaparral Drive; and signalizing the new intersection. Realigned North Shingle Road will be two through lanes with turn pockets at the intersection. Part of a larger project for the reconstruction of the US 50/Ponderosa Road/South Shingle Road interchange (project 71333). Preliminary engineering for this phase shall be performed under the interchange project. Work needs to be coordinated with 71333, 71338, and GP150. Former Project Title: North Shingle Road Realignment at Ponderosa Road.

Original Budget: $8,659,000 Expenditures thru 6/30/2013: $9,254 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Ponderosa Rd Interchange - N. Shingle Rd Realignment

Financing Plan & Tentative Schedule

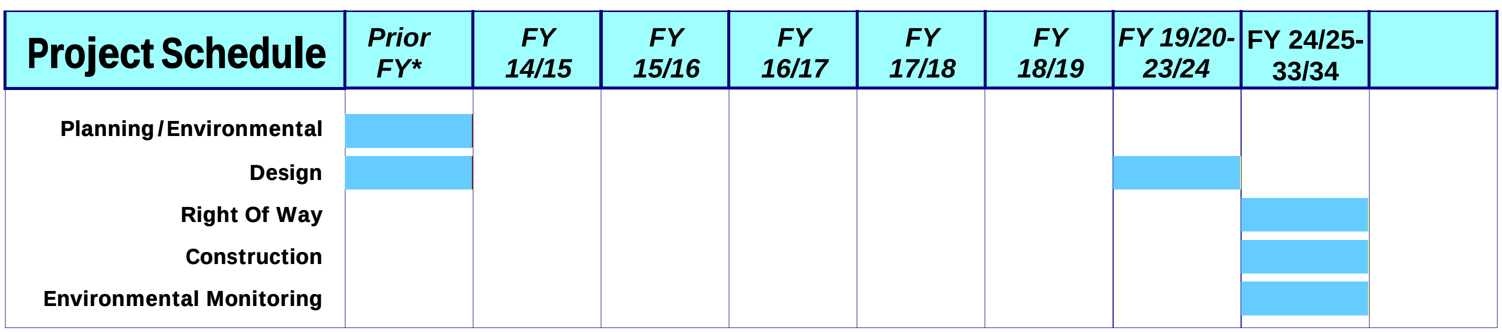
Project No: 71339 | **Type: Interchange** | **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$5	$0	$0	$0	$0	$0	$375	$2,131	$2,510
2004 GP TIM	$5	$0	$0	$0	$0	$0	$375	$2,131	$2,510
Total	$9	$0	$0	$0	$0	$0	$750	$4,261	$5,020

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$5	$0	$0	$0	$0	$0	$0	$0	$5
Design - Consultant	$0	$0	$0	$0	$0	$0	$150	$0	$150
Design - Staff	$4	$0	$0	$0	$0	$0	$600	$0	$604
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$625	$625
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$15	$15
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$25	$25
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$540	$540
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$3,000	$3,000
Env Monitoring - Consultant	$0	$0	$0	$0	$0	$0	$0	$45	$45
Env Monitoring - Staff	$0	$0	$0	$0	$0	$0	$0	$11	$11
Total	$9	$0	$0	$0	$0	$0	$750	$4,261	$5,020

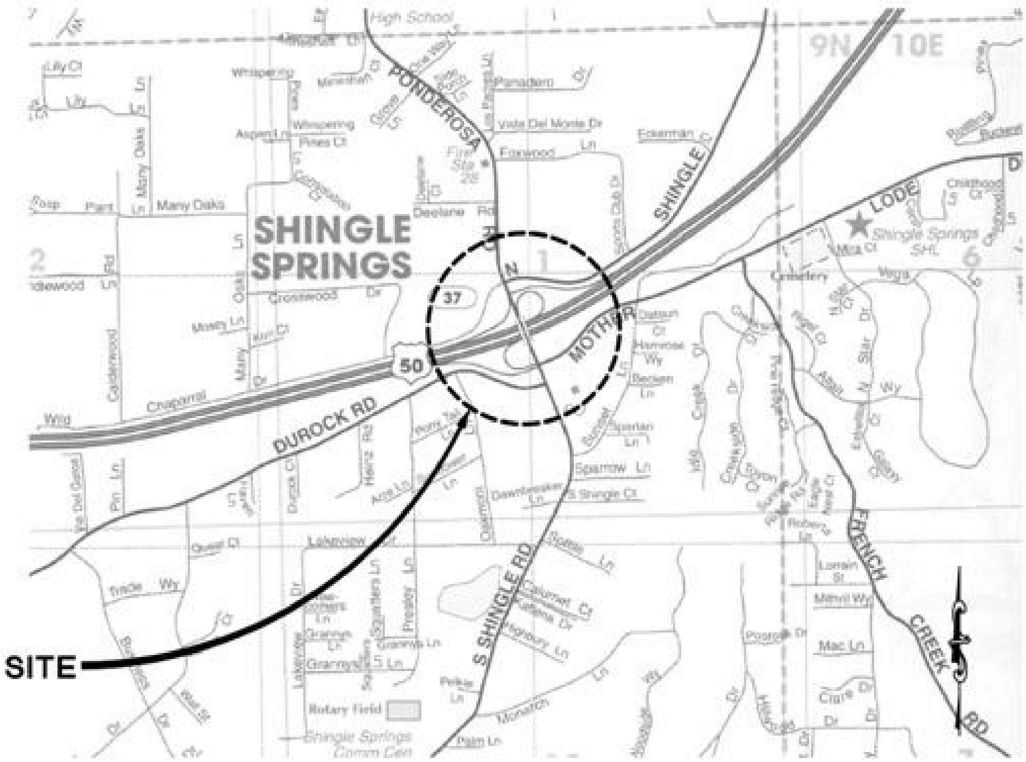


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Ponderosa Rd/So. Shingle Rd Interchange Improvements

CIP Project Summary

Project No: 71333 | **Type: Interchange** | **Supervisor District(s) 2, 4**



LOCATION MAP

NOT TO SCALE

Project Description:

Project provides capacity improvements to the interchange, includes a detailed study to identify a preferred alternative. This phase of the project includes the widening of the existing US 50 overcrossing to accommodate five lanes and the realignment of the westbound loop on-ramp, ramp widenings, and widening of Ponderosa Road, Mother Lode Drive and South Shingle Road. Preliminary engineering for all phases (projects 71333, 71338 and 71339) shall be performed under the interchange project. This project requires the construction of US 50 /Ponderosa Road - North Shingle Road Realignment (project 71338) and US 50 / Ponderosa Road Interchange - Durock Road Realignment (project 71339). This project shall also be coordinated with US 50 HOV - Phase 3 (project 53116), US 50 Eastbound Auxiliary Lanes - Cambridge Road to Ponderosa Road (project GP150), Ponderosa Road Widening (project GP175) and Durock Road Widening (project GP171). Funding for FY 12/13 is for completion of the environmental analysis.

Original Budget: $17,676,862   Expenditures thru 6/30/2013: $947,246   Project Initiation Date: 02/13/07

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Ponderosa Rd/So. Shingle Rd Interchange Improvements

Financing Plan & Tentative Schedule

Project No: 71333 **Type: Interchange** **Supervisor District(s) 2, 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Hwy 50 TIM	$498	$71	$0	$0	$0	$0	$0	$7,610	$8,179
2004 GP TIM	$498	$71	$0	$0	$0	$0	$0	$7,610	$8,179
Total	$997	$142	$0	$0	$0	$0	$0	$15,220	$16,359

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$746	$92	$0	$0	$0	$0	$0	$0	$838
Planning/Env - Staff	$213	$50	$0	$0	$0	$0	$0	$0	$263
Design - Consultant	$0	$0	$0	$0	$0	$0	$0	$300	$300
Design - Staff	$16	$0	$0	$0	$0	$0	$0	$2,800	$2,816
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$500	$500
Right of Way - Consultant	$13	$0	$0	$0	$0	$0	$0	$95	$108
Right of Way - Staff	$9	$0	$0	$0	$0	$0	$0	$125	$134
Construction Mgmt - Consultant	$0	$0	$0	$0	$0	$0	$0	$500	$500
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$1,400	$1,400
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$9,500	$9,500
Total	$997	$142	$0	$0	$0	$0	$0	$15,220	$16,359

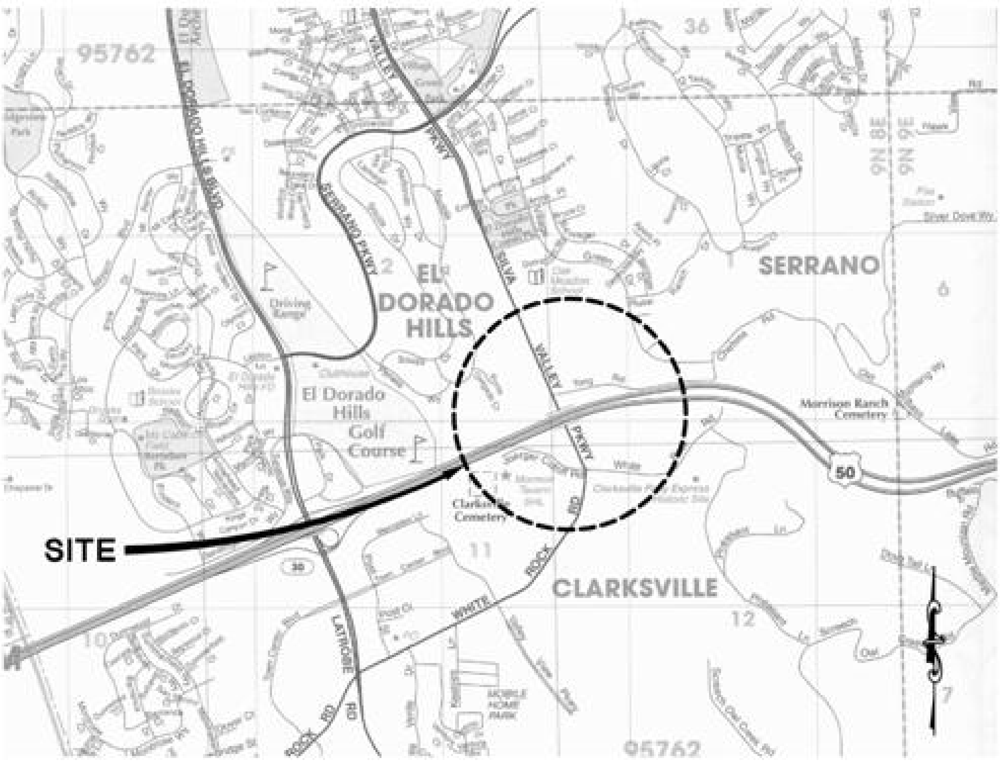
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Silva Valley Parkway Interchange - Phase 1

CIP Project Summary

Project No: 71328 **Type: Interchange** **Supervisor District(s) 1, 2**



LOCATION MAP

NOT TO SCALE

Project Description:

This project will construct a new U.S. 50 freeway interchange at Silva Valley Parkway in El Dorado Hills. The project includes a realignment of Silva Valley Parkway, a new bridge to carry Silva Valley Parkway traffic over U.S. 50, new on ramps and off ramps for both directions of U.S. 50, and auxiliary lanes between the new interchange and the interchange at El Dorado Hills Boulevard/Latrobe Road.

Original Budget: $46,250,000 Expenditures thru 6/30/2013: $10,834,111 Project Initiation Date: 09/12/05

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Silva Valley Parkway Interchange - Phase 1

Financing Plan & Tentative Schedule

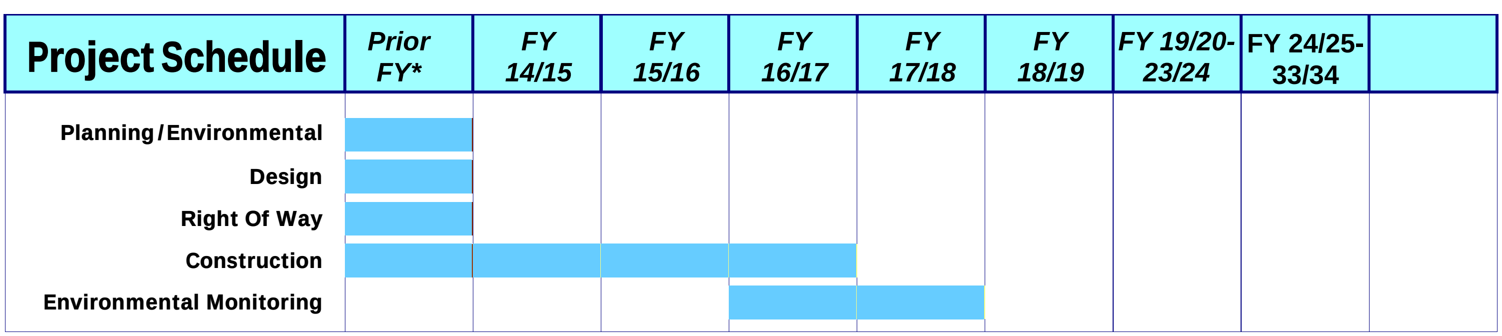
Project No: 71328 | **Type: Interchange** | **Supervisor District(s) 1, 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Silva Valley Interchange Set Aside	$0	$15,160	$330	$1,553	$80	$0	$0	$0	$17,123
Developer Advance Silva Valley IC	$5,100	$2,095	$8,733	$267	$0	$0	$0	$0	$16,195
Road Fund/Discretionary	$66	$0	$0	$0	$0	$0	$0	$0	$66
Silva Valley Interchange Set Aside	$21,790	$870	$0	$0	$0	$0	$0	$0	$22,660
State-Local Partnership Program (SLPP)	$1,000	$0	$0	$0	$0	$0	$0	$0	$1,000
Utility Agency - EID	$64	$127	$64	$0	$0	$0	$0	$0	$254
Total	$28,020	$18,252	$9,126	$1,820	$80	$0	$0	$0	$57,298

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$564	$0	$0	$0	$0	$0	$0	$0	$564
Planning/Env - Staff	$601	$0	$0	$0	$0	$0	$0	$0	$601
Design - Consultant	$373	$0	$0	$0	$0	$0	$0	$0	$373
Design - Staff	$358	$0	$0	$0	$0	$0	$0	$0	$358
Developer Advanced Design	$5,100	$0	$0	$0	$0	$0	$0	$0	$5,100
Right of Way - Acquisition	$2,672	$0	$0	$0	$0	$0	$0	$0	$2,672
Right of Way - Consultant	$8,742	$0	$0	$0	$0	$0	$0	$0	$8,742
Right of Way - Staff	$283	$0	$0	$0	$0	$0	$0	$0	$283
Construction Mgmt - Consultant	$700	$2,050	$1,223	$0	$0	$0	$0	$0	$3,973
Construction Mgmt - Staff	$1,053	$1,056	$330	$300	$0	$0	$0	$0	$2,739
Direct Construction Costs	$7,573	$15,146	$7,573	$1,500	$0	$0	$0	$0	$31,792
Env Monitoring - Consultant	$0	$0	$0	$18	$72	$0	$0	$0	$90
Env Monitoring - Staff	$0	$0	$0	$2	$8	$0	$0	$0	$10
Total	$28,020	$18,252	$9,126	$1,820	$80	$0	$0	$0	$57,298

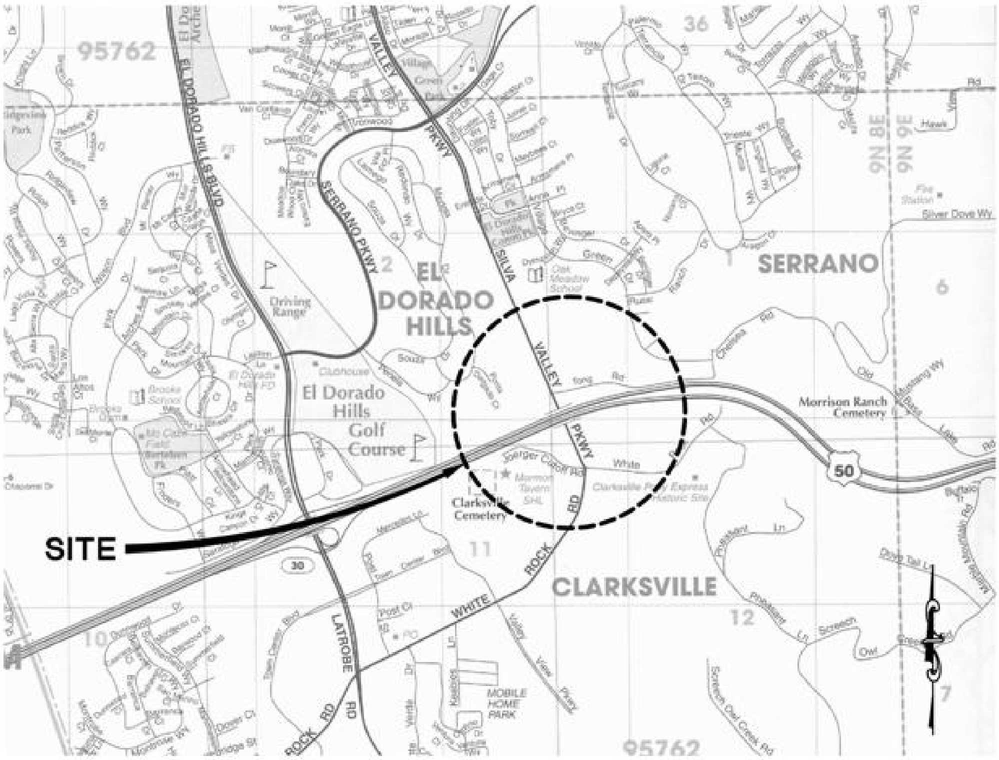


*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Silva Valley Parkway Interchange - Phase 2 - On Ramps and Auxiliary Lanes on U.S. 50

CIP Project Summary

Project No: 71345 **Type: Interchange** **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

This project is the final phase of the US 50/Silva Valley Parkway Interchange. Due to future growth in the area this project will be necessary to accommodate traffic projected for 2030. Project includes eastbound diagonal and westbound loop on-ramps to US 50. Project is in the preliminary planning phase.

Original Budget: $10,500,000 Expenditures thru 6/30/2013: $23 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

U.S. 50/Silva Valley Parkway Interchange - Phase 2 - On Ramps and Auxiliary Lanes on U.S. 50

Financing Plan & Tentative Schedule

Project No: 71345 **Type: Interchange** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP Silva Valley Interchange Set Aside	$0	$0	$0	$0	$0	$0	$0	$12,070	$12,070
Total	$0	$0	$0	$0	$0	$0	$0	$12,070	$12,070

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$1,700	$1,700
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$595	$595
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$150	$150
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$1,500	$1,500
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$8,125	$8,125
Total	$0	$0	$0	$0	$0	$0	$0	$12,070	$12,070

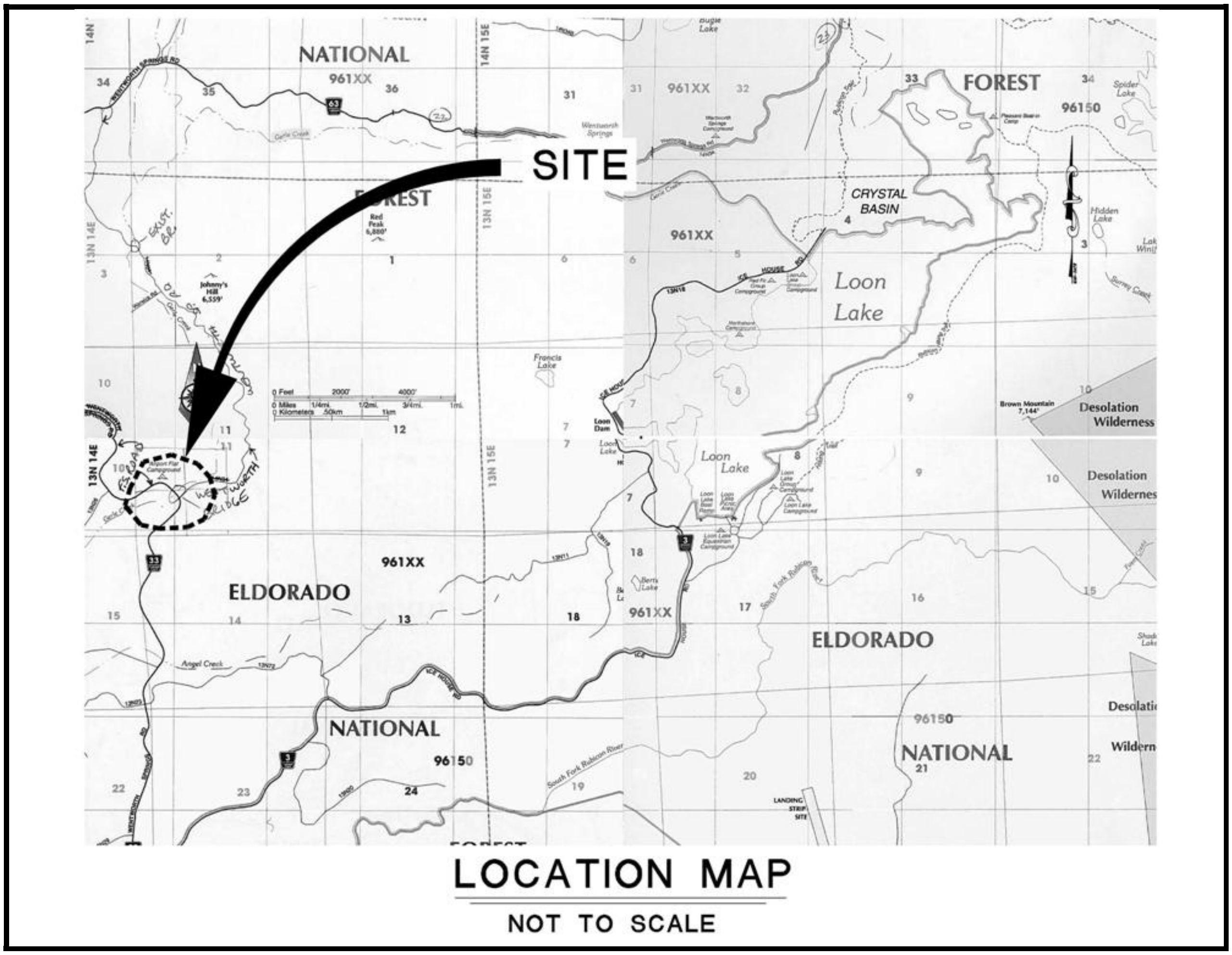
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Wentworth Springs Road at Gerle Creek - Bridge Replacement

CIP Project Summary

Project No: 77118 **Type: Bridge** **Supervisor District(s) 4**



Project Description:

Project includes replacement of a low water crossing at Gerle Creek with a new bridge, minor realignment of Wentworth Springs Road to the new bridge approaches, erosion control and restoration work at the existing low water crossing. Final cost estimate reduced due to design cost savings.

Original Budget: $1,265,000 Expenditures thru 6/30/2013: $1,395,731 Project Initiation Date: 02/11/08

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Wentworth Springs Road at Gerle Creek - Bridge Replacement

Financing Plan & Tentative Schedule

Project No: 77118 | **Type: Bridge** | **Supervisor District(s) 4**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Highway Bridge Program	$1,277	$26	$26	$0	$0	$0	$0	$0	$1,329
Off Highway Vehicle Grant	$93	$0	$0	$0	$0	$0	$0	$0	$93
Road Fund/Discretionary	($8)	$0	$0	$0	$0	$0	$0	$0	($8)
RSTP Exchange Funds-Caltrans	$29	$0	$0	$0	$0	$0	$0	$0	$29
SMUD Upper American River Project Coop Agreement	$26	$0	$0	$0	$0	$0	$0	$0	$26
Total	$1,417	$26	$26	$0	$0	$0	$0	$0	$1,469

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$99	$0	$0	$0	$0	$0	$0	$0	$99
Planning/Env - Staff	$143	$0	$0	$0	$0	$0	$0	$0	$143
Design - Consultant	$9	$0	$0	$0	$0	$0	$0	$0	$9
Design - Staff	$152	$0	$0	$0	$0	$0	$0	$0	$152
Right of Way - Acquisition	$4	$0	$0	$0	$0	$0	$0	$0	$4
Right of Way - Staff	$7	$0	$0	$0	$0	$0	$0	$0	$7
Construction Mgmt - Consultant	$147	$0	$0	$0	$0	$0	$0	$0	$147
Construction Mgmt - Staff	$35	$0	$0	$0	$0	$0	$0	$0	$35
Direct Construction Costs	$819	$0	$0	$0	$0	$0	$0	$0	$819
Env Monitoring - Consultant	$0	$20	$20	$0	$0	$0	$0	$0	$40
Env Monitoring - Staff	$1	$6	$6	$0	$0	$0	$0	$0	$13
Total	$1,417	$26	$26	$0	$0	$0	$0	$0	$1,469

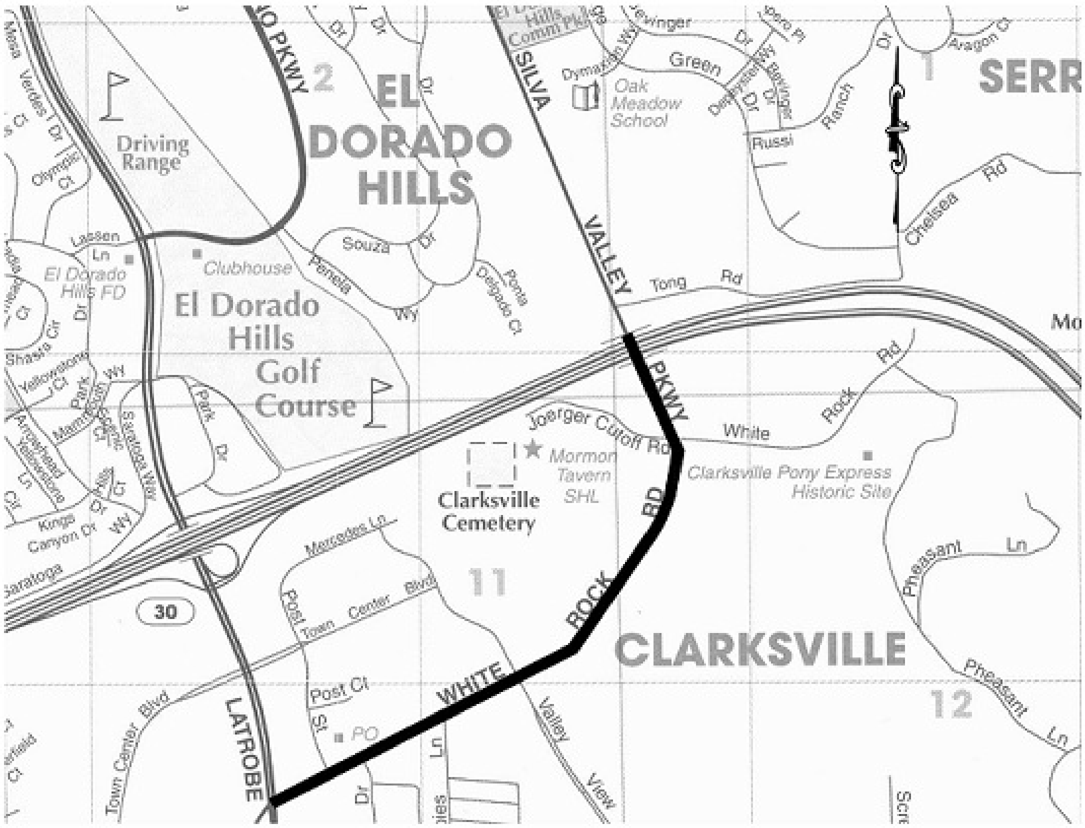
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental									
Design									
Right Of Way									
Construction									
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

White Rock Road Widening - 4 to 6 Lanes, Latrobe Road to US50/Silva Valley Parkway Interchange

CIP Project Summary

Project No: GP152 **Type: Roadway** **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen White Rock Road from four to six lanes, divided, from Latrobe Road to the new US 50/Silva Valley Parkway Interchange. Right of Way costs incurred with project 72374.

Original Budget: $6,058,000 Expenditures thru 6/30/2013: $0 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

White Rock Road Widening - 4 to 6 Lanes, Latrobe Road to US50/Silva Valley Parkway Interchange

Financing Plan & Tentative Schedule

Project No: GP152 **Type: Roadway** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$0	$6,058	$6,058
Total	$0	$0	$0	$0	$0	$0	$0	$6,058	$6,058

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$0	$230	$230
Design - Staff	$0	$0	$0	$0	$0	$0	$0	$890	$890
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$78	$78
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$480	$480
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$4,380	$4,380
Total	$0	$0	$0	$0	$0	$0	$0	$6,058	$6,058

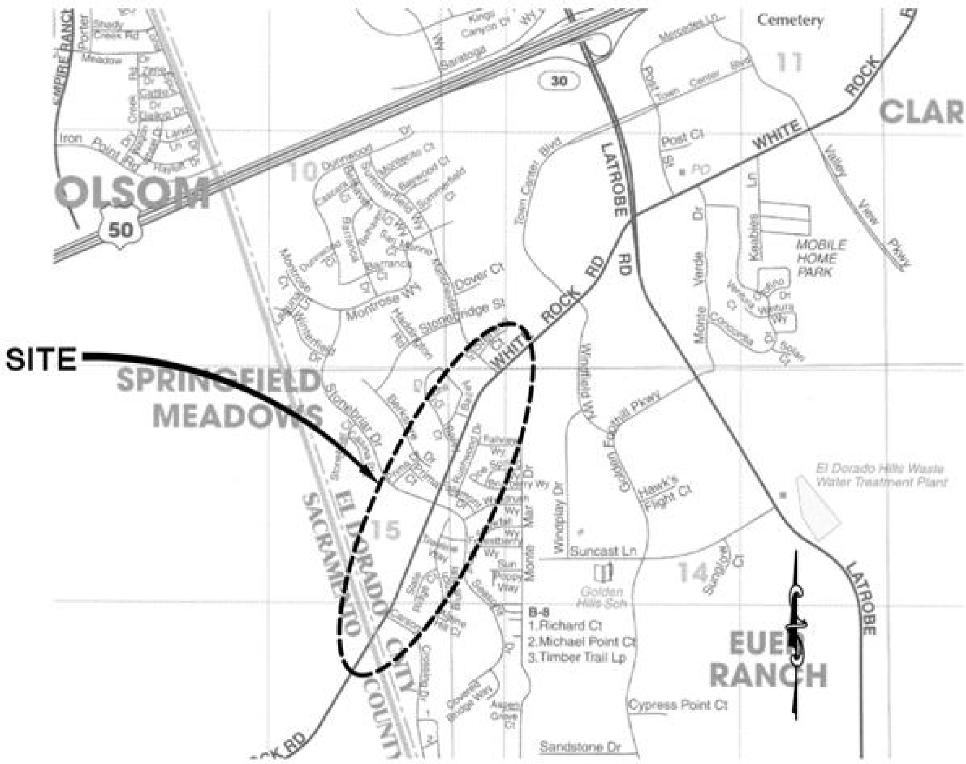
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental								■	
Design								■	
Right Of Way								■	
Construction								■	
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

White Rock Road Widening (2 to 4 lanes) - Manchester Drive to Sacramento County Line

CIP Project Summary

Project No: GP137 | **Type: Roadway** | **Supervisor District(s) 1**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen White Rock Road from two to four lanes, divided, from the Sacramento/El Dorado County line east to Manchester Drive. Portions of the design, Row and grading were completed under Project 72360.

Original Budget: $6,800,000   Expenditures thru 6/30/2013: $0   Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

White Rock Road Widening (2 to 4 lanes) - Manchester Drive to Sacramento County Line

Financing Plan & Tentative Schedule

Project No: GP137 **Type: Roadway** **Supervisor District(s) 1**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$0	$0	$0	$0	$0	$0	$717	$144	$861
Developer Advance - EDH TIM	$0	$0	$0	$0	$0	$0	$0	$2,456	$2,456
Total	$0	$0	$0	$0	$0	$0	$717	$2,600	$3,317

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Staff	$0	$0	$0	$0	$0	$0	$147	$0	$147
Design - Consultant	$0	$0	$0	$0	$0	$0	$159	$0	$159
Design - Staff	$0	$0	$0	$0	$0	$0	$411	$0	$411
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$114	$114
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$11	$11
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$19	$19
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$356	$356
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$2,100	$2,100
Total	$0	$0	$0	$0	$0	$0	$717	$2,600	$3,317

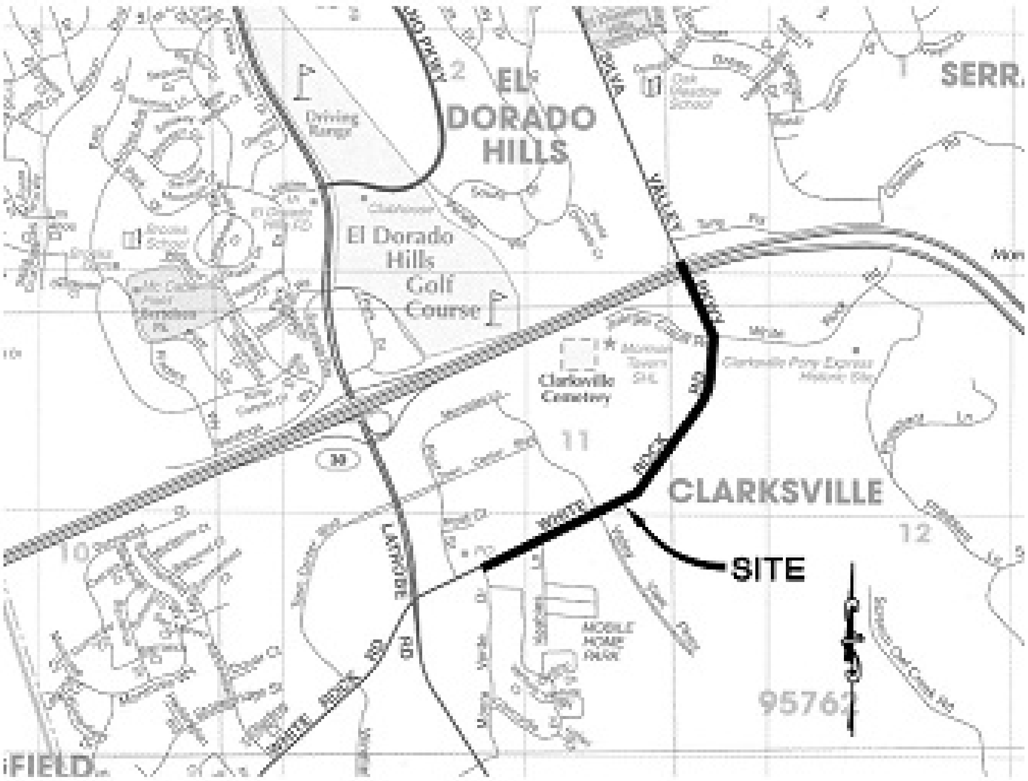
Project Schedule	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	
Planning/Environmental							■		
Design							■		
Right Of Way								■	
Construction								■	
Environmental Monitoring									

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

White Rock Road Widening (2 to 4 lanes) - Monte Verde Drive to US 50/Silva Valley Parkway Interchange

CIP Project Summary

Project No: 72374 | **Type: Roadway** | **Supervisor District(s) 2**



LOCATION MAP

NOT TO SCALE

Project Description:

Widen White Rock Road from two to four lanes from Monte Verde Drive east to the new US 50/Silva Valley Parkway Interchange. Improvements include curb, gutter, sidewalk and Class II bike lanes. Right-of-Way costs include acquisition for ultimate 6-lane facility. Reference: GP152 "White Rock Road widening 4 to 6 lanes" completes the ultimate roadway section.

Original Budget: $19,067,872 Expenditures thru 6/30/2013: $4,172 Project Initiation Date: 08/22/06

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

White Rock Road Widening (2 to 4 lanes) - Monte Verde Drive to US 50/Silva Valley Parkway Interchange

Financing Plan & Tentative Schedule

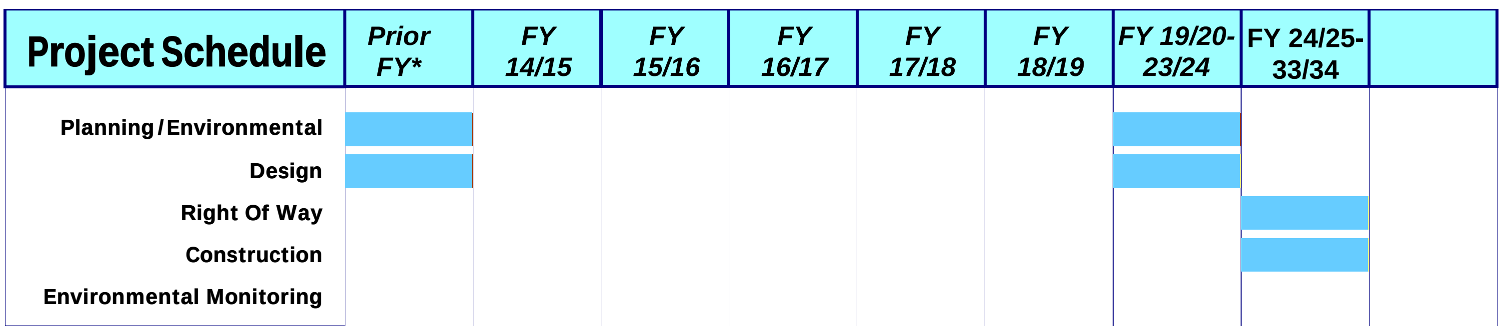
Project No: 72374 **Type: Roadway** **Supervisor District(s) 2**

All Figures in Thousands

Revenue by Funding Source	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
2004 GP El Dorado Hills TIM	$4	$0	$0	$0	$0	$0	$2,180	$16,884	$19,068
Total	$4	$0	$0	$0	$0	$0	$2,180	$16,884	$19,068

All Figures in Thousands

Expenditures	Prior FY*	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20-23/24	FY 24/25-33/34	Total
Planning/Env - Consultant	$0	$0	$0	$0	$0	$0	$350	$0	$350
Planning/Env - Staff	$1	$0	$0	$0	$0	$0	$330	$0	$331
Design - Staff	$3	$0	$0	$0	$0	$0	$1,500	$0	$1,503
Right of Way - Acquisition	$0	$0	$0	$0	$0	$0	$0	$5,980	$5,980
Right of Way - Consultant	$0	$0	$0	$0	$0	$0	$0	$81	$81
Right of Way - Staff	$0	$0	$0	$0	$0	$0	$0	$93	$93
Construction Mgmt - Staff	$0	$0	$0	$0	$0	$0	$0	$1,830	$1,830
Direct Construction Costs	$0	$0	$0	$0	$0	$0	$0	$8,900	$8,900
Total	$4	$0	$0	$0	$0	$0	$2,180	$16,884	$19,068



*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Cost Estimate by Phase Summary

West Slope

All Figures In Thousands

	Prior*	14/15	15/16	16/17	17/18	18/19	19/20-23/24	24/25-33/34	Total
Aggregate	3,181	307	97	99	100	87	857	76,286	81,015
AKT - Sophia Parkway GP082 Appr Reimb Agmt	2,054	0	0	0	0	0	0	0	2,054
AKT - White Rock Rd East 72348 Appr Reimb Agmt	114	38	38	0	0	0	0	0	190
Arrowest - Post St/White Rock Rd Signalization 72372	0	0	85	0	0	0	0	0	85
Bass Lake Rd 66109	0	0	0	0	0	0	0	6,470	6,470
Construction Mgmt - Consultant	8,322	3,039	1,886	1,097	1,028	0	1,675	12,607	29,654
Construction Mgmt - Staff	7,730	2,320	2,080	2,795	3,374	1,100	4,350	33,603	57,352
Country Club - BLR to east BLHSP Boundary GP126	0	0	0	0	0	0	0	5,043	5,043
Country Club Drive-BLR West(BLHSP) GP124 & GP125	0	0	0	0	0	0	0	6,535	6,535
Design - Consultant	6,032	3,269	3,312	784	0	0	1,237	7,723	22,357
Design - Staff	10,371	2,961	3,223	1,671	420	0	7,255	30,552	56,452
Developer Advanced Design	7,100	0	0	0	0	0	0	0	7,100
Developer Advanced Planning	250	0	0	0	0	0	0	0	250
Direct Construction Costs	63,489	27,512	23,731	24,499	33,484	5,400	37,209	257,194	472,517
Env Monitoring - Consultant	14	335	87	85	286	35	185	115	1,142
Env Monitoring - Staff	4	24	19	30	254	21	70	23	443
Forecast - White Rock Rd West 72360	4,036	504	504	0	0	0	0	0	5,045
Planning/Env - Consultant	8,367	2,428	751	15	0	0	1,006	2,901	15,468
Planning/Env - Staff	7,889	833	301	60	0	0	1,745	4,731	15,558
Pulte Homes - Bass Lake Rd (SIA) 71353	0	0	0	0	738	738	2,215	0	3,692
Right of Way - Acquisition	3,814	1,053	2,942	5,096	3,345	0	50	46,793	63,094
Right of Way - Consultant	9,422	525	746	599	92	0	0	3,208	14,591
Right of Way - Staff	2,126	485	966	1,045	239	0	50	3,214	8,124
Safeway Mktplace - EDH/Francisco Contrib 72332	0	0	0	0	0	0	0	300	300
Serrano-Bass Lake Rd Connection to Serrano Pkwy 71335/71353	1,630	181	0	0	0	0	0	0	1,812
Silver Springs Pkwy - Grn Vly Rd/Deer Vly Intersect/Overlay 76114	398	0	0	0	0	0	0	0	398
Silver Springs Pkwy - Offsite Silver Springs Pkwy 76108	0	0	0	0	480	1,094	2,441	0	4,015
Silver Springs Pkwy-SS Parkway & GV/SS Intersect/Overlay 76107	115	0	0	0	0	466	2,307	0	2,888
West Valley, LLC - Latrobe Connection 66116	0	0	0	0	0	0	0	250	250
West Vly - Silva Vly IC Ph 1 71328 Dev Adv & Design Costs	0	0	0	408	626	1,049	6,804	7,308	16,195
White Rock Road - GP137	0	0	0	0	0	0	0	2,456	2,456
Totals	146,459	45,814	40,766	38,282	44,465	9,991	69,457	507,311	902,545

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Revenue Source Summary

West Slope

All Figures In Thousands

	Prior*	14/15	15/16	16/17	17/18	18/19	19/20-23/24	24/25-33/34	Total
04 GP Hwy 50 TIM-Blackstone	*8*	*0*	*0*	*0*	*0*	*0*	*0*	*2,801*	*2,809*
2004 GP EDH TIM Blackstone Prepayment	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*16*
2004 GP El Dorado Hills TIM	*11,506*	*810*	*655*	*28*	*766*	*763*	*10,624*	*171,640*	*196,792*
2004 GP Hwy 50 TIM	*3,978*	*157*	*22*	*23*	*23*	*20*	*1,722*	*88,669*	*94,613*
2004 GP Silva Valley Interchange Set Aside	*376*	*15,197*	*342*	*1,972*	*718*	*1,059*	*6,907*	*22,784*	*49,355*
2004 GP TIM	*7,686*	*762*	*502*	*37*	*1,917*	*1,593*	*6,383*	*186,679*	*205,559*
ACO-Accumulative Capital Outlay-Parks	*13*	*0*	*0*	*78*	*0*	*0*	*0*	*0*	*91*
Air Pollution Control District Grant	*35*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*35*
American Recovery & Reinvestment Act (ARRA)	*5,174*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*5,174*
Anticipated Grant	*0*	*0*	*55*	*5,547*	*0*	*0*	*50*	*6,245*	*11,897*
Bass Lake Hills PFFP	*261*	*438*	*0*	*0*	*0*	*0*	*0*	*712*	*1,412*
Bicycle Transportation Account (BTA)	*45*	*241*	*0*	*0*	*0*	*0*	*0*	*0*	*286*
Caltrans	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Congestion Mitigation and Air Quality Program	*380*	*1,746*	*1,651*	*2,030*	*108*	*0*	*0*	*0*	*5,915*
Corridor Mobility Improvement Account	*13,880*	*1,620*	*0*	*0*	*0*	*0*	*0*	*0*	*15,500*
Developer Advance - EDH TIM	*504*	*0*	*0*	*0*	*0*	*0*	*10*	*15,197*	*15,711*
Developer Advance BLHPFFP	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,750*	*1,750*
Developer Advance Silva Valley IC	*5,100*	*2,095*	*8,733*	*267*	*0*	*0*	*0*	*0*	*16,195*
Developer Advance TIM	*3,469*	*0*	*0*	*0*	*3,736*	*0*	*0*	*5,043*	*12,248*
Developer Funded	*5,295*	*0*	*0*	*0*	*1,660*	*0*	*0*	*2,730*	*9,685*
Developer In-Lieu Fees	*150*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*150*
EDC AQMD	*97*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*97*
EDH Business Park Assessment District	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3,000*	*3,000*
El Dorado County Transportation Commission	*89*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*89*
El Dorado Hills Community Services District	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
El Dorado Hills Road Impact Fee	*23*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*23*
Federal Lands Access Program (FLAP)	*64*	*1,300*	*2,835*	*0*	*0*	*0*	*0*	*0*	*4,198*
General Fund	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Highway Bridge Program	*12,681*	*9,336*	*13,875*	*21,491*	*20,557*	*32*	*41,968*	*0*	*119,940*
Highway Safety Improvement Program	*1,887*	*2,478*	*153*	*0*	*0*	*0*	*0*	*0*	*4,517*
Interim Highway 50 Variable TIM Fee	*1,286*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,286*
Local Funds - Tribe	*3,219*	*620*	*4,611*	*3,745*	*8,638*	*5,520*	*0*	*0*	*26,353*
Master Circulation & Funding Plan Financing	*5,055*	*2,035*	*1,034*	*1,034*	*2,386*	*1,000*	*20*	*0*	*12,564*
Miscellaneous Reimbursement	*15*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*15*
Off Highway Vehicle Grant	*187*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*187*
Pollock Pines/Camino Park (ZOB)	*33*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*33*
Proposition 1B	*5,034*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*5,034*
Public Lands Highway Discretionary (PLHD)	*100*	*200*	*0*	*0*	*0*	*0*	*0*	*0*	*300*
Regional Improvement Program	*21,874*	*400*	*0*	*0*	*0*	*0*	*0*	*0*	*22,274*
Regional Surface Transportation Program-Federal	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
RIF - El Dorado / Diamond Springs	*139*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*139*
Road Fund/Discretionary	*44*	*57*	*0*	*0*	*0*	*0*	*0*	*0*	*101*
RSTP Exchange Funds-Caltrans	*1,963*	*762*	*402*	*352*	*94*	*1*	*1,769*	*61*	*5,404*

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

RSTP Exchange Funds-Rural-EDCTC	*972*	*175*	*74*	*545*	*1*	*1*	*0*	*0*	*1,769*
RSTP Exchange Funds-Urban-EDCTC	*171*	*258*	*241*	*453*	*3*	*2*	*3*	*0*	*1,130*
RSTP Federal Funds-Urban	*95*	*307*	*0*	*0*	*0*	*0*	*0*	*0*	*402*
RSTP Match Funds-Caltrans	*79*	*152*	*0*	*0*	*0*	*0*	*0*	*0*	*231*
Safe Routes to School - Federal	*460*	*540*	*0*	*0*	*0*	*0*	*0*	*0*	*1,000*
Safe Routes to School - State	*537*	*363*	*0*	*0*	*0*	*0*	*0*	*0*	*900*
SHOPP Funds	*3,950*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3,950*
Silva Valley Interchange Set Aside	*21,790*	*870*	*0*	*0*	*0*	*0*	*0*	*0*	*22,660*
SMUD Upper American River Project Coop Agreement	*91*	*228*	*445*	*0*	*0*	*0*	*0*	*0*	*764*
State Parks-Recreational Trails Program (RTP)	*12*	*55*	*146*	*245*	*0*	*0*	*0*	*0*	*458*
State Transportation Impact Mitigation Fee	*25*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*25*
State-Local Partnership Program (SLPP)	*1,550*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,550*
To Be Determined	*12*	*21*	*13*	*147*	*0*	*0*	*0*	*0*	*192*
Traffic Impact Mitigation Fee (West Slope)	*3,431*	*2,335*	*2,817*	*192*	*26*	*0*	*0*	*0*	*8,800*
Trails Now Grant	*0*	*0*	*0*	*5*	*0*	*0*	*0*	*0*	*5*
Transportation Community & System Preservation (TCSP)	*688*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*688*
Transportation Development Act (TDA)	*173*	*51*	*21*	*27*	*0*	*0*	*0*	*0*	*272*
Transportation Enhancement Activities	*472*	*70*	*0*	*0*	*0*	*0*	*0*	*0*	*542*
Transportation Enhancement State	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Utility Agencies	*10*	*10*	*2,078*	*65*	*3,832*	*0*	*0*	*0*	*5,994*
Utility Agency - EID	*276*	*127*	*64*	*0*	*0*	*0*	*0*	*0*	*467*
Totals	*146,459*	*45,814*	*40,766*	*38,282*	*44,465*	*9,991*	*69,457*	*507,311*	*902,545*

*Prior FY includes actual revenue and expenditures through 06/30/13, plus amounts budgeted through 06/30/14.

Attachment #25

Transportation Concept Report and Corridor System Management Plan

United States Route 50
District 3

Disclaimer: The information and data contained in this document are for planning purposes only and should not be relied upon for final design of any project. Any information in this Transportation Concept Report (TCR) and Corridor System Management Plan (CSMP) is subject to modification as conditions change and new information is obtained. Although planning information is dynamic and continually changing, the District 3 Office of System and Freight Planning makes every effort to ensure the accuracy and timeliness of the information contained in the TCR/CSMP. The information in the TCR/CSMP does not constitute a standard, specification, or regulation, nor is it intended to address design policies and procedures.

California Department of Transportation

Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability.

Approvals:

per Marlon Flournoy
District 3 Deputy Director
Planning and Local Assistance

6-27-14
Date

Jody Jones
District 3 Director

6/27/14
Date

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ABOUT THIS DOCUMENT

System Planning is the long-range transportation planning process for the California Department of Transportation (Caltrans). The System Planning process fulfills Caltrans' statutory responsibility as owner/operator of the State Highway System (SHS) (Gov. Code §65086) by identifying deficiencies and proposing improvements to the SHS. Through System Planning, Caltrans focuses on developing an integrated multimodal transportation system that meets Caltrans' goals of safety, mobility, delivery, stewardship, and service.

The System Planning process is primarily composed of four parts: the District System Management and Development Plan (DSMDP), the Transportation Concept Report (TCR), the Corridor System Management Plan (CSMP), and the DSMDP Project List. The district-wide **DSMDP** is a strategic policy and planning document that focuses on maintaining, operating, managing, and developing the transportation system. The **TCR** is a planning document that identifies the existing and future route conditions as well as future needs for each route on the SHS. The **CSMP** is a complex, multi-jurisdictional planning document that identifies future needs within corridors experiencing or expected to experience high levels of congestion, and is a foundation document that supports the partnership-based, integrated management of various travel modes (transit, cars, trucks, pedestrians, bicycles) and infrastructure (rail, roads, highways, information systems, bike routes) in a corridor so that mobility along the corridor is provided in the most efficient and effective manner possible. The **DSMDP Project List** is a list of planned and partially programmed transportation projects used to recommend projects for funding. These System Planning products are also intended as resources for external stakeholders, the public, related Caltrans functional units, tribal governments, and partner regional and local agencies.

TCR/CSMP Purpose

California's State Highway System needs long-range planning documents to guide the logical development of transportation systems as required by CA Gov. Code §65086 and as necessitated by the public, stakeholders, and system users. The purpose of the TCR/CSMP is to evaluate current and projected conditions along the route, and communicate the vision for the development of each route in each Caltrans District during a 20-year planning horizon. The TCR/CSMP is developed with the goals of increasing safety, improving mobility, providing excellent stewardship, and meeting community and environmental needs along the corridor through integrated management of the transportation network, including the highway, parallel and connecting roadways, transit, pedestrian, bicycle, freight, operational improvements, and travel demand management components of the corridor. The purpose of the CSMP update portion of this document is to continue with the momentum from the first generation document to achieve a seamless transportation system on urbanized segments of the corridor by revisiting the managed transportation network, updating the traffic forecast and performance measure data, and upgrading the key capital project lists with an emphasis on inclusion of projects such as Intelligent Transportation Systems (ITS) and Traffic Operations Systems (TOS) improvements.

STAKEHOLDER PARTICIPATION

Stakeholder participation was sought throughout the development of the U. S. Highway (US) 50 TCR/CSMP. Outreach involved internal and external stakeholders, regional and local agencies, advocacy groups, and the public. During the initial information resource gathering for the TCR/CSMP, stakeholders were contacted for their input related to their particular specializations, and to verify data sources used and data accuracy. As the document was finalized, stakeholders were asked to review the document for comments, edits, and for consistency with the intent of existing plans, policies, and procedures. The process of including and working closely with stakeholders adds value to the TCR/CSMP, allows for outside input and ideas to be reflected in the document, increases credibility, and helps strengthen public support and trust.

STATE AND LOCAL RESPONSIBILITY

Improvements to the State Highway System are the responsibility of both Caltrans and local agencies. Developments that add cumulative impacts to this route and the regional State Highway System may necessitate that local jurisdictions provide nexus based, proportional fair-share funding for future highway improvements. Developments or local circulation changes that will have significant traffic impacts to the highway should provide improvements to mitigate those impacts.

EXECUTIVE SUMMARY

This document is a combination of the TCR and the CSMP. These two documents complement each other, with the CSMP providing short- to mid-term planning for the urban section, and the TCR providing long-term planning for the rural section of the facility. These two documents were combined into this combined TCR/CSMP document to create greater planning coordination for the entire length of US 50. The combined TCR/CSMP is a long-term document, with a base year of 2012 and a horizon year of 2035.

US 50 is one of three remaining transcontinental routes signed with the U.S. Highway System shield in California. It begins at Interstate 80 (I-80) in West Sacramento and traverses portions of Yolo, Sacramento, and El Dorado Counties before passing into the State of Nevada. All 108 miles of US 50 in California lie within Caltrans District 3. US 50 serves as a major east-west connector. It is an officially designated Scenic Highway from Downtown Placerville to the western city limit of South Lake Tahoe.

The facility is roughly divided into two sections: the urban half, covered by the CSMP, and the rural half, covered by the TCR. The facility begins as a freeway in West Sacramento in Yolo County and continues through the cities of Sacramento, Rancho Cordova, and Folsom in Sacramento County. It then enters El Dorado County, passing through El Dorado Hills, Cameron Park, Shingle Springs, and Placerville. Approximately six miles east of Placerville the facility becomes a conventional highway to the California/Nevada State line. The Cedar Grove Exit marks the boundary between the CSMP area to the west and the TCR area to the east. The narrower, mountain section traverses small mountain communities and over 30 miles of the Eldorado National Forest, until it intersects with SR 89 near the City of South Lake Tahoe, after which it extends eastward through the City of South Lake Tahoe to the California/Nevada State line. In this section the facility is primarily used for recreational trips, particularly to reach Lake Tahoe during the peak summer travel and winter ski months. As a result, US 50 experiences strong directional peak traffic on weekends and holidays.

Concept Summary

The US 50 TCR/CSMP evaluates current and projected future traffic conditions with 2012 as the base year and with the 20-year build facility. Table 1 provides a summary of the existing facility, the 20-year build facility, and the ultimate facility concept, defined as the facility with projects and management strategies anticipated beyond the 20-year horizon. As discussed further in this document, the concept LOS for US 50 is level of service (LOS) D in rural areas and LOS E in urban areas. We recognize some segments of US 50 will not attain their respective operational concepts after the 20-year buildout of the facility. Therefore, ongoing efforts to manage and improve system performance will emphasize the system operations and management strategies discussed further on in this document.

Concept Rationale

The 20-year build facility for US 50 describes the long-term vision for how the facility will operate and what its configuration will be in the horizon year. This 20-year build facility concept is based on planned and programmed, and conceptual projects. The ultimate facility concept includes the construction of bus/carpool (HOV), and auxiliary (Aux) lanes. In the Corridor Performance section, Concept LOS is given for each segment in the base and horizon year. A minimum acceptable LOS is E for an urban segment and D for a rural one. Given greater accessibility and higher traffic in urban areas, LOS E is more appropriate and realistic for those segments while LOS D is more reasonable for a rural segment.

US 50 is an important transportation facility for the communities of Sacramento County, El Dorado County and of the Sierra Nevada, in particular Meyers, South Lake Tahoe, and the numerous recreational opportunities in those areas. US 50 also provides interregional connectivity to communities located in western Nevada. This TCR proposes change in the facility concept, balancing mobility of those communities, cost of improvements, and community character. In the segments in the Sacramento metropolitan area, a freeway and expressway concept is more appropriate because the facility serves commuters traveling to Sacramento and fewer local uses. In the rural segments (15 through 21), which experience lower traffic and provide access to properties, the conventional highway concept is appropriate due to its lesser impact on operations and the community.

TABLE 1: US 50 CONCEPT SUMMARY				
Segment #	**Segment Description**	**Existing Facility***	**20-Year Build Facility***	**Ultimate Facility***
1	Interstate 80 to Yolo/Sacramento County Line	8F (6F btw Jefferson Blvd. ramps)	8F + ITS	8F + 2HOV + Aux Lanes + ITS + ICM
2	Yolo/Sacramento County Line to State Routes (SR) 99 and 51	8F	8F + 2HOV + Aux Lanes + ITS	8F+2HOV+Aux Lanes + ITS + ICM
3	SR 99 and SR 51 to Watt Ave.	8F	8F + 2HOV +ITS	8F + 2HOV + Aux Lanes + Transition + ITS + ICM
4	Watt Ave. to Zinfandel Dr.	8F + 2HOV	8F + 2HOV + Aux Lanes + ITS	8F + 2HOV + Aux Lanes + ITS + ICM
5	Zinfandel Dr. to Sunrise Blvd.	8F + 2HOV	8F + 2HOV + Aux Lanes + ITS	8F + 2HOV + Aux Lanes + Transition + ITS + ICM
6	Sunrise Blvd. to Folsom Blvd.	6F + 2HOV to Hazel Ave, 4F + 2HOV to Folsom Blvd	8F + 2HOV + ITS + Aux Lanes to Hazel Ave., 4F + 2HOV + ITS + Aux Lanes to Folsom	8F + 2HOV + ITS + ICM + Aux Lanes to Hazel Ave., 4F + 2HOV + ITS + ICM + Aux Lanes to Folsom
7	Folsom Blvd. to Sacramento/El Dorado County Line	4F + 2HOV	4F + 2HOV + Aux Lanes + ITS	4F + 2HOV + Aux Lanes + ITS + ICM
8	Sacramento/El Dorado County Line to El Dorado Hills Blvd. (Latrobe Road)	4F + 2HOV	4F + 2HOV + Aux Lanes + ITS	4F + 2HOV + Aux Lanes + ITS + ICM
9	Latrobe Road to Bass Lake Road	4F + 2HOV	4F + 2HOV + Aux Lanes + ITS	4F + 2HOV + Aux Lanes + ITS + ICM
10	Bass Lake Road to Cameron Park Drive	4F + 2HOV	4F + 2HOV + Aux Lanes + ITS	4F + 2HOV + Aux Lanes + ITS
11	Cameron Park Drive to So. Shingle Road (Ponderosa Rd.)	4F	4F + 2HOV + Aux Lanes + ITS	4F + 2HOV + Aux Lanes + ITS
12	Ponderosa Rd to Missouri Flat Road	4F	4F + 2HOV + Aux Lanes + ITS to Greenstone, 4F + Aux Lanes + ITS to Missouri Flat	4F + 2HOV + Aux Lanes + ITS to Greenstone, 4F + Aux Lanes + ITS to Missouri Flat
13	Missouri Flat Road to End of Freeway in Placerville	4F	4F	4F + Aux Lanes + ITS
14	End of Freeway in Placerville to Bedford Ave.	4E + Merge Lanes (Eastbound)	4E + Merge Lanes + ITS	4E + Merge Lanes + ITS + ICM
15	Bedford Ave. to Cedar Grove Exit	4F to Smith Flat, 4E to Camino	4F + to Smith Flat, 4E to Camino	4F + Aux Lanes + ITS to Smith Flat, 4E + ITS to Camino
16	Cedar Grove Exit to 0.67 mi east of Sly Park Road	4F	4F	4F + ITS
17	0.67 miles east of Sly Park Road to Ice House Road	3C, 2.0 mi; 4E, 5.3 mi; 3C, 0.3 mi	3C, 2.0 mi; 4E, 5.3 mi; 3C, 0.3 mi	3C + ITS, 2.0 mi; 4E + ITS, 5.3 mi; 3C + ITS, 0.3 mi
18	Ice House Road to Echo Summit	2C; 0.35 mi of 2-way left turn lane	2C; 0.35 mi of 2-way left turn lane	2C + ITS + ICM; 0.35 mi of 2-way left turn lane
19	Echo Summit to State Route 89 South/Luther Pass Road	2C	2C	2C + ITS + ICM + Bike Lanes
20	State Route 89 South/Luther Pass Road to State Route 89 North/Lake Tahoe Blvd	3C, 0.86 mi; 2C, 3.64 mi; 5C, 0.61 mi	3C, 0.86 mi; 2C, 3.64 mi; 5C, 0.61 mi	3C + ITS + ICM, 0.86; 2C + ITS + ICM, 3.64 mi; 5C + ITS + ICM, 0.61 mi
21	State Route 89 North/Lake Tahoe Blvd to Nevada State Line	5C	5C	5C + ITS + ICM + Bike Lanes

*Facility Type Codes: C=Conventional Highway, E=Expressway, F=Freeway, HOV=High Occupancy Vehicle Lanes, Aux=Auxiliary Lanes, ITS=Intelligent Transportation Systems, ICM=Integrated Corridor Management.

Proposed Projects and Strategies

The proposed projects and strategies on US 50 are limited by the Right of Way (ROW) constraints on the facility, as well as by financial, environmental, and political factors. In the urban section of US 50, existing development limits land purchases for highway expansion, and in the rural section land purchases are limited by National Forest land and environmental constraints. The largest projects on the facility consists of a bus/carpool (HOV) lane expansion from the SR 99/51 junction to Watt Avenue (Ave.) interchange and from the Cameron Park Road interchange to the Missouri Flat Road interchange. There are also a significant number of operational and Intelligent Transportation Systems (ITS) improvements that will be constructed on the facility. These improvements, to be constructed throughout the facility, include the installation of various ITS technologies, auxiliary lanes, transition lanes, passing lanes, ramp metering, intersection improvements, interchange improvements, ramp widening, bus/carpool lanes and connectors and other improvements appropriate to the context of the interchanges to be improved.

Integrated Corridor Management (ICM) is a part of the ultimate facility concept for the US 50 corridor. As an operational management strategy, it is particularly in locations where the ultimate concept LOS performance is unattainable on the 20-year buildout facility, and where further buildout cannot occur due to constraints and limitations such as those described above. ICM is a multimodal approach to managing transportation assets, allowing partner agencies to manage the transportation corridor as an integrated asset in order to improve travel time reliability and predictability, help manage congestion and provide travelers with better information and more choices.

CORRIDOR OVERVIEW

ROUTE SEGMENTATION

US 50 is divided into 21 segments, the first 15 of which are on the CSMP corridor and highlighted in Table 2 below. As shown in Figure 1, the facility spans a large cross-section of California and is roughly evenly split between urban and rural sections.

TABLE 2: US 50 ROUTE SEGMENTATION

Segment #	Location Description	County	Begin Post Mile	End Post Mile
1	Interstate 80 to Yolo/Sacramento County Line	YOL	0	3.16
2	Yolo/Sacramento County Line to State Routes 99 and 51	SAC	L0.00	L2.48 = R0.00
3	State Routes 99 and 51 to Watt Ave.	SAC	R0.00	R5.34
4	Watt Ave. to Zinfandel Drive	SAC	R5.34	R10.92
5	Zinfandel Drive to Sunrise Boulevard	SAC	R10.92	12.5
6	Sunrise Boulevard to Folsom Boulevard	SAC	12.5	17.01
7	Folsom Boulevard to Sacramento/El Dorado County Line	SAC	17.01	23.14
8	Sacramento/El Dorado County Line to Latrobe Road	ELD	0	0.86
9	Latrobe Road to Bass Lake Road	ELD	0.86	R3.23
10	Bass Lake Road to Cameron Park Drive	ELD	R3.23	6.57
11	Cameron Park Drive to Ponderosa Rd	ELD	6.57	R8.56
12	Ponderosa Rd to Missouri Flat Road	ELD	R8.56	R15.06
13	Missouri Flat Road to End of Freeway in Placerville	ELD	R15.06	17.25
14	End of Freeway in Placerville to Bedford Ave.	ELD	17.25	18.11
15	Bedford Ave. to Cedar Grove Exit	ELD	18.11	R25.95
16	Cedar Grove Exit to 0.67 mi east of Sly Park Road	ELD	R25.95	R31.97
17	0.67 miles east of Sly Park Road to Ice House Road	ELD	R31.97	39.77
18	Ice House Road to Echo Summit	ELD	39.77	66.63
19	Echo Summit to State Route 89 South/Luther Pass Road	ELD	66.63	70.62
20	State Route 89 South/Luther Pass Road to State Route 89 North/Lake Tahoe Blvd	ELD	70.62	75.45
21	State Route 89 North/Lake Tahoe Blvd to Nevada State Line	ELD	75.45	80.44

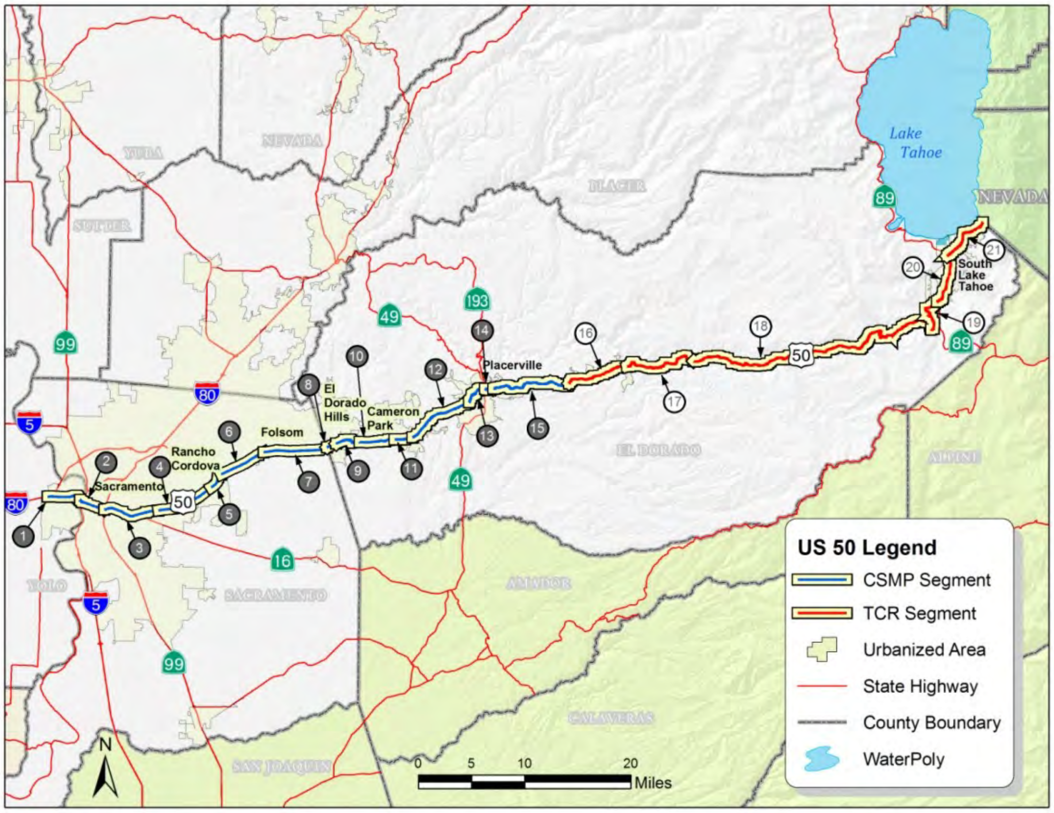


Figure 1: US 50 Route Segmentation Map

CSMP TRANSPORTATION NETWORK

The US 50 CSMP Transportation Network (managed network) includes US 50 from the US 50/Interstate 80 interchange in the City of West Sacramento to the US 50/Cedar Grove exit in the El Dorado County community of Camino, as well as select parallel roads, transit services, and bike routes. The parallel and connector roadways, transit, and bicycle route components of the managed network were selected for inclusion in the corridor in consultation with the respective local agencies. Changes in the managed network from the original US 50 CSMP include the following additions:

- Parallel and connecting roadways to US 50 in downtown Sacramento and in midtown Sacramento to Watt Ave. were added to close a gap that existed in the original CSMP. These roadways include portions of T Street (St.), Alhambra Boulevard (Blvd.), Broadway, Fruitridge Road (Rd.), Stockton Blvd., 65th St., Power Inn Rd., Florin-Perkins Rd., Folsom Blvd. In the City of Folsom, Iron Point Rd. was extended to Empire Ranch Rd. and in the City of Placerville, Jacquier Rd. and Carson Rd.
- Sacramento Regional Transit District bus routes 38 and 74, and an El Dorado County Transit Agency bus route from Placerville to Pollock Pines.
- Bicycle routes in downtown and midtown Sacramento including, but not limited, to 2nd Ave. and T St. In the City of Folsom, the Humbug Willow Creek bicycle trail was added and the American River Parkway trail was extended north. In and near the City of Placerville, the El Dorado bicycle trail was extended to Missouri Flat Rd.

As the CSMP concept matures, additional facilities may be added to the managed network. The CSMP transportation network is displayed in Figure 2.

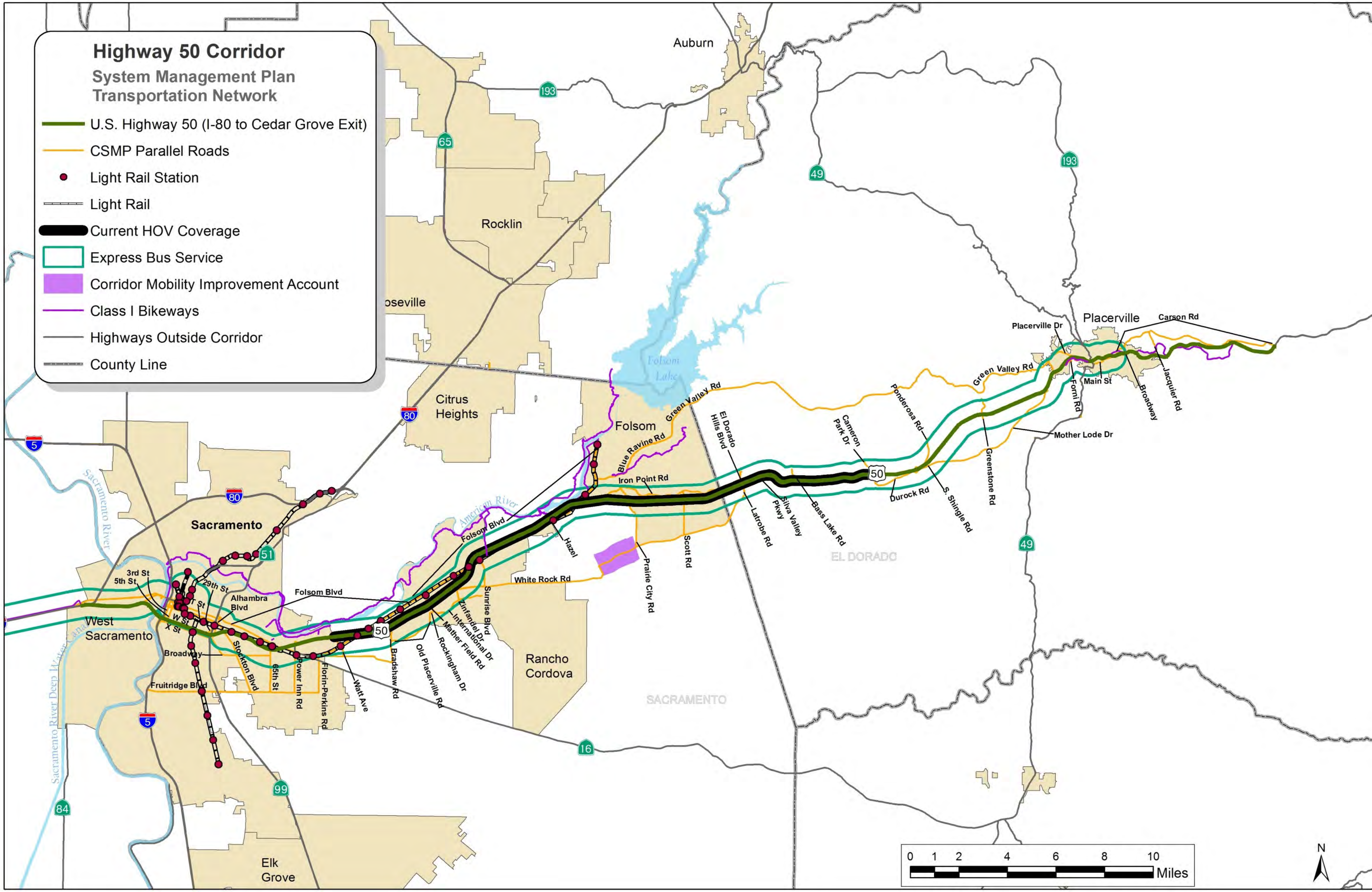


Figure 2: US 50 CSMP Transportation Network

ROUTE DESCRIPTION

Route Location

US 50 begins at the junction of I-80 and US 50 in West Sacramento and continues to beyond the Nevada state line. The urban CSMP portion runs from the beginning in West Sacramento to the Cedar Grove interchange in Camino. The CSMP portion runs through the Cities of West Sacramento, Sacramento, Rancho Cordova, Folsom, and Placerville. It also serves the unincorporated communities of Rosemont, El Dorado Hills, and Shingle Springs. For most of the CSMP portion the land is flat and begins to rise through the foothills in El Dorado County. US 50 joins with several other state highways, such as I-5, SR 99, SR 51, and SR 16 in Sacramento, and SR 49 in Placerville. The TCR portion starts at the Cedar Grove interchange and continues to Pollock Pines, the last community before the Eldorado National Forest. As US 50 enters the National Forest, it runs parallel to the South Fork American River for over thirty miles. The facility then separates from its parallel proximity to the river and heads north towards the end of the National Forest and junction with SR 89. Just after the SR 89 junction, the facility serves as a principle arterial for the unincorporated community of Meyers and for the City of South Lake Tahoe. SR 89 continues north and US 50 continues east as a conventional urban arterial through the City of South Lake Tahoe wherein it eventually crosses the California/Nevada State boundary.

Route Purpose and Major Route Features

US 50 serves the large Sacramento metropolitan area until east of Placerville, where it primarily serves recreational travel to the Sierra Nevada and Lake Tahoe. The facility provides convenient regional access to jobs and services in downtown Sacramento, Rancho Cordova, and Folsom, with peak hour traffic associated with daily commuting. East of the Sacramento metropolitan area, there are relatively few jobs, shopping, educational facilities, or other trip attractors along the highway until the facility reaches the City of South Lake Tahoe. The main attraction in the largely rural eastern half of the facility is the numerous recreation opportunities. The functional classification of the portion of US 50 between its beginning in West Sacramento and Canal St. in Placerville is classified in the California Road System as an “Other Freeway or Expressway.” The portion from Canal St. in Placerville to the California/Nevada State boundary is classified an “Other Principal Arterial.”St.

Route Designations and Characteristics

US 50 is designated a High Emphasis Route in the Interregional Transportation Strategic Plan (ITSP), the plan that guides development of the interregional transportation network. This designation means that the facility will be built to minimum standards for an expressway or freeway, in as much as environmental and ROW constraints allow. In terms of goods movement, US 50 is a part of the Surface Transportation Assistance Act (STAA) National Network until Sly Park Road, which permits larger trucks to traverse the route. This designation facilitates freight movement to the large population areas. At Sly Park Road, the designation becomes California Legal Network, which permits shorter trucks that can negotiate the mountain curves. As the route nears South Lake Tahoe, US 50 is designated a Terminal Route at the junction with SR 89, which permits STAA trucks to use the facility to reach their destinations.

Route designations and characteristics of US 50 for both the TCR and CSMP sections of the corridor are identified in Tables 3 and 4.

<table>
<tr><th colspan="12">TABLE 3: US 50 ROUTE DESIGNATIONS AND CHARACTERISTICS</th></tr>
<tr><th>Seg. #</th><th>Freeway & Express-way</th><th>National Highway System</th><th>Strategic Highway Network</th><th>Scenic Highway</th><th>Inter-regional Road System</th><th>High Empha-sis</th><th>Focus Route</th><th>Federal Functional Classifi-cation</th><th>Goods Move-ment Route</th><th>Truck Designa-tion</th><th>Rural/ Urban/ Urbanized</th></tr>
<tr><td>1</td><td rowspan="13">Yes-F</td><td rowspan="21">Yes</td><td rowspan="21">No</td><td rowspan="13">No</td><td rowspan="21">Yes</td><td rowspan="21">Yes</td><td rowspan="21">No</td><td rowspan="13">Other Freeway or Express-way</td><td rowspan="2">Yes</td><td rowspan="16">National Network</td><td rowspan="10">Urbanized</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="19">No</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td><td rowspan="2">Rural</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td><td rowspan="4">Urban</td></tr>
<tr><td>14</td><td>Yes-E</td><td>No: to Jct SR 49; Yes: from Jct SR 49</td><td>Other Freeway or Express-way / Other Principal Arterial</td></tr>
<tr><td>15</td><td>Yes-F/E/F</td><td rowspan="7">Yes</td><td rowspan="7">Other Principal Arterial</td></tr>
<tr><td>16</td><td rowspan="2">Yes</td></tr>
<tr><td>17</td><td>National Network / California Legal</td><td rowspan="3">Rural</td></tr>
<tr><td>18</td><td rowspan="4">No</td><td rowspan="3">California Legal</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td><td rowspan="2">Urban</td></tr>
<tr><td>21</td><td>Terminal Access (STAA)</td></tr>
</table>

<table>
<tr><th colspan="10">TABLE 4: US 50 ROUTE AGENCIES, TRIBES AND TERRAIN</th></tr>
<tr><th>Seg. #</th><th>Metropolitan Planning Organization</th><th>Regional Transportation Planning Agency</th><th>Congestion Management Agency</th><th>County Transportation Commission</th><th>Local Agency</th><th>Tribes</th><th>Air District</th><th>Terrain</th></tr>
<tr><td>1</td><td rowspan="18">Sacramento Area Council of Goverments (SACOG)</td><td rowspan="7">SACOG</td><td>Yolo County Transp. District</td><td rowspan="7">N/A</td><td>West Sacramento</td><td rowspan="10">None</td><td>Yolo-Solano</td><td rowspan="7">Flat and Low Terrain</td></tr>
<tr><td>2</td><td rowspan="6">Sacramento Transportation Authority</td><td rowspan="2">City of Sacramento</td><td rowspan="6">Sacramento Metro</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td>Sac. County; Rancho Cordova</td></tr>
<tr><td>5</td><td rowspan="2">Rancho Cordova</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td>Folsom</td></tr>
<tr><td>8</td><td rowspan="11">El Dorado County Transp. Commission (EDCTC)</td><td rowspan="14">N/A</td><td rowspan="11">EDCTC</td><td rowspan="5">El Dorado County</td><td rowspan="14">El Dorado</td><td rowspan="7">Foothills</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td><td rowspan="2">Shingle Springs Band of Miwok Indians</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td><td>El Dorado County; Placerville</td><td rowspan="9">None</td></tr>
<tr><td>14</td><td>Placerville</td></tr>
<tr><td>15</td><td>Placerville; El Dorado County</td><td rowspan="5">Steep Terrain</td></tr>
<tr><td>16</td><td rowspan="4">El Dorado County</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td><td rowspan="3">Tahoe Metropolitan Planning Organization (TMPO)</td><td rowspan="3">Tahoe Regional Planning Agency (TRPA)</td><td rowspan="3">N/A</td></tr>
<tr><td>20</td><td rowspan="2">El Dorado County; City of South Lake Tahoe</td><td rowspan="2">Rolling or Flat</td></tr>
<tr><td>21</td></tr>
</table>

COMMUNITY CHARACTERISTICS

US 50 begins in West Sacramento, which has mostly low-density residential and industrial land uses. It then continues to the dense urban core of downtown Sacramento, which is made up of a large office district and dense residential neighborhoods. As the facility travels east through Rancho Cordova, Folsom, and El Dorado Hills, the housing density gradually decreases.

Median household income follows a distinct pattern along US 50. It gradually increases from the low $50,000s in West Sacramento and continuing east through Sacramento and Rancho Cordova to $112,111 in Gold River, $95,143 in Folsom and $115,121 in El Dorado Hills. Median household income then decreases going east to $72,562 in Cameron Park and $53,385 in Placerville.

There are four main communities in the eastern rural portion of US 50: Camino, Pollock Pines, Meyers and South Lake Tahoe. Camino, an unincorporated community that is considered a census-designated place for statistical analysis, has over 1,700 residents with a median household income of $51,742 (2010 Census). Many of the residents work in Sacramento. Lying just east of Camino, Pollock Pines is a slightly larger community, a census-designated place of 6,871 people. Approximately 20 percent (%) of Pollock Pines housing units are vacant. In both Camino and Pollock Pines, the largest source of employment is in the Sacramento area. Camino residents travel on average 25 minutes to work, and Pollock Pines residents travel 34 minutes on average. Meyers has a population of approximately 3,000 while South Lake Tahoe has 21,403 residents. Meyers is an urbanizing community with a rural facility. South Lake Tahoe is a much more diverse community with a variety of trip attractors. The community is primarily oriented toward the tourism and recreation industries. Lake Tahoe, Casinos in Nevada, the Lake Tahoe Vacation Resort, the Lake Tahoe Airport, and the many ski resorts south of Lake Tahoe are the major draws in the South Lake Tahoe area, attracting trips to the facility.

LAND USE

Land uses along US 50 are varied and change from one community to another. West Sacramento has a mix of single family homes with industrial uses such as warehousing and the Port of West Sacramento. In downtown Sacramento there is a concentration of office buildings, entertainment, and a variety of dense, older housing. Continuing to the East Sacramento neighborhood, there is a mix of multi-family homes and single family homes with large trip attractors such as UC Davis Medical Center and California State University Sacramento (CSUS). As US 50 makes its way east to Rancho Cordova, the housing stock becomes predominantly single family home with limited multifamily home development.

In Rancho Cordova between Zinfandel Drive and Hazel Ave., there is significant office park development. Major trip attractors include Aerojet Rocketdyne, an aerospace corporation, and Mather Airport, a major air cargo hub. Further east in Folsom, El Dorado Hills, Cameron Park, and Placerville, residential densities decrease to larger lot single family homes, and most non-residential development is in retail commercial and limited office uses.

The western part of the corridor, near Placerville, has experienced rapid growth in the past decade as an increasing number of workers in the Sacramento area live in Camino and Pollock Pines. The land uses in this section are predominantly single family homes of 1-5 dwelling units (DU)/acre and 1 DU/acre. Growing agricultural and ranch uses increase seasonal visitor traffic, such as at Apple Hill during apple harvest season. In the Pollock Pines area there are some multifamily units and commercial, mostly small, businesses. After the Pollock Pines area, there is a long stretch of undeveloped forest land in the Eldorado National Forest. To the east, the land uses in South Lake Tahoe are more diverse, reflecting a larger community with a more diverse economic base. There are major nodes of commercial activity, such as at the SR 89/US 50 junction, and near the California/Nevada State line. US 50 is locally referred to as "Lake Tahoe Boulevard," and is the main street of the City, connecting these two commercial nodes. The rest of the city is mostly single-family residential housing.

US 50 is a vital transportation corridor for the economy of Sierra Nevada communities in El Dorado County. US 50 is particularly important to the economy of South Lake Tahoe and the surrounding communities that rely on Lake Tahoe and nearby ski resort tourism. Many of the residents of Camino and Pollock Pines drive west to Placerville and Sacramento for work, whereas the residents of the much more diverse Lake Tahoe communities have shorter commutes to nearby job sites.

SYSTEM CHARACTERISTICS

For the purpose of analysis, US 50 is divided into 21 total segments shown in Figures 3 through 23 below. Each segment is described in terms of its geography, classification, configuration, surrounding land uses, jurisdictions, trip attractors and features contributing to its operational characteristics.

Segment 1 consists of 3.2 miles of eight-lane freeway (six-lane between the Jefferson Blvd. ramps) from the facility's beginning at the junction of I-80 to the Yolo/Sacramento County line, extending through the City of West Sacramento. US 50 provides access to the Port of West Sacramento, several warehouses, and industrial properties along the facility. Raley Field, home to the River Cats baseball team, is also along the corridor and is a major trip attractor. It also allows easy access to downtown Sacramento and points east.

Segment 2 consists of eight lanes and spans the length of downtown Sacramento on 2.5 miles of freeway, from the Yolo/Sacramento County line to I-5 and ending at the intersection of SR 99/51. These important transportation connections from US 50 contribute to high traffic volumes, particularly during peak commute periods. Land uses along this corridor include older single family residential neighborhoods south of US 50 and commercial uses and multi-family residential north of US 50.

Figure 3: Segment 1 Map

Figure 4: Segment 2 Map

Segment 3 runs for 5.3 miles of eight-lane freeway from the junction of SR 99/51 to the City of Sacramento City line at Watt Ave. Major land uses along this segment include UC Davis Medical Center and CSUS. CSUS has a total of 28,000 students and almost 3,000 staff. There is a mix of land uses along this facility, consisting of mixed commercial and multi-family housing closer to downtown Sacramento with a higher percentage of single family housing and retail land uses as one travels east.

Segment 4 traverses the unincorporated Sacramento County community of Rosemont and half of the City of Rancho Cordova from Watt Ave. to Zinfandel Dr. It is 5.6 miles of freeway consisting of eight mixed flow lanes and two HOV lanes, and serves Mather Airport. Land uses along Segment 4 include single family residential with some multifamily residential as well as retail commercial and office commercial.

Figure 5: Segment 3 Map

Figure 6: Segment 4 Map

Segment 5 covers the core of Rancho Cordova on 1.6 miles of freeway consisting of eight mixed flow lanes and two HOV lanes from Zinfandel Dr. to Sunrise Blvd. This short segment has no significant single trip attractors. Predominant land uses along the segment consist of single family residential, retail commercial, and office commercial.

Segment 6 consists of 4.5 miles of freeway, from Sunrise Blvd. in Rancho Cordova to the Folsom Blvd. interchange in the City of Folsom. This segment is comprised of six mixed flow lanes and 2 HOV lanes from Zinfandel Dr. to Hazel Ave., and four mixed flow lanes with two HOV lanes from Hazel Ave. to Folsom Blvd. The major land uses along this segment include Aerojet Rocketdyne with its own off-ramp at Aerojet Dr. and big box retail along Sunrise Blvd. Other land uses include low density residential in the unincorporated community of Gold River.

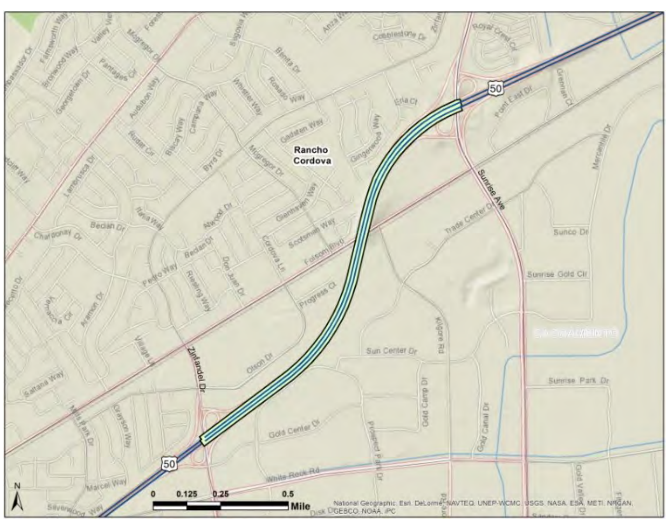


Figure 7: Segment 5 Map

Figure 8: Segment 6 Map

Figure 9: Segment 7 Map

Figure 10: Segment 8 Map

Segment 7 covers almost the entirety of the City of Folsom over 6.1 miles from the Folsom Blvd. interchange to the Sacramento/El Dorado County line. This segment is a freeway consisting of four mixed flow lanes and two HOV lanes. Major trip attractors along the segment are Intel Corporation on Prairie City Rd., the outlet mall near Folsom Blvd., the Pallaido Cinemas, regional commercial facilities along Scott Rd. and numerous small businesses in Old Town Folsom. The predominant land uses along the facility are low density residential and some big box retailers. Currently, most land uses are on the north side of US 50. The south side of US 50 is now mostly occupied by Aerojet Rocketdyne and rangeland, but there are plans for residential and retail development for the area north of White Rock Rd. between Prairie City Rd. and the Sacramento/El Dorado County line.

Segment 8 extends 0.86 miles from the Sacramento/El Dorado County line to El Dorado Hills Blvd./Latrobe Rd. It is a freeway consisting of four mixed flow lanes and two HOV lanes. Land uses along this segment are almost exclusively low density residential with some office or commercial uses.

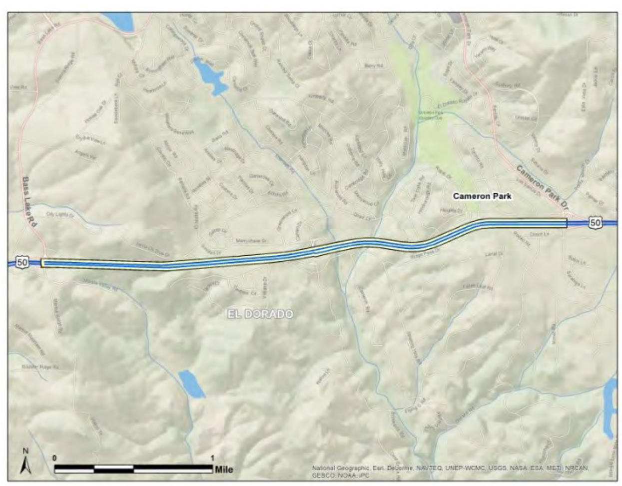


Figure 11: Segment 9 Map

Figure 12: Segment 10 Map

Segment 9 extends 2.37 miles from Latrobe Rd. to Bass Lake Rd. It is a four-lane freeway with two HOV lanes. Land uses along this segment are almost exclusively low density residential with some office or commercial uses.

Segment 10 extends 3.34 miles from Bass Lake Rd. to Cameron Park Dr. This segment is a freeway consisting of four lanes with two HOV lanes. Land uses along this segment are almost exclusively low density residential with some office or commercial uses.

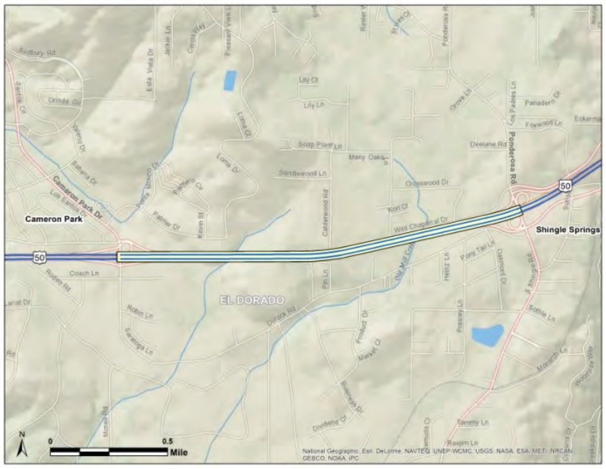


Figure 13: Segment 11 Map

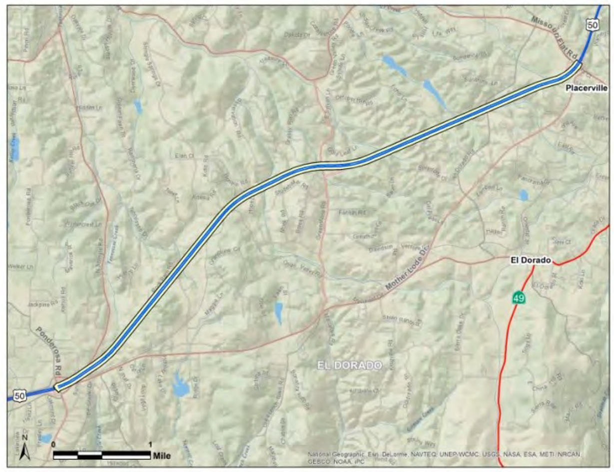


Figure 14: Segment 12 Map

Segment 11 is a four-lane freeway that spans 1.99 miles of rolling hills in El Dorado County from Cameron Park Dr. to Ponderosa Rd. The community of Shingle Springs is an important attractor along this segment. Other land uses along the facility are residential land uses.

Segment 12 is a four-lane freeway spanning 6.5 miles of rolling hills in El Dorado County from Ponderosa Rd. to Missouri Flat Rd. The major attractants along this segment are local and regional commercial land uses along Missouri Flat Rd. Another main trip attractor on the facility is a tribal gaming facility on Red Hawk Parkway. The rest of the land uses along the facility are residential land uses, especially estate residential uses of minimum 5 acre lots.

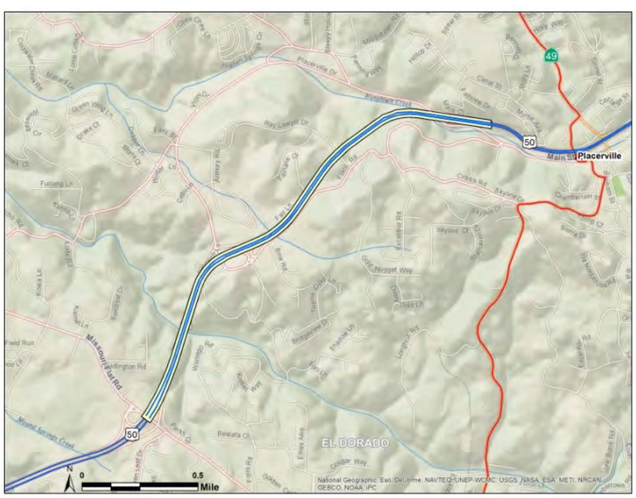


Figure 15: Segment 13 Map

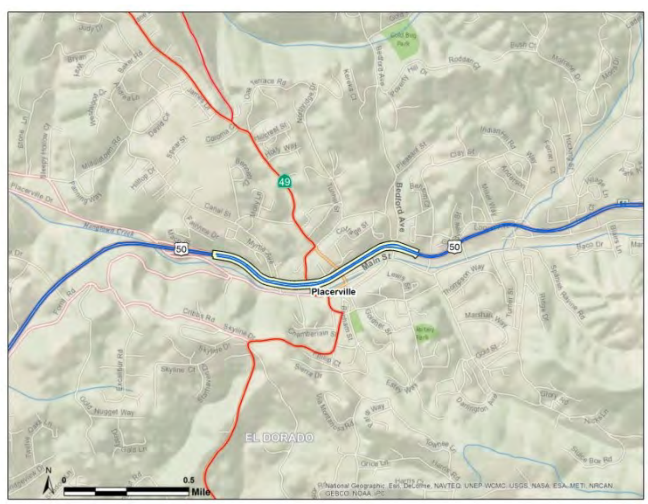


Figure 16: Segment 14 Map

Segment 13 is 2.2 miles of four-lane freeway that extends from Missouri Flat Rd. to the end of the freeway near Canal St. One of the major attractions along Segment 13 is the El Dorado Fairgrounds between Placerville Dr. and Ray Lawyer Dr. Other land uses include shopping in the vicinity of Missouri Flat Rd. and Placerville Dr. as well as low density residential land uses. The El Dorado County Government Center is adjacent to this segment.

Segment 14 is a short segment, consisting of 0.9 miles of four-lane expressway in the historic area of Placerville. The historic area has small businesses centered on Main St. with some residential uses north and south of Main St.

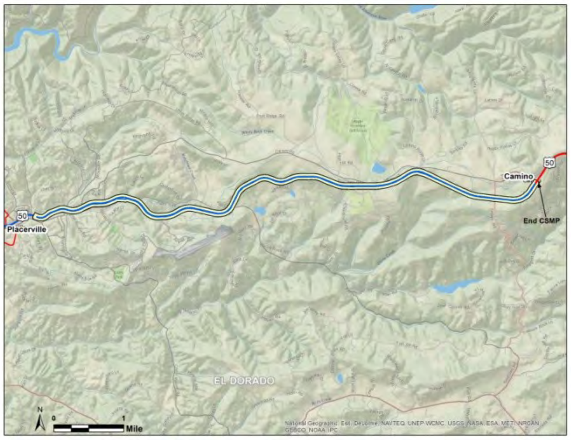


Figure 17: Segment 15 Map

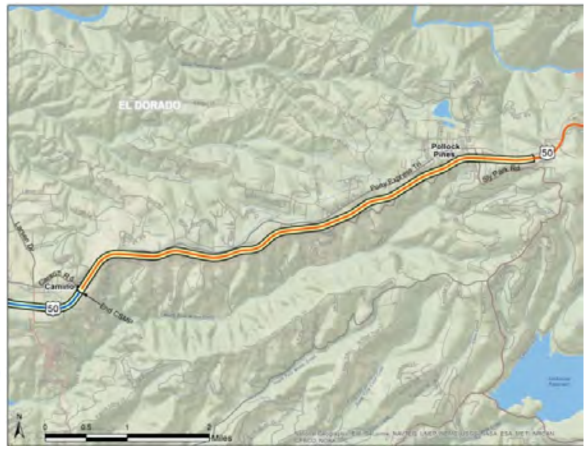


Figure 18: Segment 16 Map

Segment 15 concludes the CSMP corridor with 7.8 miles from Bedford Ave. to the Cedar Grove Exit, which is a four-lane freeway from Bedford Ave. to Smith Flat, and a four-lane expressway from Smith Flat to the Cedar Grove Exit. The segment includes retail and office commercial, primarily along Main St. and Broadway, and low density residential land uses. Significant trip attractors and operational considerations occur on a seasonal basis, such as Apple Hill during apple harvest, tree sales during the winter holidays and growing wine industry with associated tourism. EDCTC is currently conducting a study to examine travel impacts of tourism between the San Francisco Bay Area and the Tahoe Basin, from which operational management strategies will be identified.

Segment 16 consists of 6.0 miles and is a four-lane rural freeway that ends at the freeway-to-conventional highway transition east of Sly Park Rd. No capacity increases are envisioned during the 20-25 year to maintain the concept level of service, although major trip attractors include the community of Pollock Pines (via Sly Park Rd.) and Jenkinson Lake (Sly Park Lake), a recreational trip attractor.

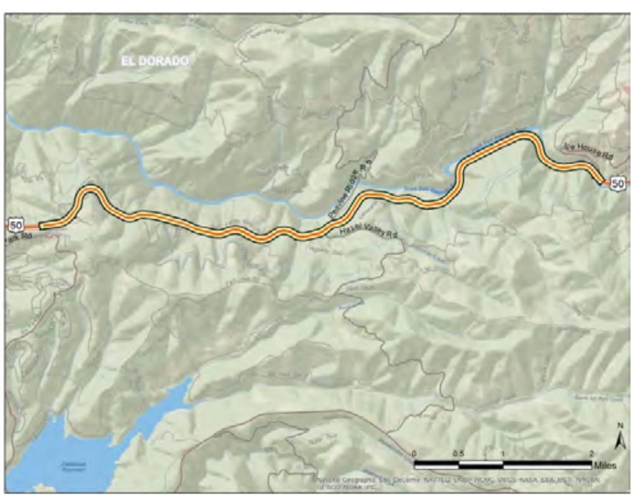


Figure 19: Segment 17 Map

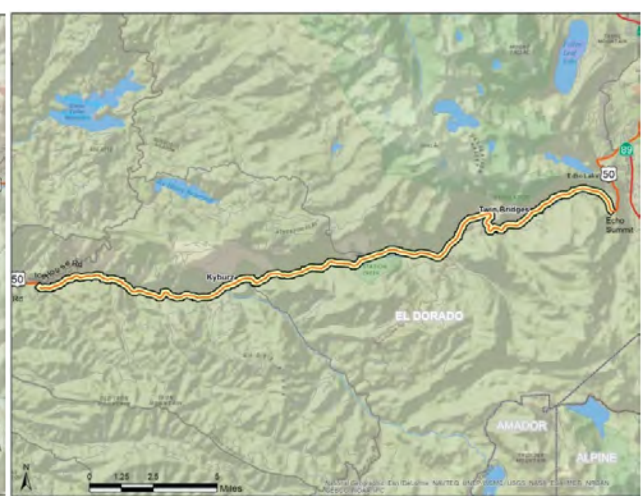


Figure 20: Segment 18 Map

Segment 17 is a 7.6 mile facility between east of Sly Park Rd. to Ice House Rd. that switches between conventional highway and expressway. For the first six lane miles, the facility is a three-lane conventional highway. For the next 0.4 lane miles, the facility is a four-lane divided expressway, and the facility closes with 1.2 lane miles of two-lane conventional highway with a passing lane. A major attractor along this segment is the Crystal Basin Recreation Area. There are few other land uses that front this facility, so there are few planning conflicts.

Segment 18 is also in the rural environment in the Eldorado National Forest. This segment, which extends from Ice House Rd. to Echo Summit, is a 2-lane, conventional highway of 26.6 miles with six extents of passing lanes in both directions. A major attractor along this segment is Sierra at Tahoe ski resort. Caltrans conducts extensive snow removal operations along this segment during winter, with maintenance facilities including stations, sand houses and chaining areas at various locations.

Figure 21: Segment 19 Map

Figure 22: Segment 20 Map

Segment 19 is a two-lane conventional highway of 5.2 centerline miles. It descends from Echo Summit through the Eldorado National Forest to the SR 89 South junction, and extends through Meyers, an unincorporated community just to the south of South Lake Tahoe. There is an agricultural inspection facility on this segment in the town of Meyers. The Meyers Area Plan proposes intensifications of land use after final approval (to be determined), and increases in trip attraction may be anticipated.

Segment 20 consists of 4.8 miles of conventional highway through low-density residential development and past the Lake Tahoe Airport from the south junction with SR 89 to the north junction with SR 89. This segment begins as a two-lane facility with a two-way left turn lane passing through the unincorporated community of Meyers. At Pioneer Trail, it becomes a two-lane highway with narrow shoulders. Toward the end of the segment, the facility crosses into the City of South Lake Tahoe limits where it becomes four-lanes with a two-way left turn lane. Within the City of South Lake Tahoe, there are a wider variety of land uses, with a commercial strip forming most of the land uses. Numerous businesses have access within the city limits, where recent improvements included bicycle and pedestrian facilities along the highway.

Figure 23: Segment 21 Map

Segment 21 is a four-lane conventional urban arterial with a center turn lane that is 5.0 miles in length that passes through mixed land uses. The facility has sidewalks along some locations and Class II bicycle lanes throughout much of this segment. On this segment, the facility is the main street for South Lake Tahoe. As such, many of the largest commercial and public land uses front US 50 and have access on this conventional highway segment. South Tahoe Middle School, South Tahoe Police Department, numerous small businesses, resorts, and restaurants are located on this facility.

The System Characteristics for the Existing, 20-Year Build, and Ultimate Facility are summarized in Tables 5 and 6 on pages 22 and 23. The tables provide basic information about US 50 on each segment, including HOV characteristics, auxiliary lanes, and passing lanes. The existing facility identifies the highway under current conditions. The 20-Year Build Facility identifies the highway with improvements planned and programmed to be completed by the horizon year of 2035. The post 25-year Ultimate Facility is also listed to identify how the highway is envisioned for beyond the horizon year. The segments are determined based on logical termini including intersections, jurisdiction, changes in land use, and status of construction. All segment lengths are given in centerline miles.

TABLE 5: US 50 SYSTEM CHARACTERISTICS – EXISTING FACILITY

Seg. #	Existing Facility[1)]							
	Facility Type	General Purpose Lanes	Lane Miles	Centerline Miles	HOV Lanes	HOV Characteristics	Auxiliary Lanes	Passing Lanes
1	F	8 / 6 / 8	23.645	3.156	--	--	--	--
2	F	8	39.664	4.958	--	--	--	--
3	F	8	22.88	2.86	--	--	59.90%	--
4	F	8	44.64	5.58	2	2+; Part-Time	6.40%	--
5	F	8	12.928	1.616	2	2+; Part-Time	--	--
6	F	6 / 4	24.558	4.51	2	2+; Part-Time	--	--
7	F	4	24.504	6.126	2	2+; Part-Time	--	--
8	F	4	3.56	0.89	2	2+; Part-Time	--	100%
9	F	4	9.36	2.34	2	2+; Part-Time	--	--
10	F	4	13.36	3.34	2	2+; Part-Time	--	--
11	F	4	7.96	1.99	--	--	--	--
12	F	4	26	6.50	--	--	4.62%	--
13	F	4	8.76	2.19	--	--	--	--
14	E	4	3.44	0.86	--	--	17.10%	--
15	F / E	4	31.344	7.836	--	--	0.50%	--
16	F	4	24.08	6.02	--	--	--	--
17	C / E / C	3 / 4 / 3	28.1	7.648	--	--	--	--
18	C	2	53.276	26.638	--	--	0.70%	15.70%
19	C	2	7.98	3.99	--	--	1.50%	--
20	C	3 / 2 / 5	11.46	4.83	--	--	--	--
21	C	5	19.96	4.99	--	--	--	--

[1)] F = Freeway, E = Expressway, C = Conventional; 3 and 5 lanes include 2-way left turn lane

TABLE 6: US 50 SYSTEM CHARACTERISTICS – 20-YEAR BUILD FACILITY									
Seg. #	20-Year Build Facility[1]								Ultimate Facility
	Facility Type	General Purpose Lanes	Lane Miles	Centerline Miles	HOV Lanes	HOV Characteristics	Auxiliary Lanes	Passing Lanes	
1	F	8	25.248	3.156	--		--	--	8F + 2HOV + Aux Lanes + ITS + ICM
2	F	8	39.664	4.958	2	2+; Part-Time	--	--	8F+2HOV+Aux Lanes + ITS + ICM
3	F	8	22.88	2.86	2	2+; Part-Time	--	--	8F + 2HOV + Aux Lanes + Transition + ITS + ICM
4	F	8	44.64	5.58	2	2+; Part-Time	6.40%	--	8F + 2HOV + Aux Lanes + ITS + ICM
5	F	8	12.928	1.616	2	2+; Part-Time	100.00%	--	8F + 2HOV + Aux Lanes + Transition + ITS + ICM
6	F	6 / 4	24.558	4.51	2	2+; Part-Time	100.00%	--	8F + 2HOV + ITS + ICM + Aux Lanes to Hazel Ave., 4F + 2HOV + ITS + ICM + Aux Lanes to Folsom
7	F	4	24.504	6.126	2	2+; Part-Time	73.29%	--	4F + 2HOV + Aux Lanes + ITS + ICM
8	F	4	3.56	0.89	2	2+; Part-Time	100.00%	10.50%	4F + 2HOV + Aux Lanes + ITS + ICM
9	F	4	9.36	2.34	2	2+; Part-Time	32.48%	--	4F + 2HOV + Aux Lanes + ICM
10	F	4	13.36	3.34	2	2+; Part-Time	100.00%	--	4F + 2HOV + Aux Lanes + ITS
11	F	4	7.96	1.99	--		100.00%	--	4F + 2HOV + Aux Lanes + ITS
12	F	4	26	6.50	--		0.50%	--	4F + 2HOV + Aux Lanes + ITS
13	F	4	8.76	2.19	--	--	6.30%	--	4F + Aux Lanes + ITS
14	E	4	3.44	0.86	--	--	17.10%	--	4E + Aux Lanes + ITS
15	F / E	4	31.344	7.836	--	--	0.50%	--	4F + Aux Lanes + ITS to Smith Flat, 4E + ITS to Camino
16	F	4	24.08	6.02	--	--	--	--	4F + ITS
17	C / E / C	3 / 4 / 3	28.1	7.648	--	--	--	--	3C + ITS, 2.0 mi; 4E + ITS, 5.3 mi; 3C + ITS, 0.3 mi
18	C	2	53.276	26.638	--	--	--	--	2C + ITS + ICM; 0.35 mi of 2-way left turn lane
19	C	2	7.98	3.99	--	--	--	--	2C + ITS + ICM + Bike Lanes
20	C	3 / 2 / 5	11.46	4.83	--	--	--	--	3C + ITS + ICM, 0.86; 2C + ITS + ICM, 3.64 mi; 5C + ITS + ICM, 0.61 mi
21	C	5	19.96	4.99	--	--	--	--	5C + ITS + ICM

1) F = Freeway, E = Expressway, C = Conventional; 3 and 5 lanes include 2-way left turn lane

2) The number of lanes in the Concept Attainment column is for both directions required to achieve LOS E in Urban and LOS D in Rural areas along the corridor. It is meant to show the severity of future conditions and what it would take to achieve the Concept LOS. Caltrans is not suggesting that it is our plan to build the facility to achieve this LOS. We recognize the difficulty in achieving the desired LOS given the financial, environmental, right of way, and political constraints.

TRAFFIC OPERATIONS SYSTEM ELEMENTS

Caltrans District 3 seeks to optimize the transportation system. Two cost-effective methods include operational improvements and ITS improvements. Operational improvements include smaller-scale capital improvements that improve efficiency such as auxiliary lanes, express bus/carpool lanes, incident management, traffic demand management, and park and ride projects. ITS improvements can be categorized into four general classifications: driver information, monitoring, vehicle detection, and operations. These traffic operations system (TOS) elements, and transportation management facilities and services are discussed below by transportation mode.

Given the complexity of the corridor and its extensive geographic range, there are a wide variety of system management strategies and elements currently being implemented by jurisdictions and transportation service providers. Strategies and elements range from vehicle detection devices to traveler information systems to traffic flow control mechanisms. A common element among all the strategies and elements is data collection and analysis. Caltrans, SACOG, and local governments have partnered together on corridor performance data and system management in the Sacramento Transportation Area Network (STARNET).

The STARNET web application initial release took place in 2010. Features implemented so far include: Changeable Message Sign (CMS) display, speed data from Caltrans and Google, integration of Regional Transit and Yolo Transit to provide schedule and routing data, California Highway Patrol incident data, connectivity to the 511 systems (web and telephone), personalized traveler information with alerts based on time of day, lane closure data, Closed Circuit Television (CCTV) displays from Caltrans, City of Roseville and County of Sacramento. Near term initiatives include national weather service (NWS) alert data, increased transit data including real time location feed data from Yolo Transit and a City of Sacramento Police Computer Aided Design (CAD) feed. Web based applications include a commercial vehicle page, full feature website, low bandwidth page, mobile device page and under development applications for iPhone and Android smart phones. Caltrans Commercial Web Portal, City of Sacramento Traffic Operation Center (TOC), Sacramento County TOC, Roseville TOC, Elk Grove TOC and Citrus Heights TOC are contributing sources for the STARNET application. STARNET's associated management strategies can and will evolve as the application is implemented throughout the region and as additional features are added as development proceeds.

The SHS has an extensive set of system management strategies in operation. Some cities, counties, and transit operators also have robust system management elements and programs applied to their facilities or services. There are also specific instances of system management linkages among transportation modes and services at particular locations.

These strategies work as a system to gather, analyze, and disseminate information through the Caltrans Transportation Management Center (TMC). Information about collisions, other incidents, road closures, and emergency notifications are fed into this information hub and disseminated to public and private information users. The TMC operates 24 hours a day, seven days a week.

Caltrans is providing the latest in ITS technology to its urban freeways. As summarized in Table 7 and depicted in Figure 25 below, US 50 has had numerous ITS elements installed on the urbanized segments of the facility. Additional ITS elements are planned or programmed for the facility under a 20-Year Build scenario and under the Ultimate Facility Concept. These elements help improve travel times and overall facility performance.

Operational improvements and services utilized by Caltrans along the US 50 corridor are identified as follows:

Auxiliary lanes are used between interchange on- and off-ramps to improve weaving and merging movements to and from adjacent travel lanes. Auxiliary lanes give drivers more room to speed up and slow down when getting on or off a freeway. An auxiliary lane makes it easier for drivers to merge into freeway traffic, and reduces ramp congestion.

Transition lanes are similar to auxiliary lanes in function, but facilitate merging transitions for traffic over the distance of two or more interchanges. By functioning as "on-system frontage," transition lanes provide broader service for merging traffic and therefore alleviate bottleneck conditions and enhance travel lane throughput along freeway segments spread out over two or more interchanges. A graphic depiction of auxiliary and transition lanes are shown in Figure 24.

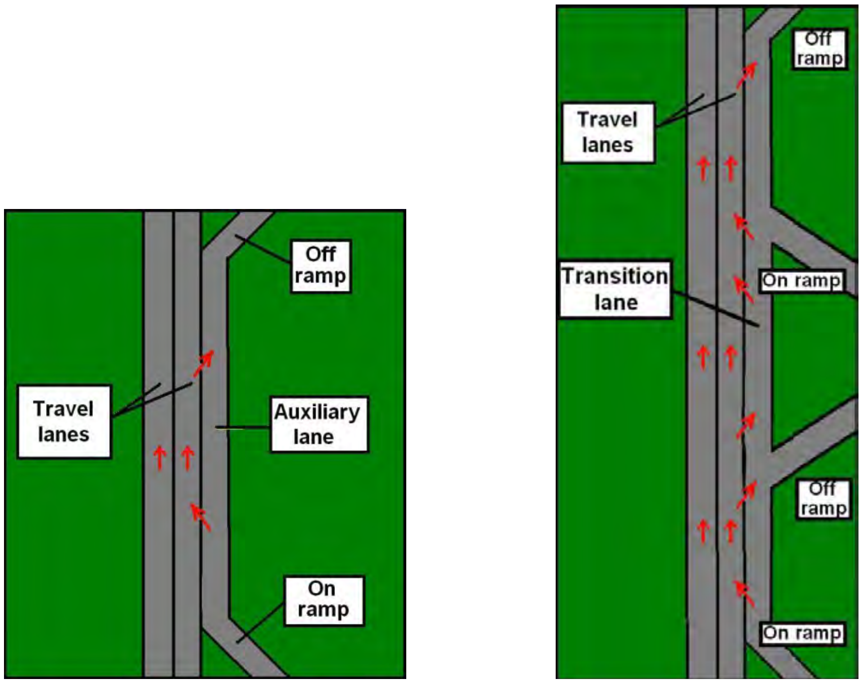


Figure 24: Auxiliary and Transition Lanes

Express Bus/Carpool Lanes sometimes referred to as HOV lanes are lanes for the exclusive use of vehicles carrying two or more occupants during the posted times dedicated to their use and can provide a travel time advantage to people who use the lanes. Express bus/carpool lanes stretch from Watt Ave. in Sacramento County to Cameron Park Dr. in El Dorado County.

Park-and-Ride Lots provide a place for commuters to park their cars and meet carpools, vanpools and buses. Some park and ride lots also provide bike lockers. A listing of lots is identified on Table 9 and shown in Figure 23 below.

Transportation Management Plans (TMP) are required by Caltrans Deputy Directive DD-60-R1 for *"all construction, maintenance, and encroachment permit activities on the State Highway System"*. All projects must be TMP Certified prior to being designated as "Ready to List". TMPs detail how a construction project will be implemented so that its impact to existing travel is minimized or mitigated.

Transportation Demand Management services include Transportation Management Associations (TMAs), employer subsidized transit passes and vanpools, the *511 Traveler Information Service*, carpool ride matching, the *Guaranteed Ride Home* program, and vanpool services. The overall intent is to reduce the number of vehicle trips using highways and roads. Many of these services are financially supported by or directly provided by EDCTC and SACOG. Area employers and office complex owners are also key supporters and funders of TDM programs at their work sites. A listing of TMAs is provided in the Stakeholders Acknowledgement section. Additional TMA information including a list of contacts can be found at: http://www.sacregion511.org/rideshare/tma.html.

Incident Management is an essential component of highway operations. Timely response to incidents reduces the amount of time lanes are blocked and speeds emergency response. A popular aspect of this program is the *Freeway Service Patrol,* which assists motorists whose vehicles break down along the highway due to flat tires, out of gas, or mechanical failure.

Traveler Information services for the corridor include web sites, which are hosted by Caltrans, the California Highway Patrol (CHP), the U.S. Weather Service, and a private company. Caltrans provides real-time data feeds to commercial/media information services, such as radio and TV stations, to help inform travelers of highway and traffic conditions. Among these is the Caltrans QuickMap web page, which can be found at the following URL: http://www.dot.ca.gov/ca511/trafficMapFaq.html.

TABLE 7: EXISTING US 50 ITS ELEMENTS

Seg. #	Cnty	PM	ITS Elements[1]								
			CCTV	CMS	EMS	ETR	HAR	RMS	RWIS	TMS	Grand Total
1	YOL	0.00 - 3.16	2	-	-	-	-	3	-	3	**8**
2	SAC	L0.00 - L2.48/R0.00	5	2	-	-	-	4	-	4	**15**
3	SAC	R0.00 - R5.34	5	2	1	-	-	11	-	8	**27**
4	SAC	R5.34 - R10.92	3	-	1	-	1	7	-	7	**19**
5	SAC	R10.92 - 12.50	1	-	1	-	-	3	-	1	**6**
6	SAC	12.50 - 17.01	2	-	-	-	-	6	-	4	**12**
7	SAC	17.01 - 23.14	1	1	-	-	-	8	-	6	**16**
8	ELD	0.00 – 0.86	-	1	-	-	-	1	-	1	**3**
9	ELD	0.86 - R3.23	-	-	-	-	-		-	2	**2**
10	ELD	R3.23-6.57	-	-	-	-	-	-	-	2	**2**
11	ELD	6.57 – R8.56	-	-	-	-	-	-	-	3	**9**
12	ELD	R8.56 – R15.06	-	-	-	-	-	2	-	4	**6**
13	ELD	R15.06 - 17.25	-	-	1	-	-	-	-	1	**2**
14	ELD	17.25 - 18.11	1	-	-	-	1	-	-	-	**2**
15	ELD	18.11 - R25.95	-	1	2	-	-	-	-	-	**3**
16	ELD	R25.95/31.97	-	1	1	-	1	-	-	-	**3**
17	ELD	R31.97/39.77	-	-	-	-	-	-	-	-	**0**
18	ELD	39.77/66.63	-	1	1	-	1	-	-	-	**3**
19	ELD	66.63/70.62	2	1	-	2	1	-	1	1	**8**
20	ELD	70.62/75.45	-	-	2	2	-	-	-	3	**7**
21	ELD	70.62/80.44	2	2	1	2	1	-	-	3	**11**
TOTAL			**24**	**12**	**11**	**6**	**6**	**44**	**1**	**53**	**158**

[1] CCTV = Closed Circuit Television, CMS = Changeable Message Sign, EMS = Extinguishable Message Sign, ETR = Electronic Tag Reader, HAR = Highway Advisory Radio, RMS = Ramp Metering Stations, RWIS = Road Weather Information System, TMS = Traffic Management Systems. ITS Elements Inventoried April 2013

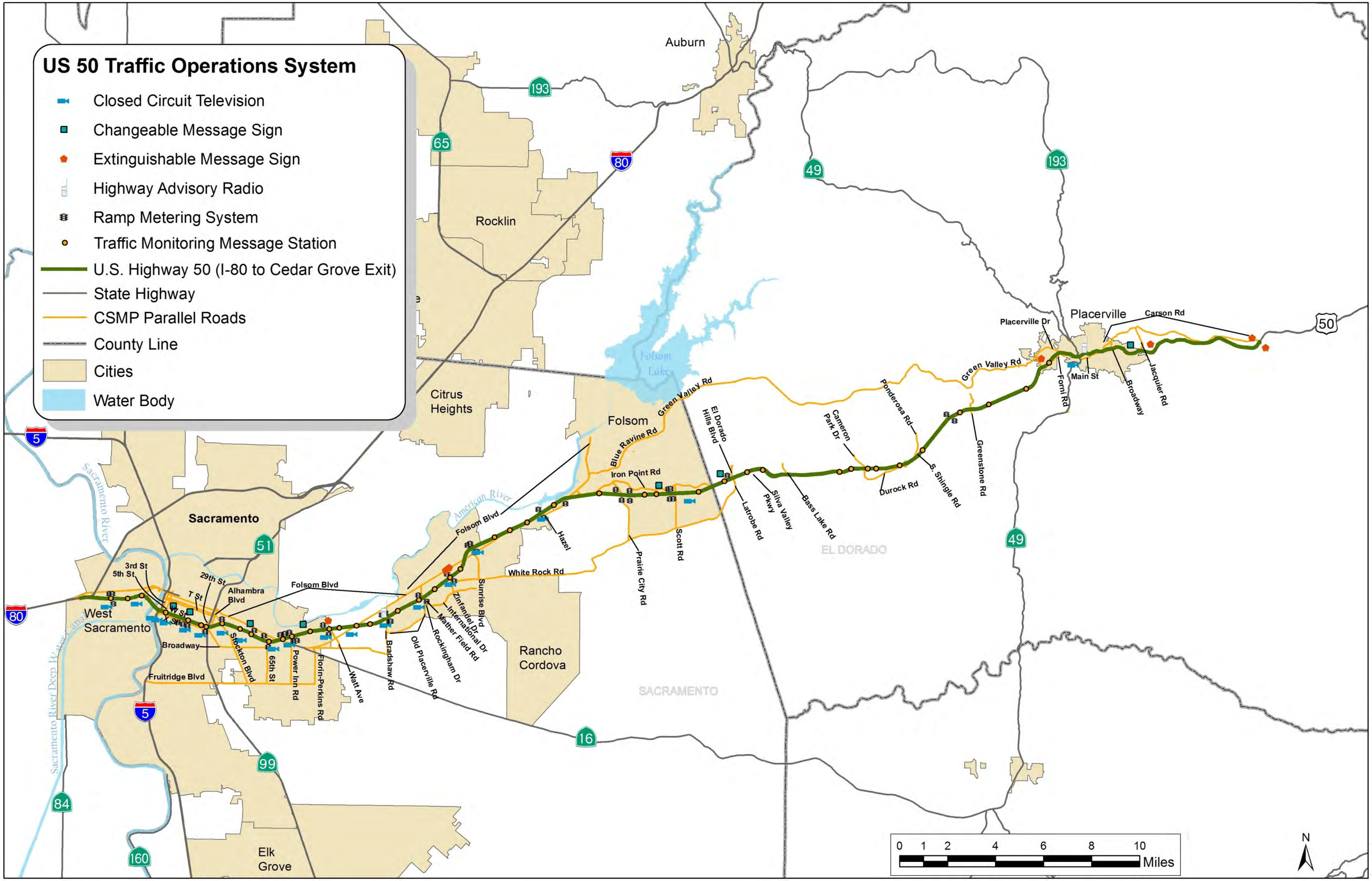


Figure 25: US 50 Traffic Operations System Map

PARALLEL AND CONNECTING ROADWAYS

Working with local agencies, Caltrans District 3 has identified several roads parallel to and connecting to US 50 in the CSMP portions of the facility, which are identified in Table 8 below and shown in Figure 2 on page 11 above. Together with transit and bicycle/pedestrian paths, the corridor functions as a whole to provide optimal system performance. It accomplishes this principally by offering alternatives to transportation along US 50 during times of peak commute or during an incident. Compared to 2009, the network of parallel and connecting roadways was expanded to include more roadways, creating a more complete system of urban streets. Major parallel and connecting roadways on the corridor are West Capitol Ave., Broadway, Stockton Blvd., Folsom Blvd., White Rock Rd., Sunrise Blvd., Iron Point Rd., Green Valley Rd., Cameron Park Dr., Mother Lode Dr., Placerville Dr., Broadway (in Placerville), and Main St.

A number of ITS elements utilized within the CSMP segments along the parallel and connecting roadways are as follows:

City of West Sacramento has one CCTV located on West Capitol Av. between Enterprise Blvd. and Capitol Mall.

City of Sacramento operates a TOC. Sensors in the street detect the passage of vehicles, vehicle speed, and the level of congestion. This information is received on a second-by-second (real-time) basis and is analyzed at the TOC.

Sacramento County also operates a TOC by gathering information through CCTV cameras, CMS, HAR, and a Fiber Optics (FO) network placed along major traffic corridors throughout the county.

City of Rancho Cordova installed CCTV cameras and a FO network on Folsom Blvd. in 2009. Currently, one CCTV exists on Sunrise Blvd. between US 50 and Folsom Blvd. Most major traffic corridors are on the network. The City contracts with the County of Sacramento to operate their systems through the County's TOC.

City of Folsom recently completed installing a FO system on all of the City's major corridors. Currently, the sole intersection that is monitored via camera is located on Iron Point Rd. and East Bidwell.

El Dorado County has three coordinated signals along Francisco Dr., at Green Valley Rd., the Market Place entrance (east side Safeway Center/west side Lake Forest Plaza), and Village Center Dr.

City of Placerville utilizes traditional control devices that includes traffic signals and stop signs. In addition, there is a CCTV at the intersection of US 50 and SR 49 (Spring St.).

TABLE 8: US 50 CSMP PARALLEL ROADWAY NETWORK							
Seg. #	Location		US 50		Parallel and Connector Roads		
	County	City	From	To	Roadway	From	To
1	YOL	West Sacramento	Interstate 80	YOL/ SAC County Line	West Capitol Ave.	Enterprise Blvd.	Capitol Mall
2	SAC	Sacramento	YOL/ SAC County Line	State Routes 99 and 51	W St.	5th St.	29th St.
					X St.	3rd St.	Alhambra Blvd.
					29th St.	W St.	T St.
					T St.	29th St.	Alhambra Blvd.
3			State Routes 99 and 51	Watt Ave.	Alhambra Blvd.	X St.	Folsom Blvd.
					Folsom Blvd.	Alhambra Blvd.	Watt Ave.
					Stockton Blvd.	Alhambra Blvd.	Fruitridge Rd.
					Broadway	5th St.	Alhambra Blvd.
					Broadway	Stockton Blvd.	65th St
					Fruitridge Rd./Seamas Ave	I-5	Florin Perkins Rd.
					65th St.	Fruitridge Rd.	US 50
					Power Inn Rd.	Fruitridge Rd.	US 50
					Florin Perkins Rd.	Fruitridge Rd.	Folsom Blvd.
4	SAC	Unincorp.	Watt Ave.	Zinfandel Dr.	Watt Ave.	Folsom Blvd.	US 50
					Folsom Blvd.	Watt Ave.	Bradshaw Rd.
		Rancho Cordova			Folsom Blvd.	Bradshaw Rd.	Sunrise Blvd.
					Bradshaw Rd.	Folsom Blvd.	Old Placerville Rd.
					Old Placerville Rd.	Bradshaw Rd.	Rockingham Dr.
					Rockingham Dr.	Old Placerville Rd.	Mather Field Rd.
					Mather Field Rd.	Rockingham Dr.	Folsom Blvd.
					International Dr.	Rockingham Dr.	Zinfandel Dr.
					Zinfandel Dr.	International Dr.	Folsom Blvd
5	SAC	Rancho Cordova	Zinfandel Dr.	Sunrise Blvd.	White Rock Rd.	Zinfandel Dr.	Sunrise Blvd
					Sunrise Blvd.	US 50	White Rock Rd.
					White Rock Rd.	Sunrise Blvd.	Rancho Cordova City limits
6	SAC	Rancho Cordova	Sunrise Blvd.	Folsom Blvd.	Folsom Blvd.	Sunrise Blvd.	Hazel Ave.
	SAC	Unincorp.	Sunrise Blvd.	Folsom Blvd.	White Rock Rd.	R. Cordova City limits	Prairie City
					Folsom Blvd.	Hazel Ave.	Iron Point Rd.
					Blue Ravine Rd.	Folsom Blvd.	Green Valley Rd.
					Prairie City Rd.	Iron Point Rd.	White Rock Rd.

TABLE 8: US 50 CSMP PARALLEL ROADWAY NETWORK							
Seg. #	Location		US 50		Parallel and Connector Roads		
	County	City	From	To	Roadway	From	To
7	SAC	Folsom	Folsom Blvd.	Sacramento/ El Dorado County Line	Iron Point Rd.	Folsom Blvd.	Empire Ranch Rd.
					Folsom Blvd.	Iron Point Rd.	Blue Ravine Rd.
					Blue Ravine Rd.	Folsom Blvd.	Green Valley Rd.
					Prairie City Rd.	Iron Point Rd.	White Rock Rd.
					E. Bidwell/Scott Rd.	Iron Point Rd.	White Rock Rd.
		Unincorp.			White Rock Rd.	Grant Line Rd.	SAC/ELD Cty. Line
8	ELD	Unincorp.	Sacramento/ El Dorado County Line	El Dorado Hills Blvd.(Latrobe)	Green Valley Rd.	Blue Ravine Rd.	Cameron Park Dr.
					White Rock Rd.	SAC/ELD Cty. Line	Latrobe Rd.
					Latrobe Rd.	White Rock Rd.	US 50
					White Rock Rd.	Latrobe Rd.	Silva Valley Pkwy.
					Silva Valley Pkwy.	White Rock Rd.	Serrano Parkway
9	ELD	Unincorp.	Latrobe Road	Bass Lake Rd	Green Valley Rd.	Francisco Dr.	Deer Valley Rd.
					White Rock Rd.	Latrobe Rd.	Silva Valley Pkwy.
					Silva Valley Pkwy.	White Rock Rd.	Serrano Pkwy.
10	ELD	Unincorp.	Bass Lake Rd	Cameron Park Dr	Green Valley Rd.	Deer Valley Rd.	Cameron Park Dr.
					Cameron Park Dr.	Durock Rd.	US 50
11	ELD	Unincorp.	Cameron Park Dr.	So. Shingle Rd. (Ponderosa Rd)	Green Valley Rd.	Cameron Park Dr.	Ponderosa Rd.
					Durock Rd.	Cameron Park Dr.	South Shingle Rd.
12	ELD	Unincorp.	Ponderosa Rd.	Missouri Flat Rd.	Green Valley Rd.	Ponderosa Rd.	Missouri Flat Rd.
					South Shingle Rd.	Durock Rd.	US 50
					Mother Lode Dr.	South Shingle Rd.	Missouri Flat Rd.
13	ELD	Unincorp.	Missouri Flat Rd.	End of Freeway, Placerville	Green Valley Rd.	Missouri Flat Rd.	Placerville Dr.
					Forni Rd.	Placerville Dr.	Main St.
					Placerville Dr.	Forni Rd.	US 50
14	ELD	Placerville	End of Fwy., Placerville	Bedford Ave., fwy. start.	Main St.	Placerville Dr.	Bedford Ave.
15	ELD	Placerville	Bedford Ave., start of Fwy.	Cedar Grove Exit	Main St.	Bedford Ave.	Broadway
					Broadway	Main St.	Point View Dr.
					Jacquier Rd.	Point View Dr.	Carson Rd.
					Carson Rd.	Main St./ Broadway	US 50 at Cedar Grove Exit

TRANSIT AND RIDESHARE FACILITIES

Transit and rideshare services within the US 50 corridor are identified on Table 9 and delineated on the CSMP segments of this Plan in Figure 26 below. They are important alternatives to automobile travel that frees roadway capacity. In the urban segments of US 50, transit services are provided by Sacramento Regional Transit (SacRT), Yolo Bus, Folsom Stage Line, El Dorado Transit, and Amtrak. Yolo Bus offers services between West Sacramento in both traditional and commuter bus options. SacRT provides traditional bus service and light rail service on the Gold Line. Folsom Stage Line has traditional bus services to major points of interest in Folsom, and El Dorado Transit makes both Sacramento commuter and traditional bus services available in western El Dorado County. Folsom Stage Line provides service to the three light rail stations at the end of the Gold Line extension.

In addition to the bus and rail services within metropolitan Sacramento, there are intercity transit services available. Amtrak California offers intrastate rail connections within California on either the Capitol Corridor or the San Joaquin lines. There are also numerous connections through the train service with the Amtrak connector bus, Amtrak Thruway. These Amtrak buses have several destinations in California and Nevada that are not on the Amtrak California rail service lines, such as Yuba City, South Lake Tahoe, and Reno. In addition, interstate Amtrak services connect the US 50 corridor to Oregon and Washington on the Coast Starlight line and to the eastern United States on the California Zephyr line.

In the rural segments of US 50, transit services are limited. Available transit services are focused on the developed areas of the corridor. Camino and Pollock Pines have limited El Dorado Transit bus service from the center of Pollock Pines near the main grocery store to the Missouri Flat Transfer Center near Placerville. Tahoe Transportation District (TTD) also offers transit service through BlueGo. The main line for South Lake Tahoe runs from the SR 89 North junction to east of the state line. With one-hour headways, both transit systems are basic services and are not a viable alternative to automobile travel for many people. Funds are being sought to maintain and possibly expand transit service in the Lake Tahoe Basin.

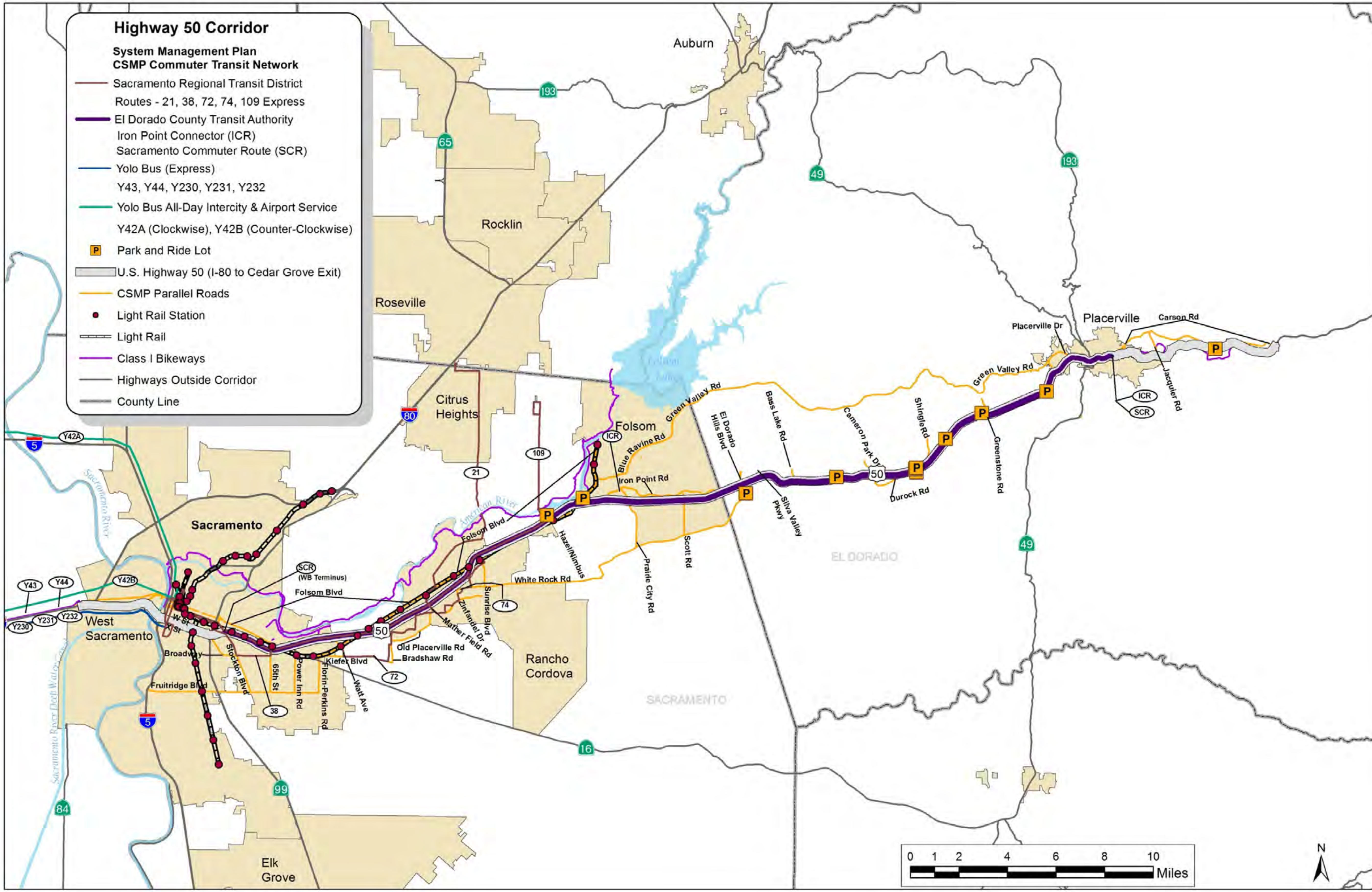


Figure 26: US 50 CSMP Network Transit Routes

Rideshare and park and ride facilities form a vital linkage in the transit system, allowing travelers to take transit when walking distances would otherwise limit its practicality. Park and ride lots can be operated by several different agencies, such as SacRT or local agencies. Caltrans has partnered with several local agencies to provide park and ride lots. These facilities are included in Table 9 below. Several of these lots also offer bicycle facilities such as lockers or stands. Additional Park and Ride lots information including specific location, capacity, and occupancy rates can be found at http://www.dot.ca.gov/dist3/departments/planning/systemplanningPR.htm.

TABLE 9: US 50 CORRIDOR TRANSIT SYSTEM				
Seg. #	**Mode & Collateral Facility**	**Name**	**Route End Points**	**Headway**
1	Traditional Bus	Yolo Bus	Downtown Sacramento; Davis; Woodland	Long
	Commuter Bus	Yolo Bus	Downtown Sacramento; Davis; Woodland	Long
	Amtrak Bus	Amtrak California	Major Cities in California	Long
	Amtrak Rail	Capital Corridor	Sacramento, Bay Area, Reno	Long
2	Traditional Bus	Sacramento Regional Transit (SacRT) and Yolo Bus	West Sacramento; Sacramento; Rancho Cordova	Short
	Commuter Bus	Yolo Bus	Yolo County; Folsom; El Dorado County;	Long
	Light Rail	SacRT Gold Line	Sacramento, Rancho Cordova, Folsom	Short
	Amtrak Bus	Amtrak California	Major Cities in California	Long
	Amtrak Rail	Capital Corridor	Sacramento, Bay Area, Reno	Long
3-6	Traditional Bus	Sacramento Regional Transit (SacRT)	Sacramento; Rancho Cordova; Fair Oaks	Short
	Commuter Bus	El Dorado County Transit Authority	Placerville, El Dorado Hills, Downtown Sacramento	Long
	Light Rail	SacRT Gold Line	Sacramento, Rancho Cordova, Folsom	Short
	Amtrak Bus	Amtrak California	Major Cities in California	Long
6	Park and Ride Lot	Hazel Park & Ride		
7	Traditional Bus	Folsom Stage Line	Places of Interest in Folsom	Short
	Traditional Bus	El Dorado County Transit Authority - Iron Point Connector	Placerville, Shingle Springs, Cameron Park, El Dorado Hills, Folsom	Long
	Light Rail	SacRT Gold Line	Sacramento, Rancho Cordova, Folsom	Short
	Park and Ride Lot	Folsom Iron Point Park & Ride		
8	Park and Ride Lot	El Dorado Hills Park & Ride		
		Cambridge Dr Park & Ride		
12	Park and Ride Lot	Ponderosa East and West Park & Ride Lots		
		Durock Park & Ride		
		Greenstone Park & Ride		
		Shingle Springs Park & Ride		
		Missouri Flat Park & Ride		

TABLE 9: US 50 CORRIDOR TRANSIT SYSTEM				
Seg. #	**Mode & Collateral Facility**	**Name**	**Route End Points**	**Headway**
8-15	Traditional Bus	El Dorado County Transit Authority	Cameron Park, Shingle Springs, Placerville	Short
	Traditional Bus	El Dorado County Transit Authority - Iron Point Connector	Placerville, Shingle Springs, Cameron Park, El Dorado Hills, Folsom	Long
	Commuter Bus	El Dorado County Transit Authority	Placerville, El Dorado Hills, Downtown Sacramento	Long
	Amtrak Bus	Amtrak California	Major Cities in California	Long
	Transit Station	Placerville Transit Station at Mosquito Rd.		
15	Park and Ride Lot	Camino Heights Park & Ride		
13-16	Traditional Bus	El Dorado County Transit Authority	Missouri Flat to Pollock Pines	Long
17-20	None			
21	Traditional Bus	BlueGo Bus Service	Jct. SR 89 North to State of Nevada	Long

A number of ITS elements utilized by Transit agencies along the corridor are as follows:

Yolo County Transit District (YCTD) uses a Global Positioning System (GPS) for locating buses in route, referred to as an Automatic Vehicle Location (AVL) system. The AVL System allows users to see where their bus is located within the last minute.

El Dorado County Transit Authority utilizes the GPS Zonar System for pre-trip inspections, maintenance, and real-time vehicle tracking.

Sacramento Regional Transit District (SacRT) has installed pre-emptive traffic signals at at-grade intersections along the Light Rail routes. SacRT has a GPS; however, it is only utilized for analysis purposes.

Computer-aided dispatch and Bus Rapid Transit are in the planning stages. In addition, SacRT has an online Trip Planning application to assist transit users. During special events such as the California State Fair, the Jazz Festival, the holiday seasons, and the Mather Field Air Show, SacRT operates additional service to connect events to light rail stations and offers free service to promote transit use during select events. The transit routes identified in the CSMP network are shown in Figure 5.

The Sacramento Valley Station in downtown Sacramento is the 7th busiest station in the national Amtrak system and serves as a multi-modal transfer facility. There are over 1.1 million passenger trips annually. Passengers can make connections with numerous local bus services as well as the SacRT light rail system.

Sacramento County installed pre-emptive traffic signals to give preferential signal timing to transit buses at selected locations that serve high priority transit corridors.

SACOG manages the 511 and rideshare programs that cost approximately $1 million per year, region-wide, to foster carpooling, transit ridership, vanpooling, and bicycling in all areas and corridors. The Regional Rideshare Program covers Placer, El Dorado, Sacramento, Yolo, Yuba, and Sutter counties. It is part of a statewide network of rideshare agencies that encourage alternative transportation modes for traveling.

BICYCLE FACILITIES

Bicycling constitutes an active transportation alternative to automobile use that can help reduce congestion and improve corridor performance. Bicycle facilities, particularly on parallel roads, are important to encourage bicycling. These bicycle facilities are located on both local parallel roads and on dedicated pathways, such as the American River Parkway Trail. Table 10 below gives details about the bicycle facilities in the corridor. Figures 27 and 28 show the bicycle routes included in the CSMP segments of this plan.

Bicycles are prohibited on the freeway portion of US 50, but are generally permitted on the conventional highway portion. Bicyclists are expected to use an alternate parallel bicycle facility where US 50 prohibits it. Bicyclists can ride on US 50 where not prohibited. While bikeway expansion on US 50 would improve bicycling on the facility, the environmental constraints, the high cost, and low bicycle ridership currently prohibit construction of bicycle facilities in the rural sections of US 50, particularly through the Eldorado National Forest. In the developed portions of the facility there are several opportunities for collaboration with local agencies to construct the bicycle facilities appropriate to the context.

Caltrans District 3 recently completed the *State Highway Bicycle Facility Plan* (SHBFP). This plan establishes policies for bicycle planning across a variety of areas, such as maintenance, operations, planning, and project management. Further, the plan includes a table and maps with recommended improvements to the bicycle transportation system, such as Class II bike lanes and Class III bike routes. These improvements are to be incorporated as funds allow or the highway segment is improved.

Several policy recommendations were made as to what types of bicycle facilities would be constructed on the SHS. Priority is to be given to ensuring consistency with local bicycle plans, unless the local proposal is inappropriate to the context of the roadway. Bicycle facilities are generally not appropriate in areas with limited access and high vehicular speeds. In particular, urban freeways are not appropriate for bicycle facilities. In these cases, Caltrans consults with local governments to identify alternative routes to segments closed to bicycles. Further, Class II bicycle lanes are appropriate on the SHS passing through town centers and in developed areas where no local routes exist. Class III bicycle routes on the SHS may be appropriate for town centers, developed areas, and some rural locations.

The SHBFP established several District actions that help achieve the plan's vision. These actions by various District 3 divisions are intended to further coordination among divisions. These actions include several measures such as communication between divisions and maintenance agreements with local governments regarding bicycle facility planning. The SHBFP can be viewed at
http://www.dot.ca.gov/dist3/departments/planning/bike/D3SHBFP_June2013.pdf.

As part of the Environmental Improvement Program (EIP) for Lake Tahoe, Caltrans has constructed 2.25 miles of bikeways on the state highways near the lake and has plans for nine more miles, six of which are on US 50. These bikeways form part of the bicycling network, which is intended to provide travel around Lake Tahoe. The plans now call for Class II bike lanes from Meyers to the State Line. Currently, there are bike lanes from Trout Creek to Wildwood. The rest of the bike lanes are slated to be constructed by 2020.

Bicycle facilities in the corridor are not actively managed in the same manner as motor vehicle facilities. However, there are traffic operation systems that serve bicyclists such as dedicated bicycle lanes, bicycle detection loops at signalized intersections, video detection, other non-loop type detection, and bicyclist-activated signal change buttons. The City of Sacramento is installing video detection at some locations.

SacRT buses and the new light rail trains are equipped with bicycle racks. There are over 150 weatherproof bicycle lockers at 19 light rail stations. YCTD has the Bikes on Buses Program that allows bicycles to travel on any YOLOBUS.

The Sacramento Area Bicycle Advocates maintain an on-line hazard reporting system to allow users to report hazardous locations for bicyclist such as potholes, inadequate signal timing, hazardous railroad crossings, insufficient shoulder, and inadequate bikeway markings. The reports are then sent to the applicable jurisdiction. SACOG is creating an on-line route planning system for bicyclists. In addition, SACOG maintains bicycle maps on their website, which are currently being updated. These maps are included in the *SACOG Bicycle, Pedestrian, and Trails Master Plan,* which can be found at http://www.sacog.org/bikeinfo/download_bike_ped_trails_mp.cfm.
SACOG has also created an on-line route planning system for bicyclists, which can be found at http://www.sacregion511.org/bicycling/trips/.

TABLE 10: US 50 BICYCLE TRANSPORTATION NETWORK							
Seg. #	County & City Location	Bicycle Access Prohibited	Bicycle Facility Type[1]	Parallel Bike Routes			
				Route	From	To	Facility Type
1	YOL, West Sacramento	Yes	Alt. Route	West Capitol Ave.	Yolo Causeway	Tower Bridge	Class II
2	SAC, Sacramento	Yes	Alt. Route	Tower Bridge	W. Capitol Ave.	Capitol Mall	C. I
				Capitol Mall	Tower Bridge	3rd/5th Sts.	None
				3rd/5th Sts.	Capitol Mall	T St.	None
2/3				T St.	3rd/5th Sts.	65th St.	C. II
3				65th St.	T St.	4th Ave.	None
				4th Ave.	65th St.	Redding Ave.	None
				Redding Ave.	4th Ave.	Folsom Blvd.	C. II
				Folsom Blvd.	Redding Ave.	State Univ. Dr. East	C. II
				State Univ. Dr. E.	Folsom Blvd.	Guy West Bridge	None
				Guy West Bridge	State University Dr. East	Am. Riv. Pkwy. Bike Tr.	C. I
				Alhambra Blvd.	2nd Ave.	Folsom Blvd.	C. II
				Folsom Blvd.	Alhambra Blvd.	Watt Ave.	C. II
				2nd Ave.	Riverside Blvd.	34th St.	C. II
				Riverside/11th St.	T St.	2nd Ave.	C. II
				18th/21st/34th Sts.	T St.	2nd Ave.	C. II
				American River Parkway Bike Trail/Jedediah Smith Memorial Trail			C. I
	SAC, Unincorp.	Yes	Alt. Route	La Riviera Dr./ College Town Dr.	Folsom Blvd.	State University Dr. East	C. II
3/4	SAC, Rancho Cordova	Yes	Alt. Route	Watt Ave. Trail	Am. Riv. Bike Tr.	La Riviera Dr.	C. I
4		Yes	Alt. Route	Folsom Blvd.	Watt Ave.	Bradshaw Rd.	C. III/None
4-7				Folsom Blvd.	Bradshaw Rd.	Iron Point Rd.	C. II
5				Folsom S. Canal Tr.	S. of Kiefer Blvd.	Am. Riv. Bike Tr.	C. I
				American River Parkway Bike Trail/Jedediah Smith Memorial Trail			C. I
5/6	SAC, Unincorp.	Yes	Alt. Route	Sunrise Blvd. Trail	Am. Riv. Bike Tr.	Folsom Blvd.	None
6				Hazel Ave. Trail	Am. Riv. Bike Tr.	Folsom Blvd.	C. II
	SAC, Folsom	Yes	Alt. Route	American River Parkway Bike Trail/Jedediah Smith Memorial Trail			C. I
7	SAC, Folsom	Yes	Alt. Route	Iron Point Rd.	Folsom Blvd.	Empire Ranch Rd.	C. II
				Blue Ravine Rd.	Folsom Blvd.	Green Valley Rd.	C. II
				Humbug-Willow Creek Tr.	Folsom-Auburn Rd.	Natoma St.	C. I
				Natoma St.	H.-W. Creek Trail	Green Valley Rd.	C. II
10	ELD, Unincorp.	Yes	Alt. Route	Green Valley Rd.	SAC/ELD County Line	Cameron Park Dr.	C. II/None
12/ 13				Green Valley Rd.	Cameron Park Dr.	Placerville Dr.	None
13	ELD, Unincorp.	Yes	Alt. Route	Ray Lawyer Dr.	Placerville Dr.	Forni Rd.	C. II
				Placerville Dr.	Ray Lawyer Dr.	Forni Rd.	C. II
				ED Bike Trail	Ray Lawyer Dr.	Main St.	C. I

TABLE 10: US 50 BICYCLE TRANSPORTATION NETWORK							
Seg. #	**County & City Location**	**Bicycle Access Prohibited**	**Bicycle Facility Type**[1]	**Parallel Bike Routes**			
				Route	**From**	**To**	**Facility Type**
13 / 14	ELD, Unincorp.	Yes	Alt. Route	Main St.	Forni Rd.	Bedford Ave.	C. I/II/III
13				ED Bike Trail	Missouri Flat Rd.	Forni Rd.	C. I
12	ELD, Placerville	Yes/No	Alt. Route/Non-Designated	ED Bike Trail	Bedford Ave.	Clay St.	C. I
		No	Non-Designated	ED Bike Trail	Clay St.	Los Trampas Rd.	C. I
13	ELD, Unincorp.	Yes	Alt. Route	None	Cedar Grove Exit	Sly Park Undercrossing	None
		No	Non-Designated	None	Sly Park Undercrossing	0.67 mi east of Sly Park Rd	None
17	ELD	No	Non-Designated	None	East of Sly Park Rd	Ice House Rd	None
18					Ice House Rd	Echo Summit	None
19					Echo Summit	SR 89 South/Luther Pass Rd	None
20	ELD, South Lake Tahoe	No	Non-Designated	Pioneer Trail	SR 89/Luther Pass Rd	SR 89/Lake Tahoe Blvd	C. II
21			Non-Designated	Pioneer Trail	SR 89/Lake Tahoe Blvd	East End Trout Creek Bridge	C. II
			Class II		East End Trout Creek Bridge	Ski Run Blvd	C. II
			Non-Designated		Ski Run Blvd	State Line	C. II

[1] Bicycle Facility Type indicates the type of bicycle facility on that segment. Class I Bike paths are separate ROWs for bicycles and pedestrians. Class II bike lanes are separate lanes for bicyclists. Class III Bike routes are roadways with signs designating the roadway for shared bicycle use. Alternate route indicates that a designated local road is to be used when the facility is closed to bicyclists. Finally, non-designated means that while the facility is not prohibited to bicyclists, there is no designated bicycle facility on the corridor.

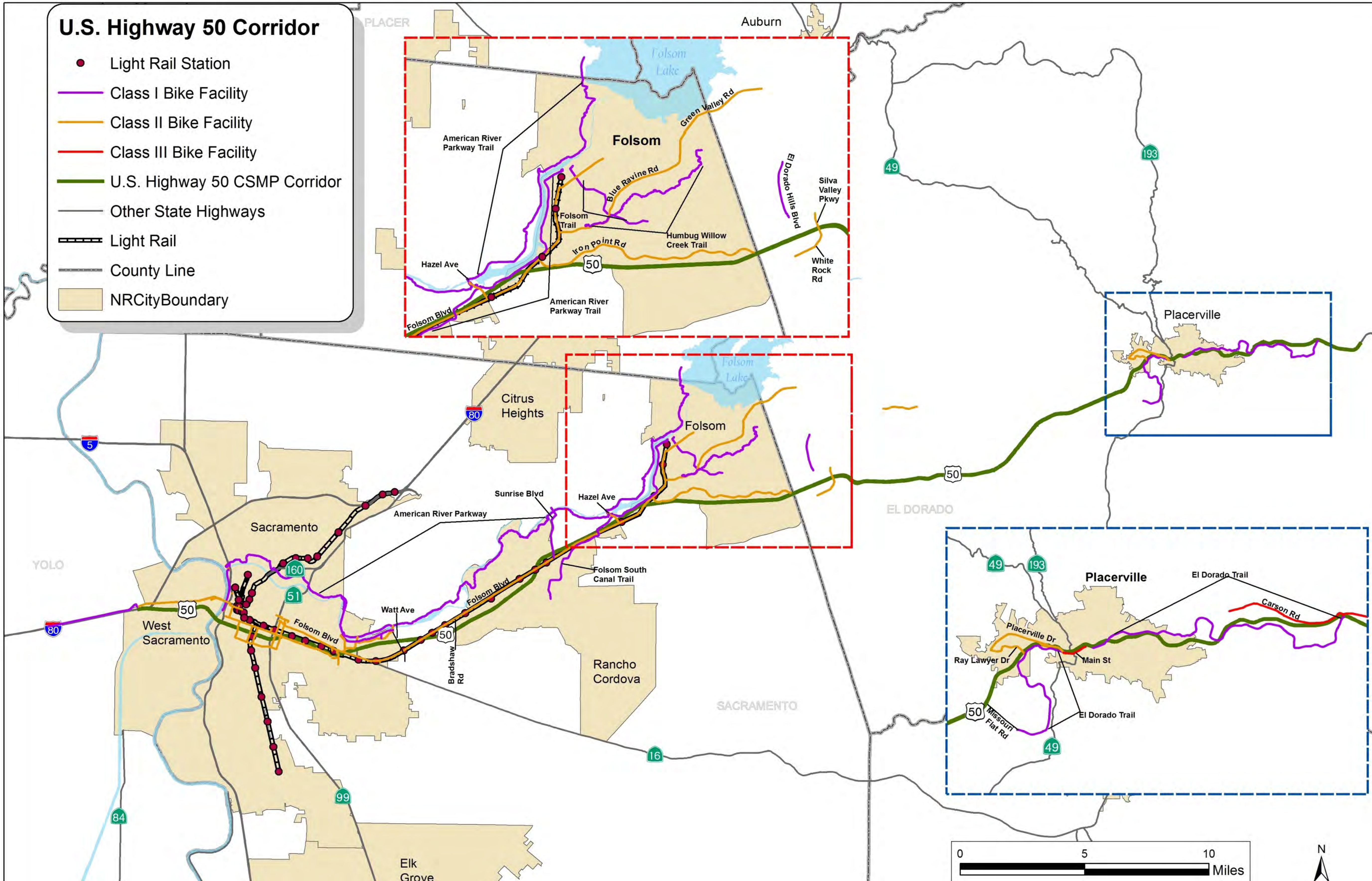


Figure 27: US 50 Corridor Bicycle Facilities Map

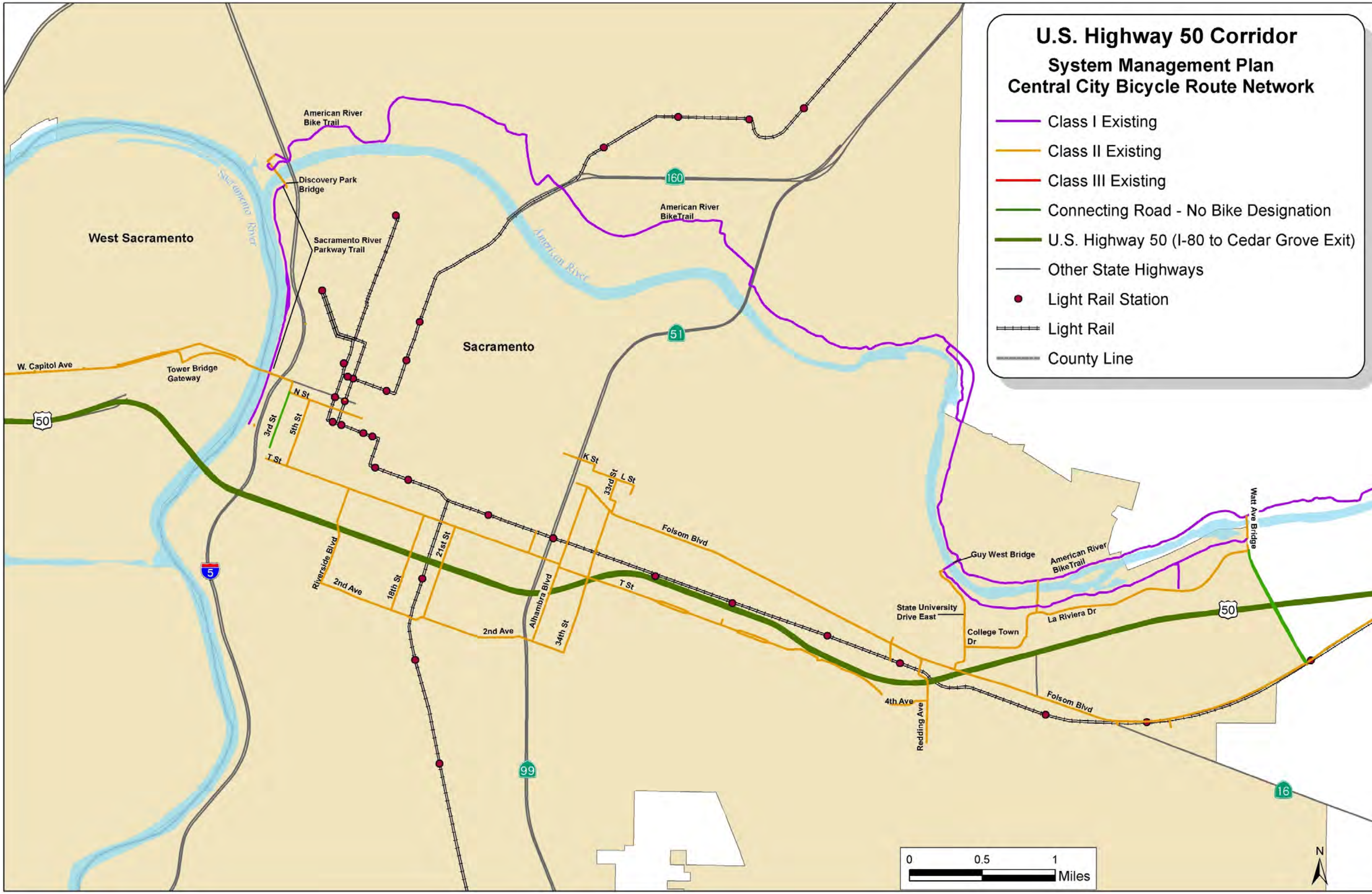


Figure 28: US 50 Corridor Bicycle Facilities Map (Inset)

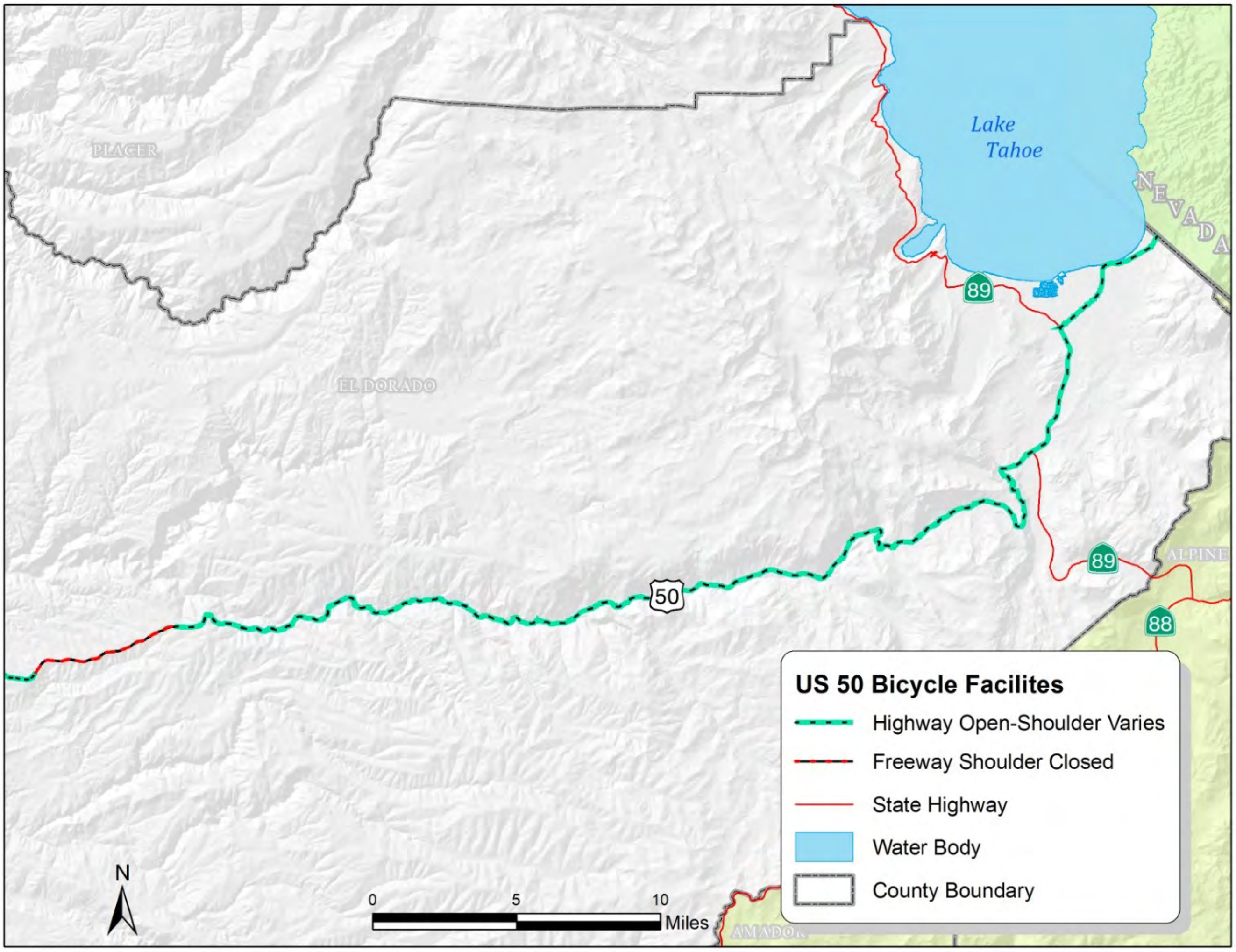


Figure 29: US 50 TCR Portion Bicycle Facilities

PEDESTRIAN FACILITIES

The pedestrian facilities on US 50 are identified in Table 11 below. In the Sacramento metropolitan area pedestrians are prohibited on US 50. For the rest of the corridor until near South Lake Tahoe, there are no pedestrian facilities due to the low pedestrian volumes. Pedestrian facilities can be very costly in areas with environmental or right-of-way constraints, especially in the Lake Tahoe area, so pedestrian sidewalks are not available in all areas. After the junction with SR 89 South near Lake Tahoe there are intermittent pedestrian facilities until the State line because US 50 functions as an urban street through the area.

As urban development takes place in the Sierra Nevada, it may become necessary to ensure pedestrian access in the conventional highway segments. For the Sacramento metropolitan areas, pedestrian bridges over US 50 could be needed. Parallel facilities could also provide a high level of service (LOS) for bicycle, pedestrian, and transit modes. In the South Lake Tahoe area, Caltrans has worked with local agencies through various agreements to develop pedestrian facilities on the state highway. Maintenance responsibilities for these and other pedestrian facilities are and will continue to be identified based on the physical and jurisdictional context of each facility. No plans are in the works for new pedestrian facilities on the urban segments or the segments within the Eldorado National Forest.

Caltrans District 3 is currently preparing the *Caltrans District 3 Complete Streets Plan* that will address the specific implementation of complete streets elements on the SHS within the District. A complete street is a transportation facility that is planned, designed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians, transit riders, and motorists appropriate to the function and context of the facility. Information regarding the addition of complete streets elements in the specific route or corridor will be included in each applicable TCR/CSMP. Caltrans will develop and implement the Plan in coordination with local and regional agencies.

TABLE 11: US 50 CORRIDOR PEDESTRIAN FACILITIES				
Seg. #	**Post mile**	**Location Description**	**Pedestrian Access Prohibited**	**Sidewalk**
1	0.00/3.16	I-80 to YOL/SAC County Line	Yes	No
2	L0.00/R0.00	YOL/SAC County Line to SR 99 and 51	Yes	No
3	R0.00/R5.34	SR 99 and 51 to Watt Ave.	Yes	No
4	R5.34/R10.92	Watt Ave. to Zinfandel Dr.	Yes	No
5	R10.92/12.50	Zinfandel Dr. to Sunrise Blvd.	Yes	No
6	12.50/17.01	Sunrise Blvd. to Folsom Blvd.	Yes	No
7	17.01/23.14	Folsom Blvd. to SAC/ED County Line	Yes	No
8	0.00/0.86	Sacramento/El Dorado County Line to Latrobe Rd.	Yes	No
9	0.86/R3.23	Latrobe Rd. to Bass Lake Rd.	Yes	No
10	R3.23/6.57	Bass Lake Rd. to Cameron Park Dr.	Yes	No
11	R6.57/R8.56	Cameron Park Dr. to Ponderosa Rd.	Yes	No
12	R8.56/R15.06	Ponderosa Rd. to Missouri Flat Rd.	Yes	No
13	R15.06/17.25	Missouri Flat Rd. to End of Freeway in Placerville	Yes	No
14	17.25/17.50	End of Freeway in Placerville to east of Canal St.	Yes	No
	17.50/17.70	East of Canal St. to Coloma Pedestrian OC (North side of US 50)	No	No
	17.70/18.11	Coloma Pedestrian OC to Bedford Ave.	Yes	No
15	18.11/20.741	Bedford Ave. to Newtown Rd. Overcrossing (OC)	Yes	No
	20.741/R25.95	Newtown Rd. OC to Cedar Grove Exit	No	No
16	R25.95 - R31.97	Cedar Grove Exit to 0.67 mi east of Sly Park Rd.	Yes	No
17	R31.97 - 39.77	0.67 miles east of Sly Park Rd. to Ice House Rd.	No	No
18	39.77 - 66.63	Ice House Rd. to Echo Summit	No	No
19	66.63 - 70.62	Echo Summit to State Route 89 South/Luther Pass Rd.	No	No
20	70.62 - 72.67	Junction with SR 89 South to Sawmill Rd.	No	Yes
	72.67 - 74.72	Sawmill Rd. to F St.	No	No
	74.72 - 75.45	F St. to SR 89 North/Lake Tahoe Blvd.	No	Yes
21	75.45 - 80.44	SR 89 North/Lake Tahoe Blvd. to State of Nevada	No	Yes

FREIGHT

There are three main types of freight facilities on the US 50 corridor as shown in Figure 29 and identified in Table 12. The first type of facility is the highway network. From the beginning of US 50 until Sly Park Rd, the facility is on the National Network, which allows trucks of Surface Transportation Assistance Act (STAA) dimensions to use the facility until that point. From Sly Park Rd until the junction with SR 89 South, US 50 is part of the California Legal network. This designation prohibits the longest truck lengths from using the facility. From SR 89 South until the state line, STAA trucks are allowed access only for terminal access, which is the permission to drive that route only to reach their destinations. Therefore, US 50 is only of limited use for goods movement. Most long distance haulers travel on I-5 and I-80.

Other important components of the highway network include the agriculture inspection station and the Riverton and Camino Commercial Vehicle Enforcement Facilities (weigh stations). The agriculture inspection station is located in Meyers and is intended to prevent invasive species from entering the State and causing serious damage to the State's agriculture industry. The commercial vehicle enforcement facilities protect the State's road infrastructure from commercial vehicles that are too heavy for facilities and could cause structural damage. Only commercial vehicles must stop at the enforcement facility.

The second type of freight facility is the Port of West Sacramento. This seaport is less than a mile south of US 50 and is easily accessible from Harbor Blvd. This Port primarily serves the import and export of agricultural goods and raw materials, in particular rice and cement. Further improvements of the surface transportation network and of the Sacramento River Deep Water Ship Canal will contribute to the attractiveness of the Port and increase freight volumes, making US 50 an even more important regional highway.

The third type of freight facility is represented by the airports in the corridor. Along US 50 there are two airports that impact goods movement: Mather Airport and the South Lake Tahoe Airport. Mather Airport has one of the longest runways in California and spacious warehousing on site from its time as an Air Force base. In 2011, Mather Airport handled 45,168 tons of cargo and plans to expand to accommodate future cargo deliveries. Caltrans is working with the airport and local agencies to ensure that development around the airport is compatible with airport operations.

The South Lake Tahoe Airport is owned by the City of South Lake Tahoe, but does not currently provide commercial scheduled air service. The airport provides another mode of access to southern Tahoe Basin communities and recreational venues. Air travelers using commercial airlines must currently reach South Lake Tahoe communities through the Reno and Sacramento International airports, and typically rent vehicles to drive to their destination into the basin. If commercial air service to the airport were restored, it could help reduce the number of vehicle trips and congestion on local roads. The City's Emergency Operations Center is located at the airport, and the airport also provides emergency air medical transport, County Search and Rescue, fire fighting, and law enforcement services to the region. The airport is served by several transit operators and private transit companies providing fixed routes, and on demand services that enhance regional connectivity and access for the Lake's residents and visitors. The City's only clean natural gas facility is located at the airport and fuels the City's clean fleet of vehicles. Lastly, the airport is used as a base of operations for Customs and Border Patrol drug interdiction, Fire Academy training, K-9 Hot Load training, and Fire Fest – a community fire education program.

Caltrans District 3 is preparing a district-wide Goods Movement Plan. The Plan will synthesize the findings of other goods movement related plans in the District and State, conduct a district-wide assessment of the District 3 Goods Movement network, propose a prioritization framework to identify and prioritize projects, and propose a list of prioritized projects for potential funding that will sustain or improve goods movement throughput. The plan will require significant outreach, collaboration, and consensus with stakeholders, including public agencies such as the Sacramento Area Council of Governments (SACOG), and the private sector entities such as the California Trucking Association. Findings from the study will be included in the California Freight Mobility Plan, and will be transferrable to other Caltrans Districts statewide for implementation. The District 3 Goods Movement Plan is scheduled to be finished in 2015. More information can be found at: https://sites.google.com/site/d03goodsmovement/.

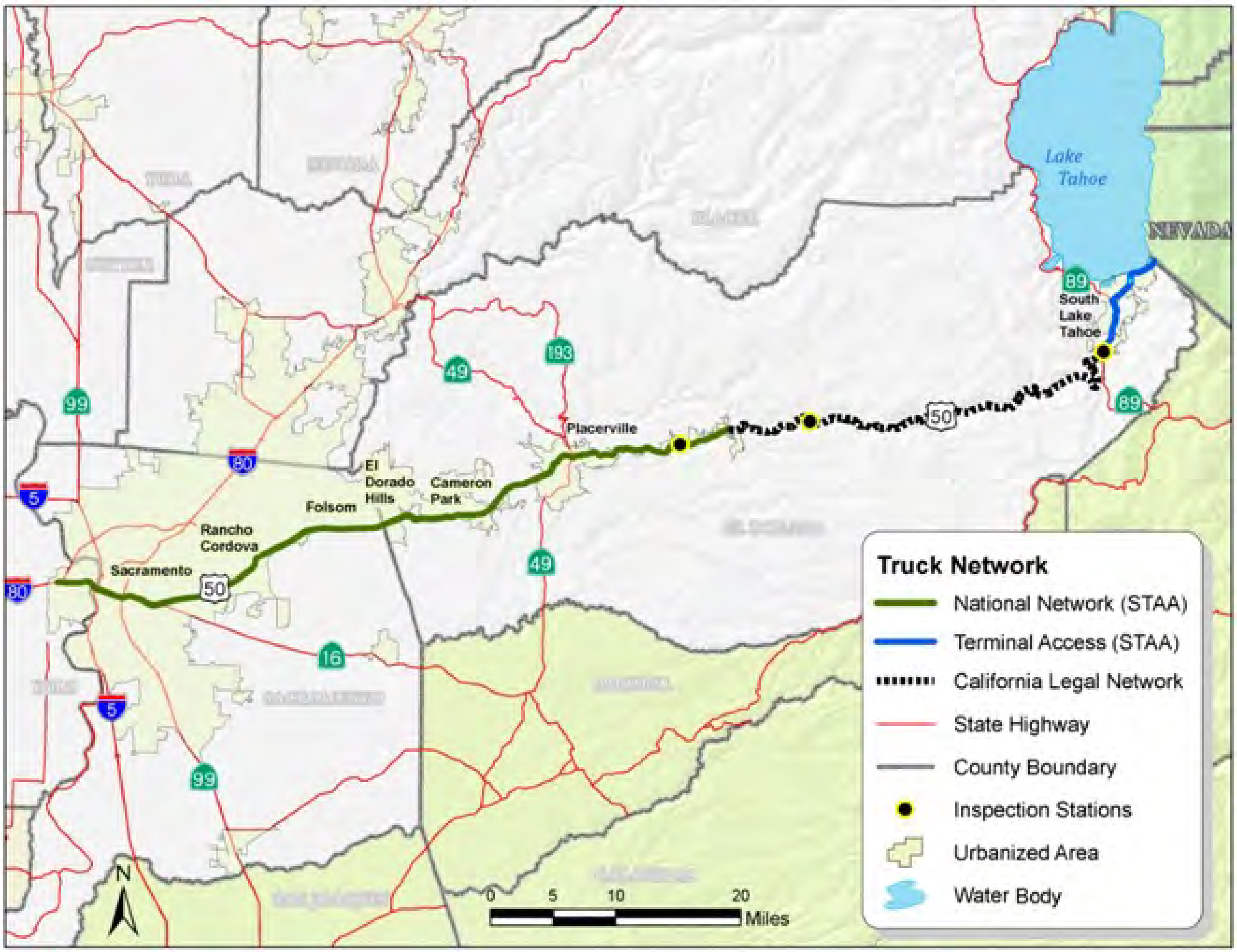


Figure 30: US 50 Truck Network Map

TABLE 12: US 50 FREIGHT FACILITIES			
Seg. #	Facility Type/Freight Generator	Location	Mode
1-21	Highway Network	National Network (STAA) to ED R31.297	Truck
		California Legal to ED PM 75.45	
		Terminal Access (STAA) to ED PM 80.44	
1 - 3	Industrial/Distribution Centers	YOL PM 1.209; SAC R3.682	Truck
1	Port of West Sacramento	YOL PM 1.094	Sea
4	Mather Airport	SAC PM R9.149	Air
20	Agriculture Inspection Station	ED PM 70.946	Automobile and Truck
17	Riverton Commercial Vehicle Enforcement Facility	ED PM 39.3	Truck
16	Camino Commercial Vehicle Enforcement Facility	ED PM R27.1	Truck

CORRIDOR PERFORMANCE MANAGEMENT

There are two major components of corridor performance management, which are performance measurement and performance monitoring.

PERFORMANCE MEASUREMENT

The use of performance measures with threshold standards is used to evaluate the degree of congestion along a highway segment or local parallel/connecting roadway, transit facility, and bicycle and pedestrian facility to determine the scope and schedule of system improvements needed to correct a performance deficiency. The performance measures used for the highway facility in this TCR/CSMP include Level of Service (LOS), Vehicle and Person Hours of Delay (VHD) at 60 MPH, Vehicle Miles Traveled (VMT), Peak Hour VMT, Peak Hour Volume over Capacity (V/C), and Peak Hour Average Speed. The tools used to determine the performance measures include Average Annual Daily Traffic (AADT), Truck AADT, Percent of Trucks, 5+ Axle Truck AADT, and 5 Axle Truck Percentage of AADT. The definitions, applicability, and sources of the baseline performance measures data used in this TCR/CSMP corridor are identified in Appendix C. This data is given for both the base (2012) and horizon (2035) years for all of US 50 where available. Basic system operation, truck traffic, and peak hour traffic performance data is summarized in Tables 13, 14, and 15 on the pages that follow.

LOS is a qualitative measure describing operational conditions within a traffic stream and perception of condition by users. Operational conditions are defined in terms of speed, travel time, freedom to maneuver, traffic interruption, comfort, and convenience. LOS is defined into six levels with letter designations from A to F. LOS A represents the best operating conditions wherein there is ample maneuverability, no speed restrictions and no delays, while LOS F represents the worst operating conditions with traffic congestions, significant delays and little maneuverability (please see Appendix A for more information including data sources). LOS is accepted as a performance measure by the Federal Highway Administration and California, as well as almost all 49 other states.

The "*Concept LOS*" is based on District 3 standards, which are from the Caltrans District 3 District System Management and Development Plan (DSMDP). Typical Concept LOS standards in District 3 are LOS "D" in rural areas and LOS "E" in urban areas. Performance variations and interchange deficiencies within a corridor segment may inadvertently increase or decrease the LOS calculations, which may warrant additional detailed operational analysis. A local agency may set a higher LOS threshold standard consistent with community wishes and other local concerns. Caltrans as the owner and operator of the facility establishes the Concept Level of Service as the **minimum acceptable level of service**. Any threshold standard LOS established by a local agency for the State Highway System (SHS) should not be lower than the Caltrans Concept LOS. For those parts of the SHS where LOS may not be an appropriate measure to describe performance such as in locations designated as a "Transit Priority" area where the Caltrans Performance Measurement System (PeMS) is available, the Caltrans District 3 DSMDP (page 34) suggests using other performance measures including, but not limited to, Vehicle Travel Time (minutes) and Vehicle Hours of Delay (VHD).

LOS is one performance measure utilized by Caltrans in the review of proposed projects during the Intergovernmental Review/CEQA development review process to determine if proposed projects might cause significant impacts to the operation of the SHS. In segments of the SHS main line where the existing LOS is at or below the Concept LOS, any land use development should not directly or cumulatively lower the existing LOS. Any impacts exceeding this threshold will be viewed by Caltrans as significant and warrant appropriate mitigation. Any CEQA lead agency should coordinate with Caltrans as early in the development review process as feasible to jointly determine the most appropriate threshold standards of significance.

Data collection for non-auto modes is not as robust as what is needed for active system management. AADT and LOS were used in the 2009 CSMPs as performance measures for the local parallel/connecting roadways. However, the availability and year date consistency of this data varied between local city and county jurisdictions, which resulted in the data not being valuable to measuring roadway performance across the corridor. Consequently, this TCR/CSMP update does not include performance measures for the roadways.

Available Average Daily and Peak Hour Capacity were used in the 2009 CSMPs as performance measures for transit. No performance measures were identified for bicycle and pedestrian facilities. Following consultation with key external stakeholders for both bicycling and transit after adoption of the 2009 CSMPs, the progress in implementing the infrastructure improvements to close system gaps by improving and facilitating bicycling, pedestrian, and mass transit, as included in the applicable regional transportation plans, was determined to replace the performance measures reported in the 2009 CSMPs for bicycling, pedestrian, and transit facilities, and to be reported in subsequent CSMPs for bicycling, pedestrian, and transit modes. It is realized that the bicycle and pedestrian transportation networks need to be completed prior to developing meaningful performance measures that quantify deficiencies.

PERFORMANCE MONITORING

The goal of performance monitoring is to continuously and dynamically examine corridor performance to identify operational problems caused by traffic congestion and implement immediate, efficient, and effective system operations and improvement actions and strategies along the corridor, including capital improvements to generate the desired results. Where available, PeMS is utilized to monitor highway performance. In other corridor segments where PeMS is not available, HCS 2010 analysis is performed using traffic counts or tachometer (tach) runs to assess performance.

TABLE 13: US 50 BASIC SYSTEM OPERATIONS

Seg. #	County	Post Miles	Distance (Miles)	Average Annual Daily Traffic			Level of Service (LOS)				Vehicle Miles Traveled (VMT)			Delay	
				Base Year (BY)*	No Build (Horizon Year (HY))*	Build (HY)	BY	No Build (HY)	Build (HY)	Concept LOS	BY	No Build (HY)	Build (HY)	Daily Vehicle Hours of Delay	Daily Person Hours of Delay
1	YOL	0.00/3.16	3.16	176,000	206,000	210,000	E	F	F	E	337,274	394,000	402,000	228	310
2	SAC	L0.00/L2.48(R0.00)	2.48	246,000	279,000	300,000	F	F	F	E	452,373	513,000	552,000	1,697	2,309
3		R0.00/R5.34	5.34	206,000	249,000	265,000	F	F	F	E	959,231	1,158,000	1,235,000	1,708	2,323
4		R5.34/R10.92	5.58	171,000	226,000	234,000	F	F	F	E	660,438	873,000	905,000	509	692
5		R10.92/12.50	1.58	141,000	196,000	204,000	E	F	F	E	194,349	271,000	281,000	204	278
6		12.50/17.01	4.51	117,000	160,000	161,000	F	F	F	E	630,648	862,000	866,000	565	768
7		17.01/23.14	6.13	91,000	113,000	132,000	F	F	F	E	521,760	645,000	759,000	158	215
8	ELD	0.00/0.86	0.86	91,000	100,000	110,000	F	F	F	E	81,060	89,000	98,000	59	80
9		0.86/R3.23	2.37	70,000	94,000	105,000	E	F	F	E	127,860	171,000	191,000	10	13
10		R3.23/6.57	3.34	61,000	86,000	84,000	D	F	D	E	207,994	294,000	286,000	51	70
11		6.57/R8.56	1.99	61,000	73,000	77,000	D	E	D	E	170,099	203,000	216,000	15	20
12		R8.56/R15.06	6.5	52,000	67,000	71,000	C	D	C	E	307,233	396,000	420,000	16	21
13		R15.06/17.25	2.19	49,500	59,000	67,000	D	D	E	E	129,242	153,000	176,000	6	9
14		17.25/18.11	0.86	52,000	59,000	58,000	C	C	C	D	37,604	43,000	42,000	132	179
15		18.11/R25.95	7.84	30,000	35,000	35,000	C	C	C	E / D*	180,361	212,000	213,000	31	43
16		R25.95/R31.97	6.02	19,900	24,880	24,900	B	C	C	E	108,240	135,300	135,420	Not available for TCR corridor	
17		R31.97/39.77	7.65	12,700	15,880	15,890	B	C	C	D	97,160	121,450	121,560		
18		39.77/66.63	26.64	13,100	16,380	16,390	E	F	F	D	351,840	439,800	440,190		
19		66.63/70.62	3.99	10,900	13,630	13,640	E	E	E	D	36,270	45,340	45,380		
20		70.62/75.45	4.83	19,000	23,750	23,770	E	F	F	D	68,450	85,560	85,640		
21		75.45/80.44	4.99	33,000	42,900	42,940	E	F	F	E	159,040	206,750	206,930		

Note: Please see Appendix A: Glossary for explanation of these terms and performance measures.
*- Concept LOS on a segment that contains both urban and rural portions

TABLE 14: US 50 TRUCK TRAFFIC DATA							
Seg. #	**County**	**Post Miles**	**Distance (Miles)**	**Average Annual Daily Truck Traffic (AADTT)**	**Total Trucks (% of AADT) (BY)**	**5+ Axle AADTT (BY)**	**5+ Axle Total Truck (% of AADT) (BY)**
1	YOL	0.00/3.16	3.16	7,093	4.0%	3,120	1.8%
2	SAC	L0.00/L2.48(R0.00)	2.48	6,012	2.4%	2,515	1.0%
3		R0.00/R5.34	5.34	8,060	3.9%	2,137	1.0%
4		R5.34/R10.92	5.58	7,709	4.5%	1,964	1.1%
5		R10.92/12.50	1.58	7,811	5.5%	2,120	1.5%
6		12.50/17.01	4.51	7,488	6.4%	3,295	2.8%
7		17.01/23.14	6.13	5,824	6.4%	2,399	2.6%
8	ED	0.00/0.86	0.86	5,824	6.4%	2,399	2.6%
9		0.86/R3.23	2.37	4,200	6.0%	1,730	2.5%
10		R3.23/6.57	3.34	3,660	6.0%	1,508	2.5%
11		6.57/R8.56	1.99	3,660	6.0%	1,508	2.5%
12		R8.56/R15.06	6.5	3,120	6.0%	1,289	2.5%
13		R15.06/17.25	2.19	2,970	6.0%	1,227	2.5%
14		17.25/18.11	0.86	3,120	6.0%	1,376	2.6%
15		18.11/R25.95	7.84	1,860	6.2%	837	2.8%
16		R25.95/R31.97	6.02	1,393	7.0%	641	3.2%
17		R31.97/39.77	7.64	800	6.3%	384	3.0%
18		39.77/66.63	26.64	537	4.1%	200	1.5%
19		66.63/70.62	3.99	338	3.1%	141	1.3%
20		70.62/75.45	4.83	760	4.0%	228	1.2%
21		75.45/80.44	4.99	1,320	4.0%	139	0.4%

TABLE 15: US 50 PEAK HOUR TRAFFIC DATA

Seg. #	County	Post Miles	Volume			Directional Split			Volume/Capacity (V/C)			VMT		
			BY	No Build (HY)	Build (HY)	BY	No Build (HY)	Build (HY)	BY	No Build (HY)	Build (HY)	BY	No Build (HY)	Build (HY)
1	YOL	0.00/3.16	14,900	17,400	17,800	55%	52%	53%	0.93	1.02	1.06	25,041	29,300	29,800
2	SAC	L0.00/L2.48 (R0.00)	20,500	23,300	25,000	54%	52%	53%	1.14	1.26	1.37	33,921	38,500	41,400
3	SAC	R0.00/R5.34	20,100	24,300	25,900	56%	54%	52%	1.16	1.36	1.29	70,378	85,000	90,600
4	SAC	R5.34/R10.92	16,600	21,900	22,700	56%	54%	53%	1.05	1.21	1.25	75,883	100,300	103,900
5	SAC	R10.92/12.50	13,000	18,100	18,800	64%	58%	58%	0.89	1.06	1.01	15,716	21,900	22,700
6	SAC	12.50/17.01	11,300	15,400	15,500	64%	60%	60%	1.02	1.26	1.09	48,560	66,300	66,600
7	SAC	17.01/23.14	8,600	10,600	12,500	65%	63%	63%	1.04	1.27	1.33	39,119	48,400	56,900
8	ED	0.00/0.86	8,600	9,500	10,400	65%	66%	66%	1.08	1.24	1.14	6,640	7,310	8,070
9	ED	0.86/R3.23	7,000	9,400	10,500	65%	66%	66%	0.95	1.22	1.16	12,120	16,220	18,110
10	ED	R3.23/6.57	5,700	8,100	7,800	65%	66%	66%	0.75	1.02	0.74	17,060	24,130	23,440
11	ED	6.57/R8.56	5,600	6,700	7,100	65%	62%	64%	0.86	0.98	0.83	12,420	14,800	15,740
12	ED	R8.56/R15.06	4,150	5,300	5,700	65%	62%	64%	0.63	0.77	0.62	22,100	28,480	30,230
13	ED	R15.06/17.25	4,600	5,400	6,300	65%	63%	63%	0.73	0.84	0.96	9,750	11,500	13,200
14	ED	17.25/18.11	4,650	5,300	5,200	63%	60%	62%	0.00	0.00	0.00	3,535	4,000	4,000
15	ED	18.11/R25.95	3,250	3,800	3,800	63%	63%	65%	0.54	0.59	0.59	20,747	24,400	24,500
16	ED	R25.95/R31.97	2,650	3,310	3,320	67%	61%	63%	0.47	0.54	0.56	15,490	19,360	19,380
17	ED	R31.97/39.77	2,150	2,690	2,690	67%	63%	63%	0.41	0.47	0.48	16,450	20,560	20,580
18	ED	39.77/66.63	1,900	2,380	2,380	67%	61%	63%	0.88	1.00	1.03	51,030	63,790	63,840
19	ED	66.63/70.62	1,550	1,940	1,940	67%	61%	63%	0.71	0.81	0.84	5,820	7,280	7,280
20	ED	70.62/75.45	2,400	3,000	3,000	61%	55%	57%	0.99	1.13	1.17	9,260	11,580	11,590
21	ED	75.45/80.44	3,850	5,010	5,010	54%	50%	51%	0.66	0.80	0.80	15,910	20,680	20,700

BOTTLENECK AND CONGESTION ANALYSIS

The 2010 Highway Capacity Manual defines a bottleneck as "a road element on which demand exceeds capacity."

The bottleneck analysis evaluates specific causes of existing recurrent traffic congestion in the corridor. Freeway bottleneck locations that create mobility constraints are identified and documented, and their relative contribution to corridor-wide congestion is reported. The bottleneck locations were determined based on a combination of the use of 2012 PeMS data, probe vehicle tach runs, and field observations. This analysis was only performed for the CSMP portion of the facility.

Traffic congestion can be categorized as either recurrent or non-recurrent.

Recurrent congestion occurs repeatedly at the same place and time of day in a predictable pattern. Recurrent congestion is often associated with facility capacity limitations, changes in capacity, conflicting vehicle movements such as lane merges, inadequate number of transit vehicles to handle passenger loads, or other persistent physical conditions of the transportation facility.

Non-recurrent congestion is usually attributed to collisions, equipment malfunction, community events, weather, construction projects and other occasional occurrences. When transportation systems are close to their maximum carrying capacity, non-recurrent congestion is more likely to occur as there is little excess capacity in the system.

Prior to analyzing the congestion and bottlenecks located within the corridor, a review of the District 3 *2012 Mobility Performance Report* (MPR) was conducted. The MPR is prepared by each Caltrans District where PeMS is utilized. Headquarters Traffic Operations Division requests and compiles these District reports annually and quarterly. The freeway congestion data is identified by freeway route and county but does not contain specific CSMP segment data. This data, which lists Vehicle Hours of Delay at 60 MPH, provides an overall perspective of the level of congestion for each route, which can be compared to prior year data so that performance can be monitored. The data presented in the MPR also identifies the top ten bottlenecks during the AM Peak Period and PM Peak Period by freeway route and county and identifies Total and Average Vehicle Hours of Delay and the Average Duration, which again can be compared to prior year data for performance monitoring purposes. The MPR data is useful in providing an overall perspective of the performance of the freeway at the county level that can be compared to the CSMP corridor segment-specific performance data. US 50 in Sacramento and El Dorado Counties is included in the District 3 MPR's top ten congested freeways and bottleneck locations. The ranking of the US 50 corridor is listed as follows:

Traffic Congestion:

- **Vehicle Hours of Delay (VHD):** Total VHD at 60 miles per hour in both directions increased in 2012 over 2011 in both Counties applicable to the CSMP corridor. The results are as follows:

Route	County	2011	2012
US 50	SAC	1,121,970 VHD	1,294,019 VHD
	ELD	247,159 VHD	254,511 VHD

- **Top 10 Congested Freeways:** Based on the VHD of all District 3 Freeway urban corridors in the Sacramento area, the congestion comparison of US 50 for 2011 and 2012 was ranked with the other corridors. As identified below, the US 50 corridor is becoming slightly more congested relative to other freeways in the District.

Route	County	2011 Rank	2012Rank
US 50	SAC	3	2
	ELD	8	8

- **Top Bottleneck Locations:** The bottleneck comparisons of US 50 for 2011 when available and 2012 by locations and rankings listed below can change from year to year, and may be indicative of temporary bottlenecks (i.e. short-term construction activities or special events) rather than major geometric constraints that require major operational strategies or capital expansion. Rankings are in comparison to all state highways in the greater Sacramento area of District 3 during both the AM peak and PM peak time periods and by direction. As identified below, US 50 captures several bottlenecks in the District top ten worst bottlenecks. These bottlenecks come in two main groups. The first and more severe group is between I-5 and SR 99 downtown, where several highways converge. The second group is near Howe Ave, close to Sacramento State and a bridge across the American River.

County	Route	Location	Time of Day	2011 Av. Daily VHD	2012 Av. Daily VHD	2011Av. Duration (min)	2012 Av. Duration (min)	2011 Rank	2012 Rank
Eastbound									
SAC	50	16^{th} St.	PM	75	141	64	122	21	6
Westbound									
SAC	50	Occidental Dr.	AM	8	145	3	54	N/A	5
SAC	50	NB Howe Ave.	AM	55	126	18	49	5	8
SAC	50	15^{th} St.	PM	118	285	32	59	13	5

Along with the MPR information, additional PeMS data was complied and analyzed so that congestion and bottleneck locations on the individual route segments within the CSMP corridor could be further refined and causality defined.

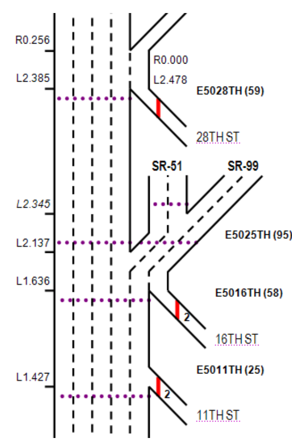
It should be noted that while both the MPR data and the data collected by District 3 Travel Forecasting and Modeling utilized PeMS, the data was collected for different time periods, and duration and delay thresholds between the two data sets vary. As such, while both data sets are generally consistent with each other, there may be some variation. Further work is being conducted to refine the identification and causality of bottlenecks within the corridor.

Table 16 shows a summary of the US 50 eastbound and westbound bottlenecks, while the analysis that follow the table discuss each bottleneck, including location and possible causality. Minor or hidden bottlenecks are those that are not as defined (or severe) as the major bottlenecks. Bottlenecks in the chart are listed in order of probability of formation. Please note that the graphics accompanying the bottlenecks are not to scale.

Bottlenecks in the eastbound direction during the PM peak period are at 16th St., 48th St., Folsom Blvd., 28th St., Howe/Power Inn, west of Scott Rd., and Sunrise Blvd. In the AM peak the sole bottleneck is at 16th St. Bottlenecks in the westbound direction during the PM peak period are at 25th St., 15th St., Stockton Blvd., and 59th St. In the AM peak the bottlenecks are at Watt Ave., Occidental Dr., El Dorado Hills Blvd., and Howe Ave.

Causalities for these bottlenecks range from high-traffic demand (congestion), heavy weaving/merging areas, or physical constraints such as lane drops, lack of ramp meters, incomplete HOV network, incomplete auxiliary lane network, poorly coordinated traffic signals and an off-ramp queue (Sunrise Blvd.).

TABLE 16: US 50 BOTTLENECK ANALYSIS DATA								
Seg. #	**Location**	**County**	**Time of Day**	**Post Miles**	**Probability of Bottleneck Forming**	**Avg Queue Length (Miles)**	**Avg Delay (Veh Hrs)**	**Avg Duration (Minutes)**
Eastbound								
2	16th St.	SAC	PM	L1.567	97.4%	0.45	141	122
2	16th St.		AM	L1.567	46.8%	0.49	63	51
2	28th St		PM	L2.394	50.6%	1.52	283	58
3	48th St.		PM	R1.453	71.8%	1.11	193	79
3	NB Howe/Power Inn		PM	R3.88	41.7%	0.72	74	56
5	SB Sunrise Blvd.		PM	12.4	21.8%	0.89	57	45
6	Folsom Blvd.		PM	16.901	53.8%	1.72	93	54
7	West of Scott Rd.		PM	20.7	23.7%	1.95	93	54
Westbound								
8	El Dorado Hills	ELD	AM	0.5	30.1%	0.95	54	46
4	NB Watt Ave.	SAC	AM	R5.4	39.1%	1.14	71	36
3	Occidental Dr.		AM	R4.5	34.0%	1.31	145	54
3	NB Howe Ave.		AM	R3.8	24.4%	1.46	126	49
3	Stockton Blvd		PM	R.595	54.5%	1.26	129	43
3	59th St.		PM	R1.9	48.1%	1.52	156	52
2	25th St.		PM	L2.166	80.1%	1.05	108	53
2	15th St.		PM	L1.351	64.7%	2.25	285	59

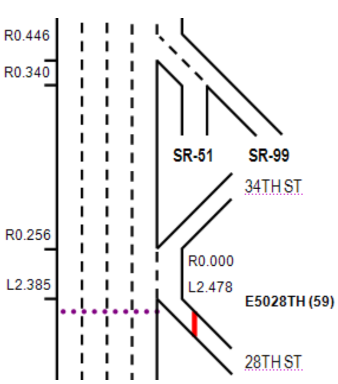


Eastbound Bottleneck Analysis

A. 16th St. Bottleneck (Both AM and PM)

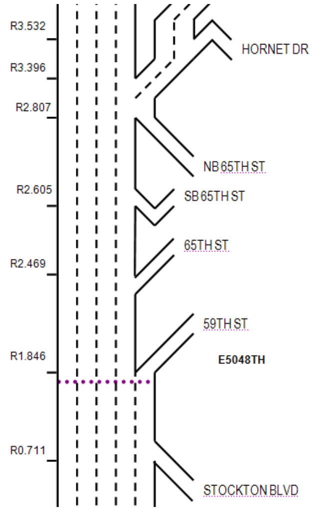
The bottleneck at 16th St. is caused by heavy volume of merging traffic, which causes weaving between vehicles merging onto US 50 and diverging vehicles for the SR 51 and SR 99 connectors. Merging traffic from the on-ramps has to cross 2+ lanes of traffic and diverge directly across diverging vehicles for SR 51 and SR 99 connectors. The combination of heavy volumes and diverging traffic approaching the SR 51 and SR 99 connectors creates bottlenecks that are exacerbated during peak hours.

B. 16th St. (See A Above)



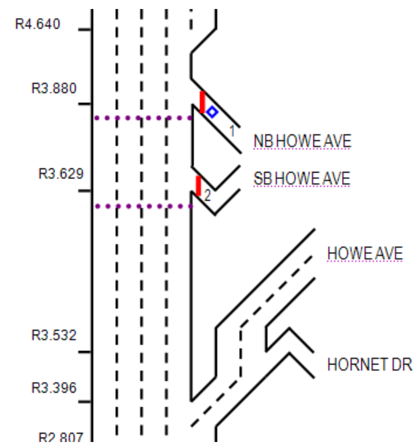
C. 28th St. Bottleneck

The bottleneck at 28th St. is caused by heavy demand, the downstream lane drop, as well as diverging traffic at the 28th St. on-ramp. Past the on-ramp, there is a slight uphill grade and horizontal curve that contributes to the formation of a bottleneck.



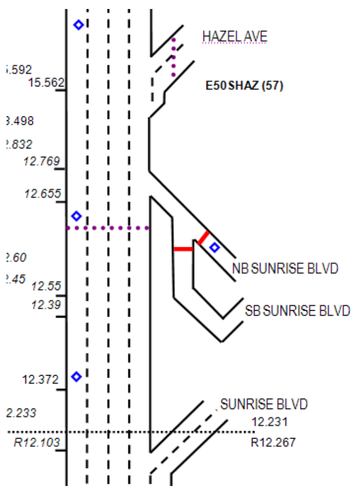
D. 48th St. Bottleneck

The bottleneck approximately located at 48th St. is due to the additional traffic merging from SR 51 and SR 99, combined with a lane drop at 59th St. This queue extends upstream past the off-ramp to SR 51 and SR 99. These off-ramps are bottlenecks in themselves, which spill back and choke the US 50 mainline.



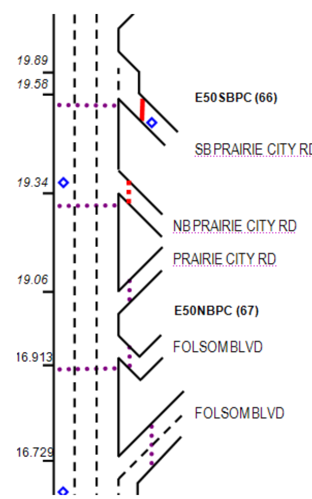
E. Howe/Power Inn

The bottleneck at Howe Ave. is due to the entering traffic from Howe Ave. Two Howe Ave. on-ramps feed into US 50 eastbound: southbound Howe Ave. loop on-ramp and northbound Howe Ave. direct ramp, approximately 300 feet apart. The Watt Ave. off-ramp is just downstream with heavy existing volumes; therefore the segment between Howe and Watt is characterized by heavy weaving.



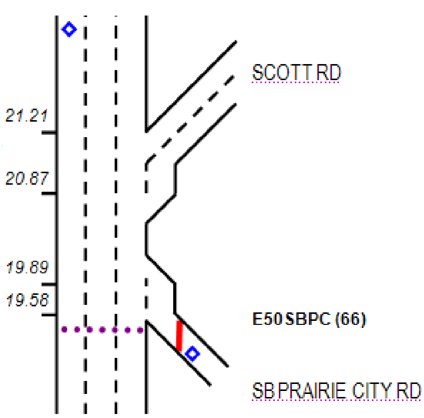
F. Sunrise Blvd Bottleneck

At Sunrise Blvd., the right-most lane exits, and high volumes of automobiles enter the facility from the large employment centers in Rancho Cordova. As a result, there is a large volume of vehicles queued at Sunrise off-ramp which spills back and negatively affects the US 50 mainline.



G. Folsom Blvd

The right-most lane exits to Folsom Blvd., leaving one HOV lane and two regular lanes along the US 50. The bottleneck is caused by this lane drop as well as the quick merge at the Folsom on-ramp.



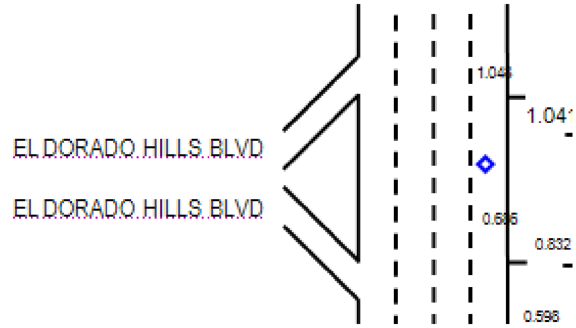
H. West of Scott Road Bottleneck

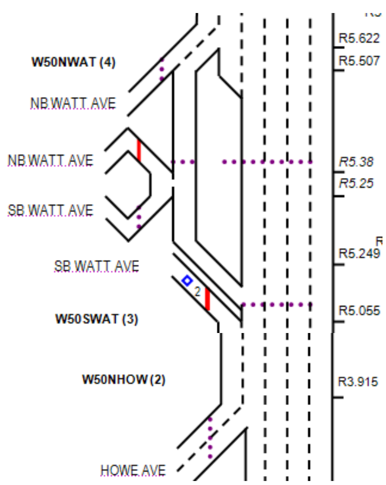
The bottleneck at Scotts Rd. is due to heavy demand and merging traffic from both southbound and northbound Prairie City on-ramps.

Westbound Bottleneck Analysis

A. El Dorado Hills Blvd Bottleneck

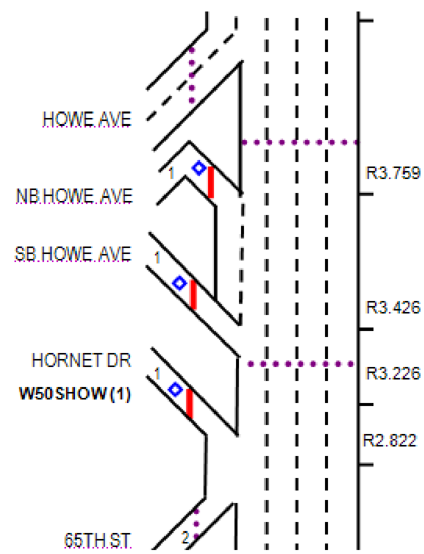
The bottleneck at El Dorado Hills Blvd is caused by heavy demand on El Dorado Hills Blvd. and traffic from El Dorado Hills Blvd. merging with existing westbound US 50 traffic.





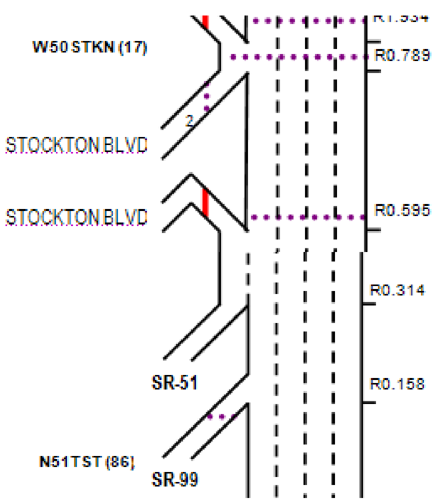
B. Occidental Dr. Bottleneck/Watt Ave. Bottleneck

The bottleneck at Watt Ave. is due to the lane drop at the Watt Ave. exit and merging traffic from the Watt Ave. on-ramp, which conflict with traffic on US 50. The auxiliary lane stretches all the way to the Howe Ave. exit. Last second weaving from vehicles merging along the auxiliary lane, before the Howe Ave. exit, creates a spill back effect on US 50 and contributes to the sections bottleneck.



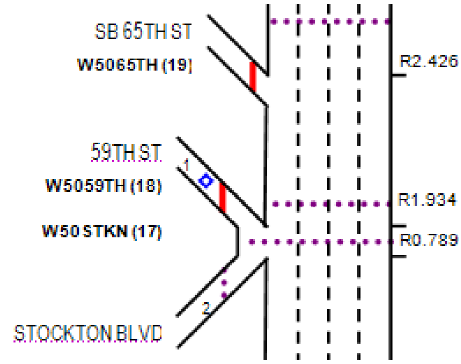
C. Howe Ave Bottleneck

The Howe Ave. bottleneck is caused by a grade change and the merging traffic entering from northbound and southbound Howe Ave. on-ramps and Hornet D.r on-ramp.



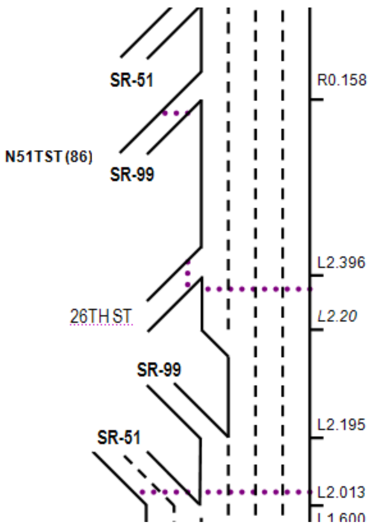
D. Stockton Blvd Bottleneck

Bottleneck at Stockton Blvd. is due to vehicles merging onto US 50 and diverging to SR 99 and SR 51 along the same auxiliary lane. High volume of weaving between entering and exiting vehicles on US 50 increases the likelihood of bottlenecks in this segment is increased during peak hours.



E. 59th St. Bottleneck

Vehicles merging onto US 50 from the 59th St. on-ramp, conflict with traffic on US 50 and weaving at the two most right lanes create a bottleneck. This bottleneck is exacerbated and/or worse from the spill back effect of the Stockton Blvd. bottleneck.

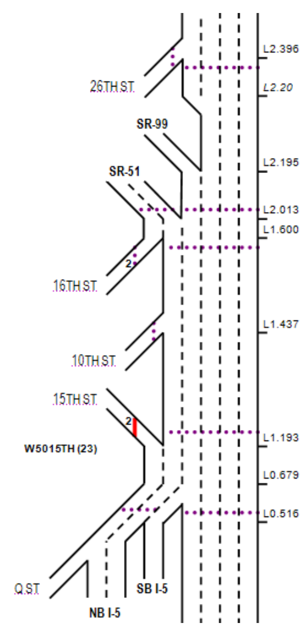


F. 25th St. Bottleneck

The bottleneck approximately at 25th St. is due to a lane drop and merging traffic from SR 99 and SR 51 connectors onto US 50. Vehicles on US 50 experience a slight horizontal curve and a lane drop approaching the SR 99 connector. A small stretch of US 50 is reduced to three lanes, but is widened back to four lanes after the SR 99 interchange. The high volume of weaving and diverging traffic, along with the downstream lane drop and slight horizontal curve, contribute to the overall sections bottleneck.

G. 15th St. Bottleneck

The bottleneck approximately at I-5 is caused by a conflict between entering SR 99 and SR 51 traffic and exiting I-5 traffic as well as the queues formed on the ramps to I-5, which spill back onto US 50. The number of lanes in this section reaches a maximum of 6 and then drops to 4 as two lanes exit at the I-5 freeway. This bottleneck is exacerbated during the peak periods when it stretches upstream to the lane drop before SR 99.



KEY CORRIDOR ISSUES

A number of significant issues provide challenges for the segments of US 50 discussed in this document, including the complicated physical, environmental, and commercial setting of the highway.

Roadway configuration is a critical issue for transportation on US 50. Lanes drop off at some specific locations, causing a bottleneck to be activated at times. Further, there is an incomplete set of auxiliary lanes on the facility, causing operational problems at those locations. Constructing auxiliary lanes would allow easier merging onto and exiting from the facility. Further the system of HOV lanes needs to be expanded to include the entire Sacramento urban area. The HOV lanes begin at Watt Ave. and run until the Cameron Park Area. Constructing HOV lanes in downtown Sacramento and West Sacramento would significantly improve traffic flow and reduce congestion.

Improvements to ITS on US 50 could also greatly improve traffic flow. Implementing ramp metering on all appropriate onramps would greatly increase throughput on the facility by reducing platooning and resulting bottlenecks. Another ITS implementation strategy is signal coordination on key arterials and freeway ramp intersections. Other ITS implementation strategies are forthcoming in the District 3 *ITS/Operational Improvement Plan* (ITS/Ops Plan).

Transit improvements have also been identified for the corridor to improve traffic. To increase transit ridership, more funding is necessary for capital and operations on expanded lines and enhanced service. For example, double tracking of the light rail Gold Line to Folsom is necessary to decrease headways at stations east of the Sunrise Blvd. station. At-grade rail crossings, in downtown Sacramento and along Folsom Blvd. going east, cause delay to motorists, bicyclists, and pedestrians. Coordination between local and regional agencies will be critical in making service improvements to transit along the corridor.

There are also deficiencies in the bicycle and pedestrian facilities on the corridor. Pavement deficiencies, maintenance issues, and gaps and barriers within the bicycle route network make active transportation modes less attractive to travelers and contribute to higher automobile usage. Keeping bicycle facilities in usable order will require the close cooperation of local agencies along the corridor. Bicyclist-activated signal change devices will also greatly improve transportation on the corridor. Finally, coordination between transit operators and bicyclists can make great improvements on transit access and bicycle storage to promote increased alternative transportation.

Recreational traffic is an important issue in US 50 transportation. This traffic is highly directional and heavily concentrated in certain times of year (ski season and summer recreation season). Traffic on this route is concentrated on weekends, particularly Fridays and Saturday mornings to Lake Tahoe and Sunday afternoons from Lake Tahoe, during the ski season and during the summer, and to the Apple Hill area during fall. Because of the difficulty of planning for these conditions, the El Dorado County Transportation Commission (EDCTC) applied for and received grants from the State to study the impact of tourism on travel and mobility issues associated with agritourism. The *Bay to Tahoe Basin Recreation and Tourism Travel Impact Study* is currently in development and will provide important information and recommendations regarding recreational travel within this corridor, covering several counties and transportation facilities and the *Sustainable Agritourism Mobility Study* will begin developing recommendations regarding agritourism mobility in the corridor in winter 2015.

Additionally, EDCTC has identified operational issues between the Smith Flat interchange and east of the Upper Carson Road/Camino intersection in the *Camino Area Parallel Capacity/Safety Study*. Transportation issues include at-grade access to US 50, left turn conflicts across US 50, increasing average daily local and interregional traffic, growth in the area, lack of alternate routes, seasonal traffic to and from Apple Hill and other local events, and seasonal access to recreation in the Lake Tahoe Region. These operational issues were further explored in a PSR-PDS that EDCTC completed in December 2009.

Large rock slides have required closure of US 50 and the need for a detour for traffic crossing the Sierra. Caltrans has partnered with El Dorado County and the Eldorado National Forest to detour traffic at the US 50/Sly Park Road turn-off which connects with Mormon Emigrant Trail, which connects with SR 88.

Climate also is an issue that the US 50 corridor must confront. During most of the year, the weather is warm and travel to Lake Tahoe is unimpeded. During the winter, access to much of the facility is restricted to vehicles with four-wheel drive or chains, and chain control locations are conveniently located throughout the corridor. This chain requirement, the inclement weather, and use of traction material on the road have a detrimental impact on the road pavement, which deteriorates more rapidly than other facilities' pavements. Special attention must be paid to ensure that US 50 is maintained in good condition. In addition, snow removal in the area is not provided on bicycle facilities during the winter months.

Another key corridor issue is the lack of right of way for modification or enhancement of the facility in some locations. The urban facility from West Sacramento to Folsom is surrounded by urban development, and expansion would be prohibitively expensive. From Folsom until Placerville there is room to expand US 50 to accommodate new development in western El Dorado County, but careful corridor planning is essential in preserving ROW for future lane expansion. Through most of the Eldorado National Forest US 50 is a two-lane conventional highway, with protected forest, steep cliffs, or mountainside, thus making modification considerably more difficult. In developed areas, such as South Lake Tahoe, the facility serves built out areas, and modifying the facility would be prohibitively costly. There is some ability to expand capacity in Camino and Pollock Pines. In planning for future facility improvements coordination with local agencies will prove vital.

Bus/Carpool Lane Degradation

A recent report, the *2011 California HOV Lane Degradation Determination Report*, determined that US 50 bus/carpool lanes are degraded in the eastbound evening and the westbound morning periods. According to federal law, a bus/carpool lane is degraded when during the peak morning or evening period the average speed drops below 45 mph for at least 10% of the time in a 180-day period. The degraded segments are from Sunrise Blvd. (PM 12.5) to halfway between Hazel Av. and Folsom Blvd. (PM 16.311) in both directions. The segments are listed as slightly degraded, 14.5% of the time degraded for eastbound evening and 18.3% of the time degraded for westbound morning. This pattern roughly reflects commuting patterns to and from downtown Sacramento and Rancho Cordova employment opportunities. Because this report uses data from before the opening of the bus/carpool lanes from Watt Ave. to Sunrise Blvd. in 2012, the conditions may have changed on the ground.

As a result of this report and the degraded bus/carpool lane conditions, Caltrans must take action to improve bus/carpool lane performance. According to the federal transportation law, Moving Ahead for Progress in the 21st Century Act (MAP 21), Caltrans must enact measures to improve bus/carpool lane performance within 180 days of the determination of degradation, or Caltrans must otherwise face sanctions of withheld funds or withheld project approval.

CORRIDOR CONCEPT FACILITY

Concept Rationale

"Concept LOS" and *"Concept Facility"* have traditionally been used in Caltrans TCRs and CSMPs to reflect the minimum level or quality of operations acceptable for each route segment and the highway facility needed in

the next 20 years and beyond. The "*Base Year", "No Build", "Build",* and *"Concept"* LOS for US 50 are identified in Table 13 by segment. The *Concept* LOS is LOS D in rural areas and LOS E in urban areas. The *"20-Year Build Facility"* and *"Ultimate Facility Concept"* for US 50 are shown above in Table 6. The *20-Year Build Facility* includes all projects expected to be completed within the 20-year horizon (2031), while the *Ultimate Facility Concept* includes all projects with an expected completion year beyond the 20-year horizon. Projects have been identified below as *Projects and Strategies*.

Over one-half of US 50 segments are forecasted to operate under LOS "F" conditions in 20 years under the *"No Build," "Build,"* and *"Concept"* scenarios. The No-Build scenario is the current facility with future traffic volumes. The Build scenario is the current facility plus planned and programmed SHS projects with future traffic volumes. The *Ultimate Facility Concept* is the facility needed to meet District performance standards for a particular segment. Many segments within the US 50 TCR/CSMP cannot be improved to perform at the District standard of E for urban areas due to financial, environmental, right of way, or political constraints. For these segments, targeted operational improvements, Intelligent Transportation Systems (ITS), and Integrated Corridor Management (ICM) including Transportation Demand Management (TDM) and active multimodal corridor management strategies will be needed to assist in achieving the Concept LOS, which are reflected in the programmed, planned, and conceptual project lists located in Tables 18 through 22. Planning and deployment of ITS and operational improvements within District 3 will be articulated in the *District 3 ITS/Operational Improvement Plan* and the *District 3 Concept of Operations Plan*, both in development.

Additionally, measures to reduce travel demand on the highway such as increased use of transit and development of parallel local road facilities may be explored as a means to prevent further LOS threshold degradation on the SHS and will be considered in the CEQA development process, provided that the reduction is quantified to the satisfaction of Caltrans. Moreover, the District *3 Complete Streets Implementation Plan* as described previously in this document, and the *District 3 State Highway Bicycle Facility Plan* identify locations for construction of pedestrian and bicycle facilities that will further reduce local vehicular trips on state highway facilities.

PROJECTS AND STRATEGIES

Projects and strategies to achieve the LOS and facility concept have two categories of funding status: fiscally constrained and fiscally unconstrained.

Fiscally constrained projects and strategies are projects that can be implemented using committed, available, or reasonably available revenue sources.[1]

Fiscally unconstrained projects and strategies are conceptual transportation improvements without an identified funding source and may be funded if reasonable additional resources become available.[2]

In addition to the funding status categories, there are three types of transportation improvements or actions: programmed, planned, and conceptual. Projects and strategies to achieve facility concept are grouped into (1) highway planned and programmed projects and strategies, (2) highway conceptual projects and strategies, and (3) off-highway corridor projects.

Planned and Programmed Projects and Strategies

A ***programmed improvement or action*** is a project listed in a near-term programming document identifying funding amounts by year, such as the State Transportation Improvement Program (STIP) or the State Highway Operations and Protection Program (SHOPP).

A ***planned improvement or action*** is a project listed in a fiscally constrained section of a long-term plan, such as an approved Regional or Metropolitan Transportation Plan (RTP or MTP), Capital Improvement Plan, or measure, including SHOPP plan projects.

Conceptual Projects and Strategies

Conceptual improvement or action is a project that is needed to maintain mobility or serve multimodal users, but is not currently included in a fiscally constrained plan and is not currently programmed. Conceptual projects are all fiscally unconstrained projects derived from documents such as local and regional General Plans, and Caltrans System Planning Documents.

Highway planned and programmed projects along the US 50 corridor are listed in Table 17, highway conceptual projects along the corridor are listed in Table 18, and off-highway corridor projects are listed in Tables 19 through 21.

To improve the bus/carpool lane segments with degraded performance, several projects have been proposed and are listed in this CSMP. Chief among these projects is the extension of bus/carpool lanes from Watt Ave. to the Oak Park Interchange, which will improve traffic flow on the entire facility. Several traffic operations projects will also improve the performance of the bus/carpool lanes. These projects include an auxiliary lane from Zinfandel Dr. to Sunrise Blvd., ramp metering, and a transition lane between the slip-on and off-ramps at Sunrise Blvd. Transit projects, such as shuttle service to light rail stations in Rancho Cordova, and bus stop and light rail station enhancements, will make transit a more attractive alternative to freeway travel. Finally, numerous bicycle and pedestrian improvements are planned for the corridor, creating a further alternative to travel on US 50. In the mean time, before these projects are built, increased enforcement by the California Highway Patrol (CHP) of minimum bus/carpool lane occupancies and more rapid Freeway Service Patrol response will yield improved bus/carpool lane performance. Further information on these actions can be found in the *2013 California High Occupancy Vehicle Lane Degradation Action Plan*.

TABLE 17: HIGHWAY PLANNED AND PROGRAMMED PROJECTS AND STRATEGIES							
Seg. #	**Description**	**Programmed or Planned[1)]**	**Location, County, Lead Agency, Post Mile**	**Purpose**	**Source[2)]**	**Total Cost Estimate (x $1,000)[3)]**	**Completion Year[3)]**
1	IC improvements	Programmed	Jefferson Blvd. YOL PM 2.495	System Management	2035 SACOG MTP/MTIP	26,450	2022
1	Install ramp meters; modify ramp design	Programmed	South River Rd. YOL PM 2.926	System Management	2035 SACOG MTP/MTIP	22,625	2020
1	Install Weigh-In-Motion (WIM) Station on SR 50 and I-80 Ramp	Planned	I-80 Junction. YOL PM 0.00	Weigh Stations and Weigh-in-Motion Stations	2014 SHOPP	2,000	2020
1-6; 20-21	Upgrade closed caption televisions (CCTV)	Programmed	80 locations in urban areas. Various PM.	Modify existing ITS elements	2014 SHOPP	2,640	2020
2	IC reconstruction including Bus/Carpool connectors	Planned	Oak Park IC. SAC PM L2.137	System Expansion	2035 SACOG MTP	300,000	2035
2/3/ 4	Construct Bus/Carpool lanes	Partially Programmed	Watt Ave. to Downtown Sacramento. SAC PM L0.00- R5.37	Priority Congestion Relief,System Expansion	2035 SACOG MTP	68,315	2020
3	Replace existing communication lines with fiber optics to improve performance	Planned	SR 99 and 51 to Watt Ave. SAC PM L0.00-R5.37	Modify existing ITS elements	2013 10 Year SHOPP Plan	952	2023
3-7	Upgrade Comm systems	Programmed	178 locations in urban areas. Various PM, routes and counties.	Modify existing ITS elements	2014 SHOPP	4600	2019
4	Construct aux lanes	Planned	NB Howe Ave. on ramp to SB Howe Ave. on ramp. SAC PM R3.68	Priority Congestion Relief,System Management	2035 SACOG MTP	3,746	2020
4	Construct aux lanes	Planned	Bradshaw Rd. overcrossing to Mather Field Rd. overcrossing. SAC PM R7.8-R9.5	Priority Congestion Relief,System Management	2035 SACOG MTP	3,700	2020
4	IC modification	Planned	Mather Field Rd. SAC PM R9.505	Interchange Modification	2035 SACOG MTP	5,647	2025
5	Bike/Ped OC of US 50 to connect Olson Dr to Prospect Dr	Planned	Olson Dr. to Prospect Park Dr. SAC PM R11.30	System Management	2035 SACOG MTP	8,500	2035
5	Construct aux lanes EB & WB	Planned	Sunrise Blvd. to Zinfandel Dr. SAC PM R10.92-12.5	System Management	2035 SACOG MTP	6,844	2035

TABLE 17: HIGHWAY PLANNED AND PROGRAMMED PROJECTS AND STRATEGIES							
Seg. #	**Description**	**Programmed or Planned[1)]**	**Location, County, Lead Agency, Post Mile**	**Purpose**	**Source[2)]**	**Total Cost Estimate (x $1,000)[3)]**	**Completion Year[3)]**
5/6	Construct transition lane WB	Planned	Sunrise Blvd. slip off ramp to Sunrise Blvd. slip on ramp. SAC PM 12.5	Priority Congestion Relief,System Management	2035 SACOG MTP	4,107	2035
6	Upgrade video wall at Regional Transportation Management Center (RTMC)	Planned	RTMC east of Sunrise Blvd. SAC PM 12.96	Modify existing ITS elements	2013 10 Year SHOPP Plan	2,000	2023
6	Multi-modal corridor improvements & IC improvements	Programmed	Hazel Ave. SAC PM 15.76	System Management	2035 SACOG MTP	85,000	2020
6/7	Natoma Overhead: widen EB US 50 and add HOV lane at on ramp, add ramp meter	Programmed	Folsom Blvd. and Natomas Overcrossing. SAC PM 16.90-17.40	Priority Congestion Relief,System Management	2013 10 Year SHOPP Plan	6,821	2015
6/7	Add aux lanes EB	Planned	Sunrise Blvd. to Scott Rd. SAC PM 12.5-21.5	System Management	2013 DSMDP	3,500	2025
6/7	Construct new IC at US 50/Rancho Cordova Pkwy. including aux lanes on US 50 btwn Hazel Ave. & Sunrise Blvd. and 4 lane arterial connection to US 50 off Rancho Cordova Pkwy. to White Rock Rd.	Partially Programmed	Rancho Cordova Pkwy. SAC PM 12.5-15.76	System Expansion	2035 SACOG MTP	100,000	2020
7	Construct new 4 lane IC	Programmed	Empire Ranch Rd. SAC PM 23	System Management	2035 SACOG MTP	38,552	2035
7	Construct new 4 lane IC	Planned	Oak Ave Pkwy. SAC PM 20.3	System Management	2035 SACOG MTP	84,646	2035
7	Ramp modifications & overpass widening	Planned	East Bidwell St./Scott Rd. IC. SAC PM 21.5	System Management	2035 SACOG MTP	3,740	2020
9	IC Phase 1	Programmed	Silva Valley Pkwy. IC ELD PM R1.65	System Management	2035 SACOG MTP/MTIP	52,375	2016
8	Construct Auxiliary Lanes - WB	Planned	WB, El Dorado Hills Blvd./Latrobe Rd. to future Empire Ranch Rd. IC. ELD PM 0.00-0.86	Priority Congestion Relief,System Management	2035 SACOG MTP	3,688	2035

TABLE 17: HIGHWAY PLANNED AND PROGRAMMED PROJECTS AND STRATEGIES							
Seg. #	Description	Programmed or Planned1)	Location, County, Lead Agency, Post Mile	Purpose	Source2)	Total Cost Estimate (x $1,000)3)	Completion Year3)
8	IC Improvements-EB Ramps	Planned	El Dorado Hills Blvd. ELD PM 0.86	System Management	2035 SACOG MTP/MTIP	5,904	2035
9	Construct Class 1 Ped/Bike overcrossing, El Dorado Hills Blvd	Programmed	El Dorado Hills Blvd. Area. ELD PM 1.183	System Management	2035 SACOG MTP/MTIP	6,783	2028
9	IC Improvements Ph 1, WB auxillary lane between Silva Valley Rd & Bass Lake Rd.	Planned	Bass Lake Rd. IC. ELD PM R1.65-R3.23	System Management	2035 SACOG MTP	20,829	2035
9	IC Phase 2	Planned	Silva Valley Parkway IC. ELD PM R1.65	System Management	2035 SACOG MTP	14,200	2035
10	Construct Aux. Lanes - WB	Planned	Bass Lake Rd. to Cambridge Rd. ELD PM R3.23-4.962	System Management	2035 SACOG MTP	23,640	2035
10	Construct Auxiliary Lanes - EB	Planned	Cambridge Rd. to Cameron Park ICs, WB Cameron Park to Bass Lake Rd. Ics. ELD PM R3.23-6.57	System Management	2035 SACOG MTP	15,500	2035
10	IC Improvements-Ph 1, EB/WB Ramps	Planned	Cambridge Rd IC. ELD PM 4.962	System Management	2035 SACOG MTP	10,645	2035
10-12	Construct Aux. Lanes - EB	Planned	Cambridge Rd. to Ponderosa Rd. ELD PM 4.962-R8.564	System Management	2035 SACOG MTP	14,550	2035
10/11	IC Improvements	Planned	Cameron Park Dr. ELD PM 6.57	System Management	2035 SACOG MTP	58,737	2035
12	IC; Realign WB Offramp with Wild Chaparral Dr and signalize intersection; Realign 0.25 Mile of North Shingle Rd at Ponderosa Rd	Programmed	Ponderosa Rd IC/ North Shingle Rd. ELD PM R8.564	System Management	2035 SACOG MTP/MTIP	5,020	2024
12	Bus/Carpool Lanes (Phase 3)	Planned	Ponderosa Rd. to Greenstone Rd. ELD PM R8.56-R12.19	System Expansion	2035 SACOG MTP	34,730	2035
12	Durock Rd Realignment; signalize new intersection	Planned	Ponderosa Rd. IC/ Durock Rd. ELD PM 8.564	System Management	2035 SACOG MTP/MTIP	7,152	2026
12	IC Improvements	Planned	South Shingle Rd. IC. ELD PM R8.564	System Management	2035 SACOG MTP	23,088	2035

TABLE 17: HIGHWAY PLANNED AND PROGRAMMED PROJECTS AND STRATEGIES							
Seg. #	**Description**	**Programmed or Planned[1)]**	**Location, County, Lead Agency, Post Mile**	**Purpose**	**Source[2)]**	**Total Cost Estimate (x $1,000)[3)]**	**Completion Year[3)]**
12	IC Improvements Ph 1 & 2	Planned	El Dorado Rd. ELD PM 14.011	System Management	2035 SACOG MTP	10,803	2035
13	IC Improvements Ph 2A & Ph 3	Planned	Western Placerville ICs, Ph 2A & Ph 3. ELD PM 15.83-16.503	System Management	2035 SACOG MTP/MTIP	23,374	2030
13	Local Road Improvements Ph 2B & 2C; improvements to Ray Lawyer Dr & Forni Rd	Programmed	Western Placerville ICs, Ph 2B & 2C. ELD PM 15.83-16.503	System Management	2035 SACOG MTP/MTIP	6,748	2018
13	Local Road Improvements Ph 1B-Realign Fair Lane to correct curve & construct Class II Bike Lanes, sidewalks & retaining walls	Programmed	Western Placerville ICs, Ph 1B, ELD PM 16.276	System Management	2035 SACOG MTP/MTIP	1,589	2014
14, 16, 18, 19, 21	Upgrade HAR systems	Planned	25 locations in rural areas. Various PM, routes and counties.	Modify existing ITS elements	2016 SHOPP	2670	2021
15	EB signalization and ramp lengthening	Planned	Broadway. ELD PM 18.517	System Management	2035 SACOG MTP	2,000	2035
15	Construct new IC	Planned	Mosquito Rd. ELD PM 18.52	System Management	2035 SACOG MTP	60,000	2035
15	Construct undercrossing, median barriers, modify local connectors, operational/ safety improvements	Planned	Camino Operational/ Safety Improvements. ELD PM 24.052	System Management	2035 SACOG MTP	33,900	2035
19	Upgrade RWIS systems	Planned	18 locations in rural areas. Various PM, routes and counties.	Modify existing ITS elements	2016 SHOPP	2300	2021
20	Construct roundabout or install signal at junction	Planned	Junction SR 89 in Meyers. ELD PM 70.64	System Management	2035 TMPO RTP	5,000	2020
20	Intersection improvements	Planned	Pioneer Trail in Myers. ELD PM 71.477	System Management	2035 TMPO RTP	2,000	2020
20/ 21	Signal synchronization - Install Adaptive Traffic Signal Control	Planned	19 locations in El Dorado County. Various PM.	System Management	ITS/OPS Project List	1,000	Long
21	Create new Loop Rd	Partially Programmed	Park Ave to Stateline. ELD PM 80.149-80.44	System Management	2035 TMPO RTP	75,000	2017

TABLE 17: HIGHWAY PLANNED AND PROGRAMMED PROJECTS AND STRATEGIES							
Seg. #	Description	Programmed or Planned[1)]	Location, County, Lead Agency, Post Mile	Purpose	Source[2)]	Total Cost Estimate (x $1,000)[3)]	Completion Year[3)]
21	Signal improvements	Planned	SR 89 (the "Y") to Nevada State line. ELD PM 75.456-80.44	Priority Congestion Relief,System Management	2035 TMPO RTP	5,000	2015

1) Programmed include those projects that are partially and fully funded. Definitions of Programmed, Planned, and Conceptual projects can be found in Appendix A.

2) Note, only SHOPP projects that improve Mobility and are Mandated for furthering Complete Streets are included. A complete listing of SHOPP projects can be viewed at http://ctips.dot.ca.gov/citrix/metaframexp/default/reports.asp.

3) Total Cost and Completion Year Estimates are from listed Source. Additional project details and programming information can be found in the District 3 DSMDP at http://www.dot.ca.gov/dist3/departments/planning/systemplanningDSMDP.htm, 2012 SACOG MTP project list at http://www.sacog.org/2035/files/MTP-SCS/appendices/A-1%20Project%20List.pdf, 2012 SACOG MTIP Appendix 3 project list at http://www.sacog.org/mtip/2013-2016/adoption/pdf/2013%20MTIP%20Transmittal%209-26-12.pdf, 2012 TMPO RTP, Chapter 6 project list at http://tahoempo.org/rtp_final/TAHOE%20RTP%2006%20Funding%20and%20Impl.pdf, and CT Programming at http://ctips.dot.ca.gov/citrix/metaframexp/default/reports.asp .

There are several conceptual projects identified in Table 18 below that are proposed for construction on US 50 in the long term, beyond year 2025. These projects consist of HOV lanes, ITS/Operations projects, interchange improvements, and bicycle/pedestrian projects. Because these projects are of an undefined time frame, they are subject to revision.

TABLE 18: HIGHWAY CONCEPTUAL PROJECTS AND STRATEGIES						
Seg. #	Description	Location, County, Lead Agency, Post Mile	Purpose	Source[1)]	Total Cost Estimate (x $1,000)[2)]	Completion Year[2)]
1	Construct HOV lanes (Sections B)	Davis to downtown Sacramento (Sections B & C). YOL PM 0.0-3.156	Construct HOV lanes to relieve congestion	2035 SACOG MTP	(see section A)	2035
2	Construct HOV lanes (Section C)	Davis to downtown Sacramento (Section C). SAC PM L0.36-0.02	Construct HOV lanes to relieve congestion	2035 SACOG MTP	(see section A)	2035
3 - 6	Ramp meter improvements on both directions	Stockton Blvd. to Folsom Blvd. SAC PM 0.6-17.01	Improve facility performance through operational enhancements	ITS/OPS Project List	8,000	2016
12/ 13	Interchange Improvements Ph 2	Missouri Flat Interchange. ELD PM R15.06	Interchange improvements to accommodate local development	2013 DSMDP	20,000	2035
11	Bus/Carpool Lanes (Phase 2B)	Cameron Park Dr. to Ponderosa Rd. IC. ELD PM 6.57-R8.56	System Expansion	2035 SACOG MTP	22,637	2035

TABLE 18: HIGHWAY CONCEPTUAL PROJECTS AND STRATEGIES						
Seg. #	**Description**	**Location, County, Lead Agency, Post Mile**	**Purpose**	**Source[1)]**	**Total Cost Estimate (x $1,000)[2)]**	**Completion Year[2)]**
13 - 19	El Dorado 50 ITS	In El Dorado County from Missouri Flat Rd to Echo Sandhill. ELD PM R15.06-67.295	Improve facility performance through ITS enhancements	ITS/OPS Project List	2,600	Long
19 - 21	Construct Class II Bike Lane	S. Upper Truckee Rd. to Stateline Rd.	Accommodate bicyclists as part of the Environmental Improvement Program (EIP)	2013 D3 SHBFP	4,800	Long

1) Note, only SHOPP projects that improve Mobility and are Mandated for furthering Complete Streets are included. A complete listing of SHOPP projects can be viewed at http://ctips.dot.ca.gov/citrix/metaframexp/default/reports.asp.

2) Total Cost and Completion Year Estimates are from listed Source. Additional project details and programming information can be found in the District 3 DSMDP at http://www.dot.ca.gov/dist3/departments/planning/systemplanningDSMDP.htm, 2012 SACOG MTP project list at http://www.sacog.org/2035/files/MTP-SCS/appendices/A-1%20Project%20List.pdf, 2012 SACOG MTIP Appendix 3 project list at http://www.sacog.org/mtip/2013-2016/adoption/pdf/2013%20MTIP%20Transmittal%209-26-12.pdf, 2012 TMPO RTP, Chapter 6 project list at http://tahoempo.org/rtp_final/TAHOE%20RTP%2006%20Funding%20and%20Impl.pdf, and CT Programming at http://ctips.dot.ca.gov/citrix/metaframexp/default/reports.asp .

Off-Highway US 50 Corridor Projects

The original US 50 CSMP from 2009 contained off-highway projects on parallel roads, bicycle routes, and transit systems. These projects, while not under Caltrans' direct purveyance, have an impact on freeway operations of US 50 by offering alternatives to travel on the highway. These alternatives reduce traffic on the freeway and improve overall functioning of the corridor. These off-highway projects as identified in Tables 20 through 22 below are either on parallel roads, cross US 50 ROW, are transit projects, or are bicycle and pedestrian projects.

TABLE 19: OFF-HIGHWAY PARALLEL AND CONNECTING ROADS PROJECTS				
Seg. #	**Description**	**Planned or Programmed**	**Location, County**	**Source**
1	Streetscape improvements, including wider sidewalks, flatter road cross-section, reconfigure lanes, roundabout, utility relocation, new lighting, and substantial planting and hardscape treatments.	Programmed	West Capitol Ave, Westacre Rd. to Harbor Blvd.	2035 SACOG MTP/MTIP
3	Widen to 5 lanes	Planned	65th St., US 50 to Broadway	2035 SACOG MTP
3	Widen to 6 lanes	Planned	Power Inn Rd., Fruitridge Rd. to 14th Ave.	2035 SACOG MTP
3	Streetscape project including pedestrian and bicycle improvements, a raised landscaped median, landscaped planters, improvements to signal operations, frontage landscaping, and enhanced connections to transit facilities.	Programmed	Folsom Blvd., Power Inn Rd. to Watt Ave.	2035 SACOG MTP/MTIP
4	Widen to 4 lanes	Planned	Mather Blvd., Rockingham Rd. to Zinfandel Dr.	2035 SACOG MTP
6	Widen to 6 lanes with special treatments. Intersection improvements at White Rock, Folsom Blvd., Coloma Rd., Zinfandel Dr., Gold Express, and Gold Country.	Planned	Sunrise Blvd., White Rock Rd. to American River	2035 SACOG MTP
6	On existing 6-lane White Rock Rd., from Sunrise Blvd. to Luyung Dr.: construct improvements. From Luyung Dr. to Grant Line Rd.: widen and reconstruct from 2 to 4 lanes.	Programmed	On White Rock Rd.: Sunrise Blvd. to Luyung Dr.; Luyung Dr. to Grant Line Rd.	2035 SACOG MTP/MTIP
6	Grant Line Expressway Phase I: Widen four lanes and complete remaining sections of four lane Expressway. Intersection improvements at Jaeger Road, Keifer Blvd, International Drive and Jackson Highway.	Planned	Grant Line Rd., Jackson Hwy. to White Rock Rd.	2035 SACOG MTP
6-7	Easton Valley Pkwy.: Construct New Road: 4 Lanes	Programmed	Hazel Ave. to Prairie City Rd.	2035 SACOG MTP
7	Widen from 2 to 4 lanes	Planned	Prairie City Rd., US 50 to White Rock Rd.	2035 SACOG MTP
7	Widen from 2 to 4 lanes	Planned	White Rock Rd., Prairie City Rd to El Dorado County Line	2035 SACOG MTP

TABLE 19: OFF-HIGHWAY PARALLEL AND CONNECTING ROADS PROJECTS				
Seg. #	**Description**	**Planned or Programmed**	**Location, County**	**Source**
7	Widen to 6 lanes	Planned	Iron Point Rd., Black Diamond Dr. to Prairie City Rd.; Outcropping Way to Broadstone Pkwy.	2035 SACOG MTP
7	Widen from 2 to 6 lanes	Planned	Scott Rd., US 50 to White Rock Rd.	2035 SACOG MTP
8	Widen from 2 to 4 lanes, divided	Planned	White Rock Rd., Sacramento County Line to Manchester Dr.	2035 SACOG MTP
8	Construct new 2 lane arterial road to extend Saratoga Way from its current terminus at Finders Way in El Dorado Hills to the Sacramento County Line / Iron Point Rd.	Planned	Saratoga Way, Iron Point Rd/Sacramento County Line to Finders Way	2013 El Dorado County CIP
8/9	Construct a second eastbound through lane from the commercial area near Sophia Parkway intersection to Francisco Drive with traffic signal installation at the Green Valley Road/Browns Ravine/Miller Road intersection. Also add a second westbound lane from Francisco Drive to the commercial area near the Sophia Parkway intersection.	Planned	On Green Valley Rd. from County line to Francisco Dr.	2035 SACOG MTP
9	Widen to 6 lanes, divided. Construct interchange.	Planned	White Rock Rd., Latrobe Rd. to Silva Valley Pkwy.	2035 SACOG MTP
9	Widen from 2 lanes undivided to 4 lanes divided, with interchange; includes curb, gutter, sidewalk and Class II bike lanes	Planned	White Rock Rd., Monte Verde Dr. to Silva Valley Pkwy.	2035 SACOG MTP
9	Widen to 4 lanes	Planned	Green Valley Rd., Francisco Dr. to Deer Valley Rd.	2035 SACOG MTP
10/11	Widen to 5-lanes: 2 NB through lanes (with right and left turn pockets) and 3 SB through lanes (with dual right turn lanes at Robin Ln.). Project includes median and signal modification at Coach Ln. intersection, realignment of Robin Ln. intersection for future extension to Rodeo Dr. and construction of a new traffic signal.	Planned	Cameron Park Dr., Cameron Park Dr. to Coach Ln.	2035 SACOG MTP
12	Intersection improvements	Planned	Green Valley Rd and Deer Valley Intersection	2035 SACOG MTP

TABLE 19: OFF-HIGHWAY PARALLEL AND CONNECTING ROADS PROJECTS				
Seg. #	**Description**	**Planned or Programmed**	**Location, County**	**Source**
12	Replace the existing 2 lane functionally obsolete bridge with a new 2 lane bridge	Programmed	Green Valley Rd. and Indian Creek	2035 SACOG MTP/MTIP
12	Widen Green Valley Rd. to two 12-ft lanes with paved shoulders. Project includes adding six left-turn pockets.	Planned	Deer Valley Rd to Lotus Rd	2035 SACOG MTP
13	Widen to 4 lanes of traffic, a dual left turn lane, sidewalks, and bike lanes on both sides.	Planned	Placerville Dr. from Fair Ln. to Ray Lawyer Dr.	2035 SACOG MTP
13	Widen to 4 lanes of traffic, a dual left turn lane, sidewalks, and bike lanes on both sides.	Planned	Placerville Dr. from Ray Lawyer Dr. to Cold Springs Rd.	2035 SACOG MTP
13	Widen bridge to 5 lanes, 2 through lanes in each direction and a median turn lane. Widening will include bike lanes and sidewalks.	Programmed	Bridge over Hangtown Creek Bridge, 0.3 mi west of Cold Springs Rd.	2035 SACOG MTP/MTIP
13	Widen to 4 lanes of traffic, a dual left turn lane, sidewalks, and bike lanes on both sides.	Planned	Placerville Dr. from Cold Springs Rd. to US 50	2035 SACOG MTP
13	Replace existing structurally deficient 2 lane bridge with new 2 lane bridge over Weber Creek, widen and realign Green Valley Rd. at bridge approaches, and drainage improvements.	Programmed	Green Valley Rd. and Weber Creek	2035 SACOG MTP/MTIP
15	Construct 700-foot of new 2-lane road. Includes sidewalks to City collector street standards between Broadway and Main St. New road will extend Main St. down Spanish Ravine Road.	Planned	Main St., Broadway, and Spanish Ravine Rd.	2035 SACOG MTP
15	Construct roundabout	Planned	Main St., Cedar Ravine Rd., and Clay St.	2035 SACOG MTP
15	Install traffic signals	Planned	Intersection with Broadway. and Blairs Ln.	2035 SACOG MTP

TABLE 20: OFF-HIGHWAY TRANSIT PROJECTS				
Seg. #	**Description**	**Planned or Programmed**	**Location, County**	**Source**
1 - 2	9 mile urban streetcar network connecting the Intermodal Terminal in downtown Sacramento to West Sacramento	Programmed	West Sacramento and downtown Sacramento	2035 SACOG MTP/MTIP
2	Light rail station improvements: Add 2 shelters, surveillance camera, pedestrian signage, 2 visible message signs	Programmed	29th St. Light Rail Station	2035 SACOG MTP/MTIP
2	North-south alignment, relocating bus berths, providing enhanced passenger connections, relocating passenger vehicle and bicycle parking.	Programmed	Sacramento Valley Station	2035 SACOG MTP/MTIP
2	Complete makeover and rehab. of the depot to make it fully usable. Accommodation of high speed trains, commuter rail, light rail, streetcars, transit bus lines, intercity buses.	Planned	Sacramento Valley Station	2035 SACOG MTP
2 - 7	Enhancement of bus stops and light rail stations	Programmed	Various bus stops and light rail stations	2035 SACOG MTP/MTIP
3	Streetscape project with pedestrian and bicycle improvements, a raised landscaped median, planters, improvements to signal operations, frontage landscaping, and connections to transit facilities.	Programmed	On Folsom Blvd, from Power Inn Rd to Watt Ave	2035 SACOG MTP/MTIP
3 - 4	Modify freeway interchange. Construct multi-modal improvements with a bicycle and pedestrian path.	Programmed	US 50/Watt Ave Interchange	2035 SACOG MTP/MTIP
4	Streetscape Project: On Folsom Blvd. Includes landscape and safety improvements for bicycle and pedestrian access to transit. Phase IV.	Planned	Bradshaw Rd to Sunrise Blvd	2035 SACOG MTP
4	Rail Crossing Projects: Plan and construct a rail grade separation for RT's Gold Line	Planned	Bradshaw Rd, Mather Field Rd, Routier Rd, and Zinfandel Dr.	2035 SACOG MTP
4 - 5	Phase 1 of Loop Streetcar (7.5 miles)	Planned	Rancho Cordova Town Center	2035 SACOG MTP
7 - 8	Construct a 250-space park-and-ride facility near Empire Ranch Interchange	Planned	South of US 50 near Empire Ranch Interchange	2035 SACOG MTP
7 - 8	Construct a regional fueling station for transit operators	Planned	Sacramento/El Dorado County Line	2035 SACOG MTP
13	Construct 150 space park and ride lot on south side of US 50 between proposed Ray Lawyer Dr eastbound off-ramp and realigned Forni Road	Programmed $1.1 million CMAQ on March 6, 2014	South of US 50 near Ray Lawyer Dr	SACOG MTIP

TABLE 21: OFF-HIGHWAY BICYCLE AND PEDESTRIAN PROJECTS				
Seg. #	**Description**	**Planned or Programmed**	**Location, County**	**Source**
4	Bicycle facility improvements at light rail station	Planned	Watt Ave Light Rail Station	SACOG MTP/MTIP
4	Add sidewalks and enhance pedestrian and disabled access.	Programmed	West side of Mather Field Road, between Folsom Blvd and Rockingham Dr. Known as the Mather Railroad Spur Rails to Trails Project	SACOG MTP/MTIP
4	Class I bike path along the south bank of the American River	Conceptual	Watt Ave. to Gristmill Park	Conceptual Project
4	Overcrossing of US 50 at Railroad ROW	Conceptual	Between Routier Rd. and Mather Field Rd.	Conceptual Project
4 - 6	Develop plan for citywide bicycle system	Planned	City of Rancho Cordova	SACOG MTP/MTIP
4 - 6	Class I bike path	Planned	From Mosher Rd. to White Rock Rd.	2013 RBPTMP
5 - 6	Provide a bicycle/pedestrian connection	Planned	Douglas Rd to Folsom South Canal Bike Trail	SACOG MTP/MTIP
6 - 7	Bicycle overcrossing of US 50	Planned	Folsom Blvd.	SACOG 2013 Regional Bicycle, Pedestrian, and Trails Master Plan (2013 RBPTMP)
7	Construct Class I bicycle path - Humbug-Willow Creek Trail/Lake Natoma Bikeway	Planned	Blue Ravine Rd to Lake Natoma Trail	SACOG MTP/MTIP
7	Overcrossing of Folsom Blvd at Humbug-Willow Creek Pkwy	Planned	Folsom Blvd at Humbug-Willow Creek Pkwy	SACOG MTP/MTIP
7	Construction of a Class I bike path parallel to US 50	Planned	Empire Ranch Rd to Alder Creek	SACOG MTP/MTIP
7 - 8	Construct Class II bike lanes as part of Saratoga Way extension	Planned	On Saratoga Way, from Finders Way to County Line	SACOG MTP
8	Bicycle/pedestrian overcrossing of US 50	Planned	El Dorado Hills Blvd.	SACOG MTP
8/9	White Rock Rd. Class II bike lanes	Planned	El Dorado County Line to Silva Valley Pkwy	2013 RBPTMP

TABLE 21: OFF-HIGHWAY BICYCLE AND PEDESTRIAN PROJECTS				
Seg. #	**Description**	**Planned or Programmed**	**Location, County**	**Source**
9	Silva Valley Pkwy. Class II bike lanes	Planned	White Rock Rd to Harvard Wy.	2013 RBPTMP
9	Sliva Valley Pkwy. Class I bike path and Class II bike lanes	Programmed CMAQ March 6, 2014	Class I bike path Harvard Way to Appian Way; Class II bike lanes Appian Way to Green Valley Road	SACOG MTIP
10	Class II bike lanes	Planned	On Country Club Dr., from Bass Lake Rd. to Cambridge Rd.	2013 RBPTMP
10	Class II bike lanes	Planned	On Country Club Dr., from Cameron Park Dr. to Cambridge Rd.	2013 RBPTMP
9	Design and construct a Class I bike path within the powerline easement operated by the Sacramento Municipal Utility District (SMUD)	Programmed	El Dorado Hills Blvd to Silva Valley Pkwy (Phase 1 from Silva Valley Parkway to New York Creek was completed and Phase II was programmed CMAQ 3/6/14	SACOG MTP/MTIP
13	Class I bike path	Planned	Missouri Flat Rd. to Mother Lode Dr.	2013 RBPTMP
12	Class II bike lanes	Planned	On Mother Lode Rd., Lindberg Ave. to Missouri Flat Rd.	2013 RBPTMP
12/13	Bicycle/pedestrian overcrossing of US 50	Planned	Missouri Flat Rd.	2010 Placerville Non-Motorized Transportation Plan
13	Widen Placerville Dr and construct sidewalks and Class II bike lanes on both sides	Planned	Cold Springs Rd to US 50	SACOG MTP/MTIP
13	Widen Placerville Dr and construct sidewalks and Class II bike lanes on both sides	Planned	Fair Ln to Ray Lawyer Dr	SACOG MTP/MTIP
13	Widen Placerville Dr and construct sidewalks and Class II bike lanes on both sides	Planned	Ray Lawyer Dr to Cold Springs Rd	SACOG MTP/MTIP
15	Design and construct a Class I bike path along the El Dorado Trail. Bike and pedestrian overcrossing.	Programmed	Clay St to Bedford Ave	SACOG MTP/MTIP
15	Class I bike path parallel to US 50	Planned	Halcon Rd. to Snows Rd. near Camino	2013 RBPTMP
15	Extend El Dorado Trail Class I bike path	Programmed CMAQ 3/6/14	Los Trampas Dr to Halcon Rd in Camino	2013 RBPTMP

APPENDIX A: GLOSSARY OF TERMS AND ACRONYMS

Acronyms and Important Abbreviations

AADT - Annual Average Daily Traffic
ADT - Average Daily Traffic
BY - Base Year
CALTRANS - California Department of Transportation
CEQA – California Environmental Quality Act
CHP – California Highway Patrol
CSMP - Corridor System Management Plan
CSUS – California State University, Sacramento
DSMP - District System Management Plan
DU - Density Unit
EDCTC - El Dorado County Transportation Commission
EIP - Environmental Improvement Program
FHWA - Federal Highway Administration
HCM - Highway Capacity Manual
HOV – High Occupancy Vehicle
HY - Horizon Year
I-5 – Interstate 5
I-80 – Interstate 80
ICM – Integrated Corridor Management
ITS - Intelligent Transportation System
ITSP - Interregional Transportation System Plan
LOS - Level of Service
MAP-21 – Moving Ahead for Progress in the 21st Century Act
MPO - Metropolitan Planning Organization
MPR – Mobility Performance Report
MTIP - Metropolitan Transportation Improvement Program
MTP - Metropolitan Transportation Plan
PeMS – Performance Measurement System
PM - Post Mile
ROW – Right of Way
RTIP – Regional Transportation Improvement Program
RTP – Regional Transportation Plan
RTPA - Regional Transportation Planning Agencies
SACOG - Sacramento Area Council of Governments
SHBFP – State Highway Bicycle Facilities Plan
SHOPP - State Highway Operation and Protection Program
SHS - State Highway System
SR - State Route
STAA - Surface Transportation Assistance Act
TCR - Transportation Concept Report
TDM – Transportation Demand Management
TMPO - Tahoe Metropolitan Planning Organization
TOC – Traffic Operations Center
TOS – Traffic Operations Systems
TRPA - Tahoe Regional Planning Agency
TTD - Tahoe Transportation District

V/C – Volume-to-Capacity Ratio
VHD – Vehicle Hours of Delay
VMT - Vehicle Miles Traveled

Definitions

AADT – Annual Average Daily Traffic is the total volume for the year divided by 365 days. The traffic count year is from October 1st through September 30th. Traffic Counting is generally performed by electronic counting instruments moved from locations throughout the State in a program of continuous traffic count sampling. The resulting counts are adjusted to an estimate of annual average daily traffic by compensating for seasonal influence, weekly variation and other variables which may be present. Annual ADT is necessary for presenting a statewide picture of traffic flow, evaluating traffic trends, computing accident rates, planning and designing highways and other purposes.

Base Year- The year that the most current data is available to the Districts.

Bikeway Class I (Bike Path) – Provides a completely separated right of way for the exclusive use of bicycles and pedestrians with cross flow by motorists minimized.

Bikeway Class II (Bike Lane) – Provides a striped lane for one-way bike travel on a street or highway.
Bikeway Class III (Bike Route) – Provides for shared use with pedestrians or motor vehicle traffic.

Capacity – The maximum sustainable hourly flow rate at which persons or vehicles reasonably can be expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, environmental, traffic, and control conditions.

Capital Facility Concept – The 20-25 year vision of future development on the route to the capital facility. The capital facility can include capacity increasing, State Highway, bicycle facility, pedestrian facility, transit facility (Intercity Passenger rail, Mass Transit Guideway, etc.), grade separation, and new managed lanes.

Concept LOS – The minimum acceptable LOS over the next 20-25 years.

Conceptual Project – A conceptual improvement or action is a project that is needed to maintain mobility or serve roadway users, but is not currently included in a financially constrained plan and is not currently programmed. It could be included in a General Plan or in the unconstrained section of a long-term plan.

Corridor – A broad geographical band that follows a general directional flow connecting major sources of trips that may contain a number of streets, highways, bicycle, pedestrian, and transit route alignments. Off system facilities are included as information purposes and not analyzed in the TCR.

Facility Concept – Describes the facility and strategies that may be needed within 20-25 years. This can include capacity increasing, State Highway, bicycle facility, pedestrian facility, transit facility, non-capacity increasing operational improvements, new managed lanes, conversion of existing managed lanes to another managed lane type or characteristic, TMS field elements, transportation demand management and incident management.

Facility Type – The facility type describes the state highway facility type. The facility could be freeway, expressway, conventional, or one-way city street.

Freight Generator – Any facility, business, manufacturing plant, distribution center, industrial development, or other location (convergence of commodity and transportation system) that produces significant commodity flow, measured in tonnage, weight, carload, or truck volume.

Headway – The time between two successive vehicles as they pass a point on the roadway, measured from the same common feature of both vehicles.

Horizon Year – The year that the future (20-25 years) data is based on.

ITS – Intelligent Transportation System improves transportation safety and mobility and enhances productivity through the integration of advanced communications technologies into the transportation infrastructure and in vehicles. Intelligent transportation systems encompass a broad range of wireless and wire line communications-based information and electronics technologies to collect information, process it, and take appropriate actions.

LOS – Level of Services is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists. A LOS definition generally describes these conditions in terms of speed, travel time, freedom to maneuver, traffic interruption, comfort, and convenience. Six levels of LOS can generally be categorized as follows:

> **LOS A** describes free flowing conditions. The operation of vehicles is virtually unaffected by the presence of other vehicles, and operations are constrained only by the geometric features of the highway.
>
> **LOS B** is also indicative of free-flowing conditions. Average travel speeds are the same as in LOS A, but drivers have slightly less freedom to maneuver.
>
> **LOS C** represents a range in which the influence of traffic density on operations becomes marked. The ability to maneuver with the traffic stream is now clearly affected by the presence of other vehicles.
>
> **LOS D** demonstrates a range in which the ability to maneuver is severely restricted because of the traffic congestion. Travel speed begins to be reduced as traffic volume increases.
>
> **LOS E** reflects operations at or near capacity and is quite unstable. Because the limits of the level of service are approached, service disruptions cannot be damped or readily dissipated.
>
> **LOS F** a stop and go, low speed conditions with little or poor maneuverability. Speed and traffic flow may drop to zero and considerable delays occur. For intersections, LOS F describes operations with delay in excess of 60 seconds per vehicle. This level, considered by most drivers unacceptable often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection.

Multimodal – The availability of transportation options using different modes within a system or corridor, such as automobile, subway, bus, rail, or air.

System Operations and Management Concept – Describes the system operations and management elements that may be needed within 20-25 years. This can include non-capacity increasing operational improvements (auxiliary Lanes, channelizations, turnouts, etc.), conversion of existing managed lanes to another managed lane type or characteristics (e.g., High Occupancy Vehicle lane to High Occupancy Toll lane), TMS Field Elements, Transportation Demand Management, and Incident Management.

Peak Hour – The hour of the day in which the maximum volume occurs across a point on the highway.

Peak Hour Volume – The hourly volume during the highest hour traffic volume of the day traversing a point on a highway segment. It is generally between 6 percent and 10 percent of the ADT. The lower values are generally found on roadways with low volumes.

Planned Project – A planned improvement or action is a project in a financially constrained section of a long-term plan, such as an approved Regional or Metropolitan Transportation Plan (RTP or MTP), Capital Improvement Plan, or measure.

Post Mile – A post mile is an identified point on the State Highway System. The milepost values increase from the beginning of a route within a count to the next county line. The milepost values start over again at each county line. Milepost values usually increase from south to north or west to east depending upon the general direction the route follows within the state. The milepost at a given location will remain the same year after year. When a section of road is relocated, new milepost (usually noted by an alphabetical prefix such as "R" or "M") are established for it. If relocation results in a change in length, "milepost equations" are introduced at the end of each relocated portion so that mileposts on the remainder of the route within the county will remain unchanged.

Programmed Project – A programmed improvement or action is a project in a near-term programming document indentifying funding amounts by year, such as the State Transportation Improvement Program or the State Highways Operations and Protection Program.

Route Designation – A route's designation is adopted through legislation and identifies what system the route is associated with on the State Highway System. A designation denotes what design standards should apply during project development and design. Typical designations include but not limited to National Highway System (NHS), Interregional Route System (IRRS), and Scenic Highway System.

Rural – Fewer than 2,500 in population designates a rural area. Limits are based upon population density as determined by the U.S. Census Bureau.

Segment – A portion of a facility between two points.

TDM – Transportation Demand Management programs designed to reduce or shift demand for transportation through various means, such as the use of public transportation, carpooling, telework, and alternative work hours. Transportation Demand Management strategies can be used to manage congestion during peak periods and mitigate environmental impacts.

TMS – Transportation Management System is the business processes and associated tools, field elements and communications systems that help maximize the productivity of the transportation system. TMS includes, but is not limited to, advanced operational hardware, software, communications systems and infrastructure, for integrated Advanced Transportation Management Systems and Information Systems, and for Electronic Toll Collection System.

Post-25 Year Concept – This dataset may be defined and re-titled at the District's discretion. In general, the Post-25 Year concept could provide the maximum reasonable and foreseeable roadway needed beyond a 20-25 year horizon. The post-25 year concept can be used to identify potential widening, realignments, future facilities, and rights-of-way required to complete the development of each corridor.

Urban Cluster – 2,500 to 49,999 in population designates an urban cluster. Limits are based upon population density as determined by the U.S. Census Bureau.

Urbanized Area – Over 50,000 in population designates an urbanized area. Limits are based upon population density as determined by the U.S. Census Bureau.

VMT – Is the total number of miles traveled by motor vehicles on a road or highway segments.

APPENDIX B: RESOURCES

California Road System (CRS) Maps, http://www.dot.ca.gov/hq/tsip/hseb/crs_maps/
Camino CDP.
http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1
El Dorado Transit. http://www.eldoradotransit.com/
Interregional Transportation Strategic Plan (ITSP). http://www.dot.ca.gov/hq/transprog/ocip/te/itsp.pdf
Pollock Pines CDP, California. http://quickfacts.census.gov/qfd/states/06/0658030.html
South Lake Tahoe (city), California. http://quickfacts.census.gov/qfd/states/06/0673108.html
South Lake Tahoe Zoning Map. http://www.cityofslt.us/DocumentCenter/Home/View/60
Tahoe Transportation District. http://www.tahoetransportation.org/southtahoe
Truck Networks on California State Highways: District 3.
http://www.dot.ca.gov/hq/traffops/trucks/truckmap/truckmap-d03.pdf
Zoning Maps. http://www.edcgov.us/Government/Planning/Zoning_Maps.aspx
http://quickfacts.census.gov/qfd/states/06/0659444.html
http://www.csus.edu/oir/Data%20Center/University%20Fact%20Book/University%20Fact%20Book.html

APPENDIX C: DATA RESOURCES

Base Year ADT: 2011 Caltrans Traffic Volumes on California State Highways Book

LOS: Used HCS in conjunction with data from this table

Base Year VMT: 2011 Caltrans Traffic Volumes on California State Highways Book (Link Based)

Horizon Year Volumes and VMT based on SACSIM model growth and SHI growth factors

Truck Data: 2011 Annual Average Daily Traffic on California State Highways Book

Base Year Peak Hour Volumes and Directional Split: 2011 Caltrans Traffic Volumes on California State Highways Book

Peak Hour VMT: 2011 Caltrans Traffic Volumes on California State Highways Book (Link Based)

Horizon Year Directional Splits based on SACSIM model projections in conjunction with 2011 Caltrans Traffic Volumes on California State Highways Book

V/C: HCS used in conjunction with data from this table

APPENDIX D: MAPS OF BICYCLE IMPROVEMENTS

The following reproduce the maps of bicycle improvements as given in the District 3 State Highway Bicycle Facility Plan.

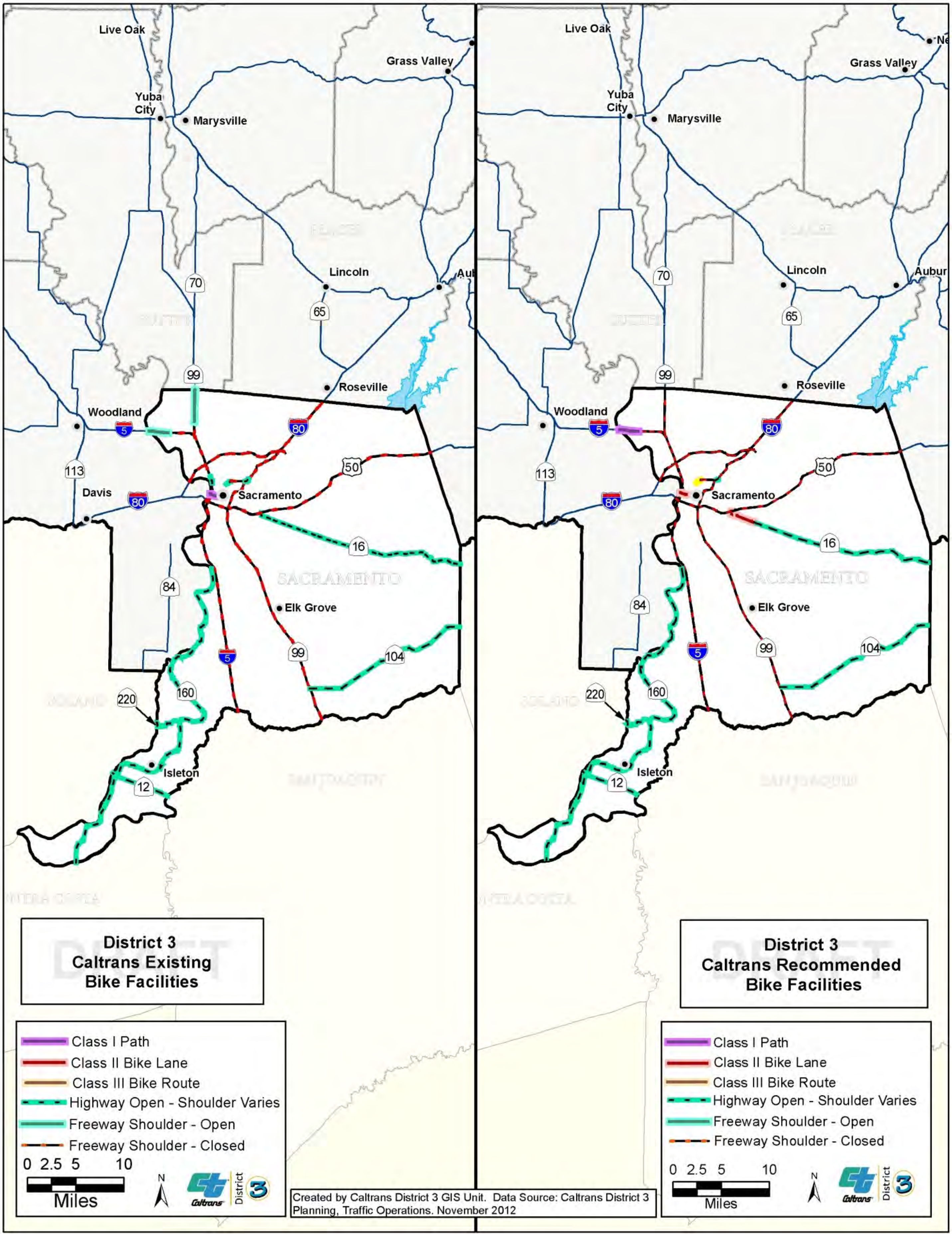


Figure 1: Sacramento County Facility Improvements

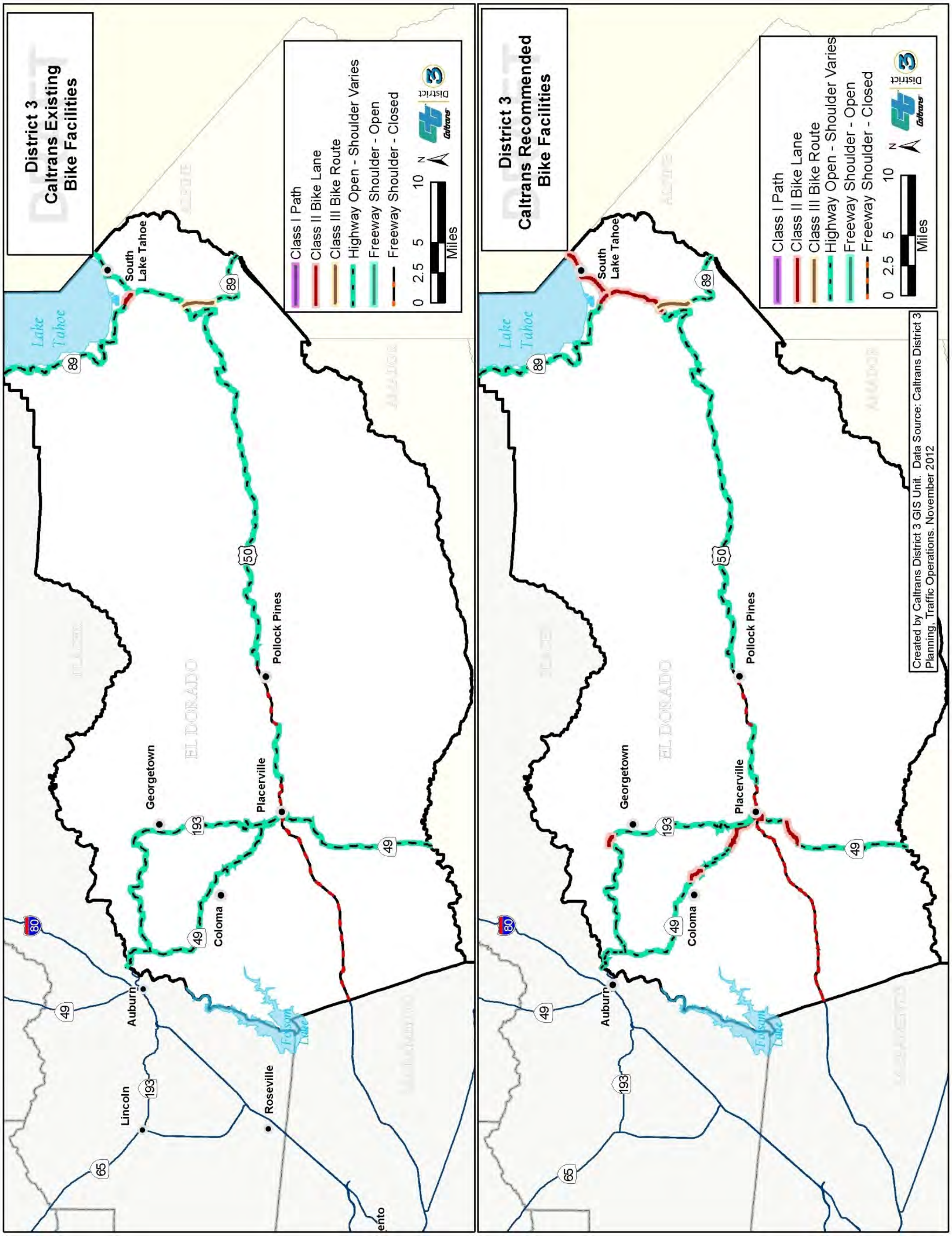


Figure 2: El Dorado County Bicycle Facility Improvements

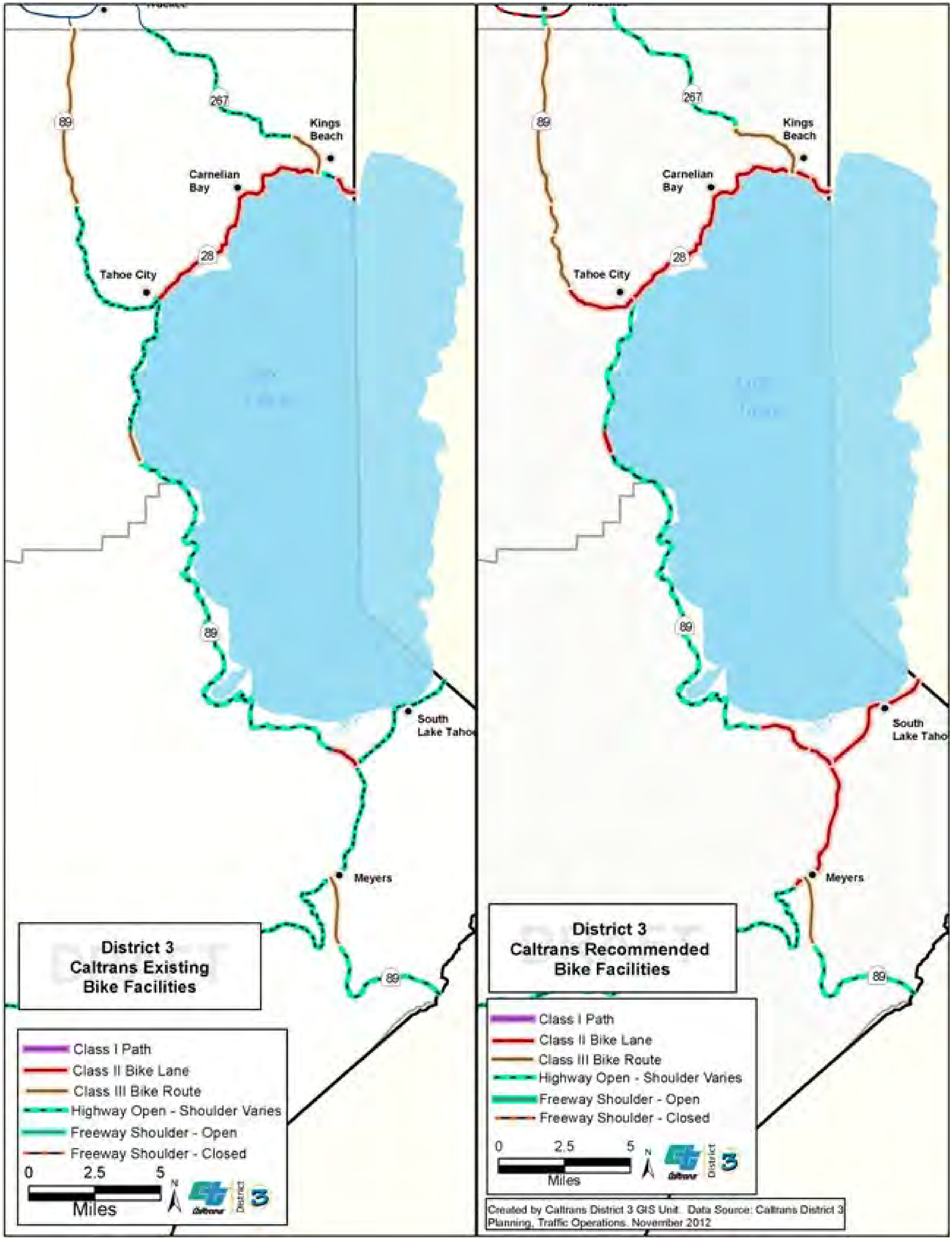


Figure 3: Lake Tahoe Area Bicycle Facility Improvements

Attachment #26

Transportation and Traffic Summary:

Policy TC-Xa of the General Plan requires that all highway and road segments, as well as all interchanges and intersections in the unincorporated areas of the county be measured. The DEIR does not measure any interchanges or intersections. It also omits several important segments of highway 50 and major roads in the county. The DEIR cannot be considered sufficient until all of these required segments, interchanges, and intersections are included in the traffic study.

The conclusions of the traffic section as contained in table 3.9-13 simply don't pass muster. Just looking at the high-level results shows that even after adding nearly 20,000 homes in the county, the number of cars traveling to Sacramento county in 2035 during the morning commute will *decrease* on highway 50 and Green Valley Road! The table purports to use 2010 numbers for baseline traffic, but these numbers don't even match the county's own DOT counts or CalTrans counts for highway 50. Why does the study use outdated 2010 information when the county DOT has counts for 2013 and even some for 2014. The county claims "parallel capacity" to highway 50 will solve our commute problems, but the table doesn't include any data for Saratoga Way, which would be the primary parallel road to highway 50. Many other high-volume sections of roadway are simply not included in the analysis.

Also particularly problematic is that the future traffic forecasts include speculative road improvements. Highway 50 improvements that are not even planned at this point are assumed to be completed. CIP projects that get pushed further out in time every year (and change wildly in cost) are assumed to be completed.

Table TC-2 (this table shows road segments allowed to operated at LOS F) is proposed to be moved to "another document". Why is this being done? Would it then not be part of the General Plan?

Detailed review:

Page 2-8 shows a proposed policy change: " Policies TC-1m, TC-1n(B), TC-1w: Road Improvements. These policies would be amended to make minor modifications to clarify language: TC-1m—delete “of effort”; TC-1n(B)—replace “accidents” with “crashes” to be consistent with transportation industry standard language; and TC-1w—delete “maximum.” The DEIR does not analyze the impact of these wording changes.

> The first change in Policy TC-1m: "The County shall ensure that road funds allocated directly or otherwise available to the County shall be programmed and expended in ways that maximize the use of federal and other matching funds, including maintenance ~~of effort~~ requirements." This proposed amendment changes the meaning of the policy. "maintenance of effort requirements" is a legal term pertaining to Federal Matching

funds. **Please explain why this change is being proposed, the impact it will have to the meaning of the policy, and the impact it will have to funding for roads**.

Policy TC-1w New streets and improvements to existing rural roads necessitated by new development shall be designed to minimize visual impacts, preserve rural character, and ensure neighborhood quality to the ~~maximum~~ extent possible consistent with the needs of emergency access, on street parking, and vehicular and pedestrian safety. **Please explain why this change is being proposed, and the impact it will have on visual impacts, rural character, and neighborhood quality.**

Page 2-8 shows a proposed policy: " Table TC-2, Policy TC-Xb, and Policy TC-Xd. Level of Service Standards. This revision entails moving Table TC-2 to another document; if it is moved, all references to TC-2, including the references in TC-Xb and TC –Xd, would be amended." **Is the "other document" part of the general plan? If so, where is the DEIR evaluation of this document? If the other document is not part of the general plan, does this then mean that Table TC-2 would then not need a general plan amendment in order to be revised (or deleted)? Please explain the impact of moving table TC-2 to "another document."**

Page 2-9 shows a proposed policy change: " Policy TC-Xi: Planning for U.S. Highway 50 Widening. this policy would be amended to allow for coordination of regional projects to be delivered on a schedule agreed to by related regional agencies, thereby excluding regional projects from the scheduling requirements of the policies of the General Plan" **Will this exempt highway 50 from the requirements of Policy TC-Xf? Please analyze the impact to traffic on highway 50 in the county if widening of highway 50 no longer needs to meet the scheduling requirements of the policies of the General Plan.**

Page 2-9 shows a proposed policy change: " Policy TC-1y: Employment Cap. The El Dorado Hills Business Park employment cap limits would be analyzed and either amended or deleted." **Please analyze the potential impact to traffic if the employment cap is amended or deleted. State the mitigations required to ensure that traffic on roads in El Dorado Hills is not worsened by amending this policy.**

Page 2-9 shows a proposed policy change: " Policies TC-Xd, TC-Xe and TC-Xf: Level of Service Standards. These policies would be amended to clarify the definition of “worsen”; to clarify what is required if a project “worsens” traffic; to identify the methodology for traffic studies (e.g., analysis period, analysis scenarios, methods); and to identify the timing of improvements." This process is very vague, and could have significant impact if certain changes are made. For instance, if the timing of improvements is relaxed, this would have a significant impact on traffic for a longer period of time. **Please analyze the potential impact of the changes (e.g. timing of improvements, definition of "worsen", etc.) to these policies. State the mitigations required to ensure that traffic is not worsened, and that the period of delay to completion of a mitigation project is not pushed further out in time.**

Page 3-9.23, bullet 3 states: " The potential impact of additional residential density was considered in the analyses that follow." **How, specifically, was this impact considered? Was each residential area evaluated at the proposed maximum density for traffic impact?**

Page 3-9.23, bullet 4 states: "New objective and policies encouraging infill development. Any future infill would be subject to the density and intensity limitations of the General Plan. As a result, this change would not incrementally alter land use patterns or intensity." **This statement is demonstrably false since the county currently has in process a proposed project (recommended by staff for approval) to convert mixed-use commercial into high density housing (55 units per acre, more than double what is currently allowed under the general plan). As a result, the DEIR must examine the impact of possible conversion of other commercial and/or high-density residential to an even higher density than allowed by the TGPA/ZOU.**

Page 3-9.24 states: " these changes generally adopt the least intensive of those zones." **Are there cases where the changes do not adopt the least intensive of the zones? How many? If so, what are these parcels, and what impact do they have on the traffic in those areas (and overall).**

Page 3-9.24 states: " The rezonings would not change the development potential. As a result, the rezonings would not change the expected traffic impacts that will occur as a result of implementation of the General Plan." **However, the ZOU/TGPA process "creates" many new entitlements *<u>without individual discretionary review</u>*. For example, under ZOU/TGPA changes, the Dixon Ranch property near Green Valley Road, would be automatically rezoned from 3 Ag parcels to approximately 28 parcels. While the resulting designation is consistent with the general plan, there is no *<u>individual</u>* review of each project in this bulk process. There are many such proposed "automatic rezones" and the traffic impact of *<u>each</u>* of these needs to be included in the cumulative impact study.**

Page 3-9.24 states: "Move Table TC-1 from the General Plan to Standards Plans or Land Development Manual." **What effect does the movement of this table have? Are the "Standards Plans or Land Development Manual" part of the general plan? If so, where is the DEIR evaluation of these manuals? If they are not part of the general plan, does this then mean that Table TC-1 would then not need a general plan amendment in order to be revised (or deleted)?**

Page 3-9.24 states: " For the project (i.e., TGPA/ZOU), LOS was determined by comparing existing and forecasted traffic volumes for selected roadway segments with peak-hour LOS capacity thresholds. These thresholds are shown in Table 3.9-3 and were developed based on the methodologies contained in the *Highway Capacity Manual* (HCM) (Transportation Research Board 2010)." The 2010 HCM clearly states that " Because passing capacity decreases as passing demand increases, two-lane highways exhibit a unique characteristic: operating quality often decreases precipitously as demand flow increases, and operations can become “unacceptable” at relatively low volume-to-capacity ratios."

It is clear that simple volume/capacity ratios are an *inadequate measure* of LOS on 2-lane highways and arterials, and over-state the actual capacity of road segments. **Does the TDM include the following factors as required by the HCM 2010? If not, please explain the rationale for not including each one:**

1. **Highway Class per segment**
2. **lane width**
3. **shoulder width**
4. **terrain**
5. **% no passing zones**
6. **Directional split**
7. **Peak hour factor**
8. **access point density**
9. **% heavy vehicles**
10. **signal spacing**

Class I, II, and III must be evaluated for LOS by the method stated in Chapter 15 of the 2010 HCM, and using table 15-3:

LOS	Class I Highways ATS (mi/h)	Class I Highways PTSF (%)	Class II Highways PTSF (%)	Class III Highways PFFS (%)
A	>55	≤35	≤40	>91.7
B	>50–55	>35–50	>40–55	>83.3–91.7
C	>45–50	>50–65	>55–70	>75.0–83.3
D	>40–45	>65–80	>70–85	>66.7–75.0
E	≤40	>80	>85	≤66.7

The information for each road segment in the study area must be updated to include the factors (1-10) above. The DEIR must be updated to utilize the methods specified in Chapter 15 of the 2010 HCM for all Class I, II, and III highways (or equivalent) in the study area.

HCM 2010, Chapter 15 states: "Isolated signalized intersections on two-lane highways may be evaluated with the methodology of Chapter 18, Signalized Intersections. Two-lane highways in urban and suburban areas with multiple signalized intersections 2 mi or less apart should be analyzed as urban streets or arterials with the methodology of Chapter 17, Urban Street Segments." **The DEIR must be updated to use the methods described in HCM 2010 for "Urban Arterials" (including signalized intersections) for study area roads designated as "major arterial", such as El Dorado Hills Blvd, segments of Green Valley Road, Saratoga Way, Sunrise Blvd., etc.**

Page 3-9.27 states: " El Dorado County's updated Travel Demand Model (TDM) was used to model six roadway network scenarios for the TGPA/ZOU project. This analysis indicates that U.S. Highway 50 will not reach LOS F in 2035 under any of the six roadway network scenarios analyzed." **This statement calls into question the validity of the EDC TDM. Clearly, as is stated on page 3-9.27, a segment of Highway 50 today operates at LOS F. The TDM does not show this segment as LOS F for any dates or scenarios, please explain why not.**

Page 3-9.27 states: "... Caltrans Operations staff has also stated that once the ramp metering for the westbound El Dorado Hills Boulevard on-ramp is operational, LOS on this segment should improve." **Please provide documentation of this statement from CalTrans operational staff. By "improve", did they state that the segment would no longer be LOS F? Did they state that by metering traffic onto highway 50, LOS on El Dorado Hills Blvd. would drop? What will be the result of ramp metering on El Dorado Hill Blvd LOS, as well as the WB on-ramp?**

Page 3-9.27. Much justification of the county TDM is placed upon the " superior zonal resolution (many times more than SACMET) enables a much more detailed analysis of county roadways**."** The county TDM can have great detail, yet poor representation of the larger area, improper initial conditions, and arrive at an unusable result. **How much of a difference does this "superior zonal resolution" make in the *highway 50* traffic forecasts?**

Page 3-9.27 states: " For example, SACMET's land use identified the El Dorado Hills Business Park as "retail," whereas EDC's TDM more accurately depicts its uses as "industrial" and "office." SACMET also showed golf courses, churches, and storage facilities in EDC as retail. Since retail uses result in higher trip generation rates than industrial, office, golf course, and church uses, these discrepancies could lead to differences in roadway impacts if not corrected." Retail is allowed in the business park (and exists there today), so this cannot be entirely discounted. Secondly, retail may generate fewer *peak* hour trips than industrial and office space. **Did the SACMET model have any areas that were identified as lower-traffic generating land uses than the county TDM assumptions? What are those areas, and what are the land uses in those areas? How much of a difference does this make in the modeling of highway 50 peak hour trips? The DEIR needs to provide table showing the difference in peak hour trips on highways between the EDC model and the SACMET model, and describe why the differences exist.**

Page 3-9.28 states: " Caltrans and El Dorado County use different practices regarding how traffic counts are collected and used to model future transportation system performance." CalTrans has wire loops and other mechanisms for real-time counts on Highway 50 in the most populated areas of El Dorado County. This data can be processed to exclude weekends and holidays. The second "justification" for using the TDM instead of CalTrans model does not pass muster. **How and when does the county collect traffic counts on Highway 50 for each segment? Please show a table of differences between the *county collected data* for Highways 49 and 50, and the CalTrans data for the baseline year (2010).**

Page 3-9.28 tries to further justify the use of the TDM rather than CalTrans data because CalTrans "is planning for LOS F on U.S. Highway in the future, while El Dorado County is tasked with maintaining LOS E on U.S. Highway 50 as required by the General Plan." This statement makes no sense. Since segments of US Highway 50 are already at LOS F (as physically measured by CalTrans), *clearly the county planning process has not worked.* CalTrans indicates that there is no way to mitigate the traffic to better than LOS F by 2035 given the amount of growth in the county. The fact that the TDM does not concur (by a large amount e.g. LOS C vs. LOS F) with the CalTrans initial conditions in 2010, this makes the county *TDM highly suspect* as a useful planning tool for Highway 50 traffic. **Please explain how the county TDM will ensure roadway segments will not reach improper LOS (LOS E, or LOS F, as appropriate), when the TDM results are demonstrably incorrect today.**

Page 3-9.28 states that CalTrans and the County use different annual growth projections (e.g. SACOG's vs. County). **The CalTrans/SACOG rate is 0.72% AGR, and the county uses 1.03% AGR. Given that CalTrans uses a more conservative growth rate (about 30% lower than the county), please explain why their traffic forecasts for 2035 are higher volume than that of the TDM.**

Page 3-9.28 states: " For these reasons, El Dorado County has chosen to use its methodology in this analysis." As has been shown above, these "reasons" are all highly suspect. EDC needs to calculate these traffic numbers conservatively (i.e. not err on the low side) since erring on the low side would place the roadway network at risk of more LOS F segments. **The DEIR needs to show in detail how each of these factors makes a difference, how much that difference is, and explain why the TDM provides a more realistic forecast of Highway 50 traffic in 2035.**

Page 3-9.31 indicates that Scenario 1 is a 2010 baseline. This is four years old. In 2010, the county was still recovering from a recession, and traffic in 2010 is not necessarily representative of current traffic on many road segments. **Please explain the rationale for using this old information when 2013 and some 2014 traffic counts are available on the EDC website. Please run the scenarios 1-6 using 2013/2014 traffic data?**

Page 3.9-32 states: " Three baselines are represented in the scenarios: 2010, 2025 with future CIP/MTP road improvements (assumes that planned roadway improvements have been constructed), and 2035 cumulative impact**."** **Please list all assumptions in the cumulative impact. This would include (but not limited to):**

- **A list of CIP and MTP road improvements, their scheduled completion dates, and funding sources/finance plans for each showing a "reasonable expectation" that these projects will in fact be fully funded and completed by the dates specified.**
- **Document the impact of the federal Highway Trust Fund projected shortfall on these projects.**
- **A list of approved but not yet constructed projects in El Dorado County and Eastern Sacramento County (including parcel counts) that were included in the cumulative scenarios.**

    - **For example, Easton, the 10,000+ homes south of highway 50 in Folsom. The adopted plans for Vineyard Springs, North Vineyard Station, Florin-Vineyard Gap, etc.**
    - **Alto, Diamante, La Canada, Migianella, Summerbrook, Silver Springs, Bass Lake, Rancho Dorado, etc.**
    - **The remaining approved units in Serrano, Valley View, Promontory, Carson Creek, etc.**
- **A list of proposed projects in El Dorado County and Eastern Sacramento County (including parcels counts) that were included in the cumulative scenarios.**
    - **For example, Marble Valley, Lime Rock, Dixon Ranch, Central EDH, San Stino, Town Center Apartments, Wilson Estates, etc.**
    - **NewBridge, Jackson Township, West Jackson Highway, Cordova Hills, Mather South, etc.**

Page 3.9-32 includes Table 3.9-6. In this table, the current (2010) number of households is listed as 55493. Scenario 6 projects 76,270 households, leaving an increase of 20,777 households. In the same table, Employment increases from 44,468 to 71,181. This is an increase of 26,713 jobs. This means that new jobs would need to be created at the rate of 1.29 jobs per new household on an average throughout the county. **Please provide the following information about assumed job creation (26,713 jobs) in scenario 6 as all of these factors impact how much traffic is added and which roads are impacted.**

- **Location of jobs/job centers**
- **Types of jobs to be created**
- **Projected salary ranges of these jobs (determines where the employees can afford to live)**
- **Price range of homes in each new area (determines what kind of job salary ranges the residents need)**
- **Assumptions about where the new employees will live (e.g. will they need to commute from Sac county, can they afford to live in El Dorado Hills, Cameron Park, Shingle Springs, etc. given the latest average housing price data from the EDC**

Association of Realtors:

RESIDENTIAL SALES BY AREA --- YEAR-TO-DATE (5/1 - 5/31)

ZONE	AREA	2013 # OF SALES	2013 AVG. PRICE	2014 # OF SALES	2014 AVG. PRICE
12601	CAMERON PARK	166	$340,890	128	$340,533
12602	EL DORADO HILLS	354	$495,054	304	$593,723
12603	SHINGLE SPRINGS	44	$397,484	47	$475,680
12604	RESCUE/NORTH AREA	20	$412,630	26	$468,528
12605	LATROBE/SOUTH AREA	12	$467,693	8	$451,125
12701	PLACERVILLE	114	$248,210	99	$296,057
12702	DIAMOND SPRINGS/EL DORADO	54	$222,395	72	$284,383
12703	PLEASANT VALLEY	44	$310,108	24	$345,246
12704	SOMERSET/SOUTH COUNTY	50	$199,271	42	$245,522
12705	LOTUS/COLOMA	4	$348,125	6	$246,667
12706	GREENSTONE,GOLD HILL WEST	21	$413,929	11	$489,864
12707	SWANSBORO	9	$167,422	14	$240,692
12801	CAMINO/CEDAR GROVE	28	$320,853	32	$311,102
12802	POLLOCK PINES/SLY PARK	100	$183,473	75	$223,172
12803	AMERICAN RIVER CANYON	6	$178,917	7	$271,004
12901	GEORGETOWN DIVIDE	52	$202,313	47	$251,166
12902	PILOT HILL/COOL	48	$262,800	35	$304,754
12903	NORTH COUNTY	5	$268,000	3	$368,330

- The county's past track record indicates that creating this many jobs will be extremely difficult. **Please show a plan that lays out how this large number of jobs will be created.**

From the 2013 report prepared by BAE for use in the El Dorado County TDM, the numbers are quite different than those presented and used in the TDM. The BAE report list growth in EDC with the following tables:

Table 1: Baseline Conditions, West Slope, Less City of Placerville

	2010
Population (a)	139,941
Housing Units (a)	59,668
Employment (b)	32,597

Notes:
(a) Based on 2010 Census. El Dorado countywide population, minus population in census tracts located in Tahoe Basin, minus City of Placerville. Tahoe Basin is defined by census tracts 302, 303.01, 303.02, 304.01, 304.02, 305.02, 305.04, 305.05, 316, 320, 9900.

(b) Based on Draft SACOG TAZ-level employment estimates for 2008 and projections for 2014, for El Dorado County West Slope, less employment in City of Placerville area. Assumes constant average annual rate of growth between 2008 and 2014, to estimate 2010 employment.

Sources: U.S. Census, 2010; SACOG, 2012; BAE, 2012.

Table 3: Projected Residential Growth, West Slope of El Dorado County, 2010-2035						
	2010	2015	2020	2025	2030	2035
Total Housing Units	59,668	62,803	66,102	69,575	73,230	77,077

The job market growth numbers are also quite different in the BAE report:

Market Area (a)	New Jobs Each Period (b) 2015	2020	2025	2030	2035	Total
#1 - El Dorado Hills	1,414	1,488	1,567	1,649	1,735	7,853
#2 - Cameron Park/ Shingle Springs	734	773	813	856	901	4,077
#3 - Diamond Springs	214	225	237	250	263	1,188
#4 - Unincorporated Placerville Area	101	107	112	118	124	563
#5 - Coloma/Gold Hill	202	212	224	235	248	1,121
#6 - Pollock Pines	0	0	0	0	0	0
#7 - Pleasant Valley	101	106	112	118	124	561
#8 - Latrobe (c)	22	23	24	25	27	121
#9 - Somerset	0	0	0	0	0	0
#10 - Cool/Pilot Hill	0	0	0	0	0	0
#11 - Georgetown/Garden Valley	31	33	35	36	38	174
#12 - Tahoe Basin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
#13 - American River	8	9	9	10	10	46
#14 - Mosquito	67	71	74	78	82	373
Total	2,895	3,047	3,207	3,376	3,553	16,078

Notes:
Figures in columns may not sum to totals due to rounding.
For the geographic boundaries of the various Market Areas, please refer to Figure 1 on page 9.
(a) Converts new housing units from Table 3 into new households assuming 7.98 percent average vacancy rate, from Table 2.
(b) Projects new jobs based on SACOG's projected ratio of new jobs to new households, from Table 4.
(c) Due to an anomaly in SACOG's projections for Market Area 8, BAE utilized the average jobs/housing ratio from all other market areas to estimate the Market Area 8 job growth.

Sources: U.S. Census, 2010; SACOG, 2012; El Dorado County, 2012; BAE, 2013.

The initial conditions for any simulation/forecast can make a large difference in the results. As shown, the number of households in the BAE report in 2010 is 59,968 vs. the number used in the DEIR Table 3.9-6 is 55,493. There is a stark difference in the number of jobs in the two reports. The BAE report lists 32,597 jobs in the county in 2010, the DEIR lists 44,468.

In the 2035 projections for total households, the BAE report shows 77,077 while Scenario 6 in the DEIR shows 76,270. This difference does not seem to be that significant. What is very significant is the difference in total number of jobs. The BAE report shows 16,078 new jobs, while DEIR Scenario 6 shows 26,713 new jobs.

Please explain why baseline condition numbers from the BAE report for number of households and Employment are not used in the TDM analyses presented in the DEIR. Please explain why there is such a large discrepancy in the projected number of jobs in 2035.

Page 3.9-32 states that " The travel demand model (TDM) analysis evaluated 227 roadway segments for each of the six study scenarios to evaluate effects on the County's roadway network." This is insufficient to determine the project impact. Measure Y and the subsequent

General Plan policies require that "all intersections and interchanges" be examined. **The DEIR must be amended to include intersections and interchanges in the analysis of scenarios 1-6.**

Table 3.9-7 shows Minimum LOS for segments 44 and 151 to be "4AU". This is a road classification, not a LOS indication. **Please amend the table.**

Page 3.9-33 states: " Two segments of Green Valley Road would operate at an unacceptable LOS F and are expected to continue to operate at LOS F in the near future. Because these levels of service reflect existing conditions without the project, no project impacts would occur." *This is incorrect*, as the project may still "worsen" the LOS F conditions as defined in the General Plan, in which case mitigation measures spelled out must be instituted. **The DEIR must examine the LOS F segments which are made worse (as defined by General Plan Policy TC-Xe) by the project and list the following information: A) % increase in AM and PM peak hour traffic, B) ADT, C) The number of additional AM and PM peak hour trips. Any road segments that meet any of the criteria of "worsen" in this context represent a significant impact, and must be listed in the DEIR.**

Page 3-9.38 states: "One of the roadway segments, Missouri Flat Road, is allowed to operate at LOS F per General Plan Policy TC-Xa." While this is true, the General Plan also states that there is a maximum v/c ratio for two segments of that road.

1. Highway 50 to Mother Lode Drive may not operate at a v/c worse than 1.12
2. Mother Lode Drive to China Garden Road may not operate at a v/c worse than 1.20

Please state the future cumulative v/c ratios for these segments of Missouri Flat Road. If these ratios are worse than allowed in the general plan, provide the subsequent necessary mitigation measures in the DEIR.

Page 3-9.39 states: " Because the County has specific traffic mitigation policies that require future development projects to construct adequate roadway facilities to maintain acceptable levels of service and payment of fees that go toward making regional traffic improvements designed for improving traffic operations, potential impacts are considered less than significant." This is incorrect. The County does not require development projects to construct adequate roadway facilities to maintain acceptable levels of service. Depending on the project and impact, many development projects simply pay a fee to help pay for a project that may be 10 years or more away. In many cases, projects listed in the CIP keep slipping out in time and changing drastically in cost. For instance, CIP project #71324 (**Saratoga Extension Phase I**) has the following revisions to schedule and cost (from county DOT website):

EDC CIP	Project Completion Date	Estimated Cost
2006	06-07	10,000,000
2007	10-11	10,694,269
2008	09-10	16,298,226
2009	13 - 18	15,062,236
2010	14-19	15,279,510

2012	"after 2021"	11,541,347
2013	"after 2022"	11,541,347
2014	"FY 24/25 - 33/34"	11,541,347

Another example is CIP project #72332 (**EDH Blvd realignment**):

EDC CIP	Project Completion Date	Estimated Cost
2004	06-07	$ 2,689,996.00
2006	Jul-08	$ 5,033,559.00
2007	After 2011	$ 5,713,826.00
2008	After 2012	$ 14,268,688.00
2009	After 2018	$ 13,899,022.00
2010	after 2019	$ 11,694,000.00
2012	After 2021	$ 9,451,507.00
2013	"FY 23/24 - 32/33"	$ 9,452,000.00
2014	"FY 24/25 - 33/34"	$ 9,452,000.00

These two examples are not unique--there are many such projects where the dates get pushed out every year and the estimated costs jump wildly. CEQA demands that there be a reasonable expectation that a mitigation will occur and it will work. Our current situation with the county CIP program provides neither.

Please describe the process used by the county to ensure that 1) TIM fees are adequate to cover the construction of the mitigation at 10 and 20 years in the future. 2) Mitigations in the CIP do not get pushed out in time, or removed from the CIP. Describe the monitoring program for this, why it has failed in the past, and why it will succeed in the future.

Please analyze as an alternative to the current CIP program (which has not been working), amending of Policy TC-Xf as follows:

> ***At the time of approval of a tentative map for a single family residential subdivision of five or more parcels that worsens (defined as a project that triggers Policy TC-Xe [A] or [B] or [C]) traffic on the County road system, the County shall ~~do one of the following: (1)~~ condition the project to construct all road improvements necessary to maintain or attain Level of Service standards detailed in this Transportation and Circulation Element based on existing traffic plus traffic generated from the development plus forecasted traffic growth at 10-years from project submittal~~; or (2) ensure the commencement of construction of the necessary road improvements are included in the County's 10-year CIP~~.***

For all other discretionary projects that worsen (defined as a project that triggers Policy TC-Xe [A] or [B] or [C]) traffic on the County road system, the County shall ~~do one of the following: (1)~~ condition the project to construct all road improvements necessary to maintain or attain Level of Service standards detailed in this Transportation and Circulation Element based on existing traffic plus traffic generated from the development plus forecasted traffic growth at 10-years from project submittal~~; or (2) ensure the construction of the necessary road improvements are included in the County's 20-year CIP~~.

Page 3-9.39 states: "The improvements are shown by roadway segment in Table 3.9-1. These improvements are considered concept facilities, meaning they are the roadway improvements that are needed in the next 20 years (California Department of Transportation 2010). The TDM included these improvements in the analysis of the study scenarios. However, there is no assurance that these improvements to U.S. Highway 50 would be in place in 20 years. Therefore, potential short-term impacts would be significant and unavoidable until these improvements are in place." [emphasis added] **Since there is currently no plan by CalTrans or other agencies to provide "concept facility" improvements within 20 years, the DEIR must assume these improvements are not constructed within the Project Time Horizon. Scenarios 3,4,6 must then be re-run with that assumption.**

Page 3-9.40 states: "These measures would reduce or avoid decreasing LOS and require payment of TIM fees that would go toward making regional traffic improvements designed for improving traffic operations. Therefore, potential impacts would be less than significant." Improvements may not take place for 10 to 20 years after the completion of a project given the TIM fee arrangement. This could create a significant impact for 10 to 20 years (or more). **Please explain the rationale for stating this 10 to 20 year delay in implementing traffic operations as "less than significant." Especially given the examples and discussion above showing CIP projects moving out in time and radically up in cost.**

Page 3.9-43 Table 3.9-13:

1. Road segments (other than freeway segments), are listed with a total volume at peak AM and peak PM hours. Using this method, the volume and capacity numbers are misleading, and err on the side making the LOS appear better than it really is. As stated in HCM 2010, the information for each segment should include the directional split if available. This information is readily available at the El Dorado County DOT website. Looking at numbers for Green Valley road, the directional split is highly biased in the commute direction (e.g. 70/30). Thus one direction could be LOS F, the other LOS B, but when the two directions are combined, the result may show a misleading LOS D. **The DEIR needs to be updated to provide directional counts and LOS calculations on all roadways in the study area where directional counts have been measured.**

2. Measurement points. Measurement points on highway 50 are presented as "W of Latrobe" or "W of Bass Lake", etc. It is unclear whether or not these measurements

would include traffic from the ramps associated with the measurement point. **Please clarify where in each highway 50 segment the measurement is obtained and whether it is west of on/off ramps or not. If the counts are not west of the associated on/off ramps, please state the justification for this, as it would not give correct volume or LOS for that freeway segment.**

3. "Worsen". In order to understand whether or not the project will worsen already LOS F traffic (Policy TC-Xe):

    Policy TC-Xe For the purposes of this Transportation and Circulation Element, "worsen" is defined as any of the following number of project trips using a road facility at the time of issuance of a use and occupancy permit for the development project:

    A. A 2 percent increase in traffic during the a.m. peak hour, p.m. peak hour, or daily, or
    B. The addition of 100 or more daily trips, or
    C. The addition of 10 or more trips during the a.m. peak hour or the p.m. peak hour.

    The DEIR must measure the % increase in traffic during the AM and PM peak hours, and the additional ADT generated by the project for all road segments, intersections, and interchanges.

4. Missing road segments. In addition to intersections and interchanges, several critical segments of roadway are missing from the analysis. **Please provide the volume/LOS information for the following roads/segments in the same format as the others in Table 3.9-13. If any of the following road segments are not considered by the county as important to review, please list the reason for each segment.**
    a. **Highway 50 W of Empire Ranch interchange.**
    b. **Highway 50 West of Silva Valley Parkway. This is important to understand the impact of the new interchange.**
    c. **Highway 50 West of Cambridge Road. This is important to understand the impact of Marble Valley/Lime Rock developments, and future commercial in this area.**
    d. **Saratoga Way: all segments from EDH Blvd to Empire Ranch. This is important to understand the parallel capacity for highway 50.**
    e. **El Dorado Hills Blvd. north of Saratoga Way. This will be important to understand the future split of traffic for parallel capacity on Saratoga Way. This segment is 4AD today. What is the future configuration?**
    f. **El Dorado Hills Blvd. south of Park Drive. (Highway 50 WB ramp dumps out here, as well as left turns from El Dorado Hills Blvd. to WB 50, and exit from Raley's center)**
    g. **Empire Ranch Road. (all segments) Important to understand highway 50 impact, parallel capacity.**

h. **Latrobe Rd/White Rock Rd Connector (all segments). Important to understand the parallel capacity for highway 50.**
i. **Marble Valley Road south of Highway 50 Important to understand Marble Valley / Lime Rock contribution to highway 50 traffic.**
j. **Flying C/Deer Creek Road South of Highway 50. Important to understand Marble Valley / Lime Rock contribution to highway 50 traffic.**
k. **Green Valley Road East of Silva Valley Parkway. Important to understand the impact from Dixon Ranch.**
l. **Silver Springs Parkway South of Green Valley Road. Important to understand impact from Silver Springs, Dixon Ranch, Summerbrook, etc.**
m. **Latrobe Road north of Town Center Blvd. Important to understand impact of south of highway 50 and Town Center development, business.**
n. **Valley View Pkwy. south of White Rock Road (this road is used by commuters as a cut-through from the business park today. This is anticipated to get much worse once the Silva Valley interchange is complete, and additional business and residential is added south of Highway 50.)**

5. Existing conditions for Highway 50 W of Latrobe (ID 1 and 2) are very different (lower) than the CalTrans measurements. The CalTrans 2010 Traffic Counts book lists peak hour traffic at this segment as 8600 vehicles on the mainline freeway. The TDM table shows a peak volume of 3330 AM and 4100 PM. Clearly since CalTrans lists this segment of Highway 50 as LOS F in peak hour, the table must be incorrect. **Please correct the volume numbers or explain the justification for the numbers used and how they were obtained. This difference is very significant.**

3	50	SAC		23.136	SACRAMENTO/E DORADO CO LN	8,600	101,000	93,000			
3	50	ED		0	~~SACRAMENTO/E DORADO CO LN~~				8,600	101,000	93,000
3	50	ED		0.857	LATROBE RD	8,600	101,000	93,000	7,000	78,000	71,000
3	50	ED	R	1.677 R	~~BEG INDEP~~ ALIGN RT LNS	7,000	78,000	71,000	3,350	37,500	34,000
3	50	ED	R	1.677 L	BEGIN INDEP ALIGN LT LANES	3,350	37,500	23,000	3,350	37,500	34,000
3	50	ED	R	3.154	END INDEPENDENT ALIGN	3,350	37,500	34,000	7,000	78,000	71,000
3	50	ED	R	3.232	BASS LAKE RD	7,000	78,000	71,000	5,700	68,000	62,000
3	50	ED		4.962	CAMBRIDGE RD	5,700	68,000	62,000	5,600	64,000	61,000
3	50	ED		6.57	CAMERON PARK	5,600	64,000	61,000	5,600	64,000	61,000
3	50	ED	R	8.564	SHINGLE SPRINGS	5,600	64,000	61,000	3,850	51,000	47,500
3	50	ED	R	10.295	EAST SHINGLE SPRINGS	3,850	51,000	47,500	3,800	48,000	47,000

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6. Segments #5 and #6 of Highway 50 at Bass lake show a total peak volume of 4350AM and 5740PM. The CalTrans 2010 Traffic Counts book lists peak hour traffic at this segment as 7000. **Please correct the base volume numbers or explain the justification for the numbers used and how they were obtained.**

7. Several other road segments in the table have numbers substantially different than the El Dorado County DOT website count numbers (e.g. Segment #44 show a total peak volume of 1060AM and 1650PM. The EDC DOT Traffic count for 2010 lists peak hour traffic at this segment as 1900AM, 2050PM in Jan, and 1314AM, 2068PM in Jul. DOT numbers also list this segment as 1909AM/2116PM in Jan 2013. **Please correct the base volume numbers on all listed road segments or explain the justification for the numbers used and how they were obtained.**

8. NOP comments: The following comments received by the county on the Draft EIR NOP have not been fully addressed in the DEIR. **Please address the following items in the DEIR:**
   a) Page 710: Caltrans requests "Specifically, the EIR should identify the impacts that the increase in traffic will have on SHS segments, *intersections, and interchanges*, and any necessary mitigations to reduce the impacts to a less than significant level."

   b) Page 711: Caltrans requests "*Average Daily Traffic*, AM and PM peak hour volumes and levels of service (LOS) on all roadways where potentially significant impacts may occur, *including crossroads and controlled intersections* for existing, existing plus project, cumulative and cumulative plus project scenarios. Calculation of cumulative traffic volumes should *consider all traffic-generating developments, both existing and future*, that would affect study area roadways and intersections. The analysis should clearly identify the project's contribution to area traffic and any degradation to existing and cumulative LOS. [emphasis added]

   c) Page 711: Schematic illustration of traffic conditions including the project site and study area roadways, trip distribution percentages and volumes as well as intersection geometrics, i.e., lane configurations, for the scenarios described above.

   d) Page 711: Identification of mitigation for any roadway mainline section or intersection with insufficient capacity to maintain an acceptable LOS with the addition of project-related and/or cumulative traffic. As noted above, the project's fair share contribution, financing, scheduling, implementation responsibilities and lead agency monitoring should also be fully discussed for all proposed mitigation measures.

Attachment #27

GUIDE FOR THE PREPARATION

OF

TRAFFIC IMPACT STUDIES

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

December 2002

PREFACE

The California Department of Transportation (Caltrans) has developed this "Guide for the Preparation of Traffic Impact Studies" in response to a survey of cities and counties in California. The purpose of that survey was to improve the Caltrans local development review process (also known as the Intergovernmental Review/California Environmental Quality Act or IGR/CEQA process). The survey indicated that approximately 30 percent of the respondents were not aware of what Caltrans required in a traffic impact study (TIS).

In the early 1990s, the Caltrans District 6 office located in Fresno identified a need to provide better quality and consistency in the analysis of traffic impacts generated by local development and land use change proposals that effect State highway facilities. At that time, District 6 brought together both public and private sector expertise to develop a traffic impact study guide. The District 6 guide has proven to be successful at promoting consistency and uniformity in the identification and analysis of traffic impacts generated by local development and land use changes.

The guide developed in Fresno was adapted for statewide use by a team of Headquarters and district staff. The guide will provide consistent guidance for Caltrans staff who review local development and land use change proposals as well as inform local agencies of the information needed for Caltrans to analyze the traffic impacts to State highway facilities. The guide will also benefit local agencies and the development community by providing more expeditious review of local development proposals.

Even though sound planning and engineering practices were used to adapt the Fresno TIS guide, it is anticipated that changes will occur over time as new technologies and more efficient practices become available. To facilitate these changes, Caltrans encourages all those who use this guide to contact their nearest district office (i.e., IGR/CEQA Coordinator) to coordinate any changes with the development team.

ACKNOWLEDGEMENTS

The District 6 traffic impact study guide provided the impetus and a starting point for developing the statewide guide. Special thanks is given to Marc Birnbaum for recognizing the need for a TIS guide and for his valued experience and vast knowledge of land use planning to significantly enhance the effort to adapt the District 6 guide for statewide use. Randy Treece from District 6 provided many hours of coordination, research and development of the original guide and should be commended for his diligent efforts. Sharri Bender Ehlert of District 6 provided much of the technical expertise in the adaptation of the District 6 guide and her efforts are greatly appreciated.

A special thanks is also given to all those Cities, Counties, Regional Agencies, Congestion Management Agencies, Consultants, and Caltrans Employees who reviewed the guide and provided input during the development of this Guide for the Preparation of Traffic Impact Studies.

T A B L E O F C O N T E N T S

Contents		Page Number

I. INTRODUCTION

Caltrans desires to provide a safe and efficient State transportation system for the citizens of California pursuant to various Sections of the California Streets and Highway Code. This is done in partnership with local and regional agencies through procedures established by the California Environmental Quality Act (CEQA) and other land use planning processes. The intent of this guide is to provide a starting point and a consistent basis in which Caltrans evaluates traffic impacts to State highway facilities. The applicability of this guide for local streets and roads (non-State highways) is at the discretion of the effected jurisdiction.

Caltrans reviews federal, State, and local agency development projects[1], and land use change proposals for their potential impact to State highway facilities. The primary objectives of this guide is to provide:

- guidance in determining if and when a traffic impact study (TIS) is needed,
- consistency and uniformity in the identification of traffic impacts generated by local land use proposals,
- consistency and equity in the identification of measures to mitigate the traffic impacts generated by land use proposals,
- lead agency[2] officials with the information necessary to make informed decisions regarding the existing and proposed transportation infrastructure (see Appendix A, Minimum Contents of a TIS)
- TIS requirements early in the planning phase of a project (i.e., initial study, notice of preparation, or earlier) to eliminate potential delays later,
- a quality TIS by agreeing to the assumptions, data requirements, study scenarios, and analysis methodologies prior to beginning the TIS, and
- early coordination during the planning phases of a project to reduce the time and cost of preparing a TIS.

II. WHEN A TRAFFIC IMPACT STUDY IS NEEDED

The level of service[3] (LOS) for operating State highway facilities is based upon measures of effectiveness (MOEs). These MOEs (see Appendix “C-2”) describe the measures best suited for analyzing State highway facilities (i.e., freeway segments, signalized intersections, on- or off-ramps, etc.). Caltrans endeavors to maintain a target LOS at the transition between LOS “C” and LOS “D” (see Appendix “C-3”) on State highway facilities, however, Caltrans acknowledges that this may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS. If an existing State highway facility is operating at less than the appropriate target LOS, the existing MOE should be maintained.

[1] "Project" refers to activities directly undertaken by government, financed by government, or requiring a permit or other approval from government as defined in Section 21065 of the Public Resources Code and Section 15378 of the California Code of Regulations.
[2] “Lead Agency” refers to the public agency that has the principal responsibility for carrying out or approving a project. Defined in Section 21165 of the Public Resources Code, the "California Environmental Quality Act, and Section 15367 of the California Code of Regulations.
[3] “Level of service” as defined in the latest edition of the Highway Capacity Manual, Transportation Research Board, National Research Council.

A. Trip Generation Thresholds

The following criterion is a starting point in determining when a TIS is needed. When a project:

1. Generates over 100 peak hour trips assigned to a State highway facility
2. Generates 50 to 100 peak hour trips assigned to a State highway facility – and, affected State highway facilities are experiencing noticeable delay; approaching unstable traffic flow conditions (LOS "C" or "D").
3. Generates 1 to 49 peak hour trips assigned to a State highway facility – the following are examples that may require a full TIS or some lesser analysis[4]:
    a. Affected State highway facilities experiencing significant delay; unstable or forced traffic flow conditions (LOS "E" or "F").
    b. The potential risk for a traffic incident is significantly increased (i.e., congestion related collisions, non-standard sight distance considerations, increase in traffic conflict points, etc.).
    c. Change in local circulation networks that impact a State highway facility (i.e., direct access to State highway facility, a non-standard highway geometric design, etc.).

Note: A traffic study may be as simple as providing a traffic count to as complex as a microscopic simulation. The appropriate level of study is determined by the particulars of a project, the prevailing highway conditions, and the forecasted traffic.

B. Exceptions

Exceptions require consultation between the lead agency, Caltrans, and those preparing the TIS. When a project's traffic impact to a State highway facility can clearly be anticipated without a study and all the parties involved (lead agency, developer, and the Caltrans district office) are able to negotiate appropriate mitigation, a TIS may not be necessary.

C. Updating An Existing Traffic Impact Study

A TIS requires updating when the amount or character of traffic is significantly different from an earlier study. Generally a TIS requires updating every two years. A TIS may require updating sooner in rapidly developing areas and not as often in slower developing areas. In these cases, consultation with Caltrans is strongly recommended.

III. SCOPE OF TRAFFIC IMPACT STUDY

Consultation between the lead agency, Caltrans, and those preparing the TIS is recommended before commencing work on the study to establish the appropriate scope. At a minimum, the TIS should include the following:

A. Boundaries of the Traffic Impact Study

All State highway facilities impacted in accordance with the criteria in Section II should be studied. Traffic impacts to local streets and roads can impact intersections with State highway facilities. In these cases, the TIS should include an analysis of adjacent local facilities, upstream and downstream, of the intersection (i.e., driveways, intersections, and interchanges) with the State highway.

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[4] A "lesser analysis" may include obtaining traffic counts, preparing signal warrants, or a focused TIS, etc.

B. Traffic Analysis Scenarios

Caltrans is interested in the effects of general plan updates and amendments as well as the effects of specific project entitlements (i.e., site plans, conditional use permits, sub-divisions, rezoning, etc.) that have the potential to impact a State highway facility. The complexity or magnitude of the impacts of a project will normally dictate the scenarios necessary to analyze the project. Consultation between the lead agency, Caltrans, and those preparing the TIS is recommended to determine the appropriate scenarios for the analysis. The following scenarios should be addressed in the TIS when appropriate:

1. When only a general plan amendment or update is being sought, the following scenarios are required:
   a) <u>Existing Conditions</u> - Current year traffic volumes and peak hour LOS analysis of effected State highway facilities.
   b) <u>Proposed Project Only with Select Zone[5] Analysis</u> - Trip generation and assignment for build-out of general plan.
   c) <u>General Plan Build-out Only</u> - Trip assignment and peak hour LOS analysis. Include current land uses and other pending general plan amendments.
   d) <u>General Plan Build-out Plus Proposed Project</u> - Trip assignment and peak hour LOS analysis. Include proposed project and other pending general plan amendments.

2. When a general plan amendment is not proposed and a proposed project is seeking specific entitlements (i.e., site plans, conditional use permits, sub-division, rezoning, etc.), the following scenarios must be analyzed in the TIS:
   a) <u>Existing Conditions</u> - Current year traffic volumes and peak hour LOS analysis of effected State highway facilities.
   b) <u>Proposed Project Only</u> - Trip generation, distribution, and assignment in the year the project is anticipated to complete construction.
   c) <u>Cumulative Conditions</u> (Existing Conditions Plus Other Approved and Pending Projects Without Proposed Project) - Trip assignment and peak hour LOS analysis in the year the project is anticipated to complete construction.
   d) <u>Cumulative Conditions Plus Proposed Project</u> (Existing Conditions Plus Other Approved and Pending Projects Plus Proposed Project) - Trip assignment and peak hour LOS analysis in the year the project is anticipated to complete construction.
   e) <u>Cumulative Conditions Plus Proposed Phases</u> (Interim Years) - Trip assignment and peak hour LOS analysis in the years the project phases are anticipated to complete construction.
3. In cases where the circulation element of the general plan is not consistent with the land use element or the general plan is outdated and not representative of current or future forecasted conditions, all scenarios from Sections III. B. 1. and 2. should be utilized with the exception of duplicating of item 2.a.

[5] "Select zone" analysis represents a project only traffic model run, where the project's trips are distributed and assigned along a loaded highway network. This procedure isolates the specific impact on the State highway network.

IV. TRAFFIC DATA

Prior to any fieldwork, consultation between the lead agency, Caltrans, and those preparing the TIS is recommended to reach consensus on the data and assumptions necessary for the study. The following elements are a starting point in that consideration.

A. Trip Generation

The latest edition of the Institute of Transportation Engineers' (ITE) TRIP GENERATION report should be used for trip generation forecasts. Local trip generation rates are also acceptable if appropriate validation is provided to support them.

1. Trip Generation Rates – When the land use has a limited number of studies to support the trip generation rates or when the Coefficient of Determination (R^2) is below 0.75, consultation between the lead agency, Caltrans and those preparing the TIS is recommended.
2. Pass-by Trips[6] – Pass-by trips are only considered for retail oriented development. Reductions greater than 15% requires consultation and acceptance by Caltrans. The justification for exceeding a 15% reduction should be discussed in the TIS.
3. Captured Trips[7] – Captured trip reductions greater than 5% requires consultation and acceptance by Caltrans. The justification for exceeding a 5% reduction should be discussed in the TIS.
4. Transportation Demand Management (TDM) – Consultation between the lead agency and Caltrans is essential before applying trip reduction for TDM strategies.

NOTE: Reasonable reductions to trip generation rates are considered when adjacent State highway volumes are sufficient (at least 5000 ADT) to support reductions for the land use.

B. Traffic Counts

Prior to field traffic counts, consultation between the lead agency, Caltrans and those preparing the TIS is recommended to determine the level of detail (e.g., location, signal timing, travel speeds, turning movements, etc.) required at each traffic count site. All State highway facilities within the boundaries of the TIS should be considered. Common rules for counting vehicular traffic include but are not limited to:

1. Vehicle counts should be conducted on Tuesdays, Wednesdays, or Thursdays during weeks not containing a holiday and conducted in favorable weather conditions.
2. Vehicle counts should be conducted during the appropriate peak hours (see peak hour discussion below).
3. Seasonal and weekend variations in traffic should also be considered where appropriate (i.e., recreational routes, tourist attractions, harvest season, etc.).

C. Peak Hours

To eliminate unnecessary analysis, consultation between the lead agency, Caltrans and those preparing the TIS is recommended during the early planning stages of a project. In general, the TIS should include a morning (a.m.) and an evening (p.m.) peak hour analyses. Other peak hours (e.g., 11:30 a.m. to 1:30 p.m., weekend, holidays, etc.) may also be required to determine the significance of the traffic impacts generated by a project.

[6] "Pass-by" trips are made as intermediate stops between an origin and a primary trip destination (i.e., home to work, home to shopping, etc.).
[7] "Captured Trips" are trips that do not enter or leave the driveways of a project's boundary within a mixed-use development.

D. Travel Forecasting (Transportation Modeling)

The local or regional traffic model should reflect the most current land use and planned improvements (i.e., where programming or funding is secured). When a general plan build-out model is not available, the closest forecast model year to build-out should be used. If a traffic model is not available, historical growth rates and current trends can be used to project future traffic volumes. The TIS should clearly describe any changes made in the model to accommodate the analysis of a proposed project.

V. TRAFFIC IMPACT ANALYSIS METHODOLOGIES

Typically, the traffic analysis methodologies for the facility types indicated below are used by Caltrans and will be accepted without prior consultation. When a State highway has saturated flows, the use of a micro-simulation model is encouraged for the analysis (please note however, the micro-simulation model must be calibrated and validated for reliable results). Other analysis methods may be accepted, however, consultation between the lead agency, Caltrans and those preparing the TIS is recommended to agree on the data necessary for the analysis.

A. Freeway Segments – Highway Capacity Manual (HCM)*, operational analysis
B. Weaving Areas – Caltrans Highway Design Manual (HDM)
C. Ramps and Ramp Junctions – HCM*, operational analysis or Caltrans HDM, Caltrans Ramp Metering Guidelines (most recent edition)
D. Multi-Lane Highways – HCM*, operational analysis
E. Two-lane Highways – HCM*, operational analysis
F. Signalized Intersections[8] – HCM*, Highway Capacity Software**, operational analysis, TRAFFIX™**, Synchro**, see footnote 8
G. Unsignalized Intersections – HCM*, operational analysis, Caltrans Traffic Manual for signal warrants if a signal is being considered
H. Transit – HCM*, operational analysis
I. Pedestrians – HCM*
J. Bicycles – HCM*
K. Caltrans Criteria/Warrants – Caltrans Traffic Manual (stop signs, traffic signals, freeway lighting, conventional highway lighting, school crossings)
L. Channelization – Caltrans guidelines for Reconstruction of Intersections, August 1985, Ichiro Fukutome

*The most current edition of the Highway Capacity Manual, Transportation Research Board, National Research Council, should be used.

****NOTE**: Caltrans does not officially advocate the use of any special software. However, consistency with the HCM is advocated in most but not all cases. The Caltrans local development review units utilize the software mentioned above. If different software or analytical techniques are used for the TIS then consultation between the lead agency, Caltrans and those preparing the TIS is recommended. Results that are significantly different than those produced with the analytical techniques above should be challenged.

[8] The procedures in the Highway Capacity Manual "do not explicitly address operations of closely spaced signalized intersections. Under such conditions, several unique characteristics must be considered, including spill-back potential from the downstream intersection to the upstream intersection, effects of downstream queues on upstream saturation flow rate, and unusual platoon dispersion or compression between intersections. An example of such closely spaced operations is signalized ramp terminals at urban interchanges. Queue interactions between closely spaced intersections may seriously distort the procedures in" the HCM.

VI. MITIGATION MEASURES

The TIS should provide the nexus [Nollan v. California Coastal Commission, 1987, 483 U.S. 825 (108 S.Ct. 314)] between a project and the traffic impacts to State highway facilities. The TIS should also establish the rough proportionality [Dolan v. City of Tigard, 1994, 512 U.S. 374 (114 S. Ct. 2309)] between the mitigation measures and the traffic impacts. One method for establishing the rough proportionality or a project proponent's equitable responsibility for a project's impacts is provided in Appendix "B." Consultation between the lead agency, Caltrans and those preparing the TIS is recommended to reach consensus on the mitigation measures and who will be responsible.

Mitigation measures must be included in the traffic impact analysis. This determines if a project's impacts can be eliminated or reduced to a level of insignificance. Eliminating or reducing impacts to a level of insignificance is the standard pursuant to CEQA and the National Environmental Policy Act (NEPA). The lead agency is responsible for administering the CEQA review process and has the principal authority for approving a local development proposal or land use change. Caltrans, as a responsible agency, is responsible for reviewing the TIS for errors and omissions that pertain to State highway facilities. However, the authority vested in the lead agency under CEQA does not take precedence over other authorities in law.

If the mitigation measures require work in the State highway right-of-way an encroachment permit from Caltrans will be required. This work will also be subject to Caltrans standards and specifications. Consultation between the lead agency, Caltrans and those preparing the TIS early in the planning process is strongly recommended to expedite the review of local development proposals and to reduce conflicts and misunderstandings in both the local agency CEQA review process as well as the Caltrans encroachment permit process.

APPENDIX “A”

MINIMUM CONTENTS

OF A

TRAFFIC IMPACT STUDY

MINIMUM CONTENTS OF TRAFFIC IMPACT STUDY REPORT

I. EXECUTIVE SUMMARY

II. TABLE OF CONTENTS

A. List of Figures (Maps)
B. List of Tables

III. INTRODUCTION

A. Description of the proposed project
B. Location of project
C. Site plan including all access to State highways (site plan, map)
D. Circulation network including all access to State highways (vicinity map)
E. Land use and zoning
F. Phasing plan including proposed dates of project (phase) completion
G. Project sponsor and contact person(s)
H. References to other traffic impact studies

IV. TRAFFIC ANALYSIS

A. Clearly stated assumptions
B. Existing and projected traffic volumes (including turning movements), facility geometry (including storage lengths), and traffic controls (including signal phasing and multi-signal progression where appropriate) (figure)
C. Project trip generation including references (table)
D. Project generated trip distribution and assignment (figure)
E. LOS and warrant analyses - existing conditions, cumulative conditions, and full build of general plan conditions with and without project

V. CONCLUSIONS AND RECOMMENDATIONS

A. LOS and appropriate MOE quantities of impacted facilities with and without mitigation measures
B. Mitigation phasing plan including dates of proposed mitigation measures
C. Define responsibilities for implementing mitigation measures
D. Cost estimates for mitigation measures and financing plan

VI. APPENDICES

A. Description of traffic data and how data was collected
B. Description of methodologies and assumptions used in analyses
C. Worksheets used in analyses (i.e., signal warrant, LOS, traffic count information, etc.)

APPENDIX “B”

METHODOLOGY FOR

CALCULATING EQUITABLE

MITIGATION MEASURES

METHOD FOR CALCULATING EQUITABLE MITIGATION MEASURES

The methodology below is neither intended as, nor does it establish, a legal standard for determining equitable responsibility and cost of a project's traffic impact, the intent is to provide:

1. A starting point for early discussions to address traffic mitigation equitably.
2. A means for calculating the equitable share for mitigating traffic impacts.
3. A means for establishing rough proportionality [Dolan v. City of Tigard, 1994, 512 U.S. 374 (114 S. Ct. 2309)].

The formulas should be used when:

- A project has impacts that do not immediately warrant mitigation, but their cumulative effects are significant and will require mitigating in the future.
- A project has an immediate impact and the lead agency has assumed responsibility for addressing operational improvements

NOTE: This formula is not intended for circumstances where a project proponent will be receiving a substantial benefit from the identified mitigation measures. In these cases, (e.g., mid-block access and signalization to a shopping center) the project should take full responsibility to toward providing the necessary infrastructure.

<u>EQUITABLE SHARE RESPONSIBILITY</u>: Equation C-1
NOTE: $T_E < T_B$, see explanation for T_B below.

$$P = \frac{T}{T_B - T_E}$$

Where:

P = The equitable share for the proposed project's traffic impact.
T = The vehicle trips generated by the project during the peak hour of adjacent State highway facility in vehicles per hour, vph.
T_B = The forecasted traffic volume on an impacted State highway facility at the time of general plan build-out (e.g., 20 year model or the furthest future model date feasible), vph.
T_E = The traffic volume existing on the impacted State highway facility plus other approved projects that will generate traffic that has yet to be constructed/opened, vph.

<u>EQUITABLE COST</u>: Equation C-2

$$C = P\,(C_T)$$

Where:

C = The equitable cost of traffic mitigation for the proposed project, ($). (Rounded to nearest one thousand dollars)
P = The equitable share for the project being considered.
C_T = The total cost estimate for improvements necessary to mitigate the forecasted traffic demand on the impacted State highway facility in question at general plan build-out, ($).

NOTES

1. Once the equitable share responsibility and equitable cost has been established on a per trip basis, these values can be utilized for all projects on that State highway facility until the forecasted general plan build-out model is revised.
2. Truck traffic should be converted to passenger car equivalents before utilizing these equations (see the Highway Capacity Manual for converting to passenger car equivalents).

3. If the per trip cost is not used for all subsequent projects, then the equation below will be necessary to determine the costs for individual project impact and will require some additional accounting.

Equation C-2.A

$$C = P\,(C_T - C_C)$$

Where:

C = Same as equation C-2.

P = Same as equation C-2.

C_T = Same as equation C-2.

C_C = The combined dollar contributions paid and committed prior to current project's contribution. This is necessary to provide the appropriate cost proportionality. Example: For the first project to impact the State highway facility in question since the total cost (C_T) estimate for improvements necessary to mitigate the forecasted traffic demand, C_C would be equal to zero. For the second project however, C would equal $P_2(C_T – C_1)$ and for the third project to come along C would equal $P_3[C_T – (C_1 + C_2)]$ and so on until build-out or the general plan build-out was recalculated.

APPENDIX “C”

MEASURES OF EFFECTIVENESS

BY

FACILITY TYPE

MEASURES OF EFFECTIVENESS BY FACILITY TYPE

TYPE OF FACILITY	MEASURE OF EFFECTIVENESS (MOE)
Basic Freeway Segments	Density (pc/mi/ln)
Ramps	Density (pc/mi/ln)
Ramp Terminals	Delay (sec/veh)
Multi-Lane Highways	Density (pc/mi/ln)
Two-Lane Highways	Percent-Time-Following Average Travel Speed (mi/hr)
Signalized Intersections	Control Delay per Vehicle (sec/veh)
Unsignalized Intersections	Average Control Delay per Vehicle (sec/veh)
Urban Streets	Average Travel Speed (mi/hr)

Measures of effectiveness for level of service definitions located in the most recent version of the Highway Capacity Manual, Transportation Research Board, National Research Council.

Transition between LOS "C" and LOS "D" Criteria

(Reference Highway Capacity Manual)

BASIC FREEWAY SEGMENTS @ 65 mi/hr

LOS	Maximum Density (pc/mi/ln)	Minimum Speed (mph)	Maximum v/c	Maximum Service Flow Rate (pc/hr/ln)
A	11	65.0	0.30	710
B	18	65.0	0.50	1170
C	26	64.6	0.71	1680
D	35	59.7	0.89	2090
E	45	52.2	1.00	2350

SIGNALIZED INTERSECTIONS and RAMP TERMINALS

LOS	Control Delay per Vehicle (sec/veh)
A	**≤ 10**
B	**> 10 - 20**
C	**> 20 - 35**
D	**> 35 - 55**
E	**> 55 - 80**
F	**> 80**

MULTI-LANE HIGHWAYS @ 55 mi/hr

LOS	Maximum Density (pc/mi/ln)	Minimum Speed (mph)	Maximum v/c	Maximum Service Flow Rate (pc/hr/ln)
A	11	55.0	0.29	600
B	18	55.0	0.47	990
C	26	54.9	0.68	1430
D	35	52.9	0.88	1850
E	41	51.2	1.00	2100

▪▪▪▪▪ Dotted line represents the transition between LOS "C" and LOS "D"

TWO-LANE HIGHWAYS

LOS	Percent Time-Spent-Following	Average Travel Speed (mi/hr)
A	35	> 55
B	> 35 - 50	> 50 - 55
C	> 50 - 65	> 45 - 50
D	> 65 - 80	> 40 - 45
E	> 80	40

URBAN STREETS

Urban Street Class	I	II	III	IV
Range of FFS	55 to 45 mi/hr	45 to 35 mi/hr	35 to 30 mi/hr	35 to 25 mi/hr
Typical FFS	50 mi/hr	40 mi/hr	35 mi/hr	30 mi/hr
LOS	Average Travel Speed (mi/hr)			
A	> 42	> 35	> 30	> 25
B	> 34 - 42	> 28 - 35	> 24 - 30	> 19 - 25
C	> 27 - 34	> 22 - 28	> 18 - 24	> 13 - 19
D	> 21 - 27	> 17 - 22	> 14 - 18	> 9 - 13
E	> 16 - 21	> 13 - 17	> 10 - 14	> 7 - 9
F	16	13	10	7

Dotted line represents the transition between LOS "C" and LOS "D"

GRAY DAVIS
Governor

MARIA CONTRERAS-SWEET
Secretary
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Additional copies of these guidelines can be copied from the internet at,
http://www.dot.ca.gov/hq/traffops/developserv/operationalsystems/

Attachment #28

DEPARTMENT OF TRANSPORTATION
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032014-ELD-0007
03-ELD-50/PM Various
SCH#2012052074

Ms. Shawna Purvines
Long Range Planning
El Dorado County
2850 Fairland Court, Building C
Placerville, CA 95672

Targeted General Plan Amendment and Zoning Ordinance Update (TGPA-ZOU) – Draft Environmental Impact Report (DEIR)

Dear Ms. Purvines:

Thank you for including the California Department of Transportation (Caltrans) in the review process for the County of El Dorado Targeted General Plan Amendment and Zoning Ordinance Update (TGPA-ZOU) DEIR. The TGPA-ZOU proposes amendments to existing policies and regulations and establishes new policies and regulations regarding land use and transportation within the unincorporated parts of El Dorado County. There are several proposed policy changes associated with the project, including densification of some existing land uses, that will influence future development throughout the County. The following comments concern the analysis and implications of these changes, so that impacts to the State Highway System are disclosed and adequately mitigated for, protecting interregional travel and safety throughout the County. We look forward to continuing to work with the County of El Dorado staff, stakeholders, and the El Dorado County community in the refinement and implementation of the TGPA-ZOU. Our comments are based on the DEIR received:

Caltrans State Highway System Planning

- ES.5 (Page ES-17), 3.9.1 Existing Conditions (Page 3.9-1), 3.9.2 Environmental Impacts (Page 3.9-23), Table 3.9-1 (Pages 3.9-3 through 3.9-4), and Table D.7-3 (Pages D-13 through D-14), Tables D.8-3 through D.8-7 (Pages D-19 through D-23) – In numerous instances, the DEIR cites highway information from the Caltrans 2009 U.S. Highway 50 (US 50) Corridor System Management Plan (CSMP) and the 2010 US 50 Transportation Concept Report (TCR). Please note that Caltrans has updated and combined these documents into the current 2014 US 50 TCR-CSMP. The 2014 US 50 TCR-CSMP for is available at:

  http://www.dot.ca.gov/dist3/departments/planning/tcr/tcr50.pdf

The "Current Level of Service (LOS)", "20 Year Concept LOS", and "Concept Facility" columns in Tables 3.9-1 and D.7-3 are inaccurate, and should be replaced with the updated information from the 2014 US 50 TCR-CSMP. Furthermore, the segmentation of US 50 has changed – for example, US 50 from the Sacramento/El Dorado County Line to Cameron Park Drive has been broken up into three distinct segments based on current traffic patterns and facility configuration. Please see Attachment A, Table 13: US 50 Basic System Characteristics (page 49 from the 2014 US 50 TCR-CSMP) for updated data and segmentation of US 50.

- <u>3.9.1 Existing Conditions (Page 3.9-15)</u> – Existing General Plan Policy TC-Xa, item No. 2 states:

  "The County shall not add any additional segments of US Highway 50, or any other roads, to the County's list of roads allowed to operate at LOS F without first getting the voter's approval or by 4/5ths vote of the Board of Supervisors."

  Table TC-2 (Page 3.9-16) subsequently lists a number of County Roads and US 50 segments within unincorporated El Dorado County which are allowed under policy TC-Xa to operate at LOS F.

  We are concerned with the application of this General Plan policy in the DEIR to determine impact significance on State Highway System facilities. This creates the potential of County Roads operating beyond their designed capacity spilling into US 50 and SR 49, thus adversely affecting highway operations and possibly safety.

  For instance, Tables 3.9-9 (Page 3.9-35) and 3.9-10 (Page 3.9-36) Study Scenario 3 and 4, state that Missouri Flat Road 400 yards north of Forni Road will worsen to LOS F during the PM Peak Hour. However, according to the DEIR, this is "Not considered an impact because this roadway segment is included in the list of roadway segments allowed to operate at LOS F as shown in Table 3.9-4." If the operations of Missouri Flat Road in the vicinity of US 50 are causing queuing that exceeds the available storage of the ramps, and this compromises the safety on US 50, this would be considered a significant impact under the California Environmental Quality Act (CEQA). Queuing that exceeds available storage denotes a breakdown in the flow of traffic and creates traffic hazards with automobiles in intersections and preventing some through traffic movements.

  Furthermore, Table TC-2, which is associated with this policy, does not reflect current Caltrans operational performance concepts for either US 50 or SR 49, presently or in the future. The table appears not to have been updated since it was first adopted in the late 1990's. While this DEIR and the associated policy changes to the 2004 General Plan do not propose changing this table, we strongly encourage El Dorado County to revise it to reflect current concepts. Caltrans has established a minimum acceptable LOS for freeway segments, called "Concept LOS," of LOS E for urban areas and LOS D for rural areas. Please see Attachment A for current Concept LOS values for US 50.

- 3.9.2 Environmental Impacts (Page 3.9-30) – Impact "5.4-3. Short term unacceptable LOS conditions related to generation of new traffic in advance of transportation improvements" states:

  "Policy TC-Xf of the General Plan includes modified language to allow a potential lag to occur between the issuance of use or occupancy permits and required roadway improvements as long as roadway improvements necessary to accommodate 'existing plus project' traffic are programmed (i.e., fully funded)."

  Again, we are concerned with how existing General Plan policy is cited in the DEIR to justify significant and unavoidable impacts to the State Highway System. Many transportation improvement projects that are programmed are not constructed for several years and are sometimes cancelled. A policy that permits a "lag" between when occupancy permits are issued and when required roadway improvements are built could potentially degrade highway operations and possibly create unsafe conditions for motorists, bicyclists, and pedestrians. Caltrans, El Dorado County, El Dorado County Transportation Commission (EDCTC), and other local agencies and entities should ensure that transportation improvements are built in concert with incoming development, so that travel growth is managed and that roadway safety is enhanced or at least maintained.

Clarification Comments

- ES.5 (Page ES-18) and 3.9.2 Environmental Impacts (Page 3.9-28) – The DEIR states:

  "Third, Caltrans is planning for the future of the State Highway system while El Dorado County is tasked with the planning, improvement, and maintenance of the local network. It should be noted that Caltrans is planning for LOS F on U.S. Highway 50 in the future, while El Dorado County is tasked with maintaining LOS E on U.S. Highway 50 where it runs through Community Regions and LOS D in all other areas of the county, as required by General Plan Policy TC-Xd and Policy 5.1.2.2."

  Caltrans is not planning for LOS F on US 50. As stated earlier, Caltrans has established "Concept LOS" values that represent minimum acceptable LOS values for highway segments. Please see Attachment A for Caltrans Concept LOS values for US 50.

  The 2014 US 50 TCR-CSMP does identify that certain segments are either currently operating at LOS F or are forecasted to operate at LOS F. Any present or future LOS analysis that concludes a freeway segment will operate at LOS F highlights areas where future demand will exceed future capacity and illustrates a need for more capacity and/or operational improvements and/or system management strategies in that area.

- ES.5 (Page ES-17) and 3.9.2 Environmental Impacts (Page 3.9-27) – The DEIR states:

  "Caltrans Operations staff has also stated that once the ramp metering for the westbound El Dorado Hills Boulevard on-ramp is operational, LOS on this segment should improve."

  The statement should be revised to read, "LOS on this segment may temporarily improve." Microsimulation analysis is needed in order to accurately determine whether or not LOS will improve with the addition of the ramp meter. The ramp meter alone may not be enough to improve the LOS, and other improvements and/or strategies may be needed to accommodate travel demand on US 50.

- ES.5 (Page ES-18) and 3.9.2 Environmental Impacts (Page 3.9-28) – The DEIR states:

  "Caltrans and El Dorado County also differ in determining the amount and distribution of future development. Caltrans determines the annual growth from SACOG's models and applies the traffic growth to the baseline conditions to determine the 20-year volumes."

  This statement is incorrect. Caltrans has previously discussed with the County that growth factors are developed for freeway segments based on all applicable Travel Demand Models in the analysis area as well as linear regression analysis of historical traffic volumes.

- ES.5 (Pages ES-17-18) and 3.9.2 Environmental Impacts (Page 3.9-28) – The DEIR states:

  "Second, Caltrans and El Dorado County use different practices regarding how traffic counts are collected and used to model future transportation system performance. Caltrans' count data for freeways are counted throughout the year, with some locations counted continuously. Locations that are not counted throughout the year are sampled every 3 years at different times during the count year. Final volumes are adjusted by compensating for seasonal influence, weekly variation, and other variables that may be present. Caltrans counts are based on a 7-day week."

  Caltrans has previously discussed with the County that traffic counts obtained from a smaller sample size are more likely to be adversely affected by weather, traffic incidents, and seasonal and weekly travel fluctuations. Our counting method endeavors to capture a representative sample so that we have a holistic understanding of traffic conditions on the State Highway System throughout the year.

El Dorado County Travel Demand Model (TDM) and Methodology

- ES.5 (Page ES-17) and 3.9.2 Environmental Impacts (Page 3.9-27) – The DEIR states:

  "El Dorado County's updated Travel Demand Model (TDM) was used to model six roadway network scenarios for the TGPA/ZOU project. This Analysis indicates that U.S. Highway 50 will not reach LOS F in 2035 under any of the six roadway network scenarios analyzed."

In a letter sent to the County of El Dorado on February 14th, 2014, regarding review of the El Dorado County TDM, Caltrans stated that comments and concerns regarding the final draft base year model and documentation had yet to be addressed. There are specific concerns about network assumptions that directly affect the demand volumes on US 50, specifically low freeway link speeds constraining demand volumes. Furthermore, Caltrans has yet to review any future El Dorado County TDM scenarios because the County stated that the future forecasts were yet to be finalized. Caltrans believes that before any future El Dorado County TDM scenarios are analyzed, the network issues in the base year El Dorado County TDM need to be corrected. Since the base year model used in this analysis did not incorporate our freeway link speed comments and the future forecasts and models have yet to be reviewed or approved, we cannot agree with the conclusions derived from the traffic analysis. The LOS analysis for US 50 should be redone once the base year and future year models are completed and approved by Caltrans.

Regarding conditions on US 50, according to the Caltrans Performance Measurement System (PeMS) and the 2010 Highway Capacity Manual freeway segment analysis, the Sacramento/El Dorado County line to Latrobe Road freeway segment of US 50 currently operates at LOS F (please see Attachment A). In order for the 2035 US 50 LOS to improve from F to E, 2035 traffic volumes on US 50 will need to be lower than current traffic volumes and/or significant mainline and parallel capacity/operational improvements are needed to offset the current travel demand and future travel demand increases on US 50. Also, using the El Dorado County TDM projected traffic volumes growth and the industry standard differential method to develop future forecasts, Caltrans projects that US 50 will operate at LOS F in 2035.

- Table D.7-1 Level of Service Typical Traffic Volumes (Page D-10) – Table D.7-1 describes the methodology and peak hour service volumes thresholds used to determine the level of service of roadways in El Dorado County. The narrative states, "These values (are) not appropriate for making detailed or final determinations regarding operational or design considerations." However, the conclusions derived from the traffic modeling make specific operational determinations that contradict this statement. For example, ES.5 states, "US 50 will not reach LOS F in 2035 under any of the six roadway network scenarios analyzed." Level of service for freeways should be calculated using the 2010 Highway Capacity Manual freeway segment analysis, which requires more input data than exclusively using the service volumes used in this DEIR.

  Caltrans would like to review the postprocessor and a more detailed summary of the methodology used to develop the forecast volumes used to determine the level of service of US 50 and SR 49. Raw volumes from travel demand models are seldom used in traffic analysis; however, the difference in volumes between forecast years and/or scenarios applied to applicable base year count volumes is standard of practice. The document does not clearly state whether this methodology was used or not. The "difference" method should have been used to develop future volumes.

Please provide our office with copies of any further actions regarding this project. We would appreciate the opportunity to review and comment on any changes related to this project.

If you have any questions regarding these comments or require additional information, please contact Robert J. Peters, Intergovernmental Review Coordinator, at (916) 274-0639 or by email at: robert.j.peters@dot.ca.gov.

Sincerely,

MARLO TINNEY
Chief, Office of Transportation Planning – East

Cc: Scott Morgan, State Clearinghouse

Attachment A

TABLE 13: US 50 BASIC SYSTEM OPERATIONS

Seg. #	County	Post Miles	Distance (Miles)	Average Annual Daily Traffic			Level of Service (LOS)				Vehicle Miles Traveled (VMT)			Delay	
				Base Year (BY)*	No Build (Horizon Year (HY))*	Build (HY)	BY	No Build (HY)	Build (HY)	Concept LOS	BY	No Build (HY)	Build (HY)	Daily Vehicle Hours of Delay	Daily Person Hours of Delay
1	YOL	0.00/3.16	3.16	176,000	206,000	210,000	E	F	F	E	337,274	394,000	402,000	228	310
2	SAC	L0.00/L2.48(R0.00)	2.48	246,000	279,000	300,000	F	F	F	E	452,373	513,000	552,000	1,697	2,309
3	SAC	R0.00/R5.34	5.34	206,000	249,000	265,000	F	F	F	E	959,231	1,158,000	1,235,000	1,708	2,323
4	SAC	R5.34/R10.92	5.58	171,000	226,000	234,000	F	F	F	E	660,438	873,000	905,000	509	692
5	SAC	R10.92/12.50	1.58	141,000	196,000	204,000	E	F	F	E	194,349	271,000	281,000	204	278
6	SAC	12.50/17.01	4.51	117,000	160,000	161,000	F	F	F	E	630,648	862,000	866,000	565	768
7	SAC	17.01/23.14	6.13	91,000	113,000	132,000	F	F	F	E	521,760	645,000	759,000	158	215
8	ELD	0.00/0.86	0.86	91,000	100,000	110,000	F	F	F	E	81,060	89,000	98,000	59	80
9	ELD	0.86/R3.23	2.37	70,000	94,000	105,000	E	F	F	E	127,860	171,000	191,000	10	13
10	ELD	R3.23/6.57	3.34	61,000	86,000	84,000	D	F	D	E	207,994	294,000	286,000	51	70
11	ELD	6.57/R8.56	1.99	61,000	73,000	77,000	D	E	D	E	170,099	203,000	216,000	15	20
12	ELD	R8.56/R15.06	6.5	52,000	67,000	71,000	C	D	C	E	307,233	396,000	420,000	16	21
13	ELD	R15.06/17.25	2.19	49,500	59,000	67,000	D	D	E	E	129,242	153,000	176,000	6	9
14	ELD	17.25/18.11	0.86	52,000	59,000	58,000	C	C	C	D	37,604	43,000	42,000	132	179
15	ELD	18.11/R25.95	7.84	30,000	35,000	35,000	C	C	C	E / D*	180,361	212,000	213,000	31	43
16	ELD	R25.95/R31.97	6.02	19,900	24,880	24,900	B	C	C	E	108,240	135,300	135,420	Not available for TCR corridor	
17	ELD	R31.97/39.77	7.65	12,700	15,880	15,890	B	C	C	D	97,160	121,450	121,560		
18	ELD	39.77/66.63	26.64	13,100	16,380	16,390	E	F	F	D	351,840	439,800	440,190		
19	ELD	66.63/70.62	3.99	10,900	13,630	13,640	E	E	E	D	36,270	45,340	45,380		
20	ELD	70.62/75.45	4.83	19,000	23,750	23,770	E	F	F	D	68,450	85,560	85,640		
21	ELD	75.45/80.44	4.99	33,000	42,900	42,940	E	F	F	E	159,040	206,750	206,930		

Note: Please see Appendix A: Glossary for explanation of these terms and performance measures.
*- Concept LOS on a segment that contains both urban and rural portions

Attachment:

Survey Results

El Dorado Hills Community Survey

Results and Summary Report

Prepared by: Chris Aguirre

1/21/2014

Introduction and Background

AIM Consulting is working with El Dorado County on a Vision Implementation Plan (VIP) to better understand the community planning status and activities within the different communities in the county. El Dorado County has provided support in order to work with the communities to assist in their respective processes. The El Dorado Hills Economic Development Advisory Committee (EDAC) has helped to establish a community planning approach and, therefore, AIM Consulting worked with the El Dorado Hills EDAC to assist in obtaining broader participation in the early phases of the planning process.

In September AIM Consulting met with the El Dorado Hills EDAC to gain a better understanding on the priorities of the committee and how best to obtain broader input from the community members. A community survey was identified as an optimal first step in involving more people in the process. The EDAC and AIM reviewed a variety of community surveys, which helped define what type of information the group would like to obtain. AIM carefully designed the survey to obtain information on what community members view as priorities in regards to different aspects of El Dorado Hills. The survey sought to acquire information pertinent to each EDAC subcommittee, gather some demographic information, and serve as a starting point for more in-depth community dialogue. The content below reports on the results of the survey and offers recommendations for next steps.

Results

The survey consisted of seventeen questions. Demographic information was captured, but the majority of questions focused on participants' perceptions on residential and commercial land-use, job development, transportation, recreation and open space, and community identity. The survey was administered online and was also made available at the El Dorado Hills CSD and Library. The EDAC also hosted a kick-off event on November 19, 2013 at the California Welcome Center in the El Dorado Hills Town Center. A total of 2,157 participants started and completed part of the survey, of the 2,157 participants that started the survey a total of 1,814 people completed the entire survey. The survey was closed on December 23, 2013.

Demographics

The demographic questions were voluntary, but over 2,000 participants answered each of the questions. The gender breakdown consisted of 54.4% female and 45.6% male. The age distribution is illustrated in the graph below:

Graph I

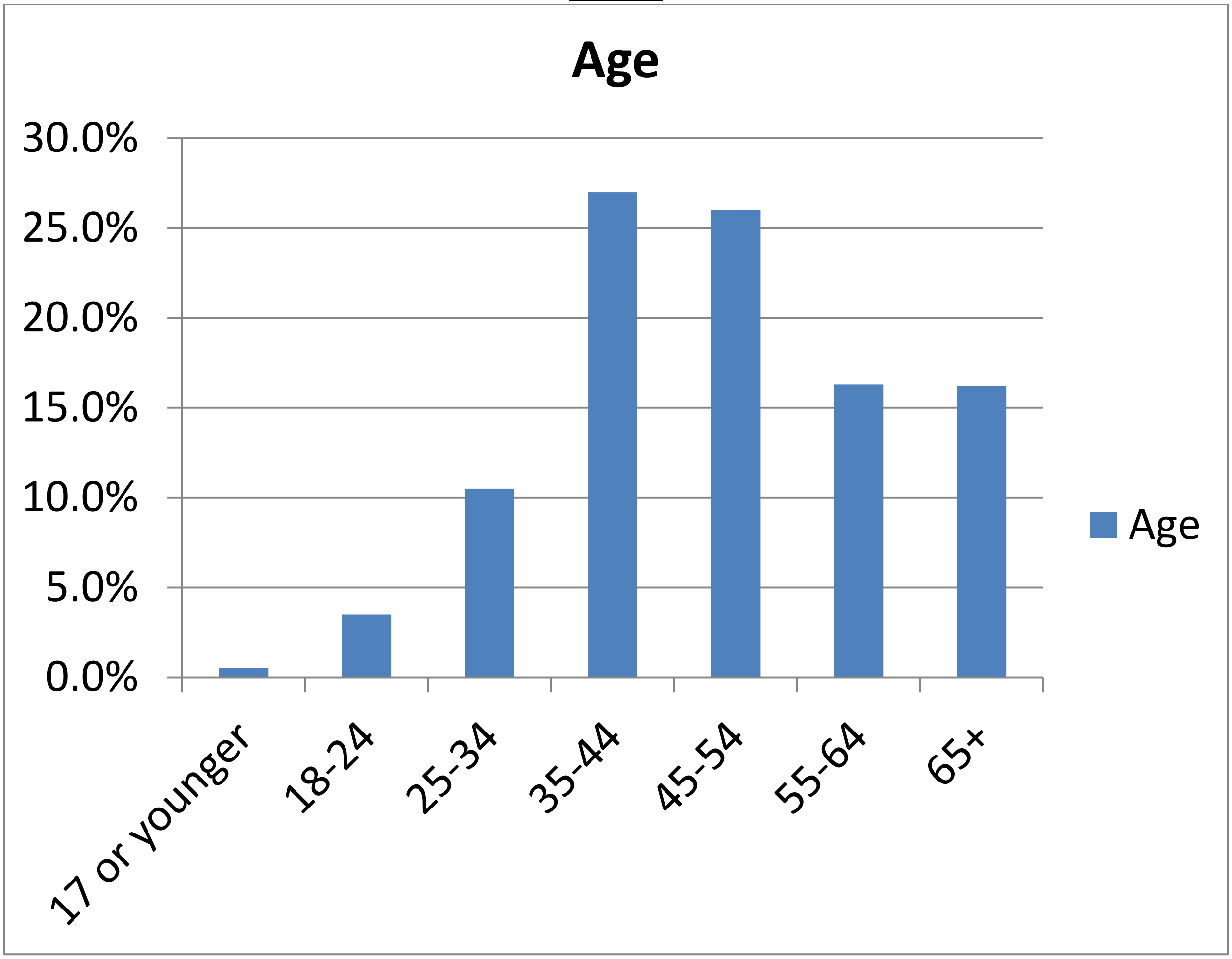


Table I displays where individuals reside and/or work:

Table I

Please select the following that best describes you:	
Reside in El Dorado Hills, but work elsewhere	38.9%
Work in El Dorado Hills, but live elsewhere	3.0%
Reside and work in El Dorado Hills	29.9%
Reside in El Dorado Hills	28.2%

Table II displays where community members reside (a map was provided within the survey that indicated the different areas):

Table II

Area in which you reside (if applicable):	
West of Salmon Falls Road	12.7%
East of Salmon Falls Road	3.8%
West of EDH Blvd.	28.7%
East of EDH Blvd.	29.8%
South of Serrano Parkway to 50	16.3%
South of 50 West	4.6%
South of 50 East	4.1%

The information below is a synopsis of the data obtained through the survey. The main areas that the survey was intended to obtain information on was people's perceptions and opinions on current land-use, local transportation, community attributes, and recreation, trails, and open space.

Land-Use

The survey requested participants provide their opinion on the amount of land devoted to certain uses by indicating if they felt there was too much, sufficient, or need more. In regards to housing land-uses, a majority of respondents felt that single-family residential, condominiums, apartment complexes, affordable housing, and senior housing were sufficient, with single-family residential being the highest at 72%. While 52% of respondents rated senior housing as sufficient, 31% rated as need more. Apartment complexes and affordable housing were rated as too much by 35% and 25%, respectively.

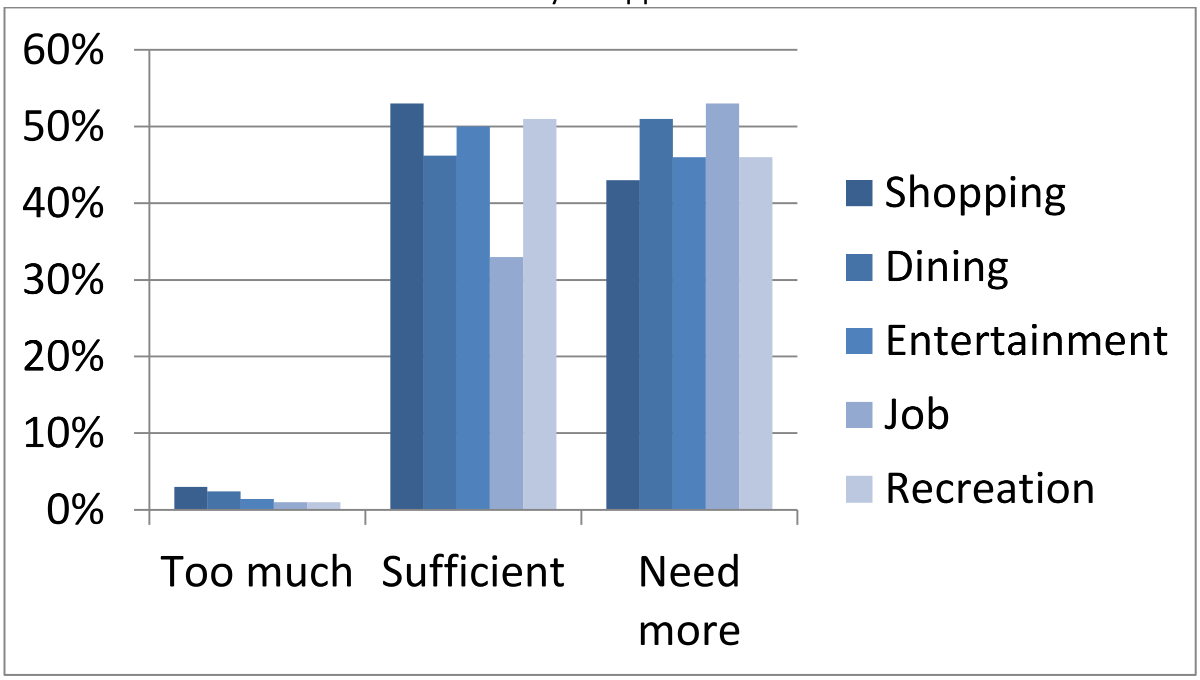
Commercial land-uses included office space, retail, mixed-use, and hotels and motels. A majority of people rated these uses as sufficient; however, there was a significant percentage of respondents that rated retail, mixed-use, and hotels and motels as need more. 38% stated the area needs more retail; 27% stated need more for mixed-use, which was described in the survey as a mixture of retail and/or office space with housing; and 23% felt there needed to be more hotels and motels (hotels and motels were one category and were not broken up separately).

Public open space areas and public parks were the only two categories to have a majority that stated need more. 61% felt there needed to be more public open space areas and 58% felt there needed to be more public parks.

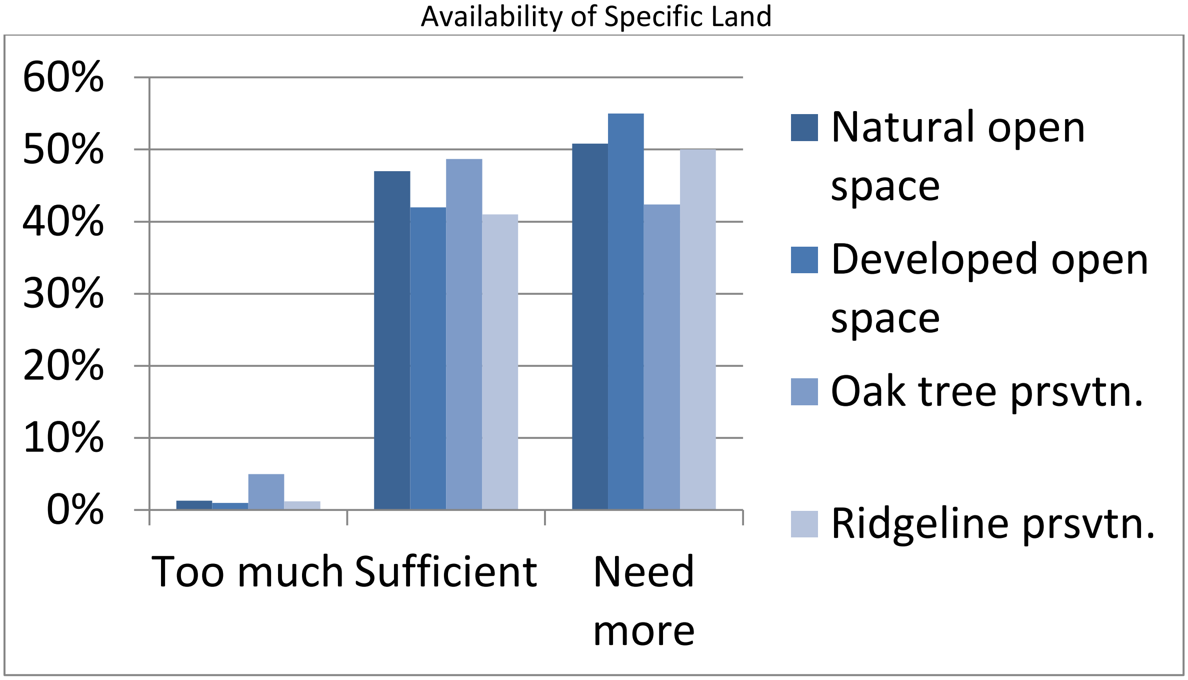
Several questions in the survey sought information about the availability of specific opportunities, for example, shopping and dining, recreation, access to jobs, and open space. Graphs II, III, and IV illustrate that a large number of people feel availability is sufficient;

however, there is also a sizable population that would like to see more. There is also a desire to recruit businesses and attract industries/quality jobs to the area. As one respondent commented, "[I] would like to see additional quality business' move to EDH to increase the availability of high paying jobs."

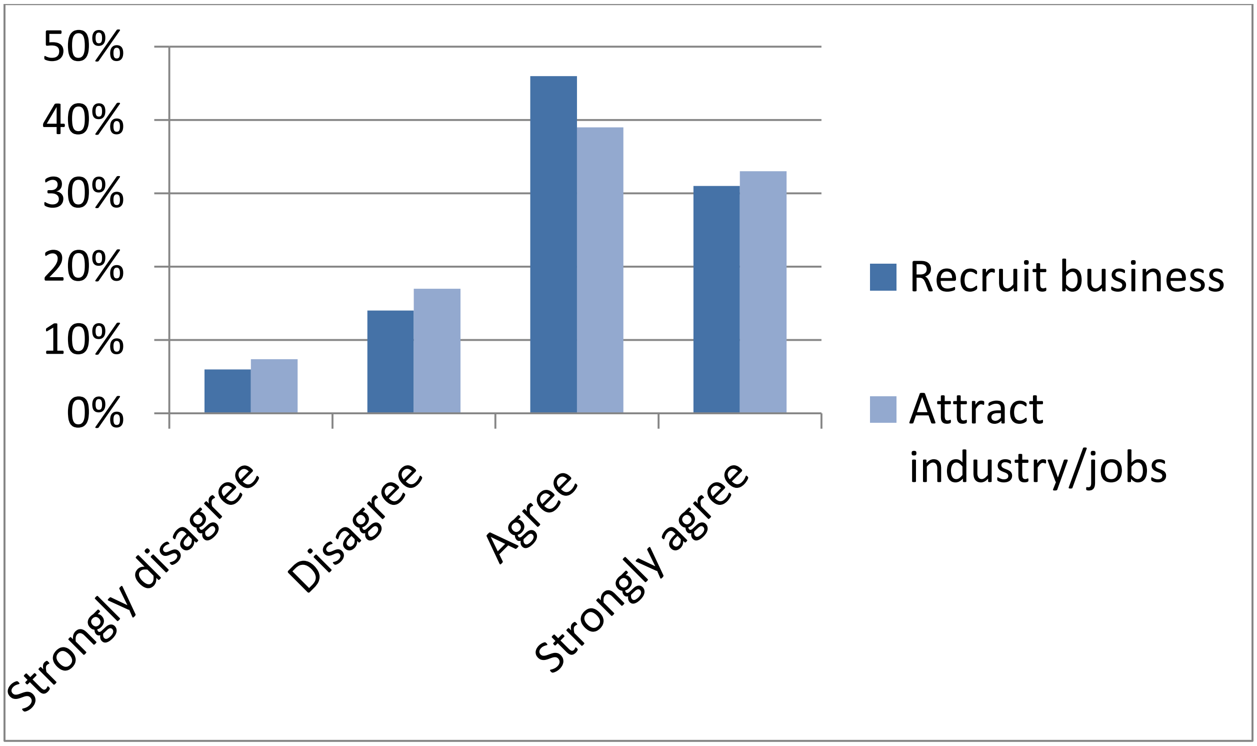
Graph II
Availability of Opportunities



Graph III
Availability of Specific Land



Graph IV
Attract Businesses and Industries



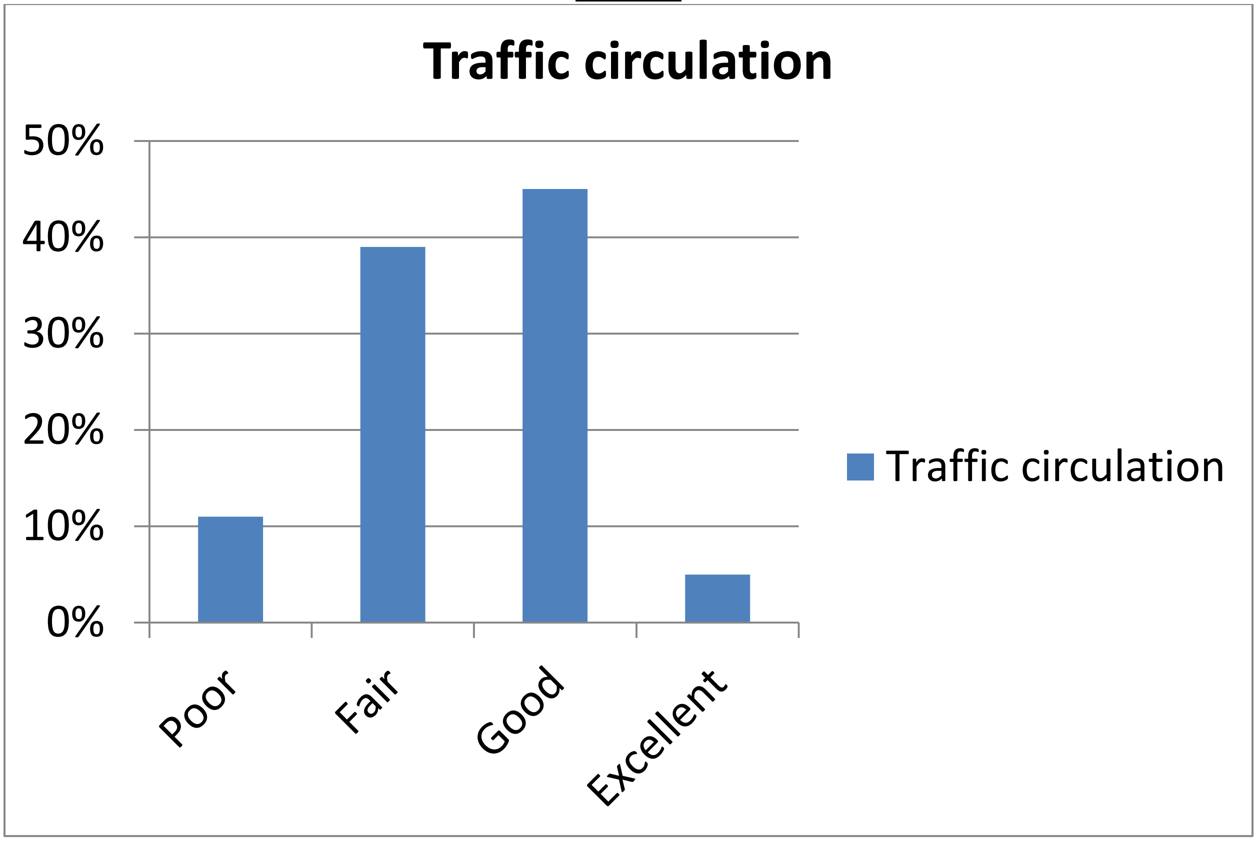
Transportation

The El Dorado Hills EDAC subcommittee has data on traffic counts in each of the main corridors, as well as other surface streets in the area, which may prove useful when coupled with the qualitative data obtained in the survey. The intent of the questions in the survey pertaining to transportation was to obtain the level of satisfaction for specific areas and streets. Participants were requested to rate their satisfaction as excellent, good, fair, or poor. Overall, the ease of driving on every street listed was rated good or fair by a majority of respondents. The areas with the highest percentage of people stating the ease of travel was poor are displayed in the table below.

Table III
Ease of Travel

Rate of Satisfaction	Poor
Pedestrian travel	29.5%
Traveling on Bicycle	26.6%
Driving on White Rock Road	22.3%
Driving on Bass Lake Road	19.1%
Driving on Green Valley Road	19.0%
Driving on Francisco Drive	17.4%

Graph V



Recreation and Trails

One of the questions in the survey requested participants rank seven different uses that an expanded network of trails in El Dorado Hills should be designed for. Table IV illustrates the trend in regards to where most respondents ranked each use, as well as, indicates the rating average. For example, routes to school had a lower rating average (a lower average indicates a higher priority) than road biking, but a higher number of respondents ranked road biking at 4 and routes to school at 5. The design of the question is relational to other uses so the ranking honors how most people arranged the uses, however, it is important to note the differences in the rating averages. This difference may indicate the need for a multi-use trail system, as well as, provide information as to the location of the trail system. One respondent commented, “Having a trail system connecting neighborhoods to open spaces, parks, and schools would add so much to this community.”

Table IV

Rank	Desired Use for Expanded Trails	Avg.
1	Hiking/Walking	2.05
2	Running	3.08
3	Mountain biking	4.11
4	Road biking	3.97
5	Routes to school	3.58
6	Routes to work	4.68
7	Horseback riding	6.53

Community Identity

Several questions within the survey sought to obtain input on different attributes that define or could define El Dorado Hills. One specific question focused on the need for a community sports complex that could accommodate tournament play. On a scale from strongly agree to strongly disagree and no opinion, over 69% respondents agreed or strongly agreed that the sports complex would be a good addition. Another question asked about the importance of keeping the look and feel of El Dorado Hills a mixture of urban-like and rural-like charm in which 66.6% strongly agreed and another 25.6% agreed. Finally, a voluntary question was asked about El Dorado Hills' greatest attributes. The word cloud below illustrates the most common words used to describe El Dorado Hills; larger words indicate is was used more often by respondents.

OBSERVATIONS & CONCLUSION

The raw data of survey results will be made available to the El Dorado Hills EDAC in order for the group to make their own conclusions and define next steps. During the analysis of the survey AIM noted several trends that are categorized in the bullet points below:

- **Additional housing is not overwhelmingly supported in the area**: 72% of respondents felt single-family residential housing was sufficient in the area and a vast majority of respondents felt there was either too much or sufficient high-density housing. One respondent commented, "I strongly disagree with the proposal to develop high density housing within the currently proposed locations. It will significantly impact traffic congestion, school overcrowding, and the rural and upscale appeal of EDH."
- **There seems to be a desire for more commercial development in specific areas**: 38% of respondents felt El Dorado Hills could use more retail and a large number of respondents felt there needed to be more shopping, dining, and entertainment opportunities (see Graph II). Comments also indicated that commercial development should be located in existing centers and that residents did not want to become like Folsom. One survey participant stated, "Town Center needs 2-3 more blocks of small retail to create and sustain any retail synergy necessary to make it a viable Town Center."
- **The area truly values it's open spaces**: Several comments lamented the loss of the golf course and want to keep El Dorado Hills' open space aspects; a majority of respondents rated both natural open space and developed open space as need more.
- **Residents seem supportive of attracting industry that provides quality jobs**: A majority of respondents agreed or strongly agreed that it was important to attract and recruit businesses that provide quality jobs. Comments indicate that specific jobs are preferable in order to assure quality employment and maintain the demographic characteristics of the area.
- **Road improvements must be responsive to new developments and mindful of pedestrian and bicycle access**: Respondents seemed reluctant to support new developments, but if development moves forward, the transportation infrastructure should be developed accordingly.
- **The community strongly supports a community sports complex and a multi-use network of trails**: A vast majority strongly agreed or agreed that a community sports complex would be a good addition. Comments supported expanding trails in El Dorado County; Table IV indicates that respondents support multiple uses for the trail system.

The survey successfully obtained more input as to what residents deem important and offers some guidance as to where the EDAC may want to focus their efforts. This initial step should be leveraged to gain more participation and to advance the community planning efforts. Providing the survey report and presenting the survey results to community members and representatives from El Dorado County could precede facilitated community forums and/or area specific focus groups.