

2.0 METHODOLOGY

The following section describes the methodology used to determine study area, analysis of the study area operations, and determine significant impacts.

Study Area

The intersections within the project boundary to be included in the study area were selected based on several factors, which included the following:

- Roadways intersecting with each other that function as a collector or higher
- On- and off-ramp intersections to/from freeways
- Intersections near approved and pending projects

Based on the criteria listed above, a total of 41 intersections have been selected for analyses and are shown in **Table 2-1** below.

TABLE 2-1 STUDY INTERSECTIONS	
Intersection	Traffic Control (a)
1 Commercial St & 16th St	Signal
2 National Ave & 16th St	TWSC
3 National Ave & Sigsbee St	Signal
4 Newton Ave & Sigsbee St	AWSC
5 Main St and Sigsbee St	AWSC
6 Harbor Dr & Sigsbee St	OWSC
7 Logan Ave & I-5 SB off-ramp (Caltrans intersection)/ Beardsley St	AWSC
8 National Ave & Beardsley St	AWSC
9 Newton Ave & Beardsley St	AWSC
10 Main St & Beardsley St	AWSC
11 Harbor Dr & Beardsley St	OWSC
12 Kearny Ave & Cesar Chavez Pkwy	Signal
13 Logan Ave & Cesar Chavez Pkwy/SR-75 on-ramp	Signal
14 National Ave & Cesar Chavez Pkwy	Signal
15 Newton Ave & Cesar Chavez Pkwy	Signal
16 Main St & Cesar Chavez Pkwy	Signal
17 Harbor Dr & Cesar Chavez Pkwy	Signal
18 Logan Ave & I-5 SB on-ramp (Caltrans intersection)	Uncontrolled
19 National Ave & SR-75 off-ramp (Caltrans intersection)	OWSC
20 National Ave & Evans St	TWSC
21 Newton Ave & Evans St	TWSC
22 Main St & Evans St	OWSC
23 Logan Ave & Sampson St	AWSC
Notes:	
(a) Signal = Traffic signal, OWSC = One-Way Stop-Control, Two-Way Stop-Control, AWSC = All-Way Stop-Control	

TABLE 2-1
STUDY INTERSECTIONS (cont.)

Intersection	Traffic Control (a)
24 National Ave & Sampson St	Signal
25 Newton Ave & Sampson St	AWSC
26 Main St & Sampson St	AWSC
27 Harbor Dr & Sampson St	Signal
28 National Ave & Sicard St	AWSC
29 National Ave & 26th St	TWSC
30 National Ave & 27th Street	OWSC
31 Main St & 26th St	AWSC
32 Harbor Dr & Schley St	Signal
33 National Ave & 28th St	Signal
34 Boston Ave & 28th St	Signal
35 Main St & 28th St	Signal
36 Harbor Dr & 28th St	Signal
37 Boston Ave & 29th St/I-5 SB on-ramp (Caltrans Intersection)	OWSC
38 Main St & 32nd St	Signal
39 Wabash & 32nd St	Signal
40 Harbor Dr & 32nd St	Signal
41 Main St & I-15 ramps (Caltrans Intersection)	Signal
Notes:	
(a) Signal = Traffic signal, OWSC = One-Way Stop-Control, Two-Way Stop-Control, AWSC = All-Way Stop-Control	

As shown in the table, 21 of the 41 intersections evaluated are signalized while 20 intersections are unsignalized with vehicles required to stop on one leg, two legs, or all legs of the intersection. Two of the intersections (Kearny Avenue/Cesar Chavez Parkway and National Avenue/28th Street) are outside of the project area boundary. However, these intersections have been included as part of the study area, since traffic heading to/from the Barrio Logan community via the freeway would travel through these two locations. **Figure 2-1** displays the location of the study intersections.



LEGEND

- Barrio Logan Community Plan Area
- Freeway/Ramp
- Park/Open Space
- City Boundary
- SDMTS Trolley and Station
- School
- Port District
- Naval Station San Diego
- Study Intersection ID

0 500 1000 2000 feet

 N

Figure 2-1: Study Intersections

Analysis Process

The analysis process includes determining the levels of service at the study intersections and freeway segments for the a.m. and p.m. peak-hours and levels of service on roadway segments using ADT volumes.

The freeway ramps within the Community of Barrio Logan are not currently metered. It is uncertain whether or not Caltrans will meter these ramps in the future. Ramp meter analysis was not included in this study. In the case that Caltrans decides to implement ramp meter analysis in the future, a ramp meter evaluation should be prepared to document the impact of the ramp metering to the City of San Diego's surface streets.

Analysis Software

To analyze the vehicular operations of both signalized and unsignalized intersections, Synchro 6 (Trafficware) was used for the analysis. Synchro 6 uses the methodologies outlined in the 2000 *Highway Capacity Manual (HCM)*.

The following list contains the assumptions used for the intersection analyses:

- Peak-hour factor (PHF) = A default PHF of 0.92 was use for all scenarios.
- Percent of heavy vehicle (PHV) = Measured in field PHV were used at all locations with available data (Harbor Drive, Cesar Chavez Parkway, Main Street, 28th Street and 32nd Street). For locations with no PHV data, a 2 percent value was used. The measured PHV ranged from 2 percent to 32 percent along Cesar Chavez Parkway south of Harbor Drive.
- Pedestrians & Bicycles = Measured in field pedestrian and bicycle data were used for the intersection analyses. Data was collected for the majority of the intersections.
- Signal Timing = With the exception of the traffic signals along Cesar Chavez Parkway between Main Street and Logan Avenue, all cycle lengths were optimized and account for the minimum pedestrian crossing times. Cesar Chavez Parkway between Main Street and Logan Avenue is a coordinated corridor with an 80 second cycle length. The coordinated 80 second cycle length for Cesar Chavez Parkway was used for all scenarios.

To accurately evaluate the interactions of the San Diego Trolley with the signalized intersections along Harbor Drive, a special signal phasing was used to simulate the signal interaction with the adjacent Light Rail crossing. When a trolley vehicle approaches a cross street, the crossing guards are lowered for approximately 30 seconds, allowing time for clearance of queues on the tracks and for the trolley to pass. This special phasing to replicate the trolley disruption to cross street traffic was simulated through the Synchro software. The phasing diagram used for the signalized intersections along Harbor Drive was extracted from a report prepared by Jeff G. Gerken and Sarah A. Tracy titled "Analysis of Traffic Impacts at Isolated Light Rail Transit (LRT) Crossings Using Sim Traffic." A copy of the report can be found in **Appendix B**.

Signalized and Unsignalized Intersections

The 2000 *HCM* published by the Transportation Research Board establishes procedures to evaluate highway facilities and rate their ability to process traffic volumes. The terminology "level of service" is used to provide a qualitative evaluation based on certain quantitative calculations, which are related to empirical values.

Level of service (LOS) for signalized intersections is defined in terms of delay, which is a measure of driver discomfort, frustration, fuel consumption, and loss of travel time. Specifically, LOS criteria are stated in terms of the average control delay per vehicle for the peak 15-minute period within the hour analyzed. The average control delay includes initial deceleration delay, queue move-up time, and final acceleration time in addition to the stop delay. The LOS for unsignalized intersections is determined by the computed or measured control delay and is defined for each minor movement. At an all-way stop controlled intersection, the delay reported is the average control delay of the intersection. At a one-way or two-way stop controlled intersection, the delay reported represents the worst movement, which are typically the left-turns from the minor street approach.

The criteria for the various levels of service designations are given in **Table 2-2**.

**TABLE 2-2
LOS CRITERIA FOR INTERSECTIONS**

LOS	Control Delay (sec/veh)		Description
	Signalized Intersections (a)	Unsignalized Intersections (b)	
A	≤10.0	≤10.0	Operations with very low delay and most vehicles do not stop.
B	>10.0 and ≤20.0	>10.0 and ≤15.0	Operations with good progression but with some restricted movement.
C	>20.0 and ≤35.0	>15.0 and ≤25.0	Operations where a significant number of vehicles are stopping with some backup and light congestion.
D	>35.0 and ≤55.0	>25.0 and ≤35.0	Operations where congestion is noticeable, longer delays occur, and many vehicles stop. The proportion of vehicles not stopping declines
E	>55.0 and ≤80.0	>35.0 and ≤50.0	Operations where there is significant delay, extensive queuing, and poor progression.
F	>80.0	>50.0	Operations that are unacceptable to most drivers, when the arrival rates exceed the capacity of the intersection.
Notes: (a) 2000 Highway Capacity Manual, Chapter 16, Page 2, Exhibit 16-2 (b) 2000 Highway Capacity Manual, Chapter 17, Page 2, Exhibit 17-2			

The acceptable Level of Service (LOS) standard for roadways and intersections in the City of San Diego is LOS D, except in the Centre City Community Plan area (Downtown) for which the acceptable LOS is E.

Roadway Segments

In order to determine the operations along the study area roadway segments, daily roadway traffic volumes were compared to assumed roadway capacities. **Table 2-3** has been developed by the City of San Diego and was used in this analysis. The segment traffic volumes under LOS E as shown in this table are considered at capacity because at LOS E the volume-to-capacity Ratio (v/c Ratio) is equal to 1.0. It should be noted that the values listed in the table are planning-level estimates only. The actual operations of a roadway segment would be affected by the type and frequency of traffic control, terrain, lane width, presence of raised median, local access/driveways, percent of heavy vehicles, distribution of traffic over the day, etc.

Road		Level of Service (LOS)				
Class	Lanes	A	B	C	D	E
Expressway	6	30,000	42,000	60,000	70,000	80,000
Prime Arterial	6	25,000	35,000	50,000	55,000	60,000
Major Arterial	6	20,000	28,000	40,000	45,000	50,000
Major Arterial	4	15,000	21,000	30,000	35,000	40,000
Collector	4	10,000	14,000	20,000	25,000	30,000
Collector (No center lane) (Continuous left-turn lane)	4 2	5,000	7,000	10,000	13,000	15,000
Collector (No fronting property)	2	4,000	5,500	7,500	9,000	10,000
Collector (Commercial/Industrial fronting)	2	2,500	3,500	5,000	6,500	8,000
Collector (Multi-family)	2	2,500	3,500	5,000	6,500	8,000
Sub-Collector (Single family)	2	---	---	2,200	---	---

Notes:
 The volumes and the average daily level of service listed above are only intended as a general planning guideline. Levels of service are not applied to residential streets since their primary purpose is to serve abutting lots, not carry through traffic. Levels of service normally apply to roads carrying through traffic between major trip generators and attractors.

Source: *City of San Diego Traffic Impact Study Manual*, Table 2, Page 8, July 1998.

Freeway Segments Analysis

In order to determine the impacts on the study area, freeway segments were evaluated using procedures developed by Caltrans District 11. The procedure involves comparing the peak-hour volume of the mainline freeway segment to the theoretical capacity of the segment, which results in a v/c ratio. The calculated v/c ratio is then compared to the accepted ranges of v/c ratio values corresponding to the respective LOS, as displayed in Table 2-4.

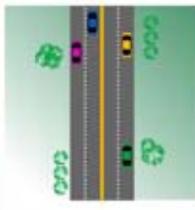
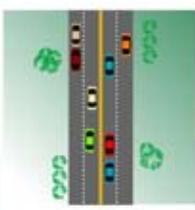
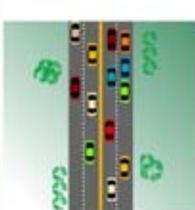
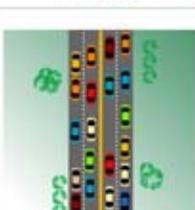
For this study, the freeway segment analysis includes the freeway segments along Interstate 5, Interstate 15 and State Route 75.

LOS	v/c Ratio	Congestion/Delay	Traffic Description
A	< 0.41	None	Free flow
B	0.41 – 0.62	None	Free to stable flow, light to moderate volumes
C	0.63 – 0.80	None to minimal	Stable flow, moderate volumes, freedom to maneuver noticeably restricted
D	0.81 – 0.92	Minimal to substantial	Approaches unstable flow, heavy volumes, and very limited freedom to maneuver
E	0.93 – 1.00	Significant	Extremely unstable flow, maneuverability and psychological comfort extremely poor
F ₀	1.01 – 1.25	Considerable 0 – 1 hour delay	Forced flow, heavy congestion, long queues form behind breakdown points, stop and go
F ₁	1.26 – 1.35	Severe 1 -2 hour delay	Very heavy congestion, very long queues
F ₂	1.36 – 1.45	Very severe 2-3 hour delay	Extremely heavy congestion, very long queues
F ₃	> 1.46	Extremely severe 3+ hours of delay	Gridlock
Notes: Based on the 1992 Caltrans guidelines.			

A graphical representation of the LOS definitions for the different facilities is shown in **Figure 2-2**.

It should be noted that all the freeway ramps within the Community of Barrio Logan are non-metered. Ramp meter analysis is not included in this study.

Figure 2-2 Graphical Summary of LOS Definitions

Levels of Service (LOS)			
LOS	Roadway Segments	Signalized Intersection	Unsignalized Intersection
A	 <p>Free-flow conditions. Vehicles unaffected by other vehicles. Movement within the traffic stream is good. Minor disruptions to flow are absorbed without change to speed.</p>	 <p>Very low delay, less than 10.0 sec. per vehicle. Most vehicles arrive during the green phase. Most vehicles do not need to stop.</p>	 <p>Delays less than 10.0 sec. per vehicle. Little or no delay to minor street traffic.</p>
B	 <p>Free-flow conditions. Other vehicles become more noticeable. Less freedom to maneuver. Minor disruptions to flow are absorbed, although local deterioration in LOS is more obvious.</p>	 <p>Delay in range of 10.1 to 20.0 sec. per vehicle. More vehicles stop than LOS A.</p>	 <p>Delay in range of 10.1 to 15.0 sec. per vehicle. Short traffic delays to minor street traffic.</p>
C	 <p>Traffic density on roadways becomes noticeable. Traffic becomes affected by other vehicles. Travel speeds may become reduced. Queuing occurs with serious traffic disruption.</p>	 <p>Delay in range of 20.1 to 35.0 sec. per vehicle. Number of vehicles are stopping with some backup and light congestion.</p>	 <p>Delay in range of 15.1 to 25.0 sec. per vehicle. Average traffic delays to minor street traffic.</p>
D	 <p>Movement becomes restricted due to traffic congestion. Speeds decline slightly with increasing flows. Minor disruptions can be absorbed without extensive queues forming and the service deteriorating.</p>	 <p>Delay in range of 35.1 to 55.0 sec. per vehicle. Congestion more noticeable. Many vehicles stop. Longer delays occur.</p>	 <p>Delay in range of 25.1 to 35.0 sec. per vehicle. Long traffic delays to minor street traffic.</p>
E	 <p>Operations at or near capacity. Minimum spacing for maintaining uniform flow. Speeds are highly variable and unpredictable.</p>	 <p>Delay in range of 55.1 to 80.0 sec. per vehicle. Extensive queuing. Poor progression.</p>	 <p>Delay in range of 35.1 to 50.0 sec. per vehicle. Very long delays to minor street traffic.</p>
F	 <p>Forced or breakdown in vehicular flow. Vehicle speeds are less than 30 mph. Complete congestion.</p>	 <p>Delay in excess of 80.0 sec. per vehicle. Delay unacceptable to most drivers. Arrival rates exceed the capacity of the intersection.</p>	 <p>Delay in excess of 50.0 sec. per vehicle. Extreme delays with queuing. Congestion affects other intersections. Warrants improvement to intersection.</p>

Source: Florida Department of Transportation 2002 *Quality/Level of Service Handbook*, Figure 1-2

Significance Determination

To determine the impacts to roadway/freeway segments and intersections, the City of San Diego has developed thresholds based on allowable increases in delay at intersections and volume to capacity (v/c) ratios for roadway and freeway segments. The existing condition analysis was compared to each of the Horizon Year conditions to determine where traffic impacts occur. . Since the Horizon Year conditions includes the project and Year 2030 growth for the San Diego region, traffic impacts that occur are considered to be cumulative impacts. At intersections, the measure of effectiveness (MOE) is based on allowable increases in delay. At roadway and freeway segments, the MOE is based on allowable increases in the v/c ratio. At intersections that are expected to operate at LOS E under Horizon Year 2030, the allowable increase in delay to existing conditions is two seconds, while for intersections that are expected to operate at LOS F, the allowable increase in delay is one second. If vehicle trips associated with the Barrio Logan Community Plan Update cause the delay at an intersection to increase by more than the City's threshold, this would be considered a significant traffic related impact. Under this condition, mitigation to restore the operations of the intersection to LOS D was investigated. If an existing intersection is operating at LOS E or F, the intersection would be considered an existing deficiency.

For roadway and freeway segments that are forecasted to operate at LOS E, the allowable increase in v/c ratio is 0.02, while for roadway and freeway segments that are forecasted to operate at LOS F, the allowable increase in v/c ratio is 0.01. An increase in v/c ratio higher than the City's thresholds would be considered a significant impact.

Table 2-5 shows the criteria for determining levels of significance for the different facilities in our study area.

TABLE 2-5 SIGNIFICANCE CRITERIA FOR FACILITIES IN STUDY AREA		
Facility	Measurement of Effectiveness (MOE)	Significance Threshold (a)
Intersection	Seconds of delay	>2.0 seconds at LOS E or >1.0 seconds at LOS F
Roadway Segment	ADT, v/c ratio	>0.02 at LOS E or >0.01 at LOS F
Freeway Segment	v/c ratio	>0.01 at LOS E or >0.005 at LOS F
Notes: Any increment of delay to cause the operations of an intersection to go from LOS D to either LOS E or LOS F, is considered to cause a significant traffic related impact. Source: City of San Diego Significance Determination Thresholds, page 71, January 2007. (a) Significance threshold applies only when the type of facility operates at LOS E or F.		