

Attachment D Level of Service Methodologies

For Freeway Facilities, the following discussion is from HCM2010, Chapter 10 - Freeway Facilities

A freeway is a separated highway with full control of access and two or more lanes in each direction dedicated to the exclusive use of traffic. Freeways are composed of various uniform segments that may be analyzed to determine capacity and Level of Service (LOS). Three types of segments are found on freeways:

- *Freeway merge and diverge segments:* Segments in which two or more traffic streams combine to form a single traffic stream (merge), or a single traffic stream divides to form two or more separate traffic streams (diverge).
- *Freeway weaving segments:* Segments in which two or more traffic streams traveling in the same general direction cross paths along a significant length of freeway without the aid of traffic control devices (except for guide signs). Weaving segments are formed when a diverge segment closely follows a merge segment or when a one-lane off-ramp closely follows a one-lane on-ramp and the two are connected by a continuous auxiliary lane.
- *Basic freeway segments:* All segments that are not merge, diverge, or weaving segments.

LOS of Component Segments

When a facility-level analysis is undertaken by using the methodology of this chapter, LOS F for a component segment will be identified in two different ways:

- When a v_d/c is greater than 1.0 (where v_d = demand flow rate, and c = capacity)
- When the density is greater than 45 pc/mi/ln for basic freeway segments or 43 pc/mi/ln for weaving, merge, or diverge segments.

The facility LOS will be based on the weighted average density for all segments within the defined facility.

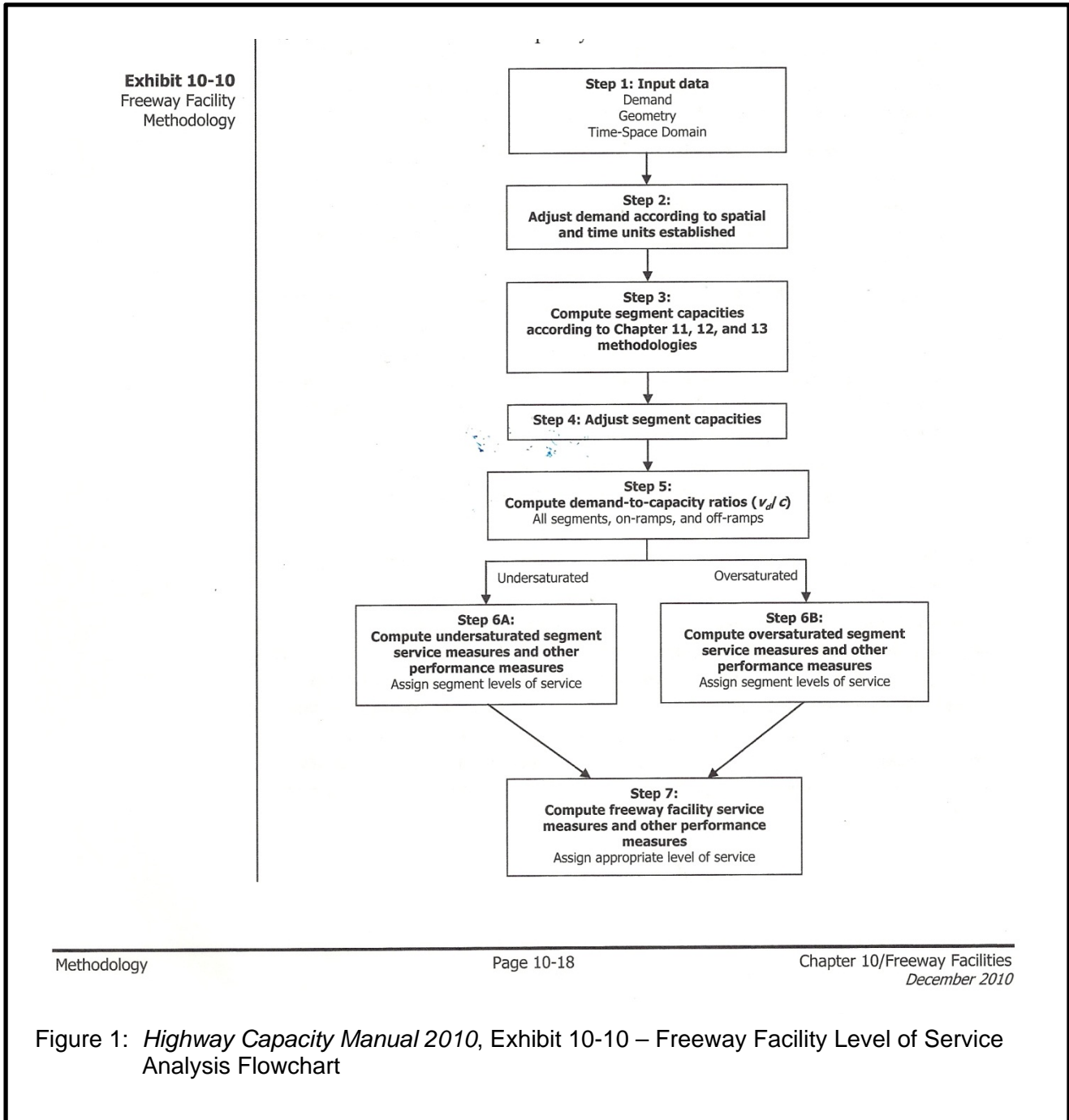
Table 1: Freeway Facility Levels of Service Criteria

Level of Service	Density (pc/mi/ln)
A	≤ 11
B	$> 11 - 18$
C	$> 18 - 26$
D	$> 26 - 35$
E	$> 35 - 45$
F	> 45 or any component v_d/c ratio > 1.0

Source: HCM2010, Chapter 10, Exhibit 10-7

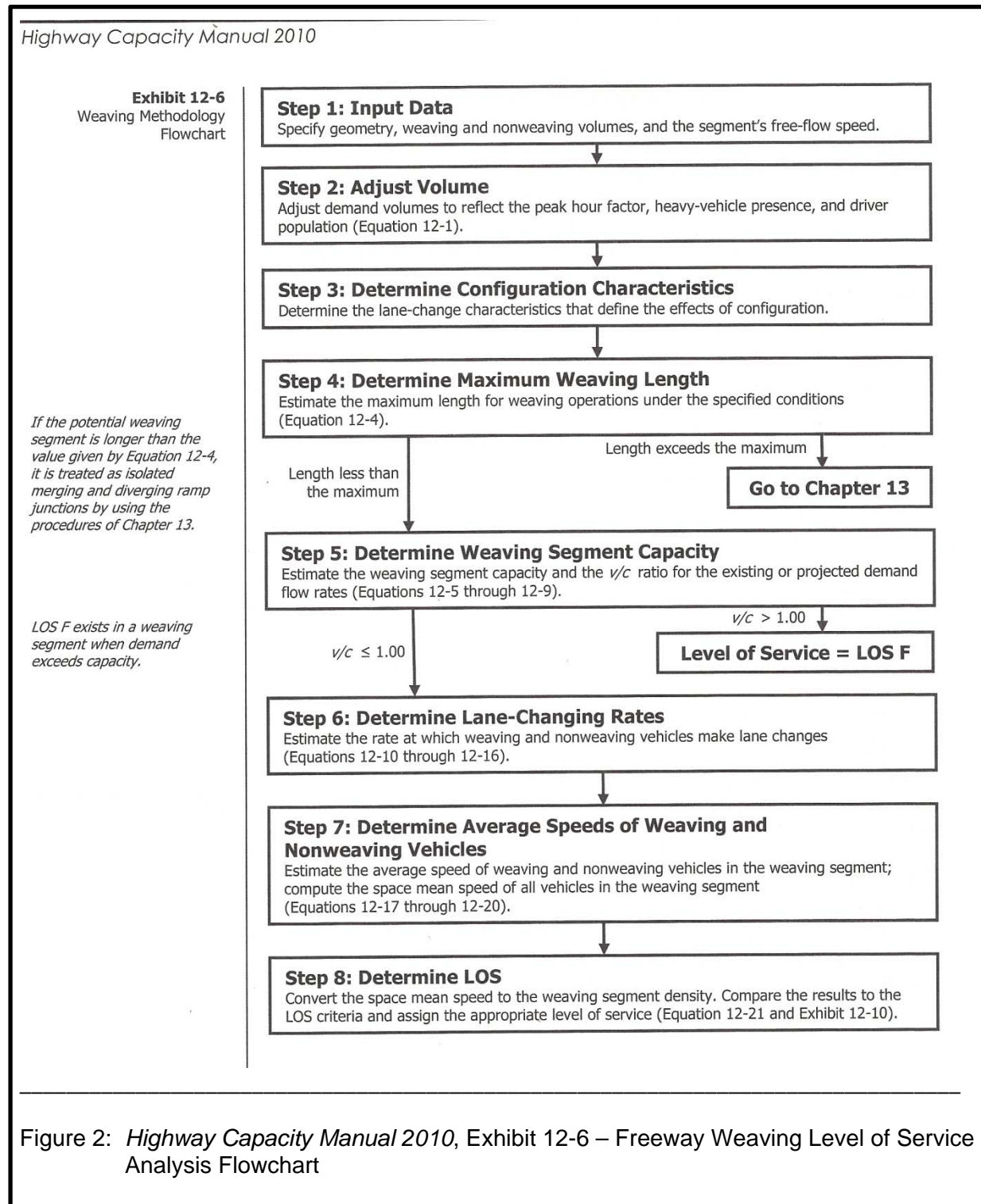
Use of LOS descriptors for the overall freeway facility must be done with care. It is critical that the LOS for individual segments composing the facility also be reported. Because the overall LOS is an average, it may mask serious problems in individual segments of the facility.

Figure 1 is a flow chart of the steps to determine LOS for a Freeway Facility.



For Freeway Weaving Segments, the following is from HCM2010, Chapter 12- Freeway Weaving Segments:

Three geometric characteristics affect a weaving segment's operating characteristics: length, width, and configuration. All have an impact on the critical lane-changing activity, which is the unique operating feature of a weaving segment.



The LOS for a weaving segment, as in all freeway analyses, is related to the density of the segment. The threshold densities for LOS A through D were set relative to the criteria for basic freeway segments or multilane highways. It is believed that drivers will tolerate higher densities in an area where lane-changing turbulence is expected than on basic segments.

Table 2: LOS for Freeway Weaving Segments

LOS	Density (pc/mi/ln)	
	Freeway Weaving Segments	Weaving Segments on Multilane Highways of C-D Roadways
A	0 - 10	0 - 12
B	> 10 - 20	> 12 - 24
C	> 20 - 28	> 24 - 32
D	> 28 - 35	> 32 - 36
E	> 35	> 36
F	Demand Exceeds Capacity	

Source: HCM2010, Chapter 12, Exhibit 12-10

For Freeway Merge/Diverge segments, the following is from HCM2010, Chapter 13 Freeway Merge and Diverge Segments:

A ramp consists of three elements: the ramp roadway and two junctions. Merge/diverge segment LOS is defined in terms of density for all cases of stable operation (LOS A - E). LOS F exists when the freeway demand exceeds the capacity of the upstream (diverges) or downstream (merges) freeway segment, or where the off-ramp demand exceeds the off-ramp capacity.

Table 3: LOS Criteria for Freeway Merge and Diverge Segments

LOS	Density (pc/mi/ln)	Comments
A	≤ 10	Unrestricted operations
B	> 10 - 20	Merging and diverging maneuvers noticeable to drivers
C	> 20 - 28	Influence area speeds begin to decline
D	> 28 - 35	Influence area turbulence becomes intrusive
E	> 35	Turbulence felt by virtually all drivers
F	Demand Exceeds Capacity	Ramp and freeway queues form

Source: HCM2010, Chapter 13, Exhibit 13-2

Exhibit 13-4 is a flowchart for the analysis of a ramp-freeway junction

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Exhibit 13-4
Flowchart for Analysis of
Ramp-Freeway Junctions

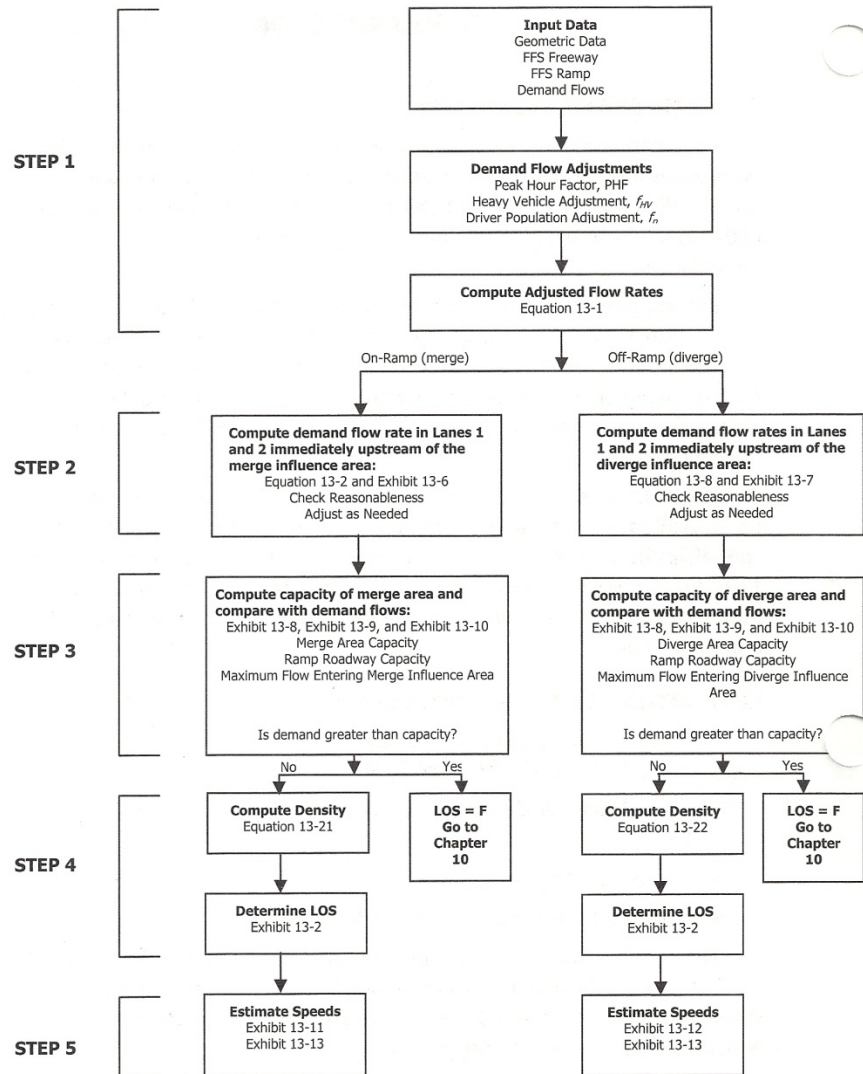


Figure 3: Highway Capacity Manual 2010, Exhibit 13-4 – Ramp Freeway Junction Level of Service Analysis Flowchart