San Bernardino Associated Governments (SANBAG)

STATE ROUTE 210/PEPPER AVENUE INTERCHANGE – SUPPLEMENTAL TRAFFIC IMPACT ANALYSIS

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1. EXECUTIVE SUMMARY

This memorandum documents the results of a supplement to the Approved Traffic Impact Study (dated March 28, 2012) for the State Route 210 and Pepper Avenue interchange (SR-210/Pepper) project. The purpose of the supplemental traffic impact analysis is to incorporate updated Year 2011 mainline traffic volumes for SR-210. This supplement then presents updated results for the analysis of traffic conditions and traffic impacts associated with the implementation of a new interchange on SR-210 at Pepper Avenue. The proposed interchange is located approximately one mile east of the existing SR-210/Riverside Avenue interchange and one mile west of the existing SR-210/State Street/University Parkway interchange. This document has been revised and formatted to function as a stand-alone document.

The results of this technical analysis conclude that the proposed diamond interchange at Pepper Avenue with signalized ramp intersections will operate at an acceptable level of service in the Project Opening Year (2016) and through the Horizon Year (2036) without significant impacts to the freeway or adjacent ramp terminal and local street intersections. Based on the forecast peak hour turning movement volumes through the interchange, no issues related to traffic progression on Pepper Avenue or Highland Avenue were identified through the Horizon Year. No significant impacts are forecast to be generated by the project with regard to queuing or level of service for study intersections, freeway ramps, freeway mainline, or freeway weaving segments.

Intersection Level of Service Summary

All intersections are forecast to perform at an acceptable level of service (LOS C or better) with the project through the Horizon Year (2036). It is assumed that the intersections of Pepper Avenue and Highland Avenue (#3), Pepper Avenue and the SR-210 westbound ramps (#4) and Pepper Avenue and the SR-210 eastbound ramps (#5) would be signalized as part of the project. No significant impacts are generated by the project as proposed.

Queuing Analysis

The queuing analysis includes all study area facilities with limited storage capacity, such as freeway off-ramps, turn pockets, and approaches between closely-spaced intersections on Pepper Avenue. Synchro software was used to estimate the 50th percentile and 95th percentile queue lengths for each of these facilities during the AM and PM peak hours under project conditions.

The eastbound and westbound SR-210 off-ramps to Pepper Avenue should provide, respectively, at least 300 feet and 150 feet of storage capacity to serve forecast traffic volumes. The actual ramp lengths should be designed to conform to national, state and local standards and should be at least 300 feet long.

Freeway Mainline Analysis

All freeway mainline segments within the study area are expected to perform at an acceptable level of service with the project through the Horizon Year (2036), and no significant impacts are generated by the proposed project. It is anticipated that HOV access to and from Pepper Avenue interchange will be provided through the existing ingress and egress areas for Riverside Avenue and State Street.

Weaving/Merge-Diverge Analysis

All freeway merge-diverge segments within the study area are expected to perform at an acceptable level of service with the project through the Horizon Year (2036). A weaving analysis was performed

for the westbound segment between Pepper Avenue and Riverside Avenue, as new auxiliary lane is proposed for this location. This weave segment is expected to operate at acceptable level of service through the project Horizon Year (2036).

Signal Warrant Analysis

Signal warrant analysis was conducted based on the Manual on Uniform Traffic Control Devices (MUTCD) Chapter 4C. A signal is warranted at the intersections of Pepper Avenue and Highland Avenue, SR-210 WB Ramp and Pepper Avenue, and SR-210 EB Ramp and Pepper Avenue in the Horizon Year (2036) condition.

Ramp Metering

Project ramps will be metered per Caltrans Deputy Directive DD-35-R1. Meter calculations will be done in concert with traffic signal design. Ramp metering will be implemented at a future date when system is implemented for the SR-210. The provisions shall include metering for one single occupancy vehicle lane and for one high occupancy vehicle lane on each ramp.

Diamond Interchange Feasibility

Based on the proposed project assumptions and analysis results above, a diamond interchange is feasible at Pepper Avenue.

2. INTRODUCTION

This supplemental memo was prepared for the San Bernardino Associated Governments (SANBAG) to document the traffic analysis results for the State Route 210 and Pepper Avenue interchange (SR-210/Pepper) project in the City of Rialto. The proposed interchange is located approximately one mile east of the existing SR-210/Riverside Avenue interchange and one mile west of the existing SR-210/State Street/University Parkway interchange.

The results of the traffic impact analysis support the new interchange to be proposed as a diamond configuration, with on and off-ramps provided in both directions on SR-210. This memo presents the following updated information for review:

- Intersection level of service
- Queuing analysis
- Freeway ramp (merge/diverge), mainline and HOV lane analysis
- Weaving analysis

A. Project Description

Final design for the proposed SR-210/Pepper interchange was initiated as part of the SR-210 Freeway Extension Project, which extended the freeway from the Los Angeles-San Bernardino County line to Interstate 215 (I-215) with three general purpose lanes and one HOV lane in each direction. The Pepper Avenue interchange was removed from the SR-210 freeway extension project in 2003 because the construction of Pepper Avenue to SR-210 was not complete. The SR-210/Pepper interchange is dependent on the extension of Pepper Avenue from Winchester Drive to SR-210, which is a separate local project managed by the City of Rialto. The City completed the Initial Study for the Pepper Avenue Extension Project in 2010, and construction of the Pepper Avenue extension is expected to be complete by the Opening Year of the SR-210/Pepper interchange.

For the purpose of this traffic analysis, the proposed project is defined as the construction of Pepper Avenue from the SR-210 freeway to Highland Avenue (approximately 850 feet), and the construction of eastbound and westbound freeway on-ramps and off-ramps to Pepper Avenue. The assumed intersection configurations and ramp lengths are based on the previously prepared (2008) Draft Geometric Approval Drawings provided by SANBAG. The study area consists of the SR-210 freeway from Riverside Avenue to State Street/University Parkway, and includes the ramps and intersections associated with these interchanges. Figure 1 illustrates the project location.

B. Land Use and Zoning

The project study area is located in the northeastern portion of the City of Rialto and is generally bounded by Riverside Avenue to the west, State Street/University Parkway to the east, Highland Avenue to the north, and Baseline Road to the south. The project is located in a commercial/residential zone in an area that is currently undeveloped. The Rialto General Plan land use designation for the area south of the freeway and west of Pepper Avenue is Business Park. The rest of the area south of the freeway surrounding the Pepper Avenue extension is designated as medium density residential (Residential 6). The land north of Highland Avenue is part of the Lytle Creek Wash and is designated as Open Space – Resources, however there is a minerals mining and quarrying company located in the area with access from Highland Avenue at Pepper Avenue.

FIGURE 1 PROJECT LOCATION

C. Phasing Plan

No phasing is proposed for the project, however, the extension of Pepper Avenue to the southern Right of Way (ROW) limit of the SR-210 freeway is assumed to occur prior to the construction of the interchange. The extension of Pepper Avenue is currently being managed by the City of Rialto and is not a part of this project.

D. Project Sponsor and Contact Persons

This project is sponsored by the San Bernardino Associated Governments (SANBAG). The contact person is:

Paul Melocoton, Project Manager
Email: pmelocoton@sanbag.ca.gov
Telephone: (909)-884-8276

E. References to Other Traffic Impact Studies

Three other studies were referenced in the preparation of this report, including:

Initial Study for Pepper Avenue Extension, 2010, City of Rialto: The Initial Study for the Pepper Avenue Extension looked at extending Pepper Avenue from Winchester Drive to SR-210. The proposed extension would include two lanes in each direction and consist of approximately 2,900 feet of new roadway.

SR-210 Freeway Extension, 2008, Caltrans: The SR-210 Freeway Extension project looked at extending the existing SR-210 freeway from the Los Angeles-San Bernardino County line to the I-215 with three general purpose lanes and one HOV lane in each direction. The project included landscaping and seismic upgrades of the Muscoy UPRR railroad overpass bridge, and dedication of Right of Way (ROW) for a diamond interchange at Pepper Avenue.

Route Concept Fact Sheet SR-210, 2000, Caltrans: This document defines the route, its purpose and classification, as well as the route concept and the improvements necessary to attain the Route Concept, among other, and defines that the SR-210 route concept is to maintain a minimum level of service (LOS) “E” during peak periods, with the rationale for maintaining LOS “E” being that this would allow for the achievement of a reasonable balance between desired levels of mobility and forecast traffic, but also take into consideration the constraints existent in an urbanized area (development, abutting rights of way and limited financial resources).

The Congestion Management Program (CMP) for San Bernardino County, prepared by the San Bernardino Associated Governments in 2007, was also used as a reference in the development of this study. Pepper Avenue and all State Highway facilities (including freeways) are included in the San Bernardino County CMP network. This Program defines LOS “E” as the minimum level of service for roadway and freeway facilities that are part of the CMP. Consistent with CMP requirements, the minimum acceptable LOS for mainline segments and intersections along Pepper Avenue and SR-210 is LOS E.

3. TRAFFIC ANALYSIS

A. Statement of Assumptions

EXISTING TRAFFIC COUNT DATA

Existing count data on the mainline was updated to reflect 2011 traffic conditions. It was found that the count data approved and used in the Caltrans-approved version of the traffic analysis (dated March 28, 2012), extracted from the latest version available of the Caltrans Traffic Volumes Report, was not up-to-date and that the mainline volume of about 27,000 ADT did not represent current traffic conditions. Caltrans District 8 Staff provided updated data from a TMP census station on the SR-210 west of the Riverside Avenue interchange, and volumes on the mainline were adjusted to reflect those observed in Year 2011. The updated existing volume is approximately 100,000 ADT in the west segment of the study area. Peak hour directional factors were updated considering the data provided and were applied to ADT volumes.

The inclusion of the updated existing mainline traffic volume results in several changes to existing traffic volumes within the traffic impact study. Updates to existing volumes include the mainline volumes, on and off-ramp volumes (as a result of volume balancing), and ramp termini intersection volumes (as a result of volume balancing).

Turning movement counts were made at the four existing intersections on Tuesday, April 26th, 2011 from 6:00 AM to 9:00 AM and from 4:00 PM to 7:00 PM. Daily (24-hour) counts were also made on Riverside Avenue (just south of SR-210), Highland Avenue (at the approximate location of the future Pepper Avenue intersection) and on State Street (north of Highland Avenue.

Ramp approach and departure volumes obtained from the updated Year 2011 counts were balanced according to methodology contained in Chapter 4 of the Federal Highway Administration's Traffic Monitoring Guide of 2001. The turning movement counts were adjusted to reflect the balanced ramp volumes, as well as Passenger Car Equivalent (PCE) values.

FORECAST TRAFFIC VOLUMES

Future forecast traffic volumes change since future volumes were developed by adding the forecast growth from the SANBAG I-10 HOV model to the existing traffic volumes. The annual growth rate remains consistent as in the March 28, 2013 approved traffic study, but the base existing traffic volumes now reflect the higher mainline ADT count. Updates to future forecast volumes include the mainline volumes, on and off-ramp volumes (as a result of volume balancing), and ramp termini intersection volumes (as a result of volume balancing).

Future forecast traffic volumes with and without the project were derived from the San Bernardino Associated Governments (SANBAG) model developed for the analysis of the I-10 HOV lanes. Originally, the Southern California Association of Governments (SCAG) Regional Travel Demand Model was proposed for use in developing future traffic volume forecasts. However, in reviewing the SCAG model forecasts, it was noted that the traffic forecast to utilize Pepper Avenue flowed exclusively to and from the east on Highland Avenue. It was determined that the SCAG model did not contain an adequate level of detail to predict travel patterns in the study area, and through coordination with SANBAG staff, and alternative model forecast was derived for use in this analysis.

The SANBAG model for the base year 2003 contains the existing configuration of Pepper Avenue (with current terminus north of Base Line Road) and the With Project condition includes the

extension of Pepper Avenue from current terminus to Highland Avenue and the SR-210 diamond interchange at Pepper Avenue.

FREEWAY LEVEL OF SERVICE

Level of service is determined for all freeway segments (basic, ramps and weaving). Consistent with other projects in the area, and the Route Concept Fact Sheet SR-210, the acceptable level of service is LOS E.

A basic freeway segment is a section of the freeway mainline that is not within the area of influence of a ramp. Analysis is performed using the methodology described in the HCM Chapter 11 (Basic Freeway Segments). The LOS for basic freeway segments is measured in terms of passenger cars/mile/hour, and LOS E occurs at 35 pc/mi/ln. Demand exceeds capacity (LOS F) at 45 pc/mi/ln.

Weaving segments occur when merge and diverge segments are closely spaced, and vehicles must cross two or more traffic streams. Level of service is defined as passenger cars/mile/hour, and LOS E occurs at 35 pc/mi/ln.

Merge and diverge segments occur when ramps (on or off) connect to the freeway. LOS for merge and diverge segments is defined as passenger cars/mile/hour, and LOS E occurs at 35 pc/mi/ln.

B. Existing Conditions

This section summarizes the existing traffic data collection at study intersections and street segments, AM and PM peak hour volumes, and Average Daily Traffic (ADT) volumes.

EXISTING FREEWAY FACILITIES

Construction of State Route 210 (SR-210) through Rialto and San Bernardino was completed in 2007. With the final stage of freeway construction complete, Route 210 spans 28.2 miles from the cities of La Verne to San Bernardino and provides connections to Interstate 210 (I-210), Interstate 15 (I-15), Interstate 215 (I-215) and Interstate 10 (I-10). In the study area, SR-210 has three eastbound general purpose lanes, an eastbound high occupancy vehicle (HOV) lane, a westbound high occupancy vehicle (HOV) lane, and three westbound general purpose lanes. In 2010, SR-210 carried an average annual daily traffic (AADT) volume of 102,500 vehicles west of the Riverside Avenue interchange.

EXISTING STREET SYSTEM

Pepper Avenue travels north and south and terminates approximately one-half mile south of the SR-210 freeway. It is currently a two-lane undivided street between Base Line Road and Winchester Avenue, and an undivided four-lane roadway south of Baseline Road. Pepper Avenue is classified as a Major Arterial and is designated as a Truck Route in the Rialto General Plan Circulation Chapter. Surrounding land use is residential and the posted speed limit south of Winchester Avenue is 35 miles per hour. The speed limit in the vicinity of the SR-210 interchange is expected to be 35 miles per hour as well. The current plan is to extend Pepper Avenue northwards and connect it across SR-210 to Highland Avenue.

Highland Avenue is a four-lane divided street that travels east and west, parallel to and north of SR-210. Highland Avenue is the only reasonable street route north of the freeway that provides east-west access across the currently undeveloped area. The land north of Highland Avenue is

designated as Open Space – Resources, but there is a minerals mining and quarrying company located in the area with access from Highland Avenue at Pepper Avenue. The posted speed limit is 45 miles per hour and there are paved shoulders.

Base Line Road is a four-lane divided street that travels east and west across the study area. Base Line Road is the first route south of SR-210 that leads east toward San Bernardino. The surrounding land use is residential and open space and the posted speed limit is 40 miles per hour.

Foothill Boulevard is a six-lane divided Major Arterial that travels east and west across the study area. Foothill is the second route south of the 210 freeway that leads toward San Bernardino. The surrounding land use is mainly commercial and residential. The posted speed limit is 50 miles per hour and on-street parking is permitted.

Easton Street is a two-lane undivided Collector street that travels east and west through the study area. The east end of the street currently terminates at Eucalyptus Avenue, but will be extended across the study area in the future. Easton Street is characterized by a variety of land uses from commercial, residential, institutional and recreational. The posted speed limit is 30 miles per hour and on-street parking is allowed on both sides of the street.

Walnut Avenue is a two-lane undivided Collector street that travels east and west in the study area. Walnut Avenue runs parallel to and south of Easton Street, but ends two blocks further east at Chestnut Avenue. The surrounding lane use is mainly residential and institutional. The posted speed limit is 30 miles per hour and on-street parking is allowed on both sides of the street.

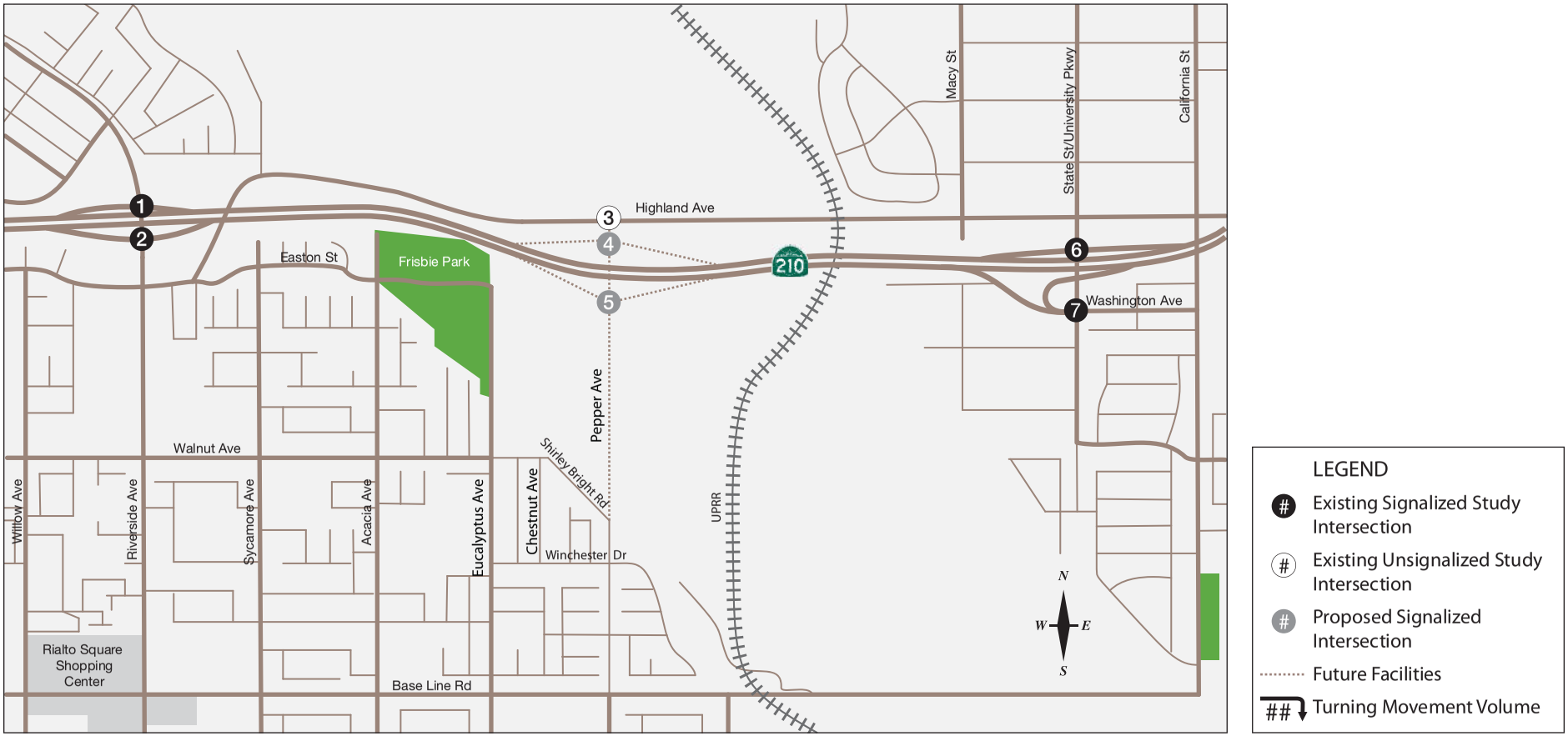
Riverside Avenue is a four-lane divided roadway that runs north and south through the study area. The corridor provides access to the first interchange west of Pepper Avenue and also travels across the freeway. Surrounding land uses consist of commercial, residential, and institutional uses. The roadway has a posted speed limit of 40 miles per hour and on-street parking is permitted on both sides of the street. Riverside Avenue is designated as a Class III Bike Route in the Rialto General Plan Circulation Chapter.

State Street is a two-lane undivided roadway that travels north and south. The street provides access to SR-210 east of Pepper Avenue as well as north and south access across the freeway. Land use is mainly residential with many undeveloped lots.

EXISTING LANE GEOMETRY AND TRAFFIC VOLUMES

Existing roadway and study intersection geometry are shown in Figure 2. Year 2011 AM peak hour turning movement volumes are shown in Figure 3, and the PM peak hour volumes are shown in Figure 4. Volumes on the freeway and ramps are presented in Tables 3-1 and 3-2.

FIGURE 2 EXISTING GEOMETRY



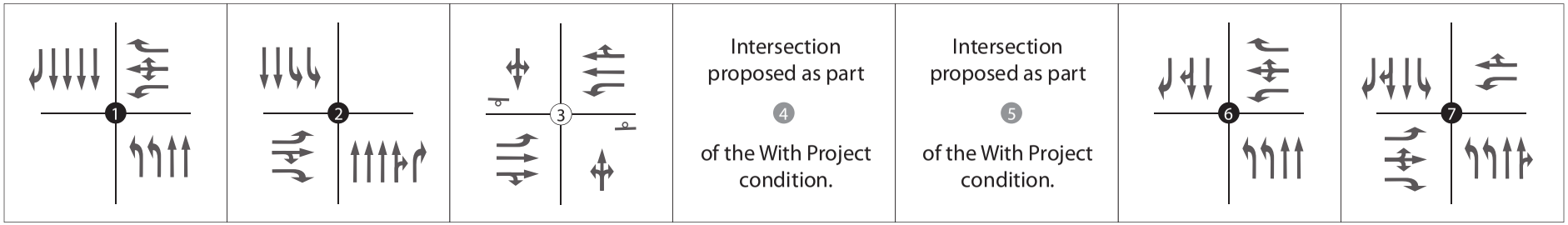


FIGURE 3 EXISTING YEAR (2011) INTERSECTION PCE VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages were obtained from the traffic counts.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Existing Unsignalized Study Intersection
- # Proposed Signalized Intersection
- Future Facilities
- ## Turning Movement Volume

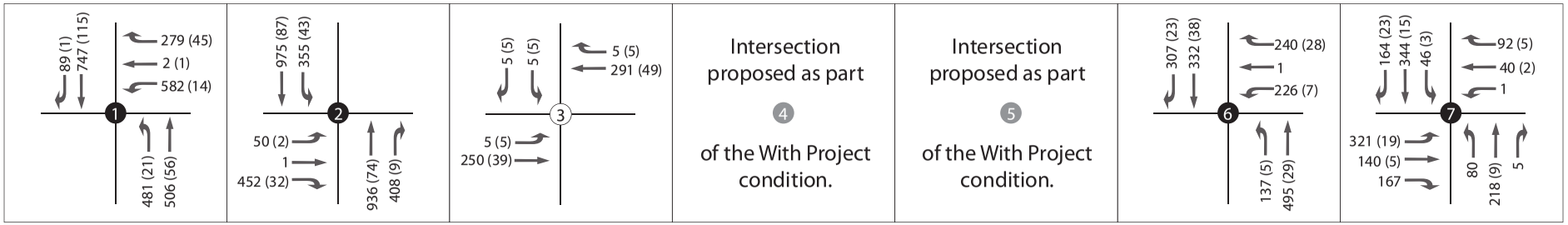


FIGURE 7 OPENING YEAR (2016) WITHOUT PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

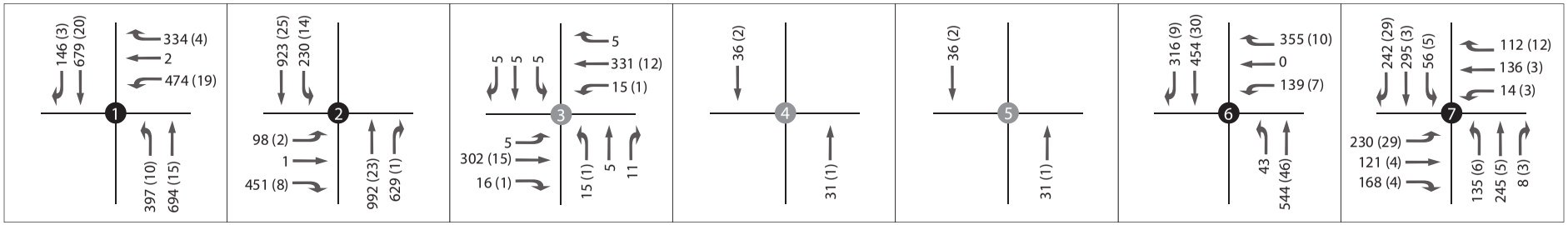


Table 3-1a: Existing Year (2011) Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	3,315	432	417	3,300	0	0	3,300	803	549	3,046

Note: Volumes are in vehicles per hour

Table 3-1b: Existing Year (2011) Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	2,918	469	712	3,161	0	0	3,161	354	368	3175

Note: Volumes are in vehicles per hour

Table 3-2a: Existing Year (2011) Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	3,456	333	317	3,440	0	0	3,440	731	467	3,176

Note: Volumes are in vehicles per hour

Table 3-2b: Existing Year (2011) Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	4,010	512	846	4,344	0	0	4,344	267	557	4,364

Note: Volumes are in vehicles per hour

C. Future Without Project (Baseline) Conditions

The assumed roadway and intersection configurations for the Opening Year (2016) and Horizon Year (2036) conditions are shown in Figure 5. The Pepper Avenue extension has been a part of the City's General Plan for 20 years, and it is assumed that Pepper Avenue would be extended north and connect with Highland Avenue by the project opening year. The intersection of Pepper Avenue and Highland Avenue (#3) is modeled with signal control. No additional changes to the existing intersection lane geometry are assumed in the Future Without Project (Baseline) scenarios.

The AM and PM peak hour forecast volumes for the Opening Year (2016) without the project are shown in Figure 6 and Figure 7, respectively. The Horizon Year (2036) AM and PM peak hour volumes for the No Project condition are shown in Figure 8 and Figure 9. Freeway and ramp peak hour volumes are presented in Tables 3-3 to 3-6.

Table 3-3a: Opening Year (2016) No Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	3,638	486	359	3,511	0	0	3,511	842	554	3,223

Note: Volumes are in vehicles per hour

Table 3-3b: Opening Year (2016) No Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	3,245	502	748	3,467	0	0	3,467	457	401	3,411

Note: Volumes are in vehicles per hour

Table 3-4a: Opening Year (2016) No Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	4,005	477	350	3,878	0	0	3,878	787	532	3,623

Note: Volumes are in vehicles per hour

Table 3-4b: Opening Year (2016) No Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	4,229	541	846	4,534	0	0	4,534	451	508	4,591

Note: Volumes are in vehicles per hour

Table 3-5a: Horizon Year (2036) No Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	4,928	710	136	4,354	0	0	4,354	1,003	581	3,932

Note: Volumes are in vehicles per hour

Table 3-5b: Horizon Year (2036) No Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	4,552	673	813	4,692	0	0	4,692	805	466	4,353

Note: Volumes are in vehicles per hour

Table 3-6a: Horizon Year (2036) No Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	6,200	1,003	430	5,629	0	0	5,629	963	744	5,410

Note: Volumes are in vehicles per hour

Table 3-6b: Horizon Year (2036) No Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	5,104	579	771	5,296	0	0	5,296	453	656	5,499

Note: Volumes are in vehicles per hour

D. Project Conditions

Intersection lane geometry assumptions for the Opening Year (2016) and Horizon Year (2036) With Project conditions are illustrated in Figure 10. In the With Project condition, the SR-210 ramp terminal intersections at Pepper Avenue (#4 and #5) are assumed to be signal controlled. The Pepper Avenue intersections with Highland Avenue (#3), the SR-210 westbound ramps (#4) and the SR-210 eastbound ramps (#5) are proposed to be constructed and signalized as part of the project. The three intersections on Pepper Avenue are assumed to be coordinated in the With Project condition.

The AM and PM peak hour forecast volumes for the Opening Year (2016) with the project are shown in Figure 11 and Figure 12. The Horizon Year (2036) AM and PM peak hour volumes for the

With Project condition are shown in Figure 13 and Figure 14, respectively. Tables 3-7 to 3-10 present freeway and ramp volumes used in the analysis.

Table 3-7a: Opening Year (2016) With Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	3,638	452	377	3,523	90	78	3,511	811	523	3,223

Note: Volumes are in vehicles per hour

Table 3-7b: Opening Year (2016) With Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline – Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	3,245	467	726	3,504	81	44	3,467	435	385	3,411

Note: Volumes are in vehicles per hour

Table 3-8a: Opening Year (2016) With Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	4,005	379	368	3,994	186	70	3,878	750	495	3,623

Note: Volumes are in vehicles per hour

Table 3-8b: Opening Year (2016) With Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	4,229	496	864	4,597	103	40	4,534	421	478	4,591

Note: Volumes are in vehicles per hour

Table 3-9a: Horizon Year (2036) With Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	4,928	530	15	4,413	448	389	4,354	847	425	3,932

Note: Volumes are in vehicles per hour

Table 3-9b: Horizon Year (2036) With Project Condition Freeway and Ramp Volumes – AM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	3,932	498	820	4,874	403	221	4,692	719	380	4,353

Note: Volumes are in vehicles per hour

Table 3-10a: Horizon Year (2036) With Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline East of State	Ramps		Mainline State - Pepper	Ramps		Mainline Pepper - Riverside	Ramps		Mainline West of Riverside
		Off State	On State		Off Pepper	On Pepper		Off Riverside	On Riverside	
WB	6,200	626	387	5,961	773	441	5,629	784	565	5,410

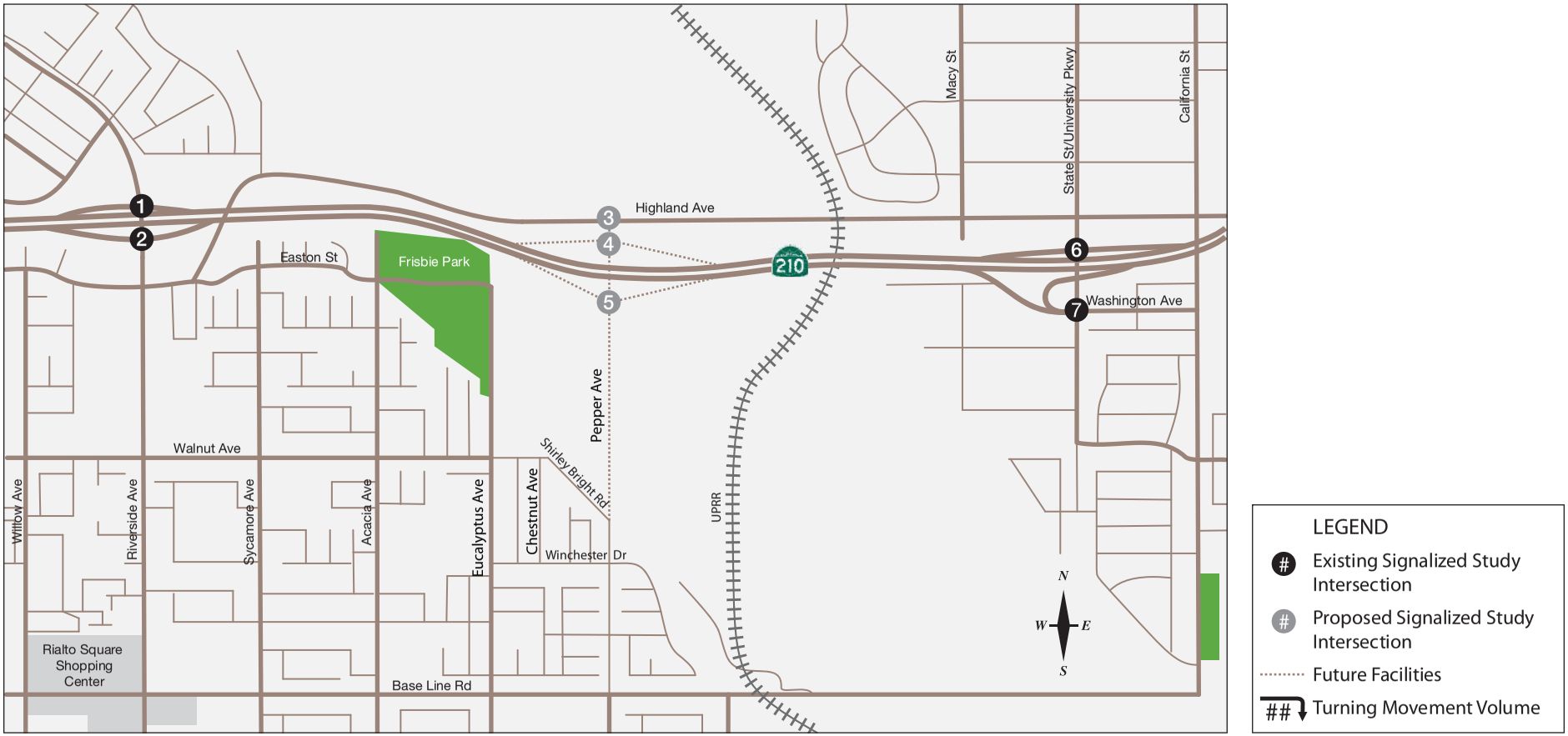
Note: Volumes are in vehicles per hour

Table 3-10b: Horizon Year (2036) With Project Condition Freeway and Ramp Volumes – PM Peak Hour

Direction	Mainline West of Riverside	Ramps		Mainline Riverside - Pepper	Ramps		Mainline Pepper - State	Ramps		Mainline East of State
		Off Riverside	On Riverside		Off Pepper	On Pepper		Off State	On State	
EB	5,104	362	865	5,607	513	202	5,296	317	470	5,499

Note: Volumes are in vehicles per hour

FIGURE 5 OPENING YEAR (2016) AND HORIZON YEAR (2036) NO PROJECT CONDITION GEOMETRY



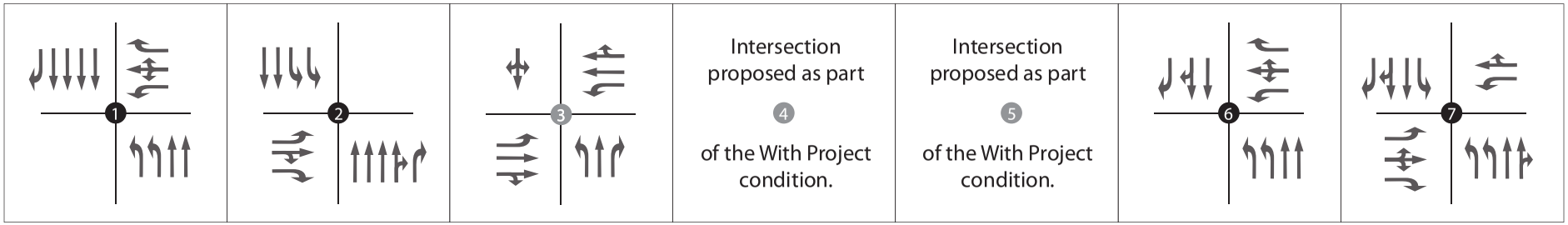


FIGURE 6 OPENING YEAR (2016) WITHOUT PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

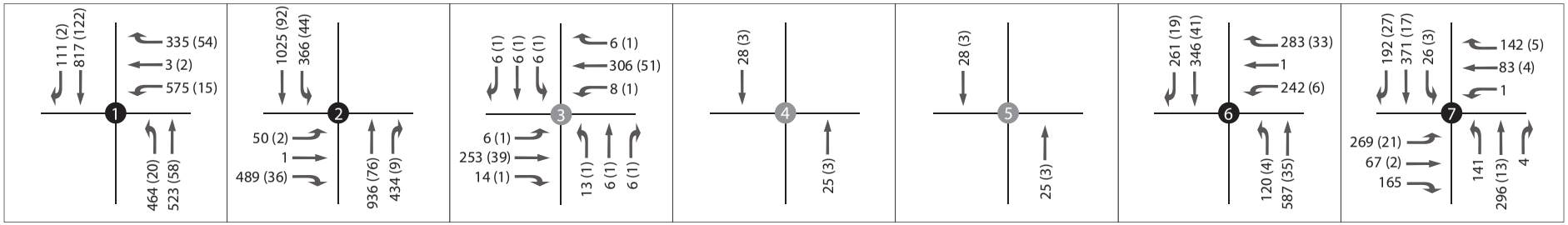


FIGURE 7 OPENING YEAR (2016) WITHOUT PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

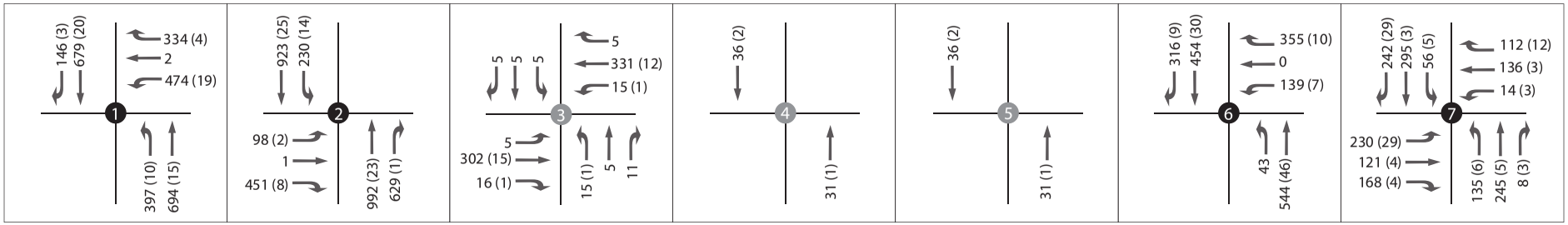


FIGURE 8 HORIZON YEAR (2036) WITHOUT PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

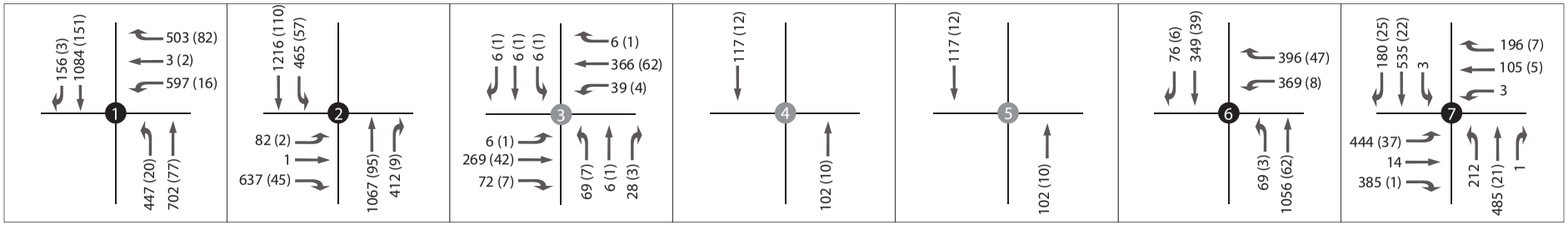


FIGURE 9 HORIZON YEAR (2036) WITHOUT PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

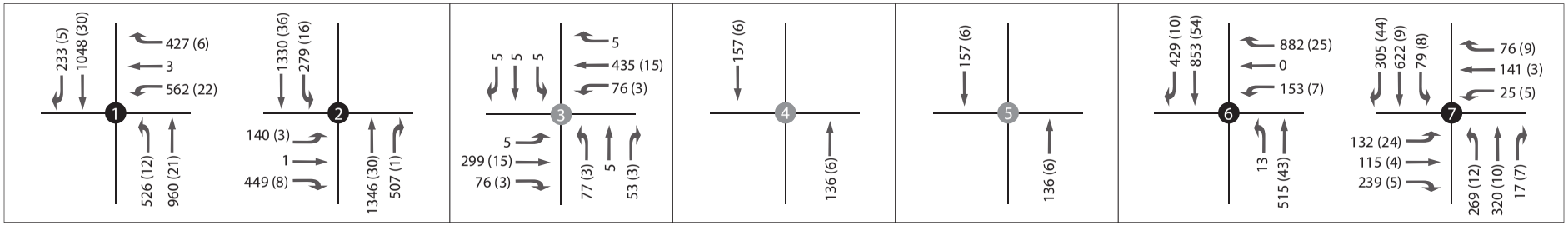


FIGURE 10 OPENING YEAR (2016) AND HORIZON YEAR (2036) WITH PROJECT CONDITION GEOMETRY

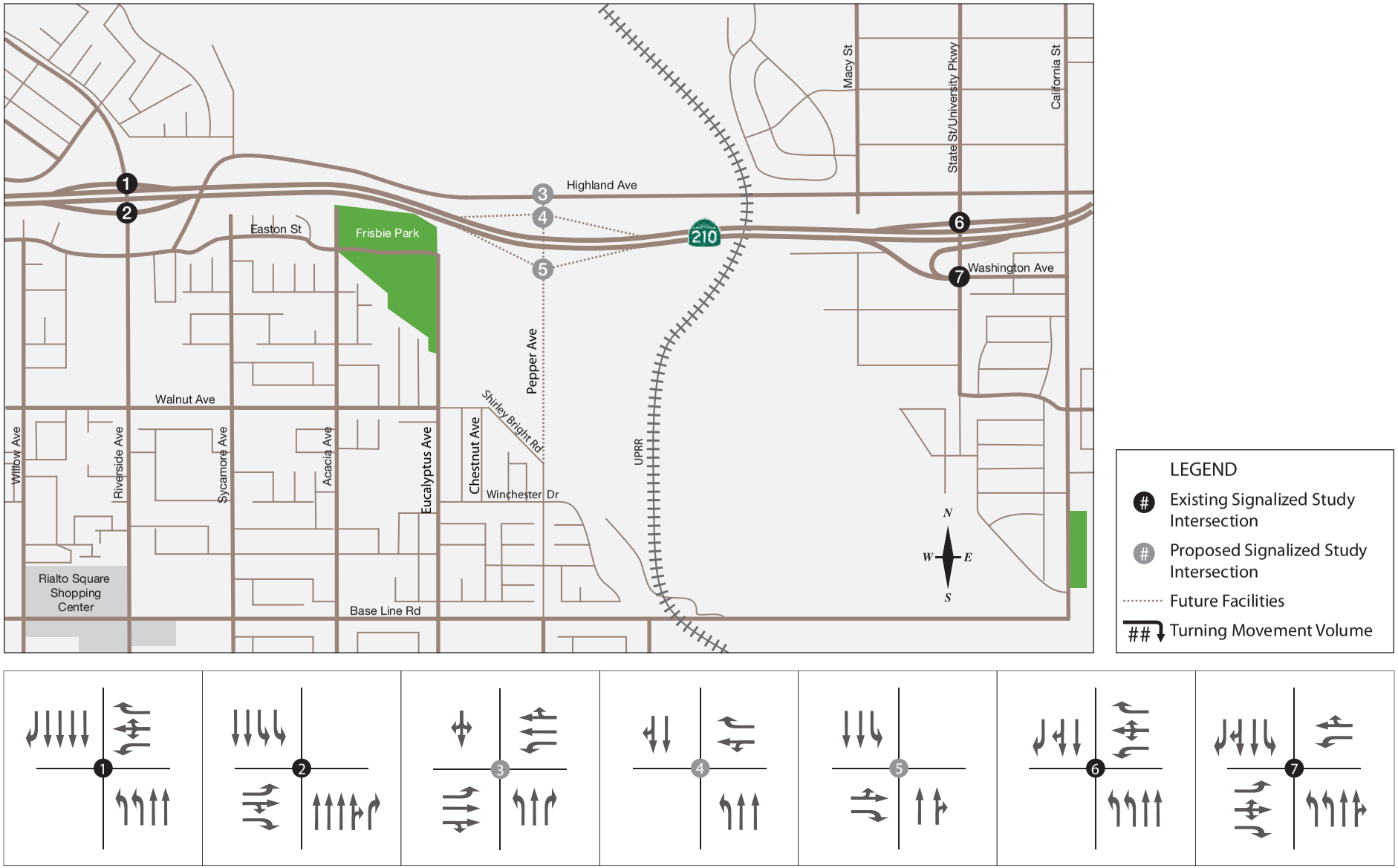


FIGURE 11 OPENING YEAR (2016) WITH PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

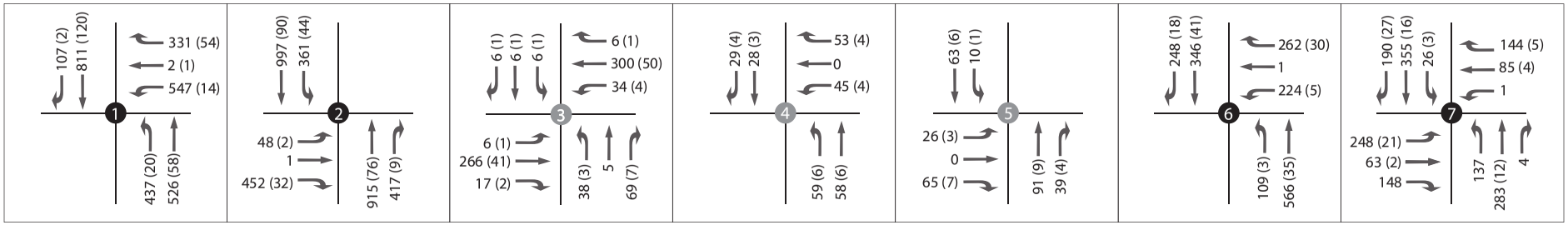


FIGURE 12 OPENING YEAR (2016) WITH PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

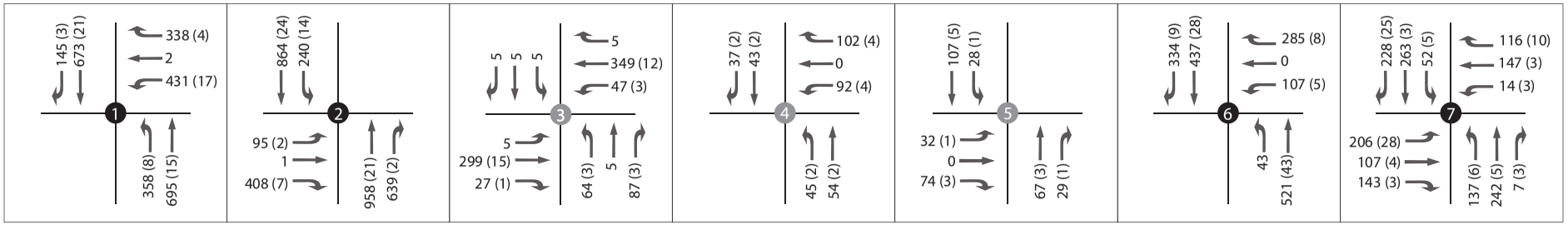


FIGURE 13 HORIZON YEAR (2036) WITH PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

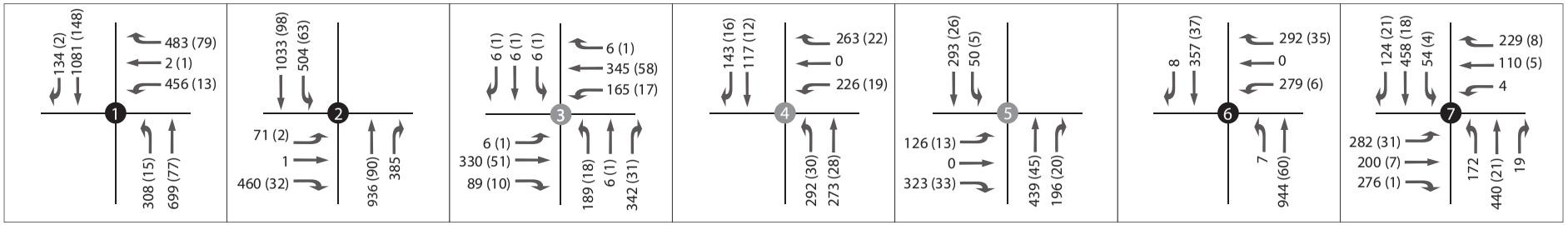
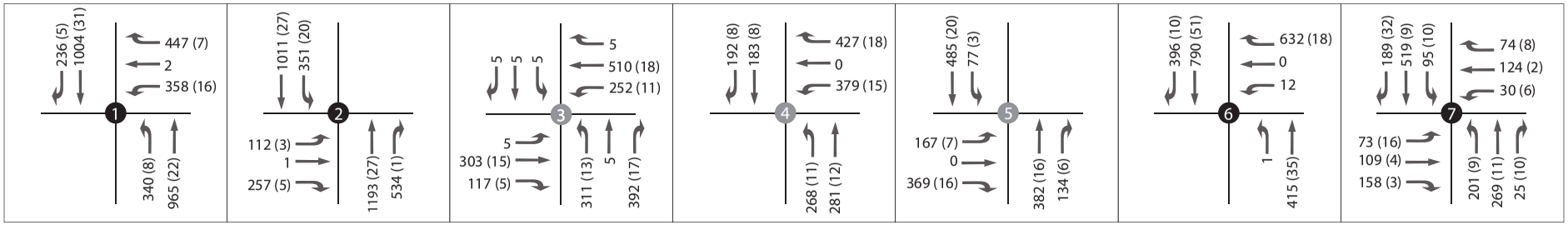


FIGURE 14 HORIZON YEAR (2036) WITH PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume



E. Level of Service (LOS) and Warrant Analyses

This section includes the results of the updated intersection level of service, queuing, ramp level of service, freeway mainline and HOV lane level of service, weaving and signal warrant analyses for existing, future without project and future with project conditions.

INTERSECTION LEVEL OF SERVICE ANALYSIS

A summary of the AM and PM peak hour level of service (LOS) analysis results for the Existing Year (2011) conditions are included in Table 3-11. All existing study intersections currently operate at LOS B or above during both peak hour time periods.

Table 3-11: Existing Year (2011) Level of Service Results

#	Intersection	Signal	AM Peak Hour		PM Peak Hour	
			Delay (sec)	LOS	Delay (sec)	LOS
1	Riverside Avenue and SR-210 WB Ramps	Signalized	18.4	B	13.9	B
2	Riverside Avenue and SR-210 EB Ramps	Signalized	15.9	B	13.0	B
3	Pepper Avenue and Highland Avenue	Unsignalized	0.3	A	0.2	A
4	Pepper Avenue and SR-210 WB Ramps	Signalized	n/a		n/a	
5	Pepper Avenue and SR-210 EB Ramps	Signalized	n/a		n/a	
6	State Street and SR-210 WB Ramps	Signalized	11.3	B	11.3	B
7	State Street and SR-210 EB Ramps	Signalized	18.5	B	20.6	C

The Opening Year (2016) AM peak hour level of service analysis results for the No Project and With Project scenarios are summarized in Table 3-12. The PM peak hour results are presented in Table 3-13. In the With Project condition, some traffic is diverted off of the Riverside Avenue and State Street ramps and onto the Pepper Avenue interchange, which results in improved operations on the existing facilities. All study intersections are forecast to operate at LOS C or better during all analysis scenarios. There are no significant impacts associated with the proposed project in the Opening Year.

Table 3-12: Opening Year (2016) LOS Results – AM Peak Hour

#	Intersection	Signal	No Project		With Project		Change in Delay
			Delay (sec)	LOS	Delay (sec)	LOS	
1	Riverside Avenue and SR-210 WB Ramps	Signalized	19.5	B	17.8	B	-1.7
2	Riverside Avenue and SR-210 EB Ramps	Signalized	16.1	B	16.0	B	-0.1
3	Pepper Avenue and Highland	Signalized	9.7	A	15.3	B	5.6
4	Pepper Avenue and SR-210 WB Ramps	Signalized	n/a		12.4	B	n/a
5	Pepper Avenue and SR-210 EB Ramps	Signalized	n/a		9.3	A	n/a
6	State Street and SR-210 WB Ramps	Signalized	11.4	B	11.1	B	-0.3
7	State Street and SR-210 EB Ramps	Signalized	18.2	B	18.6	B	0.4

Table 3-13: Opening Year (2016) LOS Results – PM Peak Hour

#	Intersection	Signal	No Project		With Project		Change in Delay
			Delay (sec)	LOS	Delay (sec)	LOS	
1	Riverside Avenue and SR-210 WB Ramps	Signalized	15.6	B	14.7	B	-0.9
2	Riverside Avenue and SR-210 EB Ramps	Signalized	14.1	B	13.9	B	-0.2
3	Pepper Avenue and Highland	Signalized	9.6	A	14.6	B	5.0
4	Pepper Avenue and SR-210 WB Ramps	Signalized	n/a		15.8	B	n/a
5	Pepper Avenue and SR-210 EB Ramps	Signalized	n/a		10.5	B	n/a
6	State Street and SR-210 WB Ramps	Signalized	11.6	B	11.2	B	-0.4
7	State Street and SR-210 EB Ramps	Signalized	17.4	B	18.5	B	1.1

The Horizon Year (2036) peak hour level of service analysis results for the No Project and With Project scenarios are summarized in Tables 3-14 and 3-15. All study intersections are forecast to operate at LOS C or better during all analysis scenarios. There are no significant impacts associated with the proposed project in the Horizon Year.

Table 3-14: Horizon Year (2036) LOS Results – AM Peak Hour

#	Intersection	Signal	No Project		With Project		Change in Delay
			Delay (sec)	LOS	Delay (sec)	LOS	
1	Riverside Avenue and SR-210 WB Ramps	Signalized	24.6	C	17.8	B	-6.8
2	Riverside Avenue and SR-210 EB Ramps	Signalized	19.2	B	16.3	B	-2.9
3	Pepper Avenue and Highland	Signalized	9.2	A	17.9	B	8.7
4	Pepper Avenue and SR-210 WB Ramps	Signalized	n/a		15.8	B	n/a
5	Pepper Avenue and SR-210 EB Ramps	Signalized	n/a		12.2	B	n/a
6	State Street and SR-210 WB Ramps	Signalized	13.1	B	11.6	B	-1.5
7	State Street and SR-210 EB Ramps	Signalized	15.7	B	16.2	B	0.5

Table 3-15: Horizon Year (2036) LOS Results – PM Peak Hour

#	Intersection	Signal	No Project		With Project		Change in Delay
			Delay (sec)	LOS	Delay (sec)	LOS	
1	Riverside Avenue and SR-210 WB Ramps	Signalized	26.5	C	14.8	B	-11.7
2	Riverside Avenue and SR-210 EB Ramps	Signalized	20.1	C	15.4	B	-4.7
3	Pepper Avenue and Highland	Signalized	9.1	A	19.4	B	10.3
4	Pepper Avenue and SR-210 WB Ramps	Signalized	n/a		19.29	B	n/a
5	Pepper Avenue and SR-210 EB Ramps	Signalized	n/a		16.6	B	n/a
6	State Street and SR-210 WB Ramps	Signalized	15.7	B	14.5	B	-1.2
7	State Street and SR-210 EB Ramps	Signalized	20.7	C	21.3	C	0.6

QUEUING ANALYSIS

The queuing analysis includes all study area facilities with limited storage capacity, such as freeway off-ramps, turn pockets, and approaches between closely-spaced intersections. Synchro software was used to estimate the 50th percentile and 95th percentile queue lengths for each of these facilities during the AM and PM peak hours under project conditions. The 50th percentile queue length is a statistical value that represents the typical queue that you would expect to observe during a given peak period. More specifically, if you measured the length of queue experienced at every signal cycle over the peak hour, half of the observed queues would be shorter than the 50th percentile queue length and half would be longer. The 95th percentile queue length is the longest queue you would expect to see on a facility under normal operating conditions. At least 95 percent of the time, you would expect the observed queue to be shorter than the 95th percentile queue length.

For the queuing analysis, the 95th percentile queue length is compared to the length of each facility to determine if sufficient storage capacity exists. The storage capacity measurements used in this analysis include:

Intersection #1 (WB 210 Ramps & Riverside Avenue) – The westbound off-ramp has two 990-foot lanes that transition into three approach lanes at Riverside Avenue. The westbound left, left-through-right, and right turn lanes are each approximately 330 feet long. The total storage capacity is 2,970 feet for all movements. The northbound-left turn pocket at this intersection is a two-lane facility with 255 feet in each lane, for a storage capacity of 510 feet.

Intersection #2 (EB 210 Ramps & Riverside Avenue) – The eastbound off-ramp currently has a single 760-foot lane that transitions into three approach lanes at Riverside Avenue. The eastbound left, through-right, and right turn lanes are each 405 feet long. The total storage capacity of the ramp is 1,975 feet. The southbound-left turn pocket at this intersection is a two-lane facility measuring 255 feet in length, for a storage capacity of 510 feet.

Intersection #3 (Highland Avenue & Pepper Avenue) – The westbound left turn pocket at this intersection is a single lane facility with a storage capacity of 320 feet. Striping plans referenced from the Pepper Avenue Extension Project Initial Study and the previously prepared Draft GAD (2008) show two northbound and two southbound lanes on Pepper Avenue. The distance between Highland Avenue and the SR-210 westbound ramp intersection is 230 feet.

Intersection #4 (WB 210 Ramps & Pepper Avenue) – The westbound off-ramp will be designed following the completion of the traffic analysis. The minimum storage capacity of the off-ramp will be determined based on a queuing analysis using horizon year forecast turning movement volumes. Striping plans referenced from the current Draft GAD shows one turn pocket lane in each direction between the eastbound and westbound ramp terminal intersections. The distance between intersections #4 and #5 and the length of the turn lane facility is 312 feet. Pepper Avenue is designed to have two northbound and two southbound lanes and the westbound SR-210 off-ramp has one through-left turn lane and one right turn lane at the intersection. These lane geometry assumptions are illustrated in Figure 10.

Intersection #5 (EB 210 Ramps & Pepper Avenue) – The eastbound off-ramp will be designed following the completion of the traffic analysis. The minimum storage capacity of the off-ramp will be determined based on a queuing analysis using horizon year forecast turning movement volumes. The storage capacity for the southbound-left turn pocket is 312 feet at this intersection. Pepper Avenue has two northbound and two southbound lanes and the eastbound SR-210 off-ramp has one through-left turn lane and one right turn lane at the intersection. These lane geometry assumptions are illustrated in Figure 10.

Intersection #6 (WB 210 Ramps & State Street) – The off-ramp currently has a single 790-foot lane that transitions into three approach lanes at State Street. The total storage capacity of the ramp is 2,290 feet. The northbound-left turn pocket at this intersection is a two-lane facility with 200 feet in each lane, for a storage capacity of 400 feet.

Intersection #7 (EB 210 Ramps & State Street) – The off-ramp currently has two 1,445-foot lanes that transition into three approach lanes at State Street. The eastbound left, through and right turn lanes are each approximately 310 feet long for a total storage capacity of 3,820 feet. The Existing Year (2011) queuing analysis results are shown in Table 3-16. All ramps have sufficient capacity to accommodate existing demand.

Table 3-16: Existing Year (2011) Queuing Analysis

Int. #	SR-210 Ramps	Storage Capacity (ft)	AM Peak Hour			PM Peak Hour		
			Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)	Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)
1	WB 210 Off-Ramp & Riverside Ave	2970	938	232	630530	825	157	345
	NBL Turn Pocket	510	523	104	178	388	64	124
2	EB 210 Off-Ramp & Riverside Ave	1975	546	15	134	566	21	137
	SBL Turn Pocket	510	386	77	114	222	40	71
4	WB 210 Off-Ramp & Pepper Ave	N/A						
	NBL Turn Pocket	N/A						
5	EB 210 Off-Ramp & Pepper Ave	N/A						
	SBL Turn Pocket	N/A						
6	WB 210 Off-Ramp & State St	2290	508	56	168	379	36	131
	NBL Turn Pocket	400	149	20	37	80	9	20
7	EB 210 Off-Ramp & State St	3820	683	125	277	325	56	148

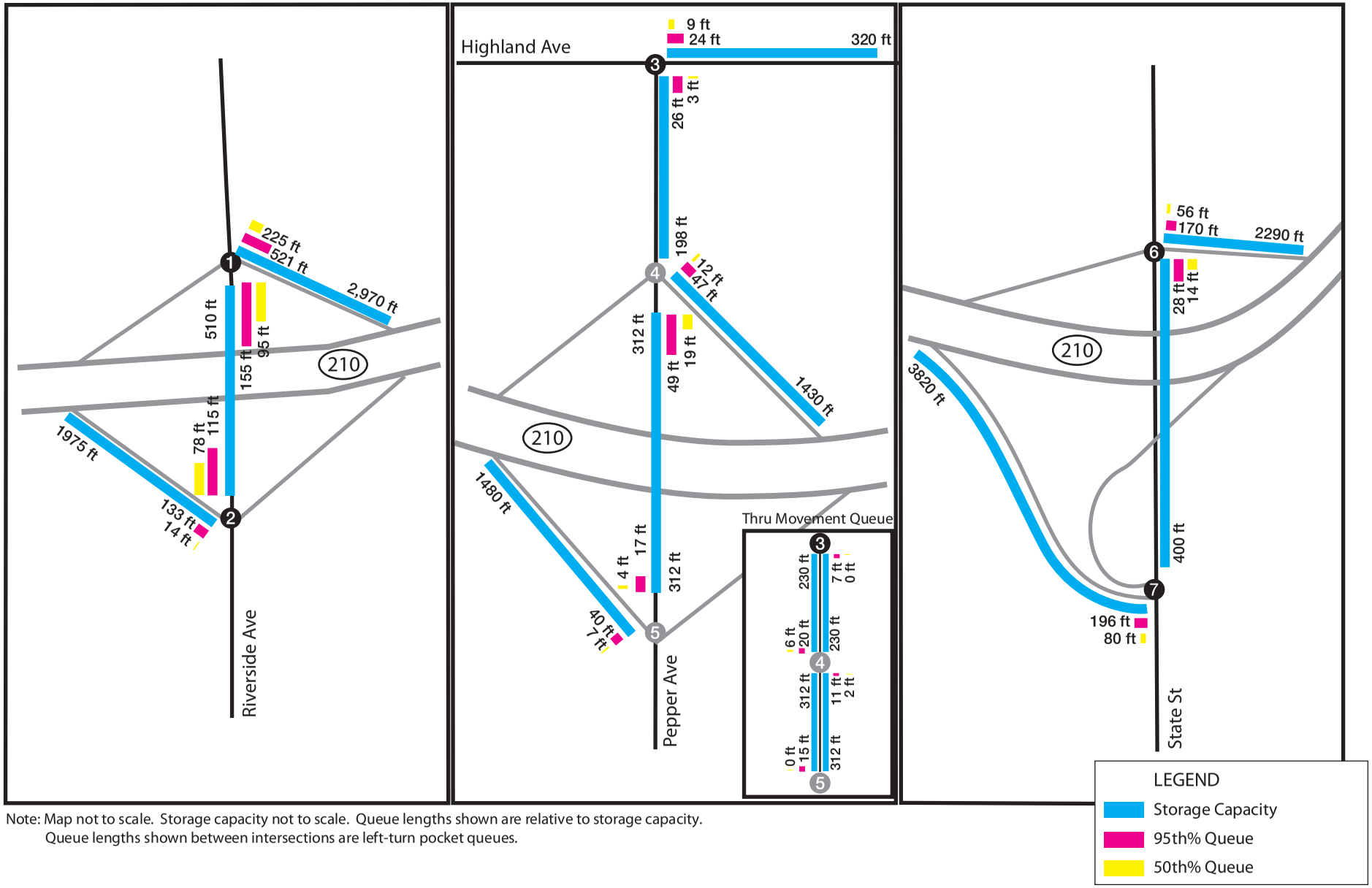
Storage capacity for the proposed intersections at Pepper Avenue was estimated based on the latest Draft GAD provided by the Consultant Team. The Opening Year (2016) queuing analysis for the AM peak hour and PM peak hour is summarized in Table 3-17 and Table 3-18. The 50th percentile and 95th percentile queue lengths for the Opening Year (2016) With Project condition during the AM peak hour are illustrated in Figure 15. The PM peak queues are shown in Figure 16.

Table 3-17: Opening Year (2016) Queuing Analysis – AM Peak Hour

Int. #	SR-210 Ramps	Storage Capacity (ft)	No Project			With Project		
			Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)	Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)
1	WB 210 Off-Ramp & Riverside Ave	2970	992	238	549	957	225	521
	NBL Turn Pocket	510	504	104	182	475	95	155
2	EB 210 Off-Ramp & Riverside Ave	1975	587	15	138	544	14	133
	SBL Turn Pocket	510	398	78	114	392	78	115
3	WB Highland Avenue	320	N/A			37	9	24
	NBL Turn Pocket	198				41	3	26
	NBT Lane	230				5	0	7
	NBR Turn Pocket	230				75	0	24
4	WB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			107	12	47
	NBL Turn Pocket[2]	312				64	19	49
	NBT Lane	312				63	2	11
	SBT Lane	312				62	6	20
5	EB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			99	7	40
	SBL Turn Pocket[2]	312				11	4	17
	SBT Lane	312				68	0	15
6	WB 210 Off-Ramp & State St	2290	572	61	179	529	56	170
	NBL Turn Pocket	400	130	15	30	118	14	28
7	EB 210 Off-Ramp & State St	3820	544	87	211	499	80	196

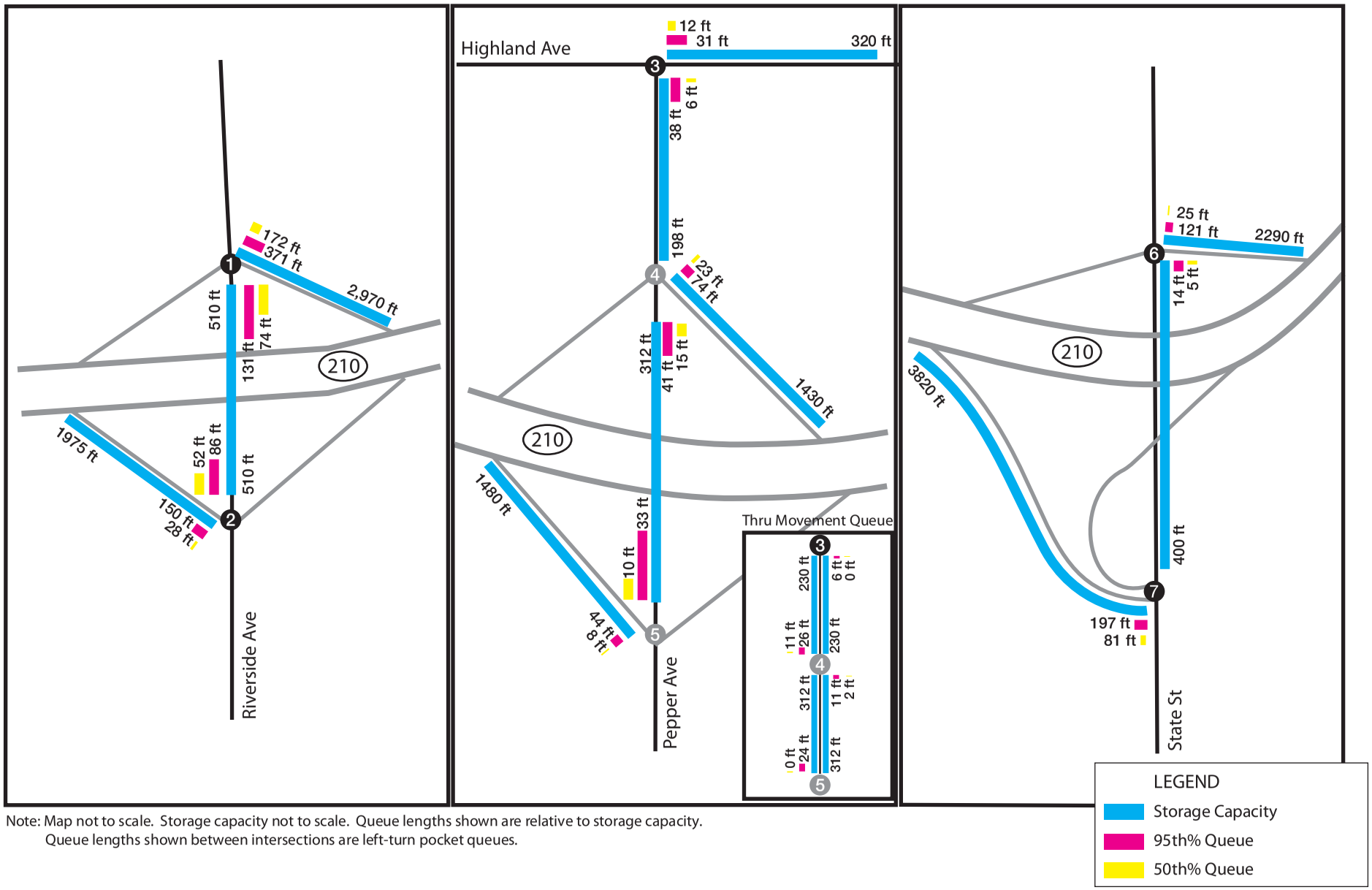
Notes:
1. The eastbound and westbound freeway access ramps at Pepper Avenue have not been designed and recommendations for minimum storage capacity will be determined as part of this analysis.
2. Left turn pockets from Pepper Avenue to the SR-210 on-ramps are side by side.

FIGURE 15 OPENING YEAR (2016) WITH PROJECT QUEUE ANALYSIS - AM PEAK HOUR



Note: Map not to scale. Storage capacity not to scale. Queue lengths shown are relative to storage capacity.
Queue lengths shown between intersections are left-turn pocket queues.

FIGURE 16 OPENING YEAR (2016) WITH PROJECT QUEUE ANALYSIS - PM PEAK HOUR



Note: Map not to scale. Storage capacity not to scale. Queue lengths shown are relative to storage capacity.
Queue lengths shown between intersections are left-turn pocket queues.

Table 3-18: Opening Year (2016) Queuing Analysis – PM Peak Hour

Int. #	SR-210 Ramps	Storage Capacity (ft)	No Project			With Project		
			Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)	Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)
1	WB 210 Off-Ramp & Riverside Ave	2970	880	196	456	837	172	371
	NBL Turn Pocket	510	432	81	142	389	74	131
2	EB 210 Off-Ramp & Riverside Ave	1975	598	30	161	547	28	150
	SBL Turn Pocket	510	250	50	81	261	52	86
3	WB Highland Avenue	320	N/A			51	12	31
	NBL Turn Pocket	198				70	6	38
	NBT Lane	230				5	0	6
	NBR Turn Pocket	230				95	0	27
4	WB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			211	23	74
	NBL Turn Pocket[2]	312				49	15	41
	NBT Lane	312				59	2	11
	SBT Lane	312				87	11	26
5	EB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			115	8	44
	SBL Turn Pocket[2]	312				30	10	33
	SBT Lane	312				116	0	24
6	WB 210 Off-Ramp & State St	2290	537	33	141	426	25	121
	NBL Turn Pocket	400	47	5	14	47	5	14
7	EB 210 Off-Ramp & State St	3820	565	93	218	495	81	197

Notes:
1. The eastbound and westbound freeway access ramps at Pepper Avenue have not been designed and recommendations for minimum storage capacity will be determined as part of this analysis.
2. Left turn pockets from Pepper Avenue to the SR-210 on-ramps are side by side.

The storage capacity measurements for the Horizon Year (2036) condition are the same as the Opening Year (2016) condition. The queuing analysis for the AM peak hour is summarized in Table 3-19 and PM peak hour analysis is presented in Table 3-20. The 50th percentile and 95th percentile queue lengths for the Horizon Year (2036) With Project condition during the AM peak hour are illustrated in Figure 17 and the PM peak queues are shown in Figure 18.

During both peak hours in Horizon Year (2036), the longest expected queue on all ramps and turn pockets is forecast to be below capacity for all movements considering side-by-side left turn pockets between intersections #4 and #5 in the project design.

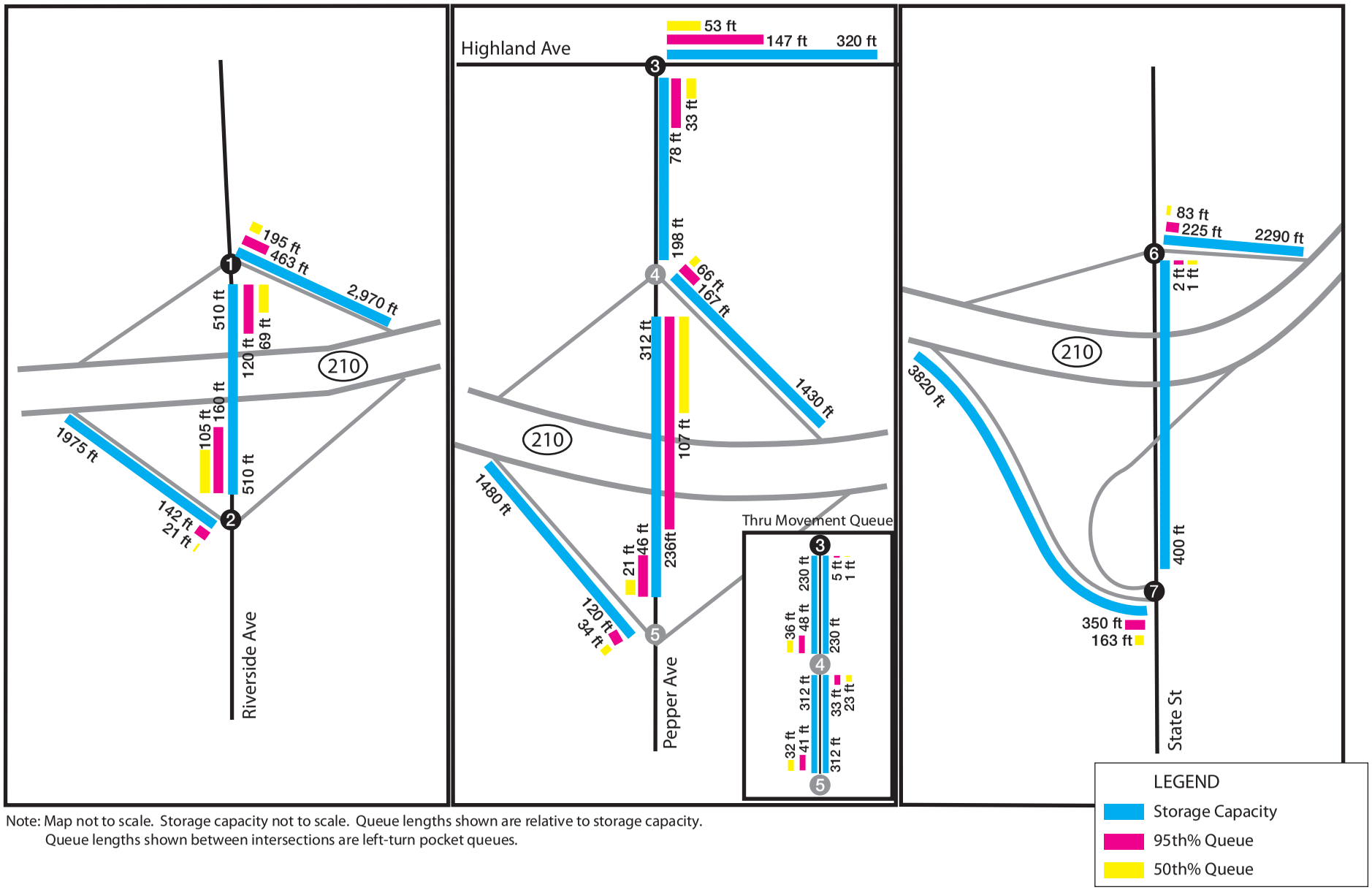
The eastbound and westbound SR-210 off-ramps to Pepper Avenue should provide, respectively, at least 300 feet and 150 feet of storage capacity to serve forecast traffic volumes. The actual ramp lengths should be designed to conform to national, state and local standards and should be at least 300 feet long.

Table 3-19: Horizon Year (2036) Queuing Analysis – AM Peak Hour

Int. #	SR-210 Ramps	Storage Capacity (ft)	No Project			With Project		
			Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)	Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)
1	WB 210 Off-Ramp & Riverside Ave	2970	1199	320	726	1023	195	463
	NBL Turn Pocket	510	486	111	193	335	69	120
2	EB 210 Off-Ramp & Riverside Ave	1975	782	31	184	578	21	142
	SBL Turn Pocket	510	505	109	144	548	105	160
3	WB Highland Avenue	320	N/A			179	53	147
	NBL Turn Pocket	198				205	33	78
	NBT Lane	230				7	1	5
	NBR Turn Pocket	230				372	0	12
4	WB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			532	66	167
	NBL Turn Pocket[2]	312				317	107	236
	NBT Lane	312				297	23	33
	SBT Lane	312				282	36	48
5	EB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			488	34	120
	SBL Turn Pocket[2]	312				54	21	46
	SBT Lane	312				318	32	41
6	WB 210 Off-Ramp & State St	2290	831	143	328	620	83	225
	NBL Turn Pocket	400	75	11	21	8	1	2
7	EB 210 Off-Ramp & State St	3820	916	166	375	824	163	350

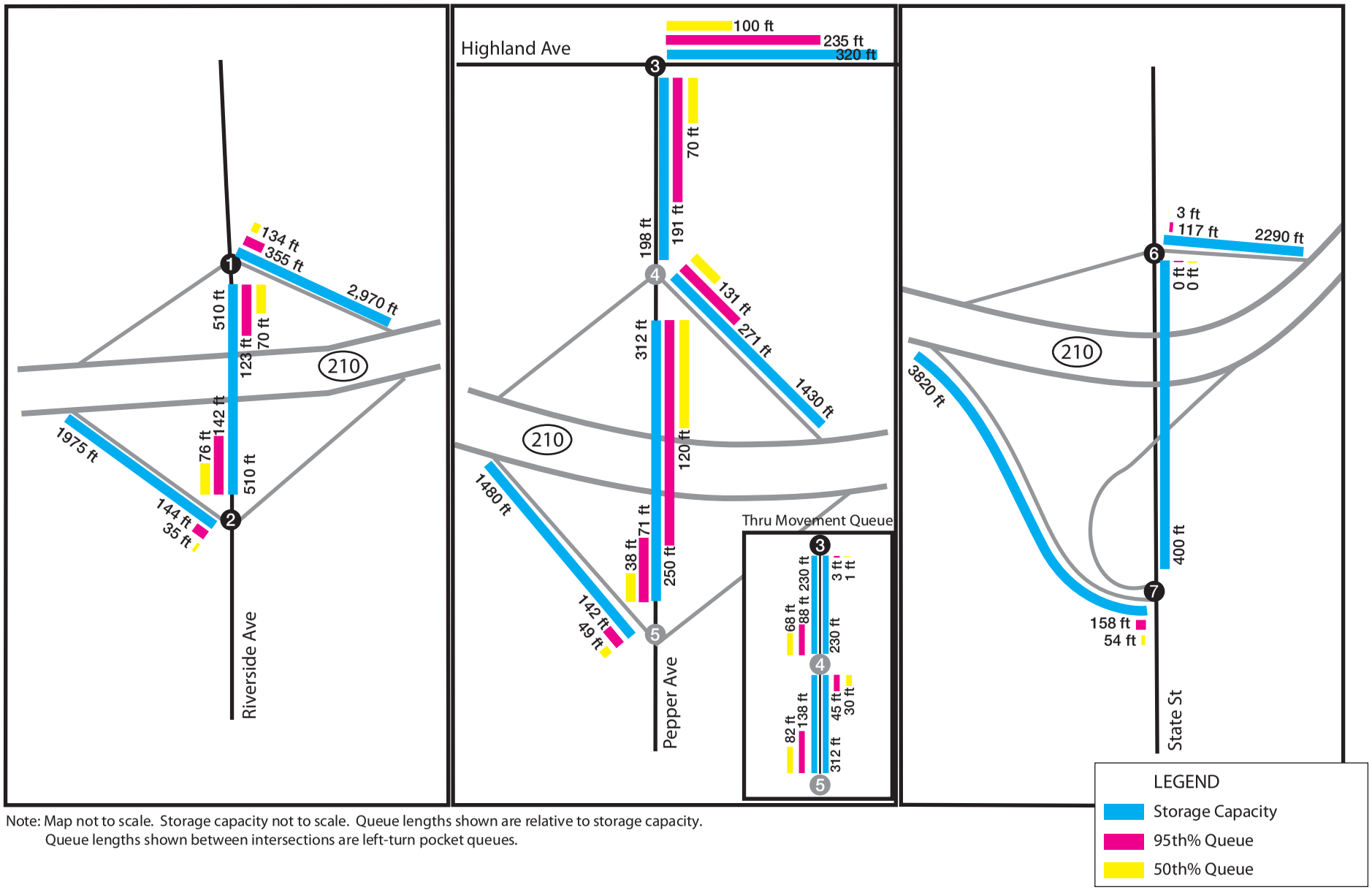
Notes:
1. The eastbound and westbound freeway access ramps at Pepper Avenue have not been designed and recommendations for minimum storage capacity will be determined as part of this analysis.
2. Left turn pockets from Pepper Avenue to the SR-210 on-ramps are side by side.

FIGURE 17 HORIZON YEAR (2036) WITH PROJECT QUEUE ANALYSIS - AM PEAK HOUR



Note: Map not to scale. Storage capacity not to scale. Queue lengths shown are relative to storage capacity.
Queue lengths shown between intersections are left-turn pocket queues.

FIGURE 18 HORIZON YEAR (2036) WITH PROJECT QUEUE ANALYSIS - PM PEAK HOUR



Note: Map not to scale. Storage capacity not to scale. Queue lengths shown are relative to storage capacity.
Queue lengths shown between intersections are left-turn pocket queues.

Table 3-20: Horizon Year (2036) Queuing Analysis – PM Peak Hour

Int. #	SR-210 Ramps	Storage Capacity (ft)	No Project			With Project		
			Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)	Peak Hour Volumes (vehicles)	50th% Q (ft)	95th% Q (ft)
1	WB 210 Off-Ramp & Riverside Ave	2970	1078	387	815	877	134	355
	NBL Turn Pocket	510	572	158	258	370	70	123
2	EB 210 Off-Ramp & Riverside Ave	1975	641	64	229	402	35	144
	SBL Turn Pocket	510	303	85	114	382	76	142
3	WB Highland Avenue	320	N/A			274	100	235
	NBL Turn Pocket	198				338	70	191
	NBT Lane	230				5	1	3
	NBR Turn Pocket	230				426	0	19
4	WB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			876	131	271
	NBL Turn Pocket[2]	312				291	120	250
	NBT Lane	312				305	30	45
	SBT Lane	312				408	68	88
5	EB 210 Off-Ramp & Pepper Ave[1]	TBD	N/A			583	49	142
	SBL Turn Pocket[2]	312				84	38	71
	SBT Lane	312				527	82	138
6	WB 210 Off-Ramp & State St	2290	1125	107	384	700	3	117
	NBL Turn Pocket	400	14	2	8	1	0	0
7	EB 210 Off-Ramp & State St	3820	528	92	237	369	54	158

Notes:
1. The eastbound and westbound freeway access ramps at Pepper Avenue have not been designed and recommendations for minimum storage capacity will be determined as part of this analysis.
2. Left turn pockets from Pepper Avenue to the SR-210 on-ramps are side by side.

RAMP ANALYSIS

The freeway ramp analysis was prepared using the HCS2010 software package. AM and PM peak hour volumes were converted to PCE using truck percentages obtained from traffic counts and from AADTT on the California State Highway System for all scenarios.

Results for the Existing Year (2011) scenario are presented in Table 3-21. All freeway ramps, with the exception of the off-ramp to Riverside Avenue currently operate at LOS C or better during both peak hour time periods.

Table 3-21: Existing Year (2011) Level of Service Results - Ramps

Ramp	Dir.	Lanes	AM Peak Hour		PM Peak Hour	
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
SR-210 off-ramp to Riverside Avenue	EB	1	22.1	C	28.0	D
SR-210 on-ramp from Riverside Avenue	EB	1	15.7	B	21.9	C
SR-210 off-ramp to State Street	EB	2	5.6	A	12.2	B
SR-210 on-ramp from State Street	EB	1	14.4	B	22.9	C
SR-210 off-ramp to State Street	WB	1	13.0	B	13.6	B
SR-210 on-ramp from State Street	WB	1	16.2	B	16.6	B
SR-210 off-ramp to Riverside Avenue	WB	2	0.0	A	0.0	A
SR-210 on-ramp from Riverside Avenue	WB	1	14.2	B	14.6	B

Ramp analysis results for the Opening Year (2016) with and without the project are presented in Table 3-22 and Table 3-23. All freeway ramps are forecast to operate at LOS C or better during the AM peak hour. In the PM peak hour, all of the ramps are expected to operate at LOS C or better, with the exception of the eastbound off-ramps on Riverside Avenue and Pepper Avenue, which are expected to operate at LOS D in the Opening Year.

Table 3-22: Opening Year (2016) Ramp LOS Results – AM Peak Hour

Ramp	Dir.	Lanes	No Project		With Project		Change in Density
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210 off-ramp to Riverside Avenue	EB	1	24.0	C	23.9	C	-0.1
SR-210 on-ramp from Riverside Avenue	EB	1	17.3	B	17.3	B	0.0
SR-210 off-ramp to Pepper Avenue	EB	1	n/a		24.7	C	n/a
SR-210 on-ramp from Pepper Avenue	EB	1	n/a		20.1	C	n/a
SR-210 off-ramp to State Street	EB	2	7.3	A	7.3	A	0.0
SR-210 on-ramp from State Street	EB	1	15.8	B	15.7	B	-0.1
SR-210 off-ramp to State Street	WB	1	14.9	B	14.8	B	-0.1
SR-210 on-ramp from State Street	WB	1	17.2	B	17.5	B	0.3
SR-210 off-ramp to Pepper	WB	1	n/a		24.8	C	n/a

Ramp	Dir.	Lanes	No Project		With Project		Change in Density
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
Avenue							
SR-210 on-ramp from Pepper Avenue	WB	1	n/a		Weaving segment		n/a
SR-210 off-ramp to Riverside Avenue	WB	2	0.0	A			
SR-210 on-ramp from Riverside Avenue	WB	1	15.1	B	15.1	B	0.0

Table 3-23: Opening Year (2016) Ramp LOS Results – PM Peak Hour

Ramp	Dir.	Lanes	No Project		With Project		Change in Density
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210 off-ramp to Riverside Avenue	EB	1	29.2	D	29.1	D	-0.1
SR-210 on-ramp from Riverside Avenue	EB	1	22.9	C	23.3	C	0.4
SR-210 off-ramp to Pepper Avenue	EB	1	n/a		30.3	D	n/a
SR-210 on-ramp from Pepper Avenue	EB	1	n/a		25.6	C	n/a
SR-210 off-ramp to State Street	EB	2	13.3	B	13.3	B	0.0
SR-210 on-ramp from State Street	EB	1	22.5	C	22.4	C	-0.1
SR-210 off-ramp to State Street	WB	1	16.7	B	16.5	B	-0.2
SR-210 on-ramp from State Street	WB	1	19.0	B	19.7	B	0.7
SR-210 off-ramp to Pepper Avenue	WB	1	n/a		27.4	C	n/a
SR-210 on-ramp from Pepper Avenue	WB	1	n/a		Weaving segment		n/a
SR-210 off-ramp to Riverside Avenue	WB	2	0.0	A			
SR-210 on-ramp from Riverside Avenue	WB	1	17.2	B	17.1	B	-0.1

Ramp analysis results for the Horizon Year (2036) with and without the project are presented in Table 3-24 and Table 3-25. All freeway ramps are forecast to operate at acceptable level of service during both peak hour time periods in the Horizon Year.

Table 3-24: Horizon Year (2036) Ramp LOS Results – AM Peak Hour

Ramp	Dir.	Lanes	No Project		With Project		Change in Density
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210 off-ramp to Riverside Avenue	EB	1	31.1	D	30.7	D	-0.4
SR-210 on-ramp from Riverside Avenue	EB	1	24.0	C	25.0	C	1.0

Ramp	Dir.	Lanes	No Project		With Project		Change in Density
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210 off-ramp to Pepper Avenue	EB	1	n/a		32.1	D	n/a
SR-210 on-ramp from Pepper Avenue	EB	1	n/a		27.1	C	n/a
SR-210 off-ramp to State Street	EB	2	14.1	B	14.1	B	0.0
SR-210 on-ramp from State Street	EB	1	21.1	C	20.8	C	-0.3
SR-210 off-ramp to State Street	WB	1	27.9	C	21.3	C	-6.6
SR-210 on-ramp from State Street	WB	1	21.1	C	21.1	C	0.0
SR-210 off-ramp to Pepper Avenue	WB	1	n/a		30.0	D	n/a
SR-210 on-ramp from Pepper Avenue	WB	1	n/a		Weaving segment		n/a
SR-210 off-ramp to Riverside Avenue	WB	2	2.5	A			
SR-210 on-ramp from Riverside Avenue	WB	1	19.1	B	18.7	B	-0.4

Table 3-25: Horizon Year (2036) Ramp LOS Results – PM Peak Hour

Ramp	Dir.	Lanes	No Project		With Project		Change in Density
			Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210 off-ramp to Riverside Avenue	EB	1	33.4	D	33.0	D	-0.4
SR-210 on-ramp from Riverside Avenue	EB	1	26.9	C	28.8	D	2.1
SR-210 off-ramp to Pepper Avenue	EB	1	n/a		35.5	E	n/a
SR-210 on-ramp from Pepper Avenue	EB	1	n/a		30.1	D	n/a
SR-210 off-ramp to State Street	EB	2	17.5	B	17.5	B	0.0
SR-210 on-ramp from State Street	EB	1	27.9	C	27.1	C	-0.8
SR-210 off-ramp to State Street	WB	1	27.9	C	27.9	C	0.0
SR-210 on-ramp from State Street	WB	1	28.7	D	30.4	D	1.7
SR-210 off-ramp to Pepper Avenue	WB	1	n/a		37.3	E	n/a
SR-210 on-ramp from Pepper Avenue	WB	1	n/a		Weaving segment		n/a
SR-210 off-ramp to Riverside Avenue	WB	2	8.8	A			
SR-210 on-ramp from Riverside Avenue	WB	1	27.4	C	27.0	B	-0.4

FREEWAY MAINLINE AND HOV LANE ANALYSIS

Freeway mainline analysis for the base year was conducted using HCS2010 software package. AM and PM peak hour volumes were converted to PCE using truck percentages obtained from traffic counts and from AADTT on the California State Highway System for all scenarios.

Results for the Existing Year (2011) condition are presented in Table 3-26. All study area freeway facilities currently operate at level of service C or better during peak hour time periods.

Table 3-26: Existing Year (2011) Level of Service Results - Basic Freeway Segment

Segment	Dir.	AM Peak Hour		PM Peak Hour	
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
SR-210, upstream Riverside Avenue off ramp	EB	16.9	B	23.3	C
SR-210, between Riverside Avenue ramps	EB	14.2	B	20.3	C
SR-210, Riverside Avenue on ramp to State Street off ramp	EB	18.3	C	25.5	C
SR-210, between State Street ramps	EB	16.3	B	23.8	B
SR-210, upstream State Street off ramp	WB	19.2	C	20.1	C
SR-210, between State Street ramps	WB	16.7	B	18.1	C
SR-210, State Street on ramp to Riverside Avenue off ramp	WB	19.2	C	20.0	C
SR-210, between Riverside Avenue ramps	WB	14.5	B	15.7	B
SR-210, downstream Riverside Avenue on ramp	WB	17.7	B	18.4	C

Freeway mainline analysis results for the Opening Year (2016) with and without the project are presented in Table 3-27 and Table 3-28. All study area freeway facilities are forecast to operate at LOS C or better in the AM peak hour and LOS D or better during the PM peak hour time period in the Opening Year. The implementation of the proposed project does not significantly impact the level of service of the segments expected to operate at LOS D in the no project condition. Mainline analysis results for the Horizon Year (2036) with and without the project are presented in Table 3-29 and Table 3-30. All study area freeway facilities are forecast to operate at LOS D or better in the AM peak hour, with occurrence of LOS E during the PM peak hour time period in the Horizon Year.. There are two forecast changes from LOS D to LOS E in the PM peak hour, on eastbound SR-210 between the Riverside Avenue on-ramp and the Pepper Avenue off-ramp and on westbound SR-210 between the State Street ramps. There is one forecast change from LOS C to LOS D, on the westbound segment between the State Street on-ramp and the Pepper Avenue off-ramp in the AM peak hour.

Table 3-27: Opening Year (2016) Freeway LOS Results – AM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, upstream Riverside Avenue off ramp	EB	18.8	C	18.8	C	0.0
SR-210, between Riverside Avenue ramps	EB	15.9	B	16.1	B	0.2
SR-210, Riverside Avenue on ramp to Pepper Avenue off ramp	EB	20.1	C	Overlap merge and diverge segments		n/a

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, between Pepper Avenue ramps	EB			19.9	C	-0.2
SR-210, Pepper Avenue on ramp to State Street off ramp	EB			Overlap merge and diverge segments		n/a
SR-210, between State Street ramps	EB	17.5	B	17.6	B	0.1
SR-210, upstream State Street off ramp	WB	21.1	C	21.1	C	0.0
SR-210, between State Street ramps	WB	18.3	C	18.5	C	0.2
SR-210, State Street on ramp to Pepper Avenue off ramp	WB			Overlap merge and diverge segments		n/a
SR-210, between Pepper Avenue ramps	WB	20.4	C	19.9	C	-0.5
SR-210, Pepper Avenue on ramp to Riverside Avenue off ramp	WB			Weaving segment		n/a
SR-210, between Riverside Avenue ramps	WB	15.5	B	15.7	B	0.2
SR-210, downstream Riverside Avenue on ramp	WB	18.7	C	18.7	C	0.0

Table 3-28: Opening Year (2016) Freeway LOS Results – PM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, upstream Riverside Avenue off ramp	EB	24.7	C	24.7	C	0.0
SR-210, between Riverside Avenue ramps	EB	21.4	C	21.7	C	0.3
SR-210, Riverside Avenue on ramp to Pepper Avenue off ramp	EB			Overlap merge and diverge segments		n/a
SR-210, between Pepper Avenue ramps	EB	26.9	D	26.6	D	-0.3
SR-210, Pepper Avenue on ramp to State Street off ramp	EB			Overlap merge and diverge segments		n/a
SR-210, between State Street ramps	EB	23.8	B	24.0	C	0.2
SR-210, upstream State Street off ramp	WB	23.3	C	23.3	C	0.0
SR-210, between State Street ramps	WB	20.5	C	21.0	C	0.5
SR-210, State Street on ramp to Pepper Avenue off ramp	WB					n/a
SR-210, between Pepper Avenue ramps	WB	22.5	C	22.1	C	-0.4
SR-210, Pepper Avenue on ramp to Riverside Avenue off ramp	WB			Weaving segment		n/a
SR-210, between Riverside Avenue ramps	WB	17.9	B	18.2	C	0.3
SR-210, downstream Riverside Avenue on ramp	WB	21.0	C	21.0	C	0.0

Table 3-29: Horizon Year (2036) Freeway LOS Results – AM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, upstream Riverside Avenue off ramp	EB	27.0	D	27.0	D	0.0
SR-210, between Riverside Avenue ramps	EB	22.5	C	23.6	C	1.1
SR-210, Riverside Avenue on ramp to Pepper Avenue off ramp	EB	28.1	D	Overlap merge and diverge segments		n/a
SR-210, between Pepper Avenue ramps	EB			26.4	D	
SR-210, Pepper Avenue on ramp to State Street off ramp	EB			Overlap merge and diverge segments		n/a
SR-210, between State Street ramps	EB	22.6	C	23.1	C	0.5
SR-210, upstream State Street off ramp	WB	30.0	D	30.0	D	0.0
SR-210, between State Street ramps	WB	24.7	C	25.9	C	1.2
SR-210, State Street on ramp to Pepper Avenue off ramp	WB	25.6	C	Overlap merge and diverge segments		n/a
SR-210, between Pepper Avenue ramps	WB			23.1	C	
SR-210, Pepper Avenue on ramp to Riverside Avenue off ramp	WB			Weaving segment		n/a
SR-210, between Riverside Avenue ramps	WB	19.4	C	20.4	C	1.0
SR-210, downstream Riverside Avenue on ramp	WB	22.8	C	22.8	C	0.0

Table 3-30: Horizon Year (2036) Freeway LOS Results – PM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, upstream Riverside Avenue off ramp	EB	31.5	D	31.5	D	0.0
SR-210, between Riverside Avenue ramps	EB	26.8	D	26.4	D	-0.4
SR-210, Riverside Avenue on ramp to Pepper Avenue off ramp	EB	33.3	D	Overlap merge and diverge segments		n/a
SR-210, between Pepper Avenue ramps	EB			31.4	D	
SR-210, Pepper Avenue on ramp to State Street off ramp	EB			Overlap merge and diverge segments		n/a
SR-210, between State Street ramps	EB	29.3	D	30.4	D	1.1
SR-210, upstream State Street off ramp	WB	44.6	E	44.6	E	0.0
SR-210, between State Street ramps	WB	32.4	D	36.2	E	3.8
SR-210, State Street on ramp to Pepper Avenue off ramp	WB	36.9	E			n/a
SR-210, between Pepper Avenue ramps	WB			32.3	D	
SR-210, Pepper Avenue on ramp to Riverside Avenue off ramp	WB			Weaving segment		n/a
SR-210, between Riverside Avenue ramps	WB	27.9	D	29.3	D	1.4

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, downstream Riverside Avenue on ramp	WB	34.5	D	34.5	D	0.0

Volumes on the HOV lanes were evaluated consistent with Caltrans HOV Guidelines. These guidelines identify that the desirable level of service is LOS C, and that this occurs at approximately 1,650 vehicles per hour. Table 3-31 presents the volumes for the Existing Year (2011) condition on the HOV lanes, and whether the volume meets the criteria for the minimum acceptable level of service.

Table 3-31: Existing Year (2011) Level of Service Results – HOV Lanes

Segment	Dir.	AM Peak Hour		PM Peak Hour	
		Volume (pc/ln)	LOS<C ?	Volume (pc/ln)	LOS<C ?
SR-210, upstream Riverside Avenue	EB	142	yes	525	yes
SR-210, Riverside Avenue to State Street	EB	153	yes	564	yes
SR-210, downstream State Street	EB	153	yes	567	yes
SR-210, upstream State Street	WB	275	yes	301	yes
SR-210, State Street to Riverside Avenue	WB	274	yes	300	yes
SR-210, downstream Riverside Avenue	WB	252	yes	277	yes

A separate analysis considering a capacity of 2,000 vehicles per lane per hour was performed and all segments present volume-to-capacity ratios below 0.3.

Table 3-32: Opening Year (2016) HOV Lane LOS Results – AM Peak Hour

Segment	Dir.	No Project		With Project	
		Volume (pc/ln)	LOS C or Better?	Volume (pc/ln)	LOS C or Better?
SR-210, upstream Riverside Avenue	EB	247	yes	247	yes
SR-210, Riverside Avenue to Pepper Avenue	EB	269	yes	269	yes
SR-210, Pepper Avenue to State Street	EB	269	yes	269	yes
SR-210, downstream State Street	EB	269	yes	269	yes
SR-210, upstream State Street	WB	368	yes	368	yes
SR-210, State Street to Pepper Avenue	WB	367	yes	367	yes
SR-210, Pepper Avenue to Riverside Avenue	WB	367	yes	367	yes
SR-210, downstream Riverside Avenue	WB	334	yes	334	yes

Table 3-33: Opening Year (2016) HOV Lane LOS Results – PM Peak Hour

Segment	Dir.	No Project		With Project	
		Volume (pc/ln)	LOS C or Better?	Volume (pc/ln)	LOS C or Better?
SR-210, upstream Riverside Avenue	EB	576	yes	576	yes
SR-210, Riverside Avenue to Pepper Avenue	EB	676	yes	676	yes
SR-210, Pepper Avenue to State Street	EB	676	yes	676	yes
SR-210, downstream State Street	EB	679	yes	679	yes
SR-210, upstream State Street	WB	482	yes	482	yes
SR-210, State Street to Riverside Avenue	WB	481	yes	481	yes
SR-210, Pepper Avenue to Riverside Avenue	WB	481	yes	481	yes
SR-210, downstream Riverside Avenue	WB	429	yes	429	yes

Volume-to-capacity ratio for all segments is less than 0.35 considering 2,000 vehicles per lane per hour, but it must be noted that vehicles entering and exiting the SR-210 HOV lanes via the Pepper Avenue interchange are assumed to use the existing HOV access points that currently serve vehicles entering and exiting from the Riverside Avenue and State Street interchanges.

Table 3-34: Horizon Year (2036) HOV Lane LOS Results – AM Peak Hour

Segment	Dir.	No Project		With Project	
		Volume (pc/ln)	LOS C or Better?	Volume (pc/ln)	LOS C or Better?
SR-210, upstream Riverside Avenue	EB	669	yes	669	yes
SR-210, Riverside Avenue to Pepper Avenue	EB	733	yes	733	yes
SR-210, Pepper Avenue to State Street	EB	733	yes	733	yes
SR-210, downstream State Street	EB	733	yes	733	yes
SR-210, upstream State Street	WB	740	yes	740	yes
SR-210, State Street to Pepper Avenue	WB	739	yes	739	yes
SR-210, Pepper Avenue to Riverside Avenue	WB	739	yes	739	yes
SR-210, downstream Riverside Avenue	WB	661	yes	661	yes

Table 3-35: Horizon Year (2036) HOV Lane LOS Results – PM Peak Hour

Segment	Dir.	No Project		With Project	
		Volume (pc/ln)	LOS C or Better?	Volume (pc/ln)	LOS C or Better?
SR-210, upstream Riverside Avenue	EB	793	yes	793	yes
SR-210, Riverside Avenue to Pepper Avenue	EB	1122	yes	1122	yes
SR-210, Pepper Avenue to State Street	EB	1122	yes	1122	yes

Segment	Dir.	No Project		With Project	
		Volume (pc/ln)	LOS C or Better?	Volume (pc/ln)	LOS C or Better?
SR-210, downstream State Street	EB	1125	yes	1125	yes
SR-210, upstream State Street	WB	1202	yes	1202	yes
SR-210, State Street to Riverside Avenue	WB	1201	yes	1201	yes
SR-210, Pepper Avenue to Riverside Avenue	WB	1201	yes	1201	yes
SR-210, downstream Riverside Avenue	WB	1038	yes	1038	yes

The volume-to-capacity ratio for all segments is equal or less than 0.6 considering 2,000 vehicles per lane per hour, but it must be noted that vehicles entering and exiting the SR-210 HOV lanes via the Pepper Avenue interchange are assumed to use the existing HOV access points that currently serve vehicles entering and exiting from the Riverside Avenue and State Street interchanges.

WEAVING ANALYSIS

A weaving section is defined by an on-ramp followed closely by an off-ramp, connected by an auxiliary lane, and requires traffic to make a lane change within this section in order to enter or exit the freeway. If the on- and off-ramps are on the same side of the freeway, but not connected by a continuous auxiliary lane, this segment is not considered to be a weaving segment, and should be analyzed as a merge, diverge and base segment[1].

In the existing conditions, the distance between the existing on-ramps and off-ramps in the study area is 7,700 feet, with no auxiliary lane connecting the ramps. These segments have been analyzed as merge, diverge and base segments.

Similar to the no project condition, no weaving analysis is performed in the With Project condition as the segments do not have the characteristics necessary to be defined as weaving segments. The freeway configuration is three lanes in the eastbound direction, with no auxiliary lanes connecting on- and off-ramps in the study area. The segment between the Riverside Avenue on-ramp and the Pepper Avenue off-ramp is 2,682 feet, and the distance between the Pepper Avenue on-ramp and the State Street off-ramp is assumed to be 2,440 feet. In the westbound direction, the freeway configuration is three lanes with no auxiliary lane between the State Street on-ramp and the Pepper Avenue off-ramp, with distance between ramps of 2,630 feet. The segment between the Pepper Avenue on-ramp and the Riverside Avenue off-ramp contains an auxiliary lane, with length between ramps of 2,502 feet, and therefore is the only weaving segment. The other segments have been analyzed as merge segments. The results are presented in Tables 3-36 to 3-39.

[1] Freeway merge and diverge segments occur primarily at on-ramp and off-ramp junctions with the freeway mainline, basic segments are defined as segments that are outside of the influence of merging, diverging or weaving maneuvers.

Table 3-36: Opening Year (2016) Weaving LOS Results – AM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, Pepper Avenue to Riverside Avenue	WB	not a weaving section		5.7	A	-1.4

Table 3-37: Opening Year (2016) Weaving LOS Results – PM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, Pepper Avenue to Riverside Avenue	WB	not a weaving section		7.5	A	-2.3

Tables 3-39 and 3-40 contain a summary of the weaving analysis results for the Horizon Year (2036). All segments analyzed are expected to operate at acceptable conditions.

Table 3-38: Horizon Year (2036) Weaving LOS Results – AM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, Pepper Avenue to Riverside Avenue	WB	not a weaving section		10.7	B	-3.1

Table 3-39: Horizon Year (2036) Weaving LOS Results – PM Peak Hour

Segment	Dir.	No Project		With Project		Change in Density
		Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	
SR-210, Pepper Avenue to Riverside Avenue	WB	not a weaving section		18.2	B	n/a

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SIGNAL WARRANT ANALYSIS

Chapter 4 of the Manual on Uniform Traffic Control Devices (MUTCD) includes criteria to determine if a traffic signal may be warranted at a stop-controlled or uncontrolled intersection. Traffic control may be needed if the criteria for one or more of the traffic signal warrants listed in Table 3-40 are met. If none of the warrants are satisfied, then a traffic signal should not be installed. However, the satisfaction of a traffic signal warrant or warrants does not in itself require the installation of traffic control signal. A signal should not be installed if it will seriously disrupt progressive traffic flow or if it will not improve overall safety or operation of the intersection.

Table 3-40: MUTCD Signal Warrants

Warrant		Intended Application	Based On
1	Eight-Hour Vehicular Volume	Where a large volume of intersecting traffic occurs throughout the day	Approach volumes over an 8-hour period
2	Four-Hour Vehicular Volume	Where both the major and minor streets experience high volumes during any 4 hours during the day	Volumes during the 4 highest hours
3	Peak Hour	Where the minor-street traffic suffers undue delay for a minimum of 1 hour of an average day	Peak hour approach volumes
4	Pedestrian Volume	Where traffic is so heavy that pedestrians experience excessive delay when crossing the major street	Pedestrian and major street volumes, traffic gaps
5	School Crossing	Where the fact that school children cross the major street is the main reason to consider a traffic signal	Distance to nearest signal, volumes
6	Coordinated Signal System	To maintain progressive movement and properly platoon vehicles in a coordinated signal system	Distance between signals, platooning
7	Crash Experience	Where the severity and frequency of crashes are the principal reason to consider installing a signal	Crash history, 8-hour volumes, speed limit
8	Roadway Network	To encourage concentration and organization of traffic flow on a roadway network	Peak hour and forecast volumes

Source: Manual on Uniform Traffic Control (MUTCD) Chapter 4C

A peak hour signal warrant calculation for the intersections of Pepper Avenue and Highland Avenue (#3), Pepper Avenue and the SR-210 Westbound Ramps (#4), and Pepper Avenue and the SR-210 Eastbound Ramps (#5) was conducted as part of this analysis. The results for Pepper Avenue and Highland Avenue are highlighted in Table 3-41. The major street is Highland Avenue, which has a speed limit above 40 miles per hour, so the thresholds in Figure 4C-4 for Signal Warrant 3, Peak Hour (70% Factor) apply. This intersection meets the criteria for a traffic signal warrant by year 2036 due to ambient traffic growth and forecast project trips.

Table 3-41: Signal Warrant Analysis – Pepper Avenue and Highland Avenue (#3)

Analysis Scenario	Major Street: Highland Avenue Volume (Both Approaches) 2 lanes in each direction	Minor Street: Pepper Avenue Volume (Highest Approach) 1 lane in each direction	Threshold on Minor Street	Warrant Met
2016 AM NP	593	43	350 vehicles	No
2016 PM NP	674	46	275 vehicles	No
2016 AM WP	629	130	325 vehicles	No
2016 PM WP	732	171	250 vehicles	No
2036 AM NP	758	121	275 vehicles	No
2036 PM NP	896	150	175 vehicles	No
2036 AM WP	941	555	175 vehicles	Yes
2036 PM WP	1,192	723	100 vehicles	Yes

The results for SR-210 WB Off-Ramp and Pepper Avenue are highlighted in Table 3-42. The major street is Pepper Avenue, which is assumed to have a speed limit of 35 miles per hour, so the thresholds in Figure 4C-3 for Signal Warrant 3, Peak Hour apply. Based on the forecast approach volumes, a traffic signal would be warranted by the year 2036 due to ambient traffic growth and forecast project trips.

Table 3-42: Signal Warrant Analysis – Pepper Avenue and SR-210 Westbound Ramps (#4)

Analysis Scenario	Major Street: Pepper Avenue Volume (Both Approaches) 2 lanes in each direction	Minor Street: 210 WB Off Ramp Volume (Highest Approach)	Threshold on Minor Street	Warrant Met
2016 AM WP	174	98	600 vehicles	No
2016 PM WP	179	194	600 vehicles	No
2036 AM WP	825	489	475 vehicles	Yes
2036 PM WP	924	806	420 vehicles	Yes

The results for SR-210 EB Off-Ramp and Pepper Avenue are highlighted in Table 3-43. The major street is Pepper Avenue, which is assumed to have a speed limit of 35 miles per hour, so the thresholds in Figure 4C-3 for Signal Warrant 3, Peak Hour apply. Based on the forecast approach volumes, a traffic signal would be warranted in the year 2036 due to ambient traffic growth and forecast project trips.

Table 3-43: Signal Warrant Analysis – Pepper Avenue and SR-210 Eastbound Ramps (#5)

Analysis Scenario	Major Street: Pepper Avenue Volume (Both Approaches) 2 lanes in each direction	Minor Street: 210 EB Off Ramp Volume (Highest Approach)	Threshold on Minor Street	Warrant Met
2016 AM WP	203	91	600 vehicles	No
2016 PM WP	231	106	600 vehicles	No
2036 AM WP	978	449	400 vehicles	Yes
2036 PM WP	1,078	536	340 vehicles	Yes

RAMP METERING

Ramp meters are required for this project by Caltrans. Forecast peak hour volumes on the project on-ramps for Horizon Year 2036 are anticipated to be less than 500 vehicles per hour in both AM and PM peak hours. Ramp meter design will be done in concert with the traffic signals. Per Caltrans Deputy Directive DD-35-R1, the project shall include provisions to meter one single occupancy vehicle lane and one high occupancy vehicle lane on each ramp.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of this technical analysis conclude that the proposed diamond interchange at Pepper Avenue with signalized ramp intersections will operate at LOS C or better in the Project Opening Year (2016) and through the Horizon Year (2036) without significant impacts to the freeway or adjacent ramp terminal and local street intersections. Based on the forecast peak hour turning movement volumes through the interchange, no issues related to traffic progression on Pepper Avenue or Highland Avenue were identified through the Horizon Year. No significant impacts are forecast to be generated by the project with regard to queuing or level of service for study intersections, freeway ramps, and freeway mainline segments.

Intersection Level of Service Summary

This supplemental analysis does not result in changes to the conclusions as summarized in the Approved Traffic Impact Study (dated March 28, 2012) for the State Route 210 and Pepper Avenue interchange (SR-210/Pepper) project. All intersections are forecast to perform at an acceptable level of service (LOS C or better) with the project through the Horizon Year (2036). It is assumed that the intersections of Pepper Avenue and Highland Avenue (#3), Pepper Avenue and the SR-210 westbound ramps (#4) and Pepper Avenue and the SR-210 eastbound ramps (#5) would be signalized as part of the project. No significant impacts are generated by the project as proposed.

Queuing Analysis

The analysis performed is consistent with current version of GAD, and the proposed storage capacity with side-by-side turn pockets on Pepper Avenue between the freeway ramps provides for adequate storage capacity. This is consistent findings from the original analysis.

Freeway Mainline Analysis

Year 2011 mainline ADT was updated from about 27,000 to over 100,000 vehicles. The increase in mainline volumes has an impact on freeway peak hour level of service. The impact of the increase in base year volumes is higher in the Horizon Year, where daily volumes are expected to be over 175,000 vehicles. These high baseline mainline volumes on the freeway are the main factors for the anticipated degradation of level of service in 2036.

Freeway mainline segments are forecast to operate at acceptable level of service, which is forecast to range from LOS D to LOS E in the Horizon Year. The implementation of the proposed project is expected to introduce a change in LOS from LOS C to LOS D in the 2036 AM peak hour on the westbound segment between State Street on-ramp and Pepper Avenue off-ramp. In the 2036 PM peak hour, level of service is expected to change from LOS D to LOS E on eastbound SR-210 between the Riverside Avenue on-ramp and Pepper Avenue off-ramp and on westbound SR-210 between the State Street ramps. LOS for all other segments in the Horizon Year is forecast to either remain the same or at LOS D. The change in LOS from LOS D to LOS E is explained by volumes that do not exit the ramps at the beginning of the study area, continuing on the freeway to exit at the Pepper off-ramp.

Weaving/Merge-Diverge Analysis

Ramp volumes for design year 2036 are below the 1,500 equivalent passenger cars per hour threshold. The ramp analysis indicates that the Pepper Avenue off-ramps are expected to operate at acceptable level of service (LOS E) in the PM peak hour, and therefore no specific mitigation is proposed.

The only weaving segment within the study area is forecast to operate at acceptable level of service in the Horizon Year (2036).

Signal Warrant Analysis

This supplemental analysis does not result in changes to the conclusions as summarized in the Approved Traffic Impact Study (dated March 28, 2012) for the State Route 210 and Pepper Avenue interchange (SR-210/Pepper) project. A signal is warranted at the intersections of Pepper Avenue and Highland Avenue, SR-210 WB Ramp and Pepper Avenue, and SR-210 EB Ramp and Pepper Avenue in the Horizon Year (2036) condition.

Ramp Metering

This supplemental analysis does not result in changes to the conclusions as summarized in the Approved Traffic Impact Study (dated March 28, 2012) for the State Route 210 and Pepper Avenue interchange (SR-210/Pepper) project.

Diamond Interchange Feasibility

Based on the proposed project assumptions and analysis results above, a diamond interchange is feasible at Pepper Avenue.

A. Mitigation Measures

The project is not expected to generate any significant impacts to the Riverside Avenue and State Street/University Parkway interchange ramp intersections. The current design provides side-by-side turn pockets on Pepper Avenue between the SR-210 ramps, and all study intersections are forecast to operate at LOS C or better in the Project Opening Year (2016) and through the Horizon Year (2036).

B. Caltrans Recommendations

The State of California Department of Transportation (Caltrans) District 8 Electrical Operations division provided comments on the analysis for this project on November 30th, 2011. Based on the future forecast volumes, the intersection and ramp geometry proposed in this report is not expected to experience any significant impacts through the Horizon Year. However, Caltrans recommends enhancements to the proposed geometry as follows:

1. Final design for both eastbound and westbound off-ramps at Pepper Avenue (#4 and #5) should have three lanes: a dedicated left turn; dedicated right turn; and a shared left, through and right-turn lane.

Caltrans concurs that Pepper Avenue should be constructed with two northbound lanes and two southbound lanes and side-by-side left turn pockets, and that the ramp terminal intersections (#4 and #5) should be signalized. The Synchro analysis prepared for this report assumes that the three closely-spaced intersections on Pepper Avenue at Highland Avenue and the ramp terminals will be coordinated and utilize a single controller. Caltrans will review the final design plans and specifications, as well as the final signal timing plan for the coordinated set of intersections (#3, #4 and #5).

APPENDIX

A. Traffic Data Collection and Sources

B. Methodologies and Assumptions

C. Analysis Worksheets – Intersection Level of Service

D. Analysis Worksheets – Ramp Analysis

E. Analysis Worksheets – Freeway Mainline and HOV Analysis

F. Analysis Worksheets – Weaving Analysis

G. Traffic Volume Technical Memorandum

APPENDIX A

TRAFFIC DATA COLLECTION AND SOURCES

24-HOUR ROADWAY SEGMENT COUNTS (WITH CLASSIFICATION)

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE: 04/26/11 TUESDAY
JOB #: CA11-0429-03

CITY: RIALTO
LOCATION: RIVERSIDE AVE S/O 210 EB RAMPS

AM	NORTHBOUND							SOUTHBOUND						
TIME	1	2	3	4	5	6	TOTAL	1	2	3	4	5	6	TOTAL
0:00	20	0	0	0	0	0	20	42	1	0	2	0	0	45
0:15	25	1	1	1	0	0	28	38	2	0	1	0	0	41
0:30	28	0	0	0	0	0	28	49	1	0	2	0	0	52
0:45	19	0	0	0	0	0	19	41	0	0	1	0	0	42
1:00	26	0	0	0	0	0	26	37	2	0	1	0	0	40
1:15	24	0	0	0	0	0	24	33	1	0	0	0	0	34
1:30	28	1	0	0	0	0	29	27	0	0	1	0	0	28
1:45	18	1	0	0	0	0	19	31	0	1	1	0	0	33
2:00	20	0	0	1	0	0	21	27	1	0	0	0	0	28
2:15	22	2	1	0	0	0	25	25	2	0	0	0	0	27
2:30	29	0	0	1	0	0	30	19	1	0	1	0	0	21
2:45	31	0	0	0	0	0	31	24	0	0	3	0	0	27
3:00	28	0	0	0	0	0	28	43	1	0	3	0	0	47
3:15	34	1	0	1	0	0	36	35	1	0	2	0	0	38
3:30	47	2	0	0	0	0	49	28	1	0	0	0	0	29
3:45	45	2	0	2	0	0	49	31	3	1	1	0	0	36
4:00	52	3	0	2	0	1	58	30	2	0	0	0	0	32
4:15	71	1	1	0	0	0	73	35	4	0	0	0	0	39
4:30	98	1	1	1	0	0	101	44	6	1	3	0	0	54
4:45	116	3	0	1	0	1	121	50	3	1	1	0	1	56
5:00	134	4	0	1	0	1	140	48	2	0	2	0	0	52
5:15	162	4	0	2	0	0	168	58	5	2	4	0	0	69
5:30	219	2	2	1	0	1	225	80	5	0	3	0	1	89
5:45	176	2	1	0	0	1	180	94	3	1	2	0	0	100
6:00	161	4	0	2	0	1	168	131	4	4	2	0	1	142
6:15	173	1	1	7	0	3	185	186	3	1	7	0	2	199
6:30	301	5	2	3	0	2	313	140	1	2	2	0	4	149
6:45	234	6	0	5	0	5	250	171	4	2	5	0	8	190
7:00	281	2	1	2	0	2	288	314	3	1	2	0	2	322
7:15	330	4	0	1	0	1	336	354	5	2	7	0	4	372
7:30	297	7	0	4	0	2	310	311	2	0	3	0	4	320
7:45	262	3	1	9	0	1	276	327	8	5	4	0	3	347
8:00	283	6	0	1	0	1	291	228	4	1	4	0	1	238
8:15	249	7	0	5	0	3	264	227	5	3	6	0	2	243
8:30	224	2	1	4	0	1	232	229	2	7	7	0	1	246
8:45	178	7	0	10	0	3	198	209	4	3	1	0	0	217
9:00	196	4	2	6	0	1	209	161	6	2	3	0	1	173
9:15	201	5	1	3	0	1	211	182	4	2	2	0	1	191
9:30	222	9	0	4	0	1	236	191	5	6	3	0	3	208
9:45	190	7	0	4	0	2	203	155	7	3	4	0	2	171
10:00	172	2	0	5	0	1	180	175	9	0	1	0	1	186
10:15	186	3	1	6	0	0	196	177	3	2	2	0	0	184
10:30	193	4	1	3	0	4	205	187	6	1	5	0	1	200
10:45	201	4	3	2	0	1	211	188	4	1	3	1	0	197
11:00	211	4	2	6	0	1	224	204	5	1	3	0	1	214
11:15	235	2	0	1	0	2	240	196	9	0	1	0	2	208
11:30	264	4	0	2	1	1	272	201	6	1	6	0	1	215
11:45	250	5	1	4	0	0	260	196	2	2	4	0	1	205
TOTAL	6,966	137	24	113	1	45	7,286	6,009	158	59	121	1	48	6,396

AM PEAK HOUR	7:15 AM	**AM PEAK HOUR**	7:00 AM
AM PEAK VOLUME	1,213	**AM PEAK VOLUME**	1,361

PM	NORTHBOUND							SOUTHBOUND						
Time	1	2	3	4	5	6	TOTAL	1	2	3	4	5	6	TOTAL
12:00	244	6	4	5	0	2	261	210	4	2	2	0	1	219
12:15	253	2	2	3	0	1	261	199	7	1	6	0	2	215
12:30	243	4	0	4	0	2	253	209	5	2	4	0	1	221
12:45	276	7	0	6	0	0	289	237	3	0	3	0	3	246
13:00	305	2	1	8	0	2	318	285	4	0	9	0	7	305
13:15	257	4	1	4	0	3	269	246	1	1	5	0	2	255
13:30	237	2	1	2	0	6	248	236	2	2	4	0	1	245
13:45	253	3	0	5	0	4	265	225	5	2	6	0	0	238
14:00	268	4	2	1	0	7	282	250	4	2	7	0	2	265
14:15	308	4	1	0	0	5	318	279	4	3	4	0	1	291
14:30	318	6	0	0	0	2	326	293	8	1	5	0	2	309
14:45	305	2	2	1	0	1	311	306	3	0	5	0	3	317
15:00	317	3	2	0	0	4	326	331	1	2	7	0	0	341
15:15	322	3	0	3	0	3	331	341	6	2	4	0	2	355
15:30	331	3	1	2	0	2	339	336	5	0	3	0	3	347
15:45	306	4	1	1	0	1	313	345	2	1	2	0	0	350
16:00	344	2	0	1	0	1	348	322	4	1	2	0	2	331
16:15	308	5	1	1	0	2	317	356	2	1	1	0	0	360
16:30	346	2	0	0	0	0	348	338	4	0	0	0	1	343
16:45	308	3	2	2	0	1	316	372	2	2	1	0	1	378
17:00	370	1	0	0	0	0	371	331	3	0	2	0	2	338
17:15	331	5	0	1	0	1	338	369	0	1	0	0	0	370
17:30	352	2	0	0	0	0	354	322	2	0	1	0	1	326
17:45	326	3	0	0	0	2	331	350	1	1	1	0	2	355
18:00	288	2	0	0	0	0	290	364	2	0	1	0	1	368
18:15	305	1	0	0	0	1	307	338	4	1	0	0	2	345
18:30	277	2	0	1	0	0	280	287	1	1	2	0	0	291
18:45	296	1	0	0	0	1	298	343	2	0	0	0	1	346
19:00	274	0	1	0	0	1	276	284	4	1	0	0	1	290
19:15	241	2	1	0	0	1	245	255	2	1	0	0	1	259
19:30	225	1	1	1	0	1	229	236	2	0	0	0	0	238
19:45	238	0	0	2	0	0	240	216	3	0	1	0	2	222
20:00	240	1	1	1	0	0	243	202	4	1	3	0	1	211
20:15	202	3	1	1	0	1	208	198	2	1	0	0	0	201
20:30	209	1	1	2	0	0	213	207	0	0	0	0	1	208
20:45	186	2	0	0	0	1	189	188	5	1	2	0	1	197
21:00	184	0	0	1	0	0	185	176	6	0	1	0	0	183
21:15	174	0	2	1	0	1	178	192	4	0	0	0	1	197
21:30	183	0	0	1	1	1	186	195	2	0	0	0	0	197
21:45	155	1	0	0	0	0	156	174	1	0	1	0	0	176
22:00	137	0	0	0	0	0	137	153	0	0	2	0	1	156
22:15	96	0	1	1	0	0	98	126	0	0	3	0	0	129
22:30	79	1	1	0	0	0	81	98	1	0	5	0	0	104
22:45	82	0	0	0	0	0	82	78	2	0	4	0	0	84
23:00	63	0	1	0	0	0	64	67	2	0	3	0	0	72
23:15	48	1	0	0	0	0	49	54	1	1	2	0	0	58
23:30	29	0	1	0	0	0	30	49	2	0	2	0	0	53
23:45	17	0	1	0	0	0	18	47	1	0	1	0	0	49
TOTAL	11,456	101	34	62	1	61	11,715	11,615	135	35	117	0	52	11,954

PM PEAK HOUR	5:00 PM	**PM PEAK HOUR**	4:30 PM
PM PEAK VOLUME	1,394	**PM PEAK VOLUME**	1,429

DAILY TOTAL	18,422	238	58	175	2	106	19,001	17,624	293	94	238	1	100	18,350
% OF TOTAL	97.0%	1.3%	0.3%	0.9%	0.0%	0.6%	100.0%	96.0%	1.6%	0.5%	1.3%	0.0%	0.5%	100.0%

CLASS 1	PASSENGER VEHICLES	**CLASS 4**	4 OR MORE AXLE TRUCKS
CLASS 2	2-AXLE TRUCKS	**CLASS 5**	RECREATION VEHICLES
CLASS 3	3-AXLE TRUCKS	**CLASS 6**	BUSSES

24-HOUR ROADWAY SEGMENT COUNTS (WITH CLASSIFICATION)

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE: 04/26/11 TUESDAY
JOB #: CA11-0429-03

CITY: RIALTO
LOCATION: HIGHLAND AVE BTWN OAKDALE AVE & MACY ST

AM	EASTBOUND							WESTBOUND							PM	EASTBOUND							WESTBOUND						
TIME	1	2	3	4	5	6	TOTAL	1	2	3	4	5	6	TOTAL	Time	1	2	3	4	5	6	TOTAL	1	2	3	4	5	6	TOTAL
0:00	7	1	0	0	0	0	8	7	0	0	0	0	0	7	12:00	37	1	4	2	0	0	44	47	1	3	1	0	0	52
0:15	2	0	0	0	0	0	2	5	0	0	0	0	0	5	12:15	40	2	4	1	0	0	47	55	0	6	2	0	0	63
0:30	4	1	0	0	0	0	5	10	0	0	0	0	0	10	12:30	45	1	3	4	0	0	53	39	1	5	4	0	0	49
0:45	5	0	0	0	0	0	5	8	0	0	0	0	0	8	12:45	53	0	1	2	0	0	56	44	2	3	4	0	0	53
1:00	5	0	0	0	0	0	5	6	0	0	0	0	0	6	13:00	45	1	3	2	0	0	51	51	0	6	6	1	0	64
1:15	7	0	0	0	0	0	7	2	1	0	0	0	0	3	13:15	35	1	5	5	0	0	46	38	1	4	3	0	1	47
1:30	3	0	0	0	0	0	3	3	0	0	0	0	0	3	13:30	43	2	3	3	0	0	51	41	3	2	2	0	0	48
1:45	2	1	0	0	0	0	3	5	0	0	0	0	0	5	13:45	48	4	2	2	0	0	56	51	3	2	1	0	0	57
2:00	6	0	0	0	0	0	6	3	0	0	0	0	0	3	14:00	45	2	3	2	0	0	52	35	1	5	4	0	0	45
2:15	4	0	0	0	0	0	4	4	1	0	0	0	0	5	14:15	57	3	4	2	0	0	66	45	2	4	6	0	0	57
2:30	2	0	0	0	0	0	2	5	0	0	0	0	0	5	14:30	63	5	2	1	1	0	72	53	3	2	1	0	0	59
2:45	0	0	0	0	0	0	0	1	0	0	0	0	0	1	14:45	45	1	1	0	0	0	47	64	0	1	1		0	66
3:00	0	0	0	0	0	0	0	2	0	0	0	0	0	2	15:00	38	0	2	3	0	0	43	68	1	0	0	0	0	69
3:15	3	0	1	0	0	0	4	3	1	0	0	0	0	4	15:15	50	2	3	0	0	0	55	57	2	0	0	0	0	59
3:30	3	0	0	0	0	0	3	6	0	0	0	0	0	6	15:30	59	2	0	2	0	0	63	61	2	0	0	0	2	65
3:45	1	1	0	0	0	0	2	8	0	1	0	0	0	9	15:45	43	1	3	1	0	0	48	71	1	1	0	0	0	73
4:00	4	0	0	0	0	0	4	4	0	0	0	0	0	4	16:00	63	2	3	1	0	0	69	69	1	0	0	0	0	70
4:15	3	0	0	0	0	0	3	7	0	0	0	0	0	7	16:15	71	4	1	0	0	0	76	73	3	2	0	0	1	79
4:30	5	0	0	0	0	0	5	11	2	0	0	0	0	13	16:30	78	2	1	0	0	0	81	61	0	1	2	0	0	64
4:45	8	0	1	0	0	0	9	16	0	0	0	0	0	16	16:45	57	1	4	0	0	0	62	58	1	0	0	0	0	59
5:00	4	1	2	1	0	0	8	14	1	1	0	0	0	16	17:00	65	2	0	0	0	0	67	70	1	0	0	0	0	71
5:15	7	1	3	0	0	0	11	13	2	1	0	0	0	16	17:15	73	3	1	0	0	0	77	62	2	0	1	0	0	65
5:30	13	2	1	1	0	0	17	15	1	0	0	0	0	16	17:30	69	1	2	0	0	0	72	69	4	0	2	0	0	75
5:45	19	0	2	2	0	0	23	23	4	0	2	0	0	29	17:45	64	5	2	0	0	0	71	71	1	0	0	0	0	72
6:00	11	1	1	2	0	0	15	19	1	2	1	0	1	24	18:00	60	3	1	0	0	0	64	79	2	0	0	0	0	81
6:15	21	1	1	1	1	0	25	22	1	1	4	0	0	28	18:15	49	1	0	0	0	0	50	62	0	0	0	0	0	62
6:30	12	3	3	1	0	0	19	27	2	1	5	0	1	36	18:30	53	3	0	0	0	0	56	46	2	0	0	0	0	48
6:45	28	3	1	3	0	0	35	36	2	1	3	0	2	44	18:45	34	2	0	0	0	0	36	55	2	0	0	0	0	57
7:00	37	1	4	1	0	0	43	48	2	3	5	0	1	59	19:00	51	4	0	0	0	0	55	41	2	0	0	0	0	43
7:15	46	3	5	3	0	0	57	53	4	1	3	0	0	61	19:15	38	2	0	0	0	0	40	49	1	0	0	0	0	50
7:30	50	3	7	1	0	0	61	60	5	2	3	1	0	71	19:30	31	6	0	0	0	0	37	43	1	0	0	0	0	44
7:45	39	2	4	2	0	0	47	42	2	4	2	0	1	51	19:45	36	1	0	0	0	0	37	32	2	1	0	0	0	35
8:00	40	1	4	1	0	0	46	31	2	2	4	0	1	40	20:00	42	2	0	0	0	0	44	38	0	0	0	0	0	38
8:15	28	1	7	2	0	0	38	41	3	1	1	0	0	46	20:15	31	3	0	0	0	0	34	25	0	0	0	0	0	25
8:30	37	2	5	2	0	0	46	29	2	8	4	0	0	43	20:30	41	2	0	0	0	0	43	28	0	0	0	0	0	28
8:45	26	3	3	4	0	0	36	38	1	5	3	0	0	47	20:45	26	1	0	0	0	0	27	36	0	0	0	0	0	36
9:00	21	4	8	3	0	0	36	52	4	7	2	0	0	65	21:00	31	0	0	0	0	0	31	30	0	0	0	0	0	30
9:15	39	2	5	5	0	0	51	43	1	7	5	0	0	56	21:15	22	0	0	0	0	0	22	24	0	0	0	0	0	24
9:30	32	4	6	6	0	0	48	32	2	10	3	0	0	47	21:30	19	1	0	0	0	0	20	19	1	0	0	0	0	20
9:45	24	2	4	3	0	0	33	54	0	6	2	0	0	62	21:45	11	1	0	0	0	0	12	13	0	0	0	0	0	13
10:00	31	1	7	4	0	1	44	41	2	8	2	0	0	53	22:00	17	1	0	0	0	0	18	14	0	0	0	0	0	14
10:15	36	0	5	2	0	0	43	33	1	9	1	0	0	44	22:15	13	0	0	0	0	0	13	9	1	0	0	0	0	10
10:30	22	1	3	3	0	0	29	38	1	8	2	0	0	49	22:30	10	0	0	0	0	0	10	13	0	0	0	0	0	13
10:45	37	3	2	4	0	0	46	45	0	6	3	0	0	54	22:45	8	2	0	0	0	0	10	8	0	0	0	0	0	8
11:00	48	0	4	1	0	0	53	39	1	9	4	0	0	53	23:00	10	0	0	0	0	0	10	10	0	0	0	0	0	10
11:15	44	1	4	3	0	1	53	54	2	5	2	0	0	63	23:15	5	0	0	0	0	0	5	7	0	0	0	0	0	7
11:30	40	0	5	3	0	0	48	53	1	2	2	1	0	59	23:30	9	0	0	0	0	0	9	5	0	0	1	0	0	6
11:45	50	1	3	1	0	0	55	38	0	3	3	0	0	44	23:45	11	0	0	0	0	0	11	3	1	0	0	0	0	4
TOTAL	916	51	111	65	1	2	1,146	1,149	55	114	71	2	7	1,398	TOTAL	1,944	83	58	33	1	0	2,119	2,042	51	48	41	1	4	2,187
				AM PEAK HOUR			7:15 AM				AM PEAK HOUR			7:00 AM					PM PEAK HOUR			4:00 PM				PM PEAK HOUR			5:15 PM
				AM PEAK VOLUME			211				AM PEAK VOLUME			242					PM PEAK VOLUME			288				PM PEAK VOLUME			293

CLASS 1	PASSENGER VEHICLES	**CLASS 4**	4 OR MORE AXLE TRUCKS
CLASS 2	2-AXLE TRUCKS	**CLASS 5**	RECREATION VEHICLES
CLASS 3	3-AXLE TRUCKS	**CLASS 6**	BUSSES

	EASTBOUND							WESTBOUND						
DAILY TOTAL	2,860	134	169	98	2	2	3,265	3,191	106	162	112	3	11	3,585
% OF TOTAL	87.6%	4.1%	5.2%	3.0%	0.1%	0.1%	100.0%	89.0%	3.0%	4.5%	3.1%	0.1%	0.3%	100.0%

24-HOUR ROADWAY SEGMENT COUNTS (WITH CLASSIFICATION)

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE: 04/26/11 TUESDAY
JOB #: CA11-0429-03

CITY: RIALTO
LOCATION: STATE ST N/O HIGHLAND AVE

AM	NORTHBOUND							SOUTHBOUND						
TIME	1	2	3	4	5	6	TOTAL	1	2	3	4	5	6	TOTAL
0:00	17	0	0	0	0	0	17	8	0	0	0	0	0	8
0:15	8	0	0	0	0	0	8	10	0	0	0	0	0	10
0:30	15	0	0	0	0	0	15	14	1	0	0	0	0	15
0:45	11	0	0	0	0	0	11	6	0	0	0	0	0	6
1:00	5	1	0	2	0	0	8	7	1	0	0	0	0	8
1:15	8	0	0	0	0	0	8	11	1	0	0	0	0	12
1:30	3	1	0	0	0	0	4	9	0	1	3	0	0	13
1:45	4	0	0	1	0	0	5	6	0	0	1	0	0	7
2:00	6	0	0	1	0	0	7	4	1	0	0	0	0	5
2:15	2	1	0	0	0	0	3	2	1	0	0	0	0	3
2:30	10	0	1	0	0	0	11	5	0	0	2	0	0	7
2:45	7	0	0	0	0	0	7	2	0	0	1	0	0	3
3:00	3	1	0	1	0	0	5	3	1	1	0	0	0	5
3:15	3	0	0	0	0	0	3	8	0	0	0	0	0	8
3:30	1	0	1	1	0	0	3	15	1	1	1	0	0	18
3:45	2	0	0	1	0	0	3	18	1	0	1	0	0	20
4:00	5	1	0	0	0	0	6	13	0	0	0	0	0	13
4:15	9	0	0	0	0	0	9	25	0	1	0	0	0	26
4:30	17	0	0	0	0	1	18	32	0	1	1	0	0	34
4:45	24	1	0	1	0	0	26	29	2	0	0	0	0	31
5:00	32	2	0	0	0	0	34	42	0	0	1	0	0	43
5:15	28	2	0	0	0	1	31	35	1	0	2	0	0	38
5:30	32	1	0	1	0	0	34	41	0	0	1	0	0	42
5:45	39	0	1	1	0	0	41	45	0	1	1	0	1	48
6:00	30	1	0	0	0	2	33	38	1	2	1	0	1	43
6:15	43	3	0	0	0	3	49	56	3	0	0	0	0	59
6:30	35	2	2	0	0	5	44	49	5	0	1	0	1	56
6:45	67	4	1	0	0	2	74	62	4	1	2	0	2	71
7:00	54	1	3	0	0	0	58	79	3	1	2	0	3	88
7:15	88	1	0	1	0	1	91	87	1	2	3	0	0	93
7:30	110	3	0	2	0	2	117	100	4	1	1	0	1	107
7:45	92	2	2	0	0	0	96	64	3	0	0	0	3	70
8:00	77	1	2	0	0	1	81	45	2	2	1	0	1	51
8:15	69	3	1	1	0	0	74	68	1	3	2	0	2	76
8:30	82	2	0	4	0	0	88	76	2	1	2	0	3	84
8:45	57	1	3	3	0	1	65	69	2	1	1	0	1	74
9:00	47	3	1	2	0	0	53	56	0	0	0	0	0	56
9:15	61	4	1	4	0	1	71	43	1	2	0	0	1	47
9:30	54	1	2	2	0	0	59	37	0	0	1	0	1	39
9:45	66	2	2	1	0	0	71	57	1	1	1	0	2	62
10:00	47	2	1	2	0	1	53	63	3	2	2	0	0	70
10:15	58	3	0	2	0	1	64	50	0	0	2	0	1	53
10:30	47	2	1	3	0	0	53	53	1	2	2	0	0	58
10:45	54	1	1	3	0	0	59	48	1	1	0	0	0	50
11:00	66	1	0	2	0	1	70	43	1	1	1	0	1	47
11:15	49	2	1	1	0	0	53	39	2	0	3	0	0	44
11:30	65	4	0	1	0	0	70	67	0	1	3	0	1	72
11:45	55	3	0	2	0	1	61	46	1	0	1	0	1	49
TOTAL	1,764	63	27	46	0	24	1,924	1,785	53	30	47	0	27	1,942

AM PEAK HOUR	7:15 AM	**AM PEAK HOUR**	6:45 AM
AM PEAK VOLUME	385	**AM PEAK VOLUME**	359

PM	NORTHBOUND							SOUTHBOUND						
Time	1	2	3	4	5	6	TOTAL	1	2	3	4	5	6	TOTAL
12:00	53	3	0	1	0	0	57	62	2	0	2	0	0	66
12:15	60	4	1	2	0	1	68	68	3	2	3	0	1	77
12:30	63	2	0	1	0	0	66	76	1	1	2	0	0	80
12:45	57	1	0	3	0	0	61	65	1	1	1	0	0	68
13:00	54	2	1	2	1	1	61	56	0	3	0	0	1	60
13:15	51	2	0	1	0	0	54	73	2	2	0	0	0	77
13:30	69	3	1	1	0	0	74	67	3	2	1	0	1	74
13:45	72	1	2	2	0	1	78	89	1	0	2	0	0	92
14:00	65	2	1	1	0	2	71	74	1	2	0	0	1	78
14:15	86	3	1	0	0	1	91	88	3	1	1	0	0	93
14:30	74	1	0	2	0	3	80	105	1	0	2	0	4	112
14:45	92	2	1	2	0	0	97	95	1	0	3	0	0	99
15:00	110	1	1	0	0	1	113	83	4	0	1	0	3	91
15:15	113	4	0	1	0	2	120	102	2	1	1	0	1	107
15:30	104	9	2	0	0	0	115	97	2	0	0	0	1	100
15:45	97	6	2	0	0	1	106	114	0	0	2	0	0	116
16:00	103	8	0	0	0	1	112	92	1	1	0	0	0	94
16:15	101	4	1	1	0	2	109	99	1	2	0	0	2	104
16:30	104	4	0	0	0	1	109	88	0	0	1	0	0	89
16:45	99	2	0	0	0	2	103	94	3	0	1	0	1	99
17:00	89	2	2	1	0	1	95	106	2	0	0	0	0	108
17:15	100	1	0	2	0	0	103	95	0	1	0	0	0	96
17:30	92	0	0	2	0	1	95	80	4	0	0	0	1	85
17:45	96	2	1	1	0	2	102	91	3	0	2	0	1	97
18:00	94	3	1	2	0	0	100	80	0	1	0	0	0	81
18:15	85	0	2	3	0	1	91	66	2	0	0	0	1	69
18:30	70	1	1	1	0	0	73	70	0	0	1	0	0	71
18:45	66	2	3	4	0	0	75	71	1	1	1	0	0	74
19:00	70	0	1	2	0	0	73	63	1	0	1	0	0	65
19:15	63	1	1	1	0	0	66	51	0	0	0	0	1	52
19:30	59	2	0	3	0	0	64	67	0	0	0	0	0	67
19:45	54	2	0	0	0	1	57	46	1	0	1	0	0	48
20:00	61	3	1	1	0	0	66	58	0	0	0	0	1	59
20:15	49	3	1	1	0	1	55	27	0	1	1	0	0	29
20:30	56	2	0	0	0	0	58	39	0	0	0	0	0	39
20:45	42	1	0	2	0	0	45	31	2	1	0	0	1	35
21:00	35	0	0	2	0	0	37	27	1	0	1	0	0	29
21:15	39	2	0	1	0	0	42	22	1	0	0	0	0	23
21:30	48	2	0	0	0	1	51	35	2	1	0	0	1	39
21:45	41	0	1	0	0	0	42	26	0	0	0	0	1	27
22:00	34	0	0	2	0	0	36	35	1	0	0	0	1	37
22:15	29	1	0	0	0	0	30	18	1	0	0	0	0	19
22:30	44	0	0	1	0	0	45	23	0	0	0	0	0	23
22:45	27	0	0	0	0	0	27	16	2	0	0	0	0	18
23:00	17	2	0	1	0	0	20	12	0	0	1	0	0	13
23:15	28	0	0	2	0	0	30	6	1	0	0	0	0	7
23:30	19	1	0	1	0	0	21	11	1	0	0	0	0	12
23:45	10	0	0	0	0	0	10	7	0	0	0	0	0	7
TOTAL	3,144	97	29	56	1	27	3,354	2,966	58	24	32	0	25	3,105

PM PEAK HOUR	3:00 PM	**PM PEAK HOUR**	3:15 PM
PM PEAK VOLUME	454	**PM PEAK VOLUME**	417

DAILY TOTAL	4,908	160	56	102	1	51	5,278	4,751	111	54	79	0	52	5,047
% OF TOTAL	93.0%	3.0%	1.1%	1.9%	0.0%	1.0%	100.0%	94.1%	2.2%	1.1%	1.6%	0.0%	1.0%	100.0%

CLASS 1	PASSENGER VEHICLES	**CLASS 4**	4 OR MORE AXLE TRUCKS
CLASS 2	2-AXLE TRUCKS	**CLASS 5**	RECREATION VEHICLES
CLASS 3	3-AXLE TRUCKS	**CLASS 6**	BUSSES

Class 1: Passenger Vehicles

- All 2-axle cars regardless of size, weight and signage.
- Vans that are not clearly identified as work vehicles will be considered passenger vehicles.

- Small pick-up trucks regardless of size, weight and signage, with the exception of a small pick-up truck that has a flat bed.
- Midsize or larger pick-up trucks that are not clearly identified as work vehicles will be considered passenger vehicles.

Class 2: Box Trucks, Flat Beds, Work Vans & Work Pick-Up Trucks.

A. Standard small 2-axle pick-up trucks are to be included in Class 1, regardless of any signage, equipment, supplies and side mounted tool box. The only exception is a small pick-up truck that has been modified to include a flat bed as indicated in "4."

B. Midsize or larger pick-up trucks that are clearly & easily identified as work vehicles. Do not include pick-up trucks with signage alone, regardless of the coverage of the markings. We are looking for vehicles with more weight and other factors. The pick-up truck must be easily & specifically identified by any one or more of the following:

1. A ladder with other work related equipment/supplies filling at least 50% of the bed. A ladder with signage will not qualify for 2, unless the bed is at least 50% filled with equipment/supplies.
2. Permanently attached side tool box.
3. Bucket lift.
4. All flatbed, such as a landscape company vehicle. This category may include a small pick-up truck

C. Vans that are clearly & easily identified as work vehicles. The van must be easily & specifically identified by any one or more of the following:

1. Ladder with signage covering the entire vehicle, such as the look as ATT(a ladder alone will not qualify the van as a class 2 vehicle).
2. Bucket lift.

D. All box type of trucks regardless of size & signage, including USPS, UPS & Fedex type of trucks.

Class 3: All 3 axle trucks, to include a 2-axle truck with a 1 axle trailer

Class 4: All 4 or more axle trucks, to include a 2-axle truck with a 2 or more axle trailer & a 3-axle truck with 1 or more axle trailer.

Class 5: All RV's regardless of the number of axles.

Class 6: All bus or extra large passage vans regardless of the number of axles.

INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

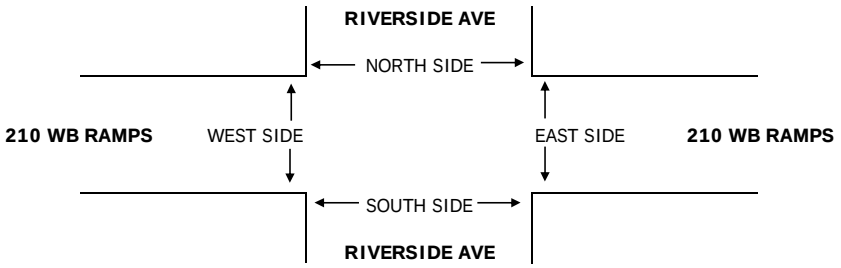
ALL CLASSES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

	NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
LANES:	NL 2	NT 2	NR X	SL X	ST 4	SR 0	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 0.33	TOTAL	NB	SB	EB	WB	TTL
AM																		
6:00 AM	116	29	0	0	58	20	0	0	0	36	0	20	279	0	0	0	0	0
6:15 AM	112	39	0	0	69	22	0	0	0	43	0	27	312	0	0	0	0	0
6:30 AM	160	66	0	0	95	43	0	0	0	71	0	52	487	0	0	0	0	0
6:45 AM	135	70	0	0	100	31	0	0	0	92	0	54	482	0	0	0	0	0
7:00 AM	180	108	0	0	147	54	0	0	0	120	0	57	666	0	0	0	0	0
7:15 AM	168	82	0	0	180	47	0	0	0	105	0	41	623	0	0	0	0	0
7:30 AM	169	92	0	0	178	44	0	0	0	90	1	37	611	0	0	0	0	0
7:45 AM	126	96	0	0	151	31	0	0	0	92	0	60	556	0	0	0	0	0
8:00 AM	133	93	0	0	141	37	0	0	0	56	0	43	503	0	0	0	0	0
8:15 AM	119	104	0	0	157	37	0	0	0	53	0	30	500	0	0	0	0	0
8:30 AM	104	72	0	0	144	29	0	0	0	75	3	21	448	0	0	0	0	0
8:45 AM	95	70	0	0	99	23	0	0	0	75	1	23	386	0	0	0	0	0
VOLUMES	1,617	921	0	0	1,519	418	0	0	0	908	5	465	5,853	0	0	0	0	0
APPROACH %	64%	36%	0%	0%	78%	22%	0%	0%	0%	66%	0%	34%						
APP/DEPART	2,538	/	1,386	1,937	/	2,427	0	/	0	1,378	/	2,040	0					
BEGIN PEAK HR		7:00 AM																
VOLUMES	643	378	0	0	656	176	0	0	0	407	1	195	2,456					
APPROACH %	63%	37%	0%	0%	79%	21%	0%	0%	0%	67%	0%	32%						
PEAK HR FACTOR		0.886			0.916			0.000			0.852		0.922					
APP/DEPART	1,021	/	573	832	/	1,063	0	/	0	603	/	820	0					
PM																		
4:00 PM	125	153	0	0	132	39	0	0	0	94	1	56	600	0	0	0	0	0
4:15 PM	109	147	0	0	116	34	0	0	0	72	1	48	527	0	0	0	0	0
4:30 PM	116	156	0	0	155	29	0	0	0	81	1	45	583	0	0	0	0	0
4:45 PM	116	170	0	0	130	44	0	0	0	81	1	74	616	0	0	0	0	0
5:00 PM	133	172	0	0	119	33	0	0	0	77	0	60	594	0	0	0	0	0
5:15 PM	114	157	0	0	159	49	0	0	0	96	0	61	636	0	0	0	0	0
5:30 PM	121	166	0	0	127	33	0	0	0	62	0	60	569	0	0	0	0	0
5:45 PM	126	190	0	0	102	40	0	0	0	69	0	59	586	0	0	0	0	0
6:00 PM	98	133	0	0	162	41	0	0	0	76	0	59	569	0	0	0	0	0
6:15 PM	119	121	0	0	128	30	0	0	0	68	0	45	511	0	0	0	0	0
6:30 PM	108	128	0	0	102	35	0	0	0	79	0	30	482	0	0	0	0	0
6:45 PM	113	115	0	0	120	36	0	0	0	59	1	31	475	0	0	0	0	0
VOLUMES	1,398	1,808	0	0	1,552	443	0	0	0	914	5	628	6,748	0	0	0	0	0
APPROACH %	44%	56%	0%	0%	78%	22%	0%	0%	0%	59%	0%	41%						
APP/DEPART	3,206	/	2,436	1,995	/	2,466	0	/	0	1,547	/	1,846	0					
BEGIN PEAK HR		4:30 PM																
VOLUMES	479	655	0	0	563	155	0	0	0	335	2	240	2,429					
APPROACH %	42%	58%	0%	0%	78%	22%	0%	0%	0%	58%	0%	42%						
PEAK HR FACTOR		0.930			0.863			0.000			0.919		0.955					
APP/DEPART	1,134	/	895	718	/	898	0	/	0	577	/	636	0					



	PEDESTRIAN + BIKE CROSSINGS					PEDESTRIAN CROSSINGS					BICYCLE CROSSINGS				
	N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	NS	SS	ES	WS	TOTAL
AM															
6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM															
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

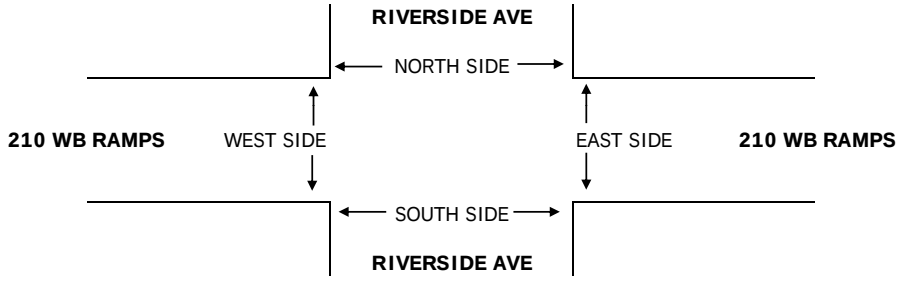
CLASS 1: PASSENGER VEHICLES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 4	SR 0	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 0.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	112	24			54	20				35	0	15	260					0
	6:15 AM	108	37			55	21				43	0	21	285					0
	6:30 AM	149	61			87	43				69	0	45	454					0
	6:45 AM	132	64			88	31				90	0	51	456					0
	7:00 AM	179	102			134	52				119	0	53	639					0
	7:15 AM	167	80			174	47				103	0	36	607					0
	7:30 AM	163	87			169	44				87	1	33	584					0
	7:45 AM	118	92			137	31				91	0	54	523					0
	8:00 AM	128	89			129	35				53	0	39	473					0
	8:15 AM	115	92			145	37				51	0	27	467					0
	8:30 AM	96	65			129	29				73	3	19	414					0
	8:45 AM	87	64			88	22				73	0	16	350					0
	VOLUMES	1,554	857	0	0	1,389	412	0	0	0	887	4	409	5,512	0	0	0	0	0
	APPROACH %	64%	36%	0%	0%	77%	23%	0%	0%	0%	68%	0%	31%						
	APP/DEPART	2,411	/	1,266	1,801	/	2,276	0	/	0	1,300	/	1,970	0					
	BEGIN PEAK HR		7:00 AM																
	VOLUMES	627	361	0	0	614	174	0	0	0	400	1	176	2,353					
	APPROACH %	63%	37%	0%	0%	78%	22%	0%	0%	0%	69%	0%	31%						
	PEAK HR FACTOR		0.879			0.891			0.000			0.839		0.921					
	APP/DEPART	988	/	537	788	/	1,014	0	/	0	577	/	802	0					
PM	4:00 PM	125	146			129	39				90	1	54	584					0
	4:15 PM	104	147			113	31				70	1	47	513					0
	4:30 PM	113	152			151	28				81	1	43	569					0
	4:45 PM	112	168			129	43				80	1	73	606					0
	5:00 PM	132	169			117	31				77	0	60	586					0
	5:15 PM	114	153			156	49				94	0	61	627					0
	5:30 PM	121	164			125	33				62	0	60	565					0
	5:45 PM	125	187			101	40				68	0	59	580					0
	6:00 PM	94	131			157	40				74	0	58	554					0
	6:15 PM	119	120			126	30				67	0	45	507					0
	6:30 PM	106	127			101	35				78	0	29	476					0
	6:45 PM	113	112			120	36				59	1	31	472					0
	VOLUMES	1,378	1,776	0	0	1,525	435	0	0	0	900	5	620	6,639	0	0	0	0	0
	APPROACH %	44%	56%	0%	0%	78%	22%	0%	0%	0%	59%	0%	41%						
	APP/DEPART	3,154	/	2,396	1,960	/	2,425	0	/	0	1,525	/	1,818	0					
	BEGIN PEAK HR		4:30 PM																
	VOLUMES	471	642	0	0	553	151	0	0	0	332	2	237	2,388					
	APPROACH %	42%	58%	0%	0%	79%	21%	0%	0%	0%	58%	0%	42%						
	PEAK HR FACTOR		0.924			0.859			0.000			0.921		0.952					
	APP/DEPART	1,113	/	879	704	/	885	0	/	0	571	/	624	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

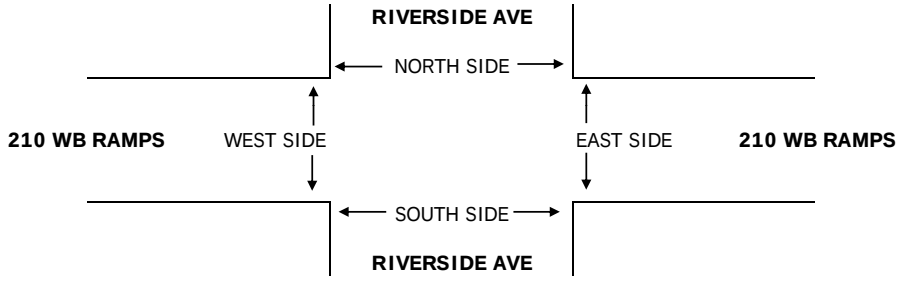
CLASS 2: 2-AXLE WORK VEHICLES/ TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

◄ W ▲ N S ▼ E ►

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 4	SR 0	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 0.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	1	2			2	0				0	0	1	6					0
	6:15 AM	0	0			2	0				0	0	0	2					0
	6:30 AM	4	0			1	0				2	0	2	9					0
	6:45 AM	1	1			1	0				1	0	0	4					0
	7:00 AM	1	4			1	0				1	0	0	7					0
	7:15 AM	1	1			2	0				0	0	0	4					0
	7:30 AM	5	0			1	0				1	0	0	7					0
	7:45 AM	5	0			3	0				1	0	2	11					0
	8:00 AM	4	0			3	1				3	0	2	13					0
	8:15 AM	3	2			2	0				0	0	0	7					0
	8:30 AM	4	1			1	0				2	0	0	8					0
	8:45 AM	4	1			1	0				0	0	0	6					0
	VOLUMES	33	12	0	0	20	1	0	0	0	11	0	7	84	0	0	0	0	0
	APPROACH %	73%	27%	0%	0%	95%	5%	0%	0%	0%	61%	0%	39%						
	APP/DEPART	45	/	19	21	/	31	0	/	0	18	/	34	0					
	BEGIN PEAK HR		7:45 AM																
	VOLUMES	16	3	0	0	9	1	0	0	0	6	0	4	39					
	APPROACH %	84%	16%	0%	0%	90%	10%	0%	0%	0%	60%	0%	40%						
	PEAK HR FACTOR		0.950			0.625			0.000			0.500		0.750					
	APP/DEPART	19	/	7	10	/	15	0	/	0	10	/	17	0					
PM	4:00 PM	0	5			2	0				2	0	2	11					0
	4:15 PM	3	0			3	2				1	0	0	9					0
	4:30 PM	2	3			1	0				0	0	2	8					0
	4:45 PM	1	0			1	1				1	0	1	5					0
	5:00 PM	0	2			1	2				0	0	0	5					0
	5:15 PM	0	2			1	0				0	0	0	3					0
	5:30 PM	0	1			1	0				0	0	0	2					0
	5:45 PM	0	2			1	0				0	0	0	3					0
	6:00 PM	3	1			2	1				0	0	1	8					0
	6:15 PM	0	1			1	0				0	0	0	2					0
	6:30 PM	1	0			0	0				1	0	1	3					0
	6:45 PM	0	3			0	0				0	0	0	3					0
	VOLUMES	10	20	0	0	14	6	0	0	0	5	0	7	62	0	0	0	0	0
	APPROACH %	33%	67%	0%	0%	70%	30%	0%	0%	0%	42%	0%	58%						
	APP/DEPART	30	/	27	20	/	19	0	/	0	12	/	16	0					
	BEGIN PEAK HR		4:00 PM																
	VOLUMES	6	8	0	0	7	3	0	0	0	4	0	5	33					
	APPROACH %	43%	57%	0%	0%	70%	30%	0%	0%	0%	44%	0%	56%						
	PEAK HR FACTOR		0.700			0.500			0.000			0.563		0.750					
	APP/DEPART	14	/	13	10	/	11	0	/	0	9	/	9	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

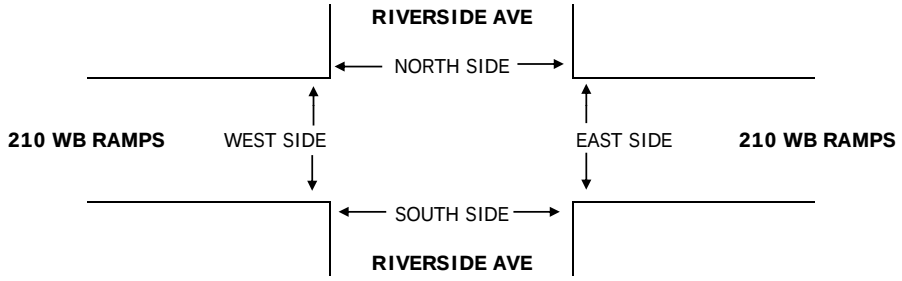
CLASS 3: 3-AXLE TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

	NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL	NB	SB	EB	WB	TTL
LANES:	2	2	X	X	4	0	X	X	X	1.33	0.33	0.33						
AM																		
6:00 AM	1	0			0	0				0	0	0	1					0
6:15 AM	1	0			7	0				0	0	0	8					0
6:30 AM	1	0			0	0				0	0	1	2					0
6:45 AM	0	1			0	0				0	0	1	2					0
7:00 AM	0	0			2	0				0	0	0	2					0
7:15 AM	0	1			0	0				0	0	0	1					0
7:30 AM	0	0			0	0				1	0	3	4					0
7:45 AM	0	0			4	0				0	0	2	6					0
8:00 AM	0	0			3	1				0	0	0	4					0
8:15 AM	0	3			1	0				0	0	0	4					0
8:30 AM	0	0			3	0				0	0	0	3					0
8:45 AM	0	0			6	0				1	0	0	7					0
VOLUMES	3	5	0	0	26	1	0	0	0	2	0	7	44	0	0	0	0	0
APPROACH %	38%	63%	0%	0%	96%	4%	0%	0%	0%	22%	0%	78%						
APP/DEPART	8	/	12	27	/	28	0	/	0	9	/	4	0					
BEGIN PEAK HR		8:00 AM																
VOLUMES	0	3	0	0	13	1	0	0	0	1	0	0	18					
APPROACH %	0%	100%	0%	0%	93%	7%	0%	0%	0%	100%	0%	0%						
PEAK HR FACTOR		0.250			0.583			0.000			0.063		0.643					
APP/DEPART	3	/	3	14	/	14	0	/	0	1	/	1	0					
PM																		
4:00 PM	0	1			0	0				0	0	0	1					0
4:15 PM	0	0			0	0				0	0	1	1					0
4:30 PM	1	0			1	0				0	0	0	2					0
4:45 PM	0	0			0	0				0	0	0	0					0
5:00 PM	0	0			0	0				0	0	0	0					0
5:15 PM	0	1			0	0				0	0	0	1					0
5:30 PM	0	0			0	0				0	0	0	0					0
5:45 PM	0	0			0	0				0	0	0	0					0
6:00 PM	0	0			0	0				0	0	0	0					0
6:15 PM	0	0			0	0				1	0	0	1					0
6:30 PM	0	0			0	0				0	0	0	0					0
6:45 PM	0	0			0	0				0	0	0	0					0
VOLUMES	1	2	0	0	1	0	0	0	0	1	0	1	6	0	0	0	0	0
APPROACH %	33%	67%	0%	0%	100%	0%	0%	0%	0%	50%	0%	50%						
APP/DEPART	3	/	3	1	/	2	0	/	0	2	/	1	0					
BEGIN PEAK HR		4:00 PM																
VOLUMES	1	1	0	0	1	0	0	0	0	0	0	1	4					
APPROACH %	50%	50%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%						
PEAK HR FACTOR		0.500			0.250			0.000			0.250		0.500					
APP/DEPART	2	/	2	1	/	1	0	/	0	1	/	1	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

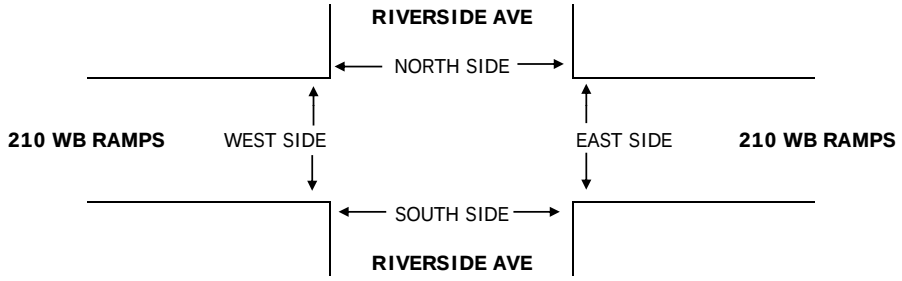
CLASS 4: 4 OR MORE AXLE TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 4	SR 0	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 0.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	2	1			2	0				1	0	3	9					0
	6:15 AM	3	0			4	1				0	0	3	11					0
	6:30 AM	5	2			5	0				0	0	2	14					0
	6:45 AM	1	3			2	0				1	0	2	9					0
	7:00 AM	0	0			3	2				0	0	4	9					0
	7:15 AM	0	0			2	0				1	0	5	8					0
	7:30 AM	1	3			6	0				0	0	1	11					0
	7:45 AM	3	4			5	0				0	0	2	14					0
	8:00 AM	1	1			5	0				0	0	2	9					0
	8:15 AM	1	4			7	0				2	0	3	17					0
	8:30 AM	4	5			7	0				0	0	2	18					0
	8:45 AM	3	3			4	1				0	1	6	18					0
	VOLUMES	24	26	0	0	52	4	0	0	0	5	1	35	147	0	0	0	0	0
	APPROACH %	48%	52%	0%	0%	93%	7%	0%	0%	0%	12%	2%	85%						
	APP/DEPART	50	/	61	56	/	57	0	/	0	41	/	29	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	9	13	0	0	23	1	0	0	0	2	1	13	62					
	APPROACH %	41%	59%	0%	0%	96%	4%	0%	0%	0%	13%	6%	81%						
	PEAK HR FACTOR		0.611			0.857			0.000			0.571		0.861					
	APP/DEPART	22	/	26	24	/	25	0	/	0	16	/	11	0					
PM	4:00 PM	0	0			0	0				2	0	0	2					0
	4:15 PM	1	0			0	1				0	0	0	2					0
	4:30 PM	0	0			0	0				0	0	0	0					0
	4:45 PM	2	1			0	0				0	0	0	3					0
	5:00 PM	1	0			0	0				0	0	0	1					0
	5:15 PM	0	0			0	0				1	0	0	1					0
	5:30 PM	0	0			0	0				0	0	0	0					0
	5:45 PM	1	0			0	0				0	0	0	1					0
	6:00 PM	0	0			0	0				0	0	0	0					0
	6:15 PM	0	0			0	0				0	0	0	0					0
	6:30 PM	0	0			0	0				0	0	0	0					0
	6:45 PM	0	0			0	0				0	0	0	0					0
	VOLUMES	5	1	0	0	0	1	0	0	0	3	0	0	10	0	0	0	0	0
	APPROACH %	83%	17%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%						
	APP/DEPART	6	/	1	1	/	3	0	/	0	3	/	6	0					
	BEGIN PEAK HR		4:00 PM																
	VOLUMES	3	1	0	0	0	1	0	0	0	2	0	0	7					
	APPROACH %	75%	25%	0%	0%	0%	100%	0%	0%	0%	100%	0%	0%						
	PEAK HR FACTOR		0.333			0.250			0.000			0.250		0.583					
	APP/DEPART	4	/	1	1	/	2	0	/	0	2	/	4	0					



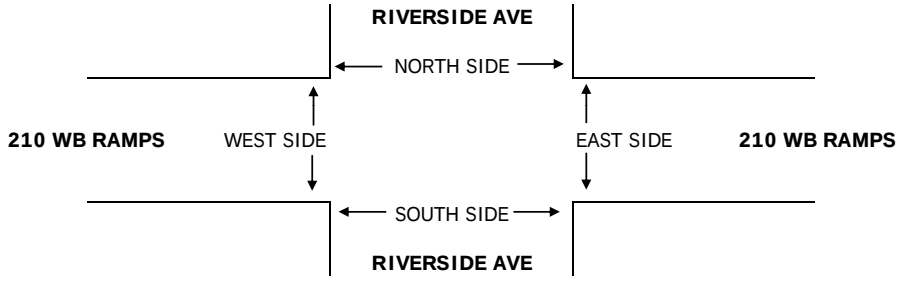
INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

CLASS 5:	NOTES:	AM		▲	
RECREATIONAL VEHICLES		PM		N	
		MD	◄ W		E ►
		OTHER		S	
		OTHER		▼	

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 4	SR 0	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 0.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0			0	0				0	0	0	0					0
	6:15 AM	0	0			0	0				0	0	0	0					0
	6:30 AM	1	0			0	0				0	0	0	1					0
	6:45 AM	0	0			0	0				0	0	0	0					0
	7:00 AM	0	0			0	0				0	0	0	0					0
	7:15 AM	0	0			0	0				0	0	0	0					0
	7:30 AM	0	0			0	0				0	0	0	0					0
	7:45 AM	0	0			0	0				0	0	0	0					0
	8:00 AM	0	0			0	0				0	0	0	0					0
	8:15 AM	0	0			0	0				0	0	0	0					0
	8:30 AM	0	0			0	0				0	0	0	0					0
	8:45 AM	0	0			0	0				0	0	0	0					0
	VOLUMES	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	APPROACH %	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	1	/	0	0	/	0	0	/	0	0	/	1	0					
	BEGIN PEAK HR		6:30 AM																
	VOLUMES	1	0	0	0	0	0	0	0	0	0	0	0	1					
	APPROACH %	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.250			0.000			0.000			0.000		0.250					
	APP/DEPART	1	/	0	0	/	0	0	/	0	0	/	1	0					
PM	4:00 PM	0	0			0	0				0	0	0	0					0
	4:15 PM	0	0			0	0				0	0	0	0					0
	4:30 PM	0	0			0	0				0	0	0	0					0
	4:45 PM	1	0			0	0				0	0	0	1					0
	5:00 PM	0	0			0	0				0	0	0	0					0
	5:15 PM	0	0			0	0				0	0	0	0					0
	5:30 PM	0	0			0	0				0	0	0	0					0
	5:45 PM	0	0			0	0				0	0	0	0					0
	6:00 PM	0	0			1	0				0	0	0	1					0
	6:15 PM	0	0			0	0				0	0	0	0					0
	6:30 PM	0	0			0	0				0	0	0	0					0
	6:45 PM	0	0			0	0				0	0	0	0					0
	VOLUMES	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0
	APPROACH %	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	1	/	0	1	/	1	0	/	0	0	/	1	0					
	BEGIN PEAK HR		6:00 PM																
	VOLUMES	0	0	0	0	1	0	0	0	0	0	0	0	1					
	APPROACH %	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.250			0.000			0.000		0.250					
	APP/DEPART	0	/	0	1	/	1	0	/	0	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	1
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

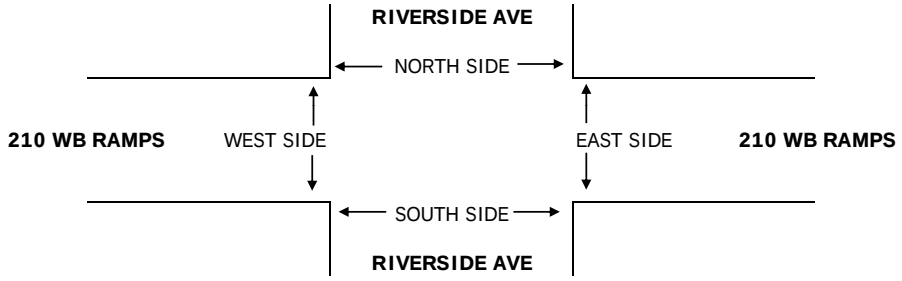
CLASS 6: BUSSES

NOTES:

AM
PM
MD
OTHER
OTHER

N ▲ ◄ W E ► S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 4	SR 0	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 0.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	2			0	0				0	0	1	3					0
	6:15 AM	0	2			1	0				0	0	3	6					0
	6:30 AM	0	3			2	0				0	0	2	7					0
	6:45 AM	1	1			9	0				0	0	0	11					0
	7:00 AM	0	2			7	0				0	0	0	9					0
	7:15 AM	0	0			2	0				1	0	0	3					0
	7:30 AM	0	2			2	0				1	0	0	5					0
	7:45 AM	0	0			2	0				0	0	0	2					0
	8:00 AM	0	3			1	0				0	0	0	4					0
	8:15 AM	0	3			2	0				0	0	0	5					0
	8:30 AM	0	1			4	0				0	0	0	5					0
	8:45 AM	1	2			0	0				1	0	1	5					0
	VOLUMES	2	21	0	0	32	0	0	0	0	3	0	7	65	0	0	0	0	0
	APPROACH %	9%	91%	0%	0%	100%	0%	0%	0%	0%	30%	0%	70%						
	APP/DEPART	23	/	28	32	/	35	0	/	0	10	/	2	0					
	BEGIN PEAK HR		6:15 AM																
	VOLUMES	1	8	0	0	19	0	0	0	0	0	0	5	33					
	APPROACH %	11%	89%	0%	0%	100%	0%	0%	0%	0%	0%	0%	100%						
	PEAK HR FACTOR		0.750			0.528			0.000			0.417		0.750					
	APP/DEPART	9	/	13	19	/	19	0	/	0	5	/	1	0					
PM	4:00 PM	0	1			1	0				0	0	0	2					0
	4:15 PM	1	0			0	0				1	0	0	2					0
	4:30 PM	0	1			2	1				0	0	0	4					0
	4:45 PM	0	1			0	0				0	0	0	1					0
	5:00 PM	0	1			1	0				0	0	0	2					0
	5:15 PM	0	1			2	0				1	0	0	4					0
	5:30 PM	0	1			1	0				0	0	0	2					0
	5:45 PM	0	1			0	0				1	0	0	2					0
	6:00 PM	1	1			2	0				2	0	0	6					0
	6:15 PM	0	0			1	0				0	0	0	1					0
	6:30 PM	1	1			1	0				0	0	0	3					0
	6:45 PM	0	0			0	0				0	0	0	0					0
	VOLUMES	3	9	0	0	11	1	0	0	0	5	0	0	29	0	0	0	0	0
	APPROACH %	25%	75%	0%	0%	92%	8%	0%	0%	0%	100%	0%	0%						
	APP/DEPART	12	/	9	12	/	16	0	/	0	5	/	4	0					
	BEGIN PEAK HR		5:15 PM																
	VOLUMES	1	4	0	0	5	0	0	0	0	4	0	0	14					
	APPROACH %	20%	80%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%						
	PEAK HR FACTOR		0.625			0.625			0.000			0.500		0.583					
	APP/DEPART	5	/	4	5	/	9	0	/	0	4	/	1	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

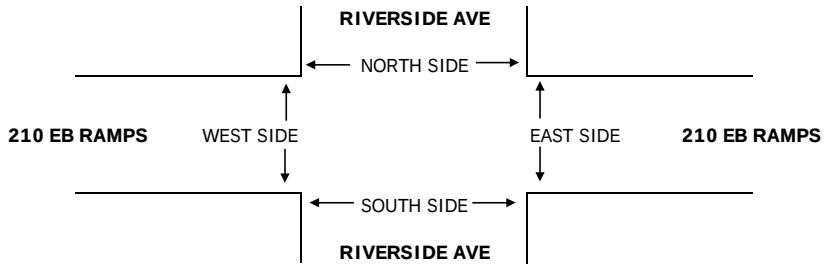
ALL CLASSES

NOTES:

AM
PM
MD
OTHER
OTHER

▲ N
◄ W
E ►
S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
		NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	TOTAL	NB	SB	EB	WB	TTL
	LANES:	X	3.5	1.5	2	2	X	1.33	0.33	1.33	X	X	X						
AM	6:00 AM	0	144	36	16	78	0	8	0	41	0	0	0	323	0	0	0	0	0
	6:15 AM	0	140	30	32	87	0	13	0	50	0	0	0	352	0	0	0	0	0
	6:30 AM	0	233	80	34	132	0	15	0	63	0	0	0	557	0	0	0	0	0
	6:45 AM	0	197	56	32	165	0	18	0	105	0	0	0	573	0	0	0	0	0
	7:00 AM	0	264	67	48	210	0	18	0	103	0	0	0	710	0	0	0	0	0
	7:15 AM	0	234	53	80	218	0	17	0	164	0	0	0	766	0	0	0	0	0
	7:30 AM	0	223	103	82	191	0	20	0	123	0	0	0	742	0	0	0	0	0
	7:45 AM	0	200	88	53	184	0	24	1	145	0	0	0	695	0	0	0	0	0
	8:00 AM	0	196	80	47	139	0	22	0	79	0	0	0	563	0	0	0	0	0
	8:15 AM	0	204	70	46	164	0	22	1	74	0	0	0	581	0	0	0	0	0
	8:30 AM	0	152	72	57	168	0	21	0	76	0	0	0	546	0	0	0	0	0
	8:45 AM	0	135	64	33	134	0	21	0	88	0	0	0	475	0	0	0	0	0
	VOLUMES	0	2,322	799	560	1,870	0	219	2	1,111	0	0	0	6,883	0	0	0	0	0
	APPROACH %	0%	74%	26%	23%	77%	0%	16%	0%	83%	0%	0%	0%						
	APP/DEPART	3,121	/	2,541	2,430	/	2,981	1,332	/	1,361	0	/	0	0					
	BEGIN PEAK HR		7:00 AM																
	VOLUMES	0	921	311	263	803	0	79	1	535	0	0	0	2,913					
	APPROACH %	0%	75%	25%	25%	75%	0%	13%	0%	87%	0%	0%	0%						
	PEAK HR FACTOR		0.931			0.894			0.849			0.000		0.951					
	APP/DEPART	1,232	/	1,000	1,066	/	1,338	615	/	575	0	/	0	0					
PM	4:00 PM	0	231	124	45	175	0	39	0	179	0	0	0	793	0	0	0	0	0
	4:15 PM	0	205	94	43	157	0	52	1	183	0	0	0	735	0	0	0	0	0
	4:30 PM	0	235	103	47	180	0	58	0	169	0	0	0	792	0	0	0	0	0
	4:45 PM	0	216	99	36	177	0	60	0	190	0	0	0	778	0	0	0	0	0
	5:00 PM	0	250	103	44	160	0	53	2	158	0	0	0	770	0	0	0	0	0
	5:15 PM	0	240	114	42	216	0	39	0	175	0	0	0	826	0	0	0	0	0
	5:30 PM	0	237	122	28	147	0	39	2	200	0	0	0	775	0	0	0	0	0
	5:45 PM	0	263	110	37	135	0	53	0	184	0	0	0	782	0	0	0	0	0
	6:00 PM	0	186	98	46	188	0	45	1	194	0	0	0	758	0	0	0	0	0
	6:15 PM	0	193	104	46	151	0	47	0	183	0	0	0	724	0	0	0	0	0
	6:30 PM	0	197	90	35	147	0	39	1	160	0	0	0	669	0	0	0	0	0
	6:45 PM	0	193	95	31	151	0	35	0	173	0	0	0	678	0	0	0	0	0
	VOLUMES	0	2,646	1,256	480	1,984	0	559	7	2,148	0	0	0	9,080	0	0	0	0	0
	APPROACH %	0%	68%	32%	19%	81%	0%	21%	0%	79%	0%	0%	0%						
	APP/DEPART	3,902	/	3,205	2,464	/	4,132	2,714	/	1,743	0	/	0	0					
	BEGIN PEAK HR		4:30 PM																
	VOLUMES	0	941	419	169	733	0	210	2	692	0	0	0	3,166					
	APPROACH %	0%	69%	31%	19%	81%	0%	23%	0%	77%	0%	0%	0%						
	PEAK HR FACTOR		0.960			0.874			0.904			0.000		0.958					
	APP/DEPART	1,360	/	1,151	902	/	1,425	904	/	590	0	/	0	0					



		PEDESTRIAN + BIKE CROSSINGS					PEDESTRIAN CROSSINGS					BICYCLE CROSSINGS				
		N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	NS	SS	ES	WS	TOTAL
AM	6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM	4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

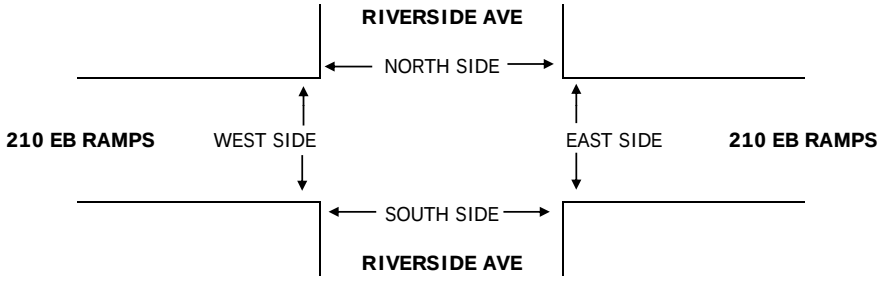
CLASS 1: PASSENGER VEHICLES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

	NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
LANES:	NL X	NT 3.5	NR 1.5	SL 2	ST 2	SR X	EL 1.33	ET 0.33	ER 1.33	WL X	WT X	WR X	TOTAL	NB	SB	EB	WB	TTL
AM																		
6:00 AM		136	35	14	76		7	0	37				305					0
6:15 AM		133	30	27	76		13	0	46				325					0
6:30 AM		219	77	31	127		14	0	58				526					0
6:45 AM		188	54	30	154		17	0	97				540					0
7:00 AM		258	66	44	199		16	0	96				679					0
7:15 AM		231	52	78	211		17	0	160				749					0
7:30 AM		211	102	76	185		20	0	120				714					0
7:45 AM		189	87	49	172		23	1	137				658					0
8:00 AM		188	79	42	131		22	0	76				538					0
8:15 AM		189	66	39	159		21	1	67				542					0
8:30 AM		140	72	49	154		19	0	73				507					0
8:45 AM		122	63	29	127		21	0	84				446					0
VOLUMES	0	2,204	783	508	1,771	0	210	2	1,051	0	0	0	6,529	0	0	0	0	0
APPROACH %	0%	74%	26%	22%	78%	0%	17%	0%	83%	0%	0%	0%						
APP/DEPART	2,987	/	2,414	2,279	/	2,822	1,263	/	1,293	0	/	0	0					
BEGIN PEAK HR		7:00 AM																
VOLUMES	0	889	307	247	767	0	76	1	513	0	0	0	2,800					
APPROACH %	0%	74%	26%	24%	76%	0%	13%	0%	87%	0%	0%	0%						
PEAK HR FACTOR		0.923			0.877			0.833			0.000		0.935					
APP/DEPART	1,196	/	965	1,014	/	1,280	590	/	555	0	/	0	0					
PM																		
4:00 PM		226	124	44	170		37	0	174				775					0
4:15 PM		202	92	41	154		51	1	179				720					0
4:30 PM		228	103	46	176		57	0	165				775					0
4:45 PM		213	99	35	176		60	0	188				771					0
5:00 PM		246	103	44	158		51	2	156				760					0
5:15 PM		240	112	39	214		37	0	172				814					0
5:30 PM		234	120	27	146		39	2	197				765					0
5:45 PM		259	110	37	133		53	0	183				775					0
6:00 PM		181	97	43	184		44	1	192				742					0
6:15 PM		193	104	44	150		46	0	177				714					0
6:30 PM		195	88	35	145		38	1	159				661					0
6:45 PM		192	95	31	151		33	0	171				673					0
VOLUMES	0	2,609	1,247	466	1,957	0	546	7	2,113	0	0	0	8,945	0	0	0	0	0
APPROACH %	0%	68%	32%	19%	81%	0%	20%	0%	79%	0%	0%	0%						
APP/DEPART	3,856	/	3,155	2,423	/	4,070	2,666	/	1,720	0	/	0	0					
BEGIN PEAK HR		4:30 PM																
VOLUMES	0	927	417	164	724	0	205	2	681	0	0	0	3,120					
APPROACH %	0%	69%	31%	18%	82%	0%	23%	0%	77%	0%	0%	0%						
PEAK HR FACTOR		0.955			0.877			0.895			0.000		0.958					
APP/DEPART	1,344	/	1,132	888	/	1,405	888	/	583	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

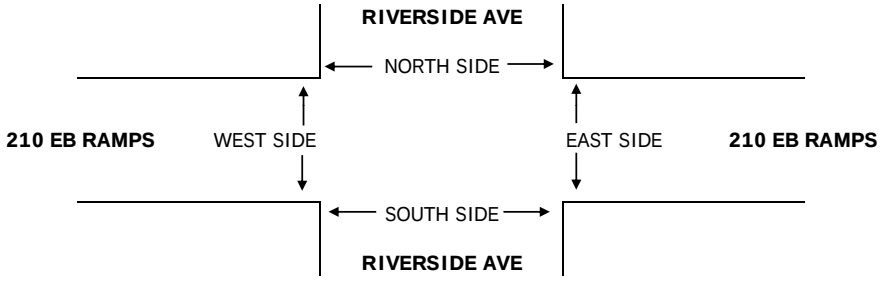
DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

CLASS 2:	NOTES:
2-AXLE WORK VEHICLES/ TRUCKS	

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL X	NT 3.5	NR 1.5	SL 2	ST 2	SR X	EL 1.33	ET 0.33	ER 1.33	WL X	WT X	WR X	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM		2	0	0	2		1	0	0				5					0
	6:15 AM		0	0	0	2		0	0	0				2					0
	6:30 AM		5	1	0	3		0	0	0				9					0
	6:45 AM		3	1	0	1		0	0	1				6					0
	7:00 AM		4	1	0	3		1	0	4				13					0
	7:15 AM		2	1	1	2		0	0	1				7					0
	7:30 AM		5	0	0	1		0	0	2				8					0
	7:45 AM		4	1	1	4		0	0	3				13					0
	8:00 AM		2	1	0	4		0	0	2				9					0
	8:15 AM		7	3	2	0		0	0	1				13					0
	8:30 AM		2	0	0	5		2	0	0				9					0
	8:45 AM		5	1	1	0		0	0	2				9					0
	VOLUMES	0	41	10	5	27	0	4	0	16	0	0	0	103	0	0	0	0	0
	APPROACH %	0%	80%	20%	16%	84%	0%	20%	0%	80%	0%	0%	0%						
	APP/DEPART	51	/	45	32	/	43	20	/	15	0	/	0	0					
	BEGIN PEAK HR		7:45 AM																
	VOLUMES	0	15	5	3	13	0	2	0	6	0	0	0	44					
	APPROACH %	0%	75%	25%	19%	81%	0%	25%	0%	75%	0%	0%	0%						
	PEAK HR FACTOR		0.500			0.800			0.667			0.000		0.846					
	APP/DEPART	20	/	17	16	/	19	8	/	8	0	/	0	0					
PM	4:00 PM		3	0	1	2		2	0	2				10					0
	4:15 PM		2	2	2	2		1	0	3				12					0
	4:30 PM		4	0	0	2		1	0	3				10					0
	4:45 PM		1	0	1	1		0	0	2				5					0
	5:00 PM		2	0	0	1		2	0	1				6					0
	5:15 PM		0	2	1	0		0	0	1				4					0
	5:30 PM		1	2	1	0		0	0	1				5					0
	5:45 PM		2	0	0	1		0	0	1				4					0
	6:00 PM		3	1	1	1		1	0	2				9					0
	6:15 PM		0	0	1	0		1	0	3				5					0
	6:30 PM		1	2	0	1		0	0	1				5					0
	6:45 PM		1	0	0	0		2	0	1				4					0
	VOLUMES	0	20	9	8	11	0	10	0	21	0	0	0	79	0	0	0	0	0
	APPROACH %	0%	69%	31%	42%	58%	0%	32%	0%	68%	0%	0%	0%						
	APP/DEPART	29	/	30	19	/	32	31	/	17	0	/	0	0					
	BEGIN PEAK HR		4:00 PM																
	VOLUMES	0	10	2	4	7	0	4	0	10	0	0	0	37					
	APPROACH %	0%	83%	17%	36%	64%	0%	29%	0%	71%	0%	0%	0%						
	PEAK HR FACTOR		0.750			0.688			0.875			0.000		0.771					
	APP/DEPART	12	/	14	11	/	17	14	/	6	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

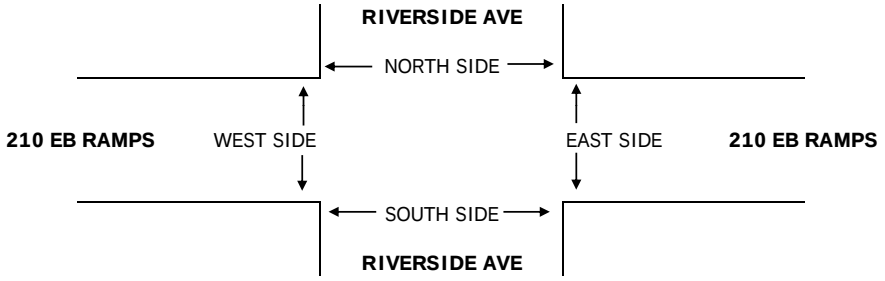
CLASS 3: 3-AXLE TRUCKS

NOTES:

AM
PM
MD
OTHER
OTHER

▲ N
◄ W
E ►
S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL X	NT 3.5	NR 1.5	SL 2	ST 2	SR X	EL 1.33	ET 0.33	ER 1.33	WL X	WT X	WR X	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM		1	0	0	0		0	0	2				3					0
	6:15 AM		0	0	0	7		0	0	0				7					0
	6:30 AM		1	0	0	0		0	0	0				1					0
	6:45 AM		0	0	0	0		1	0	1				2					0
	7:00 AM		0	0	1	1		0	0	0				2					0
	7:15 AM		1	0	0	0		0	0	0				1					0
	7:30 AM		0	0	1	1		0	0	0				2					0
	7:45 AM		0	0	0	4		0	0	0				4					0
	8:00 AM		1	0	0	2		0	0	0				3					0
	8:15 AM		1	0	0	1		1	0	1				4					0
	8:30 AM		0	0	1	5		0	0	0				6					0
	8:45 AM		0	0	0	5		0	0	1				6					0
	VOLUMES	0	5	0	3	26	0	2	0	5	0	0	0	41	0	0	0	0	0
	APPROACH %	0%	100%	0%	10%	90%	0%	29%	0%	71%	0%	0%	0%						
	APP/DEPART	5	/	7	29	/	31	7	/	3	0	/	0	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	0	2	0	1	13	0	1	0	2	0	0	0	19					
	APPROACH %	0%	100%	0%	7%	93%	0%	33%	0%	67%	0%	0%	0%						
	PEAK HR FACTOR		0.500			0.583			0.375			0.000		0.792					
	APP/DEPART	2	/	3	14	/	15	3	/	1	0	/	0	0					
PM	4:00 PM		1	0	0	0		0	0	1				2					0
	4:15 PM		0	0	0	0		0	0	1				1					0
	4:30 PM		1	0	0	1		0	0	0				2					0
	4:45 PM		0	0	0	0		0	0	0				0					0
	5:00 PM		0	0	0	0		0	0	0				0					0
	5:15 PM		0	0	0	0		1	0	2				3					0
	5:30 PM		0	0	0	0		0	0	0				0					0
	5:45 PM		0	0	0	0		0	0	0				0					0
	6:00 PM		0	0	0	0		0	0	0				0					0
	6:15 PM		0	0	0	1		0	0	1				2					0
	6:30 PM		0	0	0	0		0	0	0				0					0
	6:45 PM		0	0	0	0		0	0	0				0					0
	VOLUMES	0	2	0	0	2	0	1	0	5	0	0	0	10	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	100%	0%	17%	0%	83%	0%	0%	0%						
	APP/DEPART	2	/	3	2	/	7	6	/	0	0	/	0	0					
	BEGIN PEAK HR		4:30 PM																
	VOLUMES	0	1	0	0	1	0	1	0	2	0	0	0	5					
	APPROACH %	0%	100%	0%	0%	100%	0%	33%	0%	67%	0%	0%	0%						
	PEAK HR FACTOR		0.250			0.250			0.250			0.000		0.417					
	APP/DEPART	1	/	2	1	/	3	3	/	0	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

CLASS 4: 4 OR MORE AXLE TRUCKS

NOTES:

AM
PM
MD
OTHER
OTHER

▲ N
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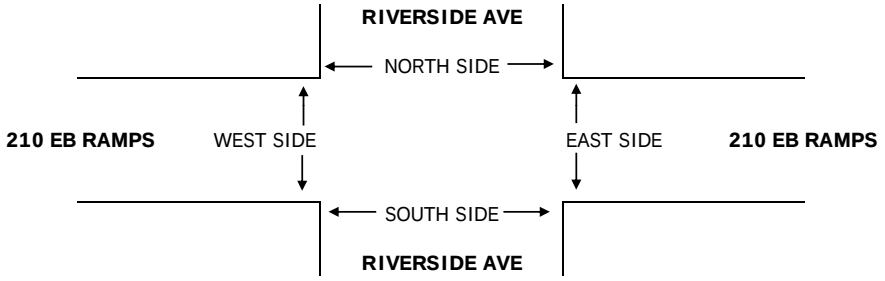
E ►
S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL X	NT 3.5	NR 1.5	SL 2	ST 2	SR X	EL 1.33	ET 0.33	ER 1.33	WL X	WT X	WR X	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM		3	1	2	0		0	0	2				8					0
	6:15 AM		5	0	5	1		0	0	4				15					0
	6:30 AM		4	2	3	0		1	0	4				14					0
	6:45 AM		4	0	2	1		0	0	3				10					0
	7:00 AM		0	0	2	1		1	0	3				7					0
	7:15 AM		0	0	1	2		0	0	3				6					0
	7:30 AM		5	0	5	1		0	0	1				12					0
	7:45 AM		7	0	3	2		0	0	5				17					0
	8:00 AM		2	0	4	2		0	0	1				9					0
	8:15 AM		5	1	5	3		0	0	5				19					0
	8:30 AM		9	0	4	3		0	0	3				19					0
	8:45 AM		5	0	3	1		0	0	1				10					0
	VOLUMES	0	49	4	39	17	0	2	0	35	0	0	0	146	0	0	0	0	0
	APPROACH %	0%	92%	8%	70%	30%	0%	5%	0%	95%	0%	0%	0%						
	APP/DEPART	53	/	51	56	/	52	37	/	43	0	/	0	0					
	BEGIN PEAK HR		7:45 AM																
	VOLUMES	0	23	1	16	10	0	0	0	14	0	0	0	64					
	APPROACH %	0%	96%	4%	62%	38%	0%	0%	0%	100%	0%	0%	0%						
	PEAK HR FACTOR		0.667			0.813			0.700			0.000		0.842					
	APP/DEPART	24	/	23	26	/	24	14	/	17	0	/	0	0					
PM	4:00 PM		0	0	0	2		0	0	2				4					0
	4:15 PM		1	0	0	0		0	0	0				1					0
	4:30 PM		1	0	0	0		0	0	0				1					0
	4:45 PM		1	0	0	0		0	0	0				1					0
	5:00 PM		1	0	0	0		0	0	1				2					0
	5:15 PM		0	0	0	1		0	0	0				1					0
	5:30 PM		1	0	0	0		0	0	2				3					0
	5:45 PM		1	0	0	0		0	0	0				1					0
	6:00 PM		0	0	0	0		0	0	0				0					0
	6:15 PM		0	0	0	0		0	0	1				1					0
	6:30 PM		0	0	0	0		0	0	0				0					0
	6:45 PM		0	0	0	0		0	0	1				1					0
	VOLUMES	0	6	0	0	3	0	0	0	7	0	0	0	16	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%						
	APP/DEPART	6	/	6	3	/	10	7	/	0	0	/	0	0					
	BEGIN PEAK HR		5:00 PM																
	VOLUMES	0	3	0	0	1	0	0	0	3	0	0	0	7					
	APPROACH %	0%	100%	0%	0%	100%	0%	0%	0%	100%	0%	0%	0%						
	PEAK HR FACTOR		0.750			0.125			0.375			0.000		0.438					
	APP/DEPART	3	/	3	1	/	4	3	/	0	0	/	0	0					



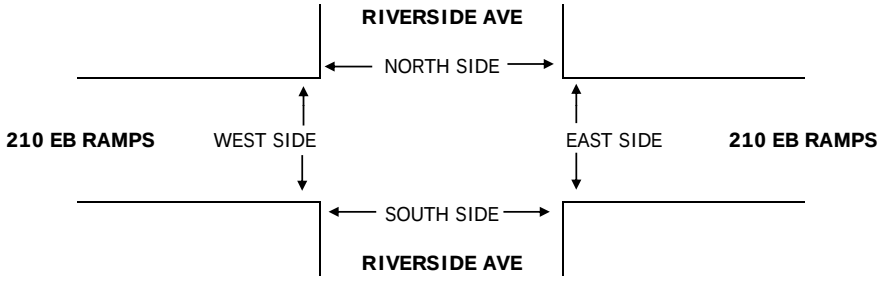
INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

CLASS 5:	NOTES:	AM		▲	
RECREATIONAL VEHICLES		PM		N	
		MD	◄ W		E ►
		OTHER		S	
		OTHER		▼	

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL X	NT 3.5	NR 1.5	SL 2	ST 2	SR X	EL 1.33	ET 0.33	ER 1.33	WL X	WT X	WR X	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM		0	0	0	0		0	0	0				0					0
	6:15 AM		0	0	0	0		0	0	0				0					0
	6:30 AM		0	0	0	0		0	0	0				0					0
	6:45 AM		0	0	0	0		0	0	0				0					0
	7:00 AM		0	0	0	0		0	0	0				0					0
	7:15 AM		0	0	0	0		0	0	0				0					0
	7:30 AM		0	0	0	0		0	0	0				0					0
	7:45 AM		0	0	0	0		0	0	0				0					0
	8:00 AM		0	0	0	0		0	0	0				0					0
	8:15 AM		0	0	0	0		0	0	0				0					0
	8:30 AM		0	0	0	0		0	0	0				0					0
	8:45 AM		0	0	0	0		0	0	0				0					0
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	0	/	0	0	/	0	0	/	0	0	/	0	0					
	BEGIN PEAK HR		8:45 AM																
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	0	0					
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.000			0.000			0.000		0.000					
	APP/DEPART	0	/	0	0	/	0	0	/	0	0	/	0	0					
PM	4:00 PM		0	0	0	0		0	0	0				0					0
	4:15 PM		0	0	0	0		0	0	0				0					0
	4:30 PM		0	0	0	0		0	0	0				0					0
	4:45 PM		0	0	0	0		0	0	0				0					0
	5:00 PM		0	0	0	0		0	0	0				0					0
	5:15 PM		0	0	0	0		0	0	0				0					0
	5:30 PM		0	0	0	0		0	0	0				0					0
	5:45 PM		0	0	0	0		0	0	0				0					0
	6:00 PM		0	0	1	0		0	0	0				1					0
	6:15 PM		0	0	0	0		0	0	0				0					0
	6:30 PM		0	0	0	0		0	0	0				0					0
	6:45 PM		0	0	0	0		0	0	0				0					0
	VOLUMES	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	APPROACH %	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	0	/	0	1	/	0	0	/	1	0	/	0	0					
	BEGIN PEAK HR		6:00 PM																
	VOLUMES	0	0	0	1	0	0	0	0	0	0	0	0	1					
	APPROACH %	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.250			0.000			0.000		0.250					
	APP/DEPART	0	/	0	1	/	0	0	/	1	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

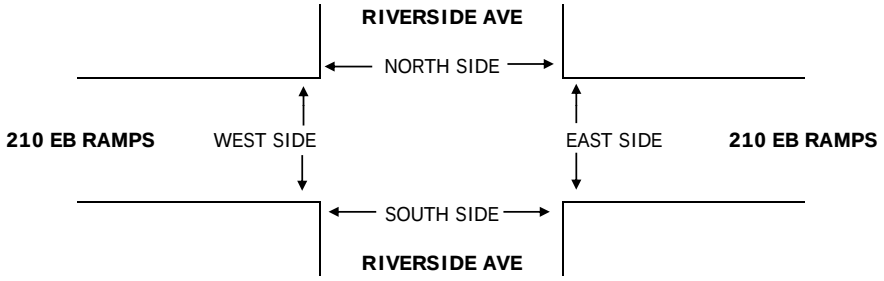
DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	RIVERSIDE AVE	LOCATION #:	2
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

CLASS 6:	NOTES:
BUSSES	

AM / PM / MD / OTHER / OTHER

N ▲ ◄ W E ► S ▼

		NORTHBOUND RIVERSIDE AVE			SOUTHBOUND RIVERSIDE AVE			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL X	NT 3.5	NR 1.5	SL 2	ST 2	SR X	EL 1.33	ET 0.33	ER 1.33	WL X	WT X	WR X	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM		2	0	0	0		0	0	0				2					0
	6:15 AM		2	0	0	1		0	0	0				3					0
	6:30 AM		4	0	0	2		0	0	1				7					0
	6:45 AM		2	1	0	9		0	0	3				15					0
	7:00 AM		2	0	1	6		0	0	0				9					0
	7:15 AM		0	0	0	3		0	0	0				3					0
	7:30 AM		2	1	0	3		0	0	0				6					0
	7:45 AM		0	0	0	2		1	0	0				3					0
	8:00 AM		3	0	1	0		0	0	0				4					0
	8:15 AM		2	0	0	1		0	0	0				3					0
	8:30 AM		1	0	3	1		0	0	0				5					0
	8:45 AM		3	0	0	1		0	0	0				4					0
	VOLUMES	0	23	2	5	29	0	1	0	4	0	0	0	64	0	0	0	0	0
	APPROACH %	0%	92%	8%	15%	85%	0%	20%	0%	80%	0%	0%	0%						
	APP/DEPART	25	/	24	34	/	33	5	/	7	0	/	0	0					
	BEGIN PEAK HR		6:30 AM																
	VOLUMES	0	8	1	1	20	0	0	0	4	0	0	0	34					
	APPROACH %	0%	89%	11%	5%	95%	0%	0%	0%	100%	0%	0%	0%						
	PEAK HR FACTOR		0.563			0.583			0.333			0.000		0.567					
	APP/DEPART	9	/	8	21	/	24	4	/	2	0	/	0	0					
PM	4:00 PM		1	0	0	1		0	0	0				2					0
	4:15 PM		0	0	0	1		0	0	0				1					0
	4:30 PM		1	0	1	1		0	0	1				4					0
	4:45 PM		1	0	0	0		0	0	0				1					0
	5:00 PM		1	0	0	1		0	0	0				2					0
	5:15 PM		0	0	2	1		1	0	0				4					0
	5:30 PM		1	0	0	1		0	0	0				2					0
	5:45 PM		1	0	0	1		0	0	0				2					0
	6:00 PM		2	0	1	3		0	0	0				6					0
	6:15 PM		0	0	1	0		0	0	1				2					0
	6:30 PM		1	0	0	1		1	0	0				3					0
	6:45 PM		0	0	0	0		0	0	0				0					0
	VOLUMES	0	9	0	5	11	0	2	0	2	0	0	0	29	0	0	0	0	0
	APPROACH %	0%	100%	0%	31%	69%	0%	50%	0%	50%	0%	0%	0%						
	APP/DEPART	9	/	11	16	/	13	4	/	5	0	/	0	0					
	BEGIN PEAK HR		5:15 PM																
	VOLUMES	0	4	0	3	6	0	1	0	0	0	0	0	14					
	APPROACH %	0%	100%	0%	33%	67%	0%	100%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.500			0.563			0.250			0.000		0.583					
	APP/DEPART	4	/	5	9	/	6	1	/	3	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

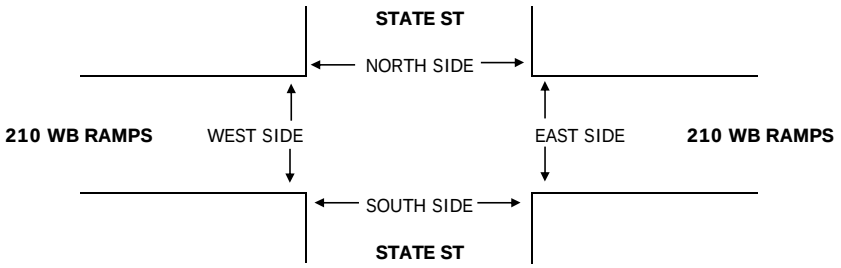
ALL CLASSES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	32	31	0	0	23	101	0	0	0	15	0	14	216	0	0	0	0	0
	6:15 AM	36	38	0	0	16	93	0	0	0	15	0	14	212	0	0	0	0	0
	6:30 AM	45	59	0	0	28	103	0	0	0	27	0	22	284	0	0	0	0	0
	6:45 AM	46	70	0	0	53	97	0	0	0	48	0	45	359	0	0	0	0	0
	7:00 AM	55	74	0	0	75	106	0	0	0	59	0	22	391	0	0	0	0	0
	7:15 AM	62	122	0	0	65	110	0	0	0	40	0	35	434	0	0	0	0	0
	7:30 AM	72	118	0	0	60	114	0	0	0	37	0	40	441	0	0	0	0	0
	7:45 AM	37	96	0	0	58	112	0	0	0	31	1	49	384	0	0	0	0	0
	8:00 AM	39	68	0	0	37	86	0	0	0	26	0	46	302	0	0	0	0	0
	8:15 AM	24	68	0	0	40	79	0	0	0	20	1	45	277	0	0	0	0	0
	8:30 AM	18	76	0	0	59	72	0	0	0	17	0	36	278	0	0	0	0	0
	8:45 AM	21	80	0	0	54	72	0	0	0	22	0	28	277	0	0	0	0	0
	VOLUMES	487	900	0	0	568	1,145	0	0	0	357	2	396	3,855	0	0	0	0	0
	APPROACH %	35%	65%	0%	0%	33%	67%	0%	0%	0%	47%	0%	52%						
	APP/DEPART	1,387	/	1,296	1,713	/	925	0	/	0	755	/	1,634	0					
	BEGIN PEAK HR		7:00 AM																
	VOLUMES	226	410	0	0	258	442	0	0	0	167	1	146	1,650					
	APPROACH %	36%	64%	0%	0%	37%	63%	0%	0%	0%	53%	0%	46%						
	PEAK HR FACTOR		0.837			0.967			0.000			0.969		0.935					
	APP/DEPART	636	/	556	700	/	425	0	/	0	314	/	669	0					
PM	4:00 PM	46	82	0	0	63	145	0	0	0	36	0	41	413	0	0	0	0	0
	4:15 PM	41	109	0	0	59	124	0	0	0	21	1	26	381	0	0	0	0	0
	4:30 PM	64	109	0	0	57	120	0	0	0	24	0	26	400	0	0	0	0	0
	4:45 PM	51	121	0	0	69	106	0	0	0	27	0	33	407	0	0	0	0	0
	5:00 PM	46	98	0	0	76	129	0	0	0	23	0	30	402	0	0	0	0	0
	5:15 PM	49	130	0	0	69	129	0	0	0	24	0	29	430	0	0	0	0	0
	5:30 PM	42	102	0	0	52	111	0	0	0	20	0	34	361	0	0	0	0	0
	5:45 PM	46	94	0	0	59	113	0	0	0	27	0	37	376	0	0	0	0	0
	6:00 PM	45	109	0	0	77	97	0	0	0	20	1	31	380	0	0	0	0	0
	6:15 PM	46	83	0	0	48	88	0	0	0	32	0	34	331	0	0	0	0	0
	6:30 PM	26	94	0	0	42	77	0	0	0	15	0	24	278	0	0	0	0	0
	6:45 PM	26	83	0	0	39	65	0	0	0	22	0	28	263	0	0	0	0	0
	VOLUMES	528	1,214	0	0	710	1,304	0	0	0	291	2	373	4,422	0	0	0	0	0
	APPROACH %	30%	70%	0%	0%	35%	65%	0%	0%	0%	44%	0%	56%						
	APP/DEPART	1,742	/	1,587	2,014	/	1,001	0	/	0	666	/	1,834	0					
	BEGIN PEAK HR		4:30 PM																
	VOLUMES	210	458	0	0	271	484	0	0	0	98	0	118	1,639					
	APPROACH %	31%	69%	0%	0%	36%	64%	0%	0%	0%	45%	0%	55%						
	PEAK HR FACTOR		0.933			0.921			0.000			0.900		0.953					
	APP/DEPART	668	/	576	755	/	369	0	/	0	216	/	694	0					



		PEDESTRIAN + BIKE CROSSINGS					PEDESTRIAN CROSSINGS					BICYCLE CROSSINGS				
		N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	NS	SS	ES	WS	TOTAL
AM	6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM	4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

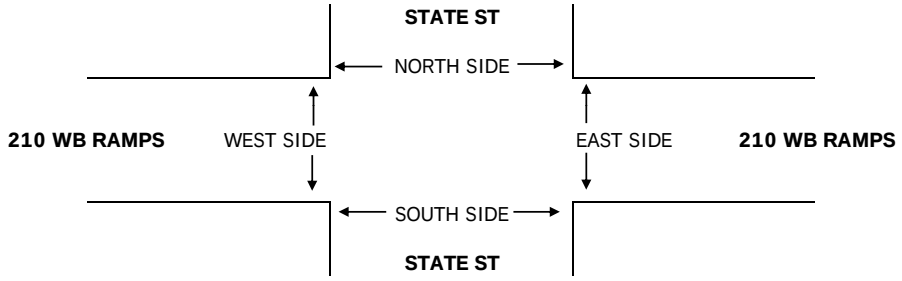
CLASS 1: PASSENGER VEHICLES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	32	31			20	94				15	0	12	204					0
	6:15 AM	35	34			16	87				14	0	14	200					0
	6:30 AM	44	54			27	97				26	0	16	264					0
	6:45 AM	44	67			46	92				48	0	42	339					0
	7:00 AM	53	71			71	97				58	0	21	371					0
	7:15 AM	62	115			63	104				40	0	31	415					0
	7:30 AM	69	111			57	108				36	0	39	420					0
	7:45 AM	36	94			55	109				31	1	46	372					0
	8:00 AM	39	63			29	81				26	0	44	282					0
	8:15 AM	22	66			36	74				20	1	40	259					0
	8:30 AM	18	72			57	66				17	0	36	266					0
	8:45 AM	18	76			50	64				20	0	26	254					0
	VOLUMES	472	854	0	0	527	1,073	0	0	0	351	2	367	3,646	0	0	0	0	0
	APPROACH %	36%	64%	0%	0%	33%	67%	0%	0%	0%	49%	0%	51%						
	APP/DEPART	1,326	/	1,221	1,600	/	878	0	/	0	720	/	1,547	0					
	BEGIN PEAK HR		7:00 AM																
	VOLUMES	220	391	0	0	246	418	0	0	0	165	1	137	1,578					
	APPROACH %	36%	64%	0%	0%	37%	63%	0%	0%	0%	54%	0%	45%						
	PEAK HR FACTOR		0.849			0.988			0.000			0.959		0.939					
	APP/DEPART	611	/	528	664	/	411	0	/	0	303	/	639	0					
PM	4:00 PM	45	77			62	145				35	0	40	404					0
	4:15 PM	41	107			56	121				20	1	26	372					0
	4:30 PM	64	105			56	118				24	0	26	393					0
	4:45 PM	51	116			66	104				26	0	28	391					0
	5:00 PM	46	93			73	128				23	0	28	391					0
	5:15 PM	49	123			66	129				24	0	27	418					0
	5:30 PM	42	100			51	107				19	0	34	353					0
	5:45 PM	46	90			57	108				27	0	37	365					0
	6:00 PM	44	104			77	94				19	1	31	370					0
	6:15 PM	46	82			47	88				31	0	34	328					0
	6:30 PM	26	92			41	75				15	0	24	273					0
	6:45 PM	26	79			39	61				22	0	27	254					0
	VOLUMES	526	1,168	0	0	691	1,278	0	0	0	285	2	362	4,312	0	0	0	0	0
	APPROACH %	31%	69%	0%	0%	35%	65%	0%	0%	0%	44%	0%	56%						
	APP/DEPART	1,694	/	1,530	1,969	/	976	0	/	0	649	/	1,806	0					
	BEGIN PEAK HR		4:30 PM																
	VOLUMES	210	437	0	0	261	479	0	0	0	97	0	109	1,593					
	APPROACH %	32%	68%	0%	0%	35%	65%	0%	0%	0%	47%	0%	53%						
	PEAK HR FACTOR		0.940			0.920			0.000			0.954		0.953					
	APP/DEPART	647	/	546	740	/	358	0	/	0	206	/	689	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

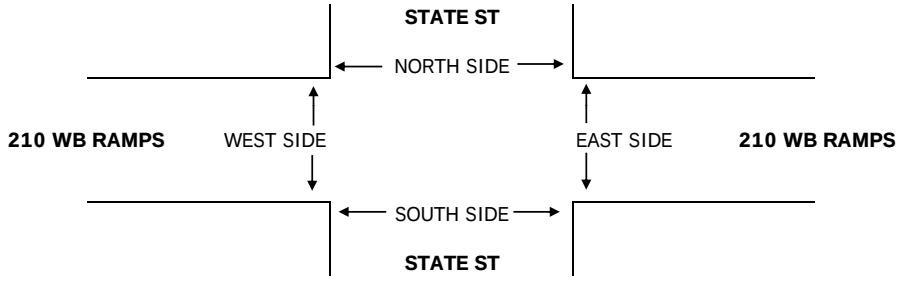
CLASS 2: 2-AXLE WORK VEHICLES/ TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0			0	2				0	0	1	3					0
	6:15 AM	1	2			0	3				1	0	0	7					0
	6:30 AM	1	1			0	3				0	0	0	5					0
	6:45 AM	2	2			2	2				0	0	0	8					0
	7:00 AM	2	2			0	1				0	0	1	6					0
	7:15 AM	0	4			1	3				0	0	2	10					0
	7:30 AM	2	3			1	1				1	0	0	8					0
	7:45 AM	1	0			3	1				0	0	1	6					0
	8:00 AM	0	1			2	2				0	0	0	5					0
	8:15 AM	1	0			1	1				0	0	1	4					0
	8:30 AM	0	1			0	3				0	0	0	4					0
	8:45 AM	0	3			0	3				0	0	2	8					0
	VOLUMES	10	19	0	0	10	25	0	0	0	2	0	8	74	0	0	0	0	0
	APPROACH %	34%	66%	0%	0%	29%	71%	0%	0%	0%	20%	0%	80%						
	APP/DEPART	29	/	27	35	/	12	0	/	0	10	/	35	0					
	BEGIN PEAK HR		6:45 AM																
	VOLUMES	6	11	0	0	4	7	0	0	0	1	0	3	32					
	APPROACH %	35%	65%	0%	0%	36%	64%	0%	0%	0%	25%	0%	75%						
	PEAK HR FACTOR		0.850			0.688			0.000			0.500		0.800					
	APP/DEPART	17	/	14	11	/	5	0	/	0	4	/	13	0					
PM	4:00 PM	0	3			0	0				0	0	0	3					0
	4:15 PM	0	1			1	2				0	0	0	4					0
	4:30 PM	0	2			0	0				0	0	0	2					0
	4:45 PM	0	4			0	0				1	0	4	9					0
	5:00 PM	0	2			1	1				0	0	2	6					0
	5:15 PM	0	1			0	0				0	0	1	2					0
	5:30 PM	0	1			0	4				0	0	0	5					0
	5:45 PM	0	1			1	2				0	0	0	4					0
	6:00 PM	1	3			0	1				1	0	0	6					0
	6:15 PM	0	1			1	0				1	0	0	3					0
	6:30 PM	0	1			1	0				0	0	0	2					0
	6:45 PM	0	1			0	2				0	0	1	4					0
	VOLUMES	1	21	0	0	5	12	0	0	0	3	0	8	50	0	0	0	0	0
	APPROACH %	5%	95%	0%	0%	29%	71%	0%	0%	0%	27%	0%	73%						
	APP/DEPART	22	/	29	17	/	8	0	/	0	11	/	13	0					
	BEGIN PEAK HR		4:45 PM																
	VOLUMES	0	8	0	0	1	5	0	0	0	1	0	7	22					
	APPROACH %	0%	100%	0%	0%	17%	83%	0%	0%	0%	13%	0%	88%						
	PEAK HR FACTOR		0.500			0.375			0.000			0.400		0.611					
	APP/DEPART	8	/	15	6	/	2	0	/	0	8	/	5	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

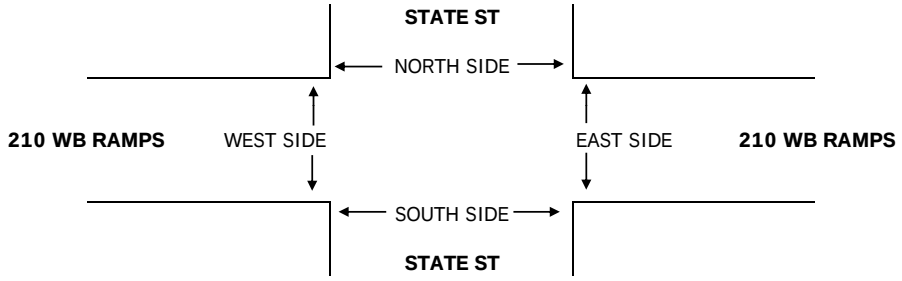
CLASS 3: 3-AXLE TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0			0	1				0	0	0	1					0
	6:15 AM	0	0			0	2				0	0	0	2					0
	6:30 AM	0	0			0	1				0	0	0	1					0
	6:45 AM	0	0			3	1				0	0	0	4					0
	7:00 AM	0	0			0	1				0	0	0	1					0
	7:15 AM	0	1			0	0				0	0	0	1					0
	7:30 AM	0	0			0	4				0	0	1	5					0
	7:45 AM	0	0			0	2				0	0	0	2					0
	8:00 AM	0	1			1	0				0	0	1	3					0
	8:15 AM	1	0			3	1				0	0	1	6					0
	8:30 AM	0	0			0	1				0	0	0	1					0
	8:45 AM	2	0			1	2				1	0	0	6					0
	VOLUMES	3	2	0	0	8	16	0	0	0	1	0	3	33	0	0	0	0	0
	APPROACH %	60%	40%	0%	0%	33%	67%	0%	0%	0%	25%	0%	75%						
	APP/DEPART	5	/	5	24	/	9	0	/	0	4	/	19	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	3	1	0	0	5	4	0	0	0	1	0	2	16					
	APPROACH %	75%	25%	0%	0%	56%	44%	0%	0%	0%	33%	0%	67%						
	PEAK HR FACTOR		0.500			0.563			0.000			0.750		0.667					
	APP/DEPART	4	/	3	9	/	6	0	/	0	3	/	7	0					
PM	4:00 PM	0	1			1	0				0	0	0	2					0
	4:15 PM	0	0			0	1				0	0	0	1					0
	4:30 PM	0	0			0	0				0	0	0	0					0
	4:45 PM	0	0			0	1				0	0	0	1					0
	5:00 PM	0	0			0	0				0	0	0	0					0
	5:15 PM	0	1			0	0				0	0	0	1					0
	5:30 PM	0	0			0	0				0	0	0	0					0
	5:45 PM	0	0			0	0				0	0	0	0					0
	6:00 PM	0	1			0	1				0	0	0	2					0
	6:15 PM	0	0			0	0				0	0	0	0					0
	6:30 PM	0	0			0	1				0	0	0	1					0
	6:45 PM	0	1			0	2				0	0	0	3					0
	VOLUMES	0	4	0	0	1	6	0	0	0	0	0	0	11	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	14%	86%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	4	/	4	7	/	1	0	/	0	0	/	6	0					
	BEGIN PEAK HR		6:00 PM																
	VOLUMES	0	2	0	0	0	4	0	0	0	0	0	0	6					
	APPROACH %	0%	100%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.500			0.500			0.000			0.000		0.500					
	APP/DEPART	2	/	2	4	/	0	0	/	0	0	/	4	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

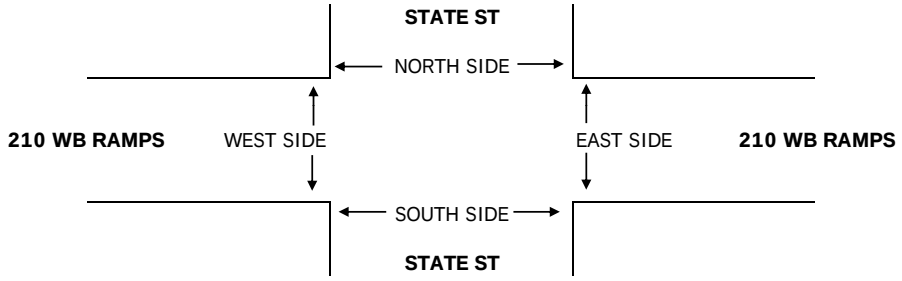
CLASS 4: 4 OR MORE AXLE TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0			3	4				0	0	1	8					0
	6:15 AM	0	1			0	1				0	0	0	2					0
	6:30 AM	0	2			1	2				1	0	1	7					0
	6:45 AM	0	1			0	2				0	0	0	3					0
	7:00 AM	0	1			0	4				0	0	0	5					0
	7:15 AM	0	2			0	2				0	0	2	6					0
	7:30 AM	0	3			1	1				0	0	0	5					0
	7:45 AM	0	1			0	0				0	0	0	1					0
	8:00 AM	0	1			3	2				0	0	0	6					0
	8:15 AM	0	1			0	3				0	0	0	4					0
	8:30 AM	0	3			1	2				0	0	0	6					0
	8:45 AM	0	1			1	3				0	0	0	5					0
	VOLUMES	0	17	0	0	10	26	0	0	0	1	0	4	58	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	28%	72%	0%	0%	0%	20%	0%	80%						
	APP/DEPART	17	/	21	36	/	11	0	/	0	5	/	26	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	0	6	0	0	5	10	0	0	0	0	0	0	21					
	APPROACH %	0%	100%	0%	0%	33%	67%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.500			0.750			0.000			0.000		0.750					
	APP/DEPART	6	/	6	15	/	5	0	/	0	0	/	10	0					
PM	4:00 PM	1	1			0	0				1	0	1	4					0
	4:15 PM	0	0			0	0				0	0	0	0					0
	4:30 PM	0	1			0	2				0	0	0	3					0
	4:45 PM	0	0			2	1				0	0	1	4					0
	5:00 PM	0	3			2	0				0	0	0	5					0
	5:15 PM	0	5			3	0				0	0	0	8					0
	5:30 PM	0	1			0	0				1	0	0	2					0
	5:45 PM	0	3			0	3				0	0	0	6					0
	6:00 PM	0	1			0	1				0	0	0	2					0
	6:15 PM	0	0			0	0				0	0	0	0					0
	6:30 PM	0	1			0	1				0	0	0	2					0
	6:45 PM	0	1			0	0				0	0	0	1					0
	VOLUMES	1	17	0	0	7	8	0	0	0	2	0	2	37	0	0	0	0	0
	APPROACH %	6%	94%	0%	0%	47%	53%	0%	0%	0%	50%	0%	50%						
	APP/DEPART	18	/	19	15	/	9	0	/	0	4	/	9	0					
	BEGIN PEAK HR		5:00 PM																
	VOLUMES	0	12	0	0	5	3	0	0	0	1	0	0	21					
	APPROACH %	0%	100%	0%	0%	63%	38%	0%	0%	0%	100%	0%	0%						
	PEAK HR FACTOR		0.600			0.667			0.000			0.250		0.656					
	APP/DEPART	12	/	12	8	/	6	0	/	0	1	/	3	0					



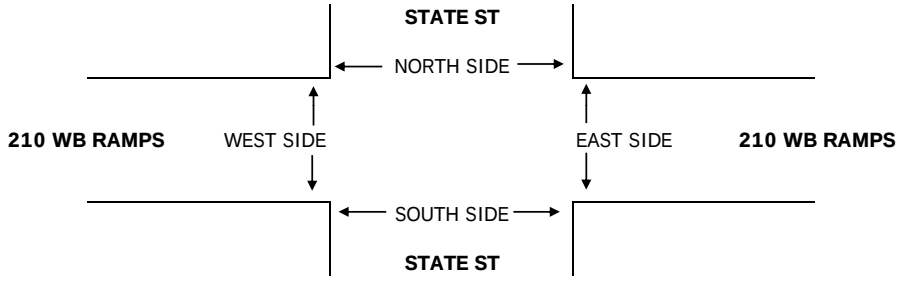
INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

CLASS 5:	NOTES:	AM		▲	
RECREATIONAL VEHICLES		PM		N	
		MD	◄ W		E ►
		OTHER		S	
		OTHER		▼	

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0			0	0				0	0	0	0					0
	6:15 AM	0	0			0	0				0	0	0	0					0
	6:30 AM	0	0			0	0				0	0	0	0					0
	6:45 AM	0	0			0	0				0	0	0	0					0
	7:00 AM	0	0			0	0				0	0	0	0					0
	7:15 AM	0	0			0	0				0	0	0	0					0
	7:30 AM	0	0			0	0				0	0	0	0					0
	7:45 AM	0	0			0	0				0	0	0	0					0
	8:00 AM	0	0			0	0				0	0	0	0					0
	8:15 AM	0	0			0	0				0	0	0	0					0
	8:30 AM	0	0			0	0				0	0	0	0					0
	8:45 AM	0	0			0	0				0	0	0	0					0
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	0	/	0	0	/	0	0	/	0	0	/	0	0					
	BEGIN PEAK HR		8:45 AM																
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	0	0					
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.000			0.000			0.000		0.000					
	APP/DEPART	0	/	0	0	/	0	0	/	0	0	/	0	0					
PM	4:00 PM	0	0			0	0				0	0	0	0					0
	4:15 PM	0	0			0	0				0	0	0	0					0
	4:30 PM	0	0			0	0				0	0	0	0					0
	4:45 PM	0	0			0	0				0	0	0	0					0
	5:00 PM	0	0			0	0				0	0	0	0					0
	5:15 PM	0	0			0	0				0	0	0	0					0
	5:30 PM	0	0			0	0				0	0	0	0					0
	5:45 PM	0	0			0	0				0	0	0	0					0
	6:00 PM	0	0			0	0				0	0	0	0					0
	6:15 PM	0	0			0	0				0	0	0	0					0
	6:30 PM	0	0			0	0				0	0	0	0					0
	6:45 PM	0	1			0	0				0	0	0	1					0
	VOLUMES	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	1	/	1	0	/	0	0	/	0	0	/	0	0					
	BEGIN PEAK HR		6:45 PM																
	VOLUMES	1	3	1	0	0	0	0	0	0	0	0	0	5					
	APPROACH %	20%	60%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		1.250			0.000			0.000			0.000		1.250					
	APP/DEPART	5	/	3	0	/	0	0	/	1	0	/	1	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	3
TUESDAY	EAST & WEST:	210 WB RAMPS	CONTROL:	SIGNAL

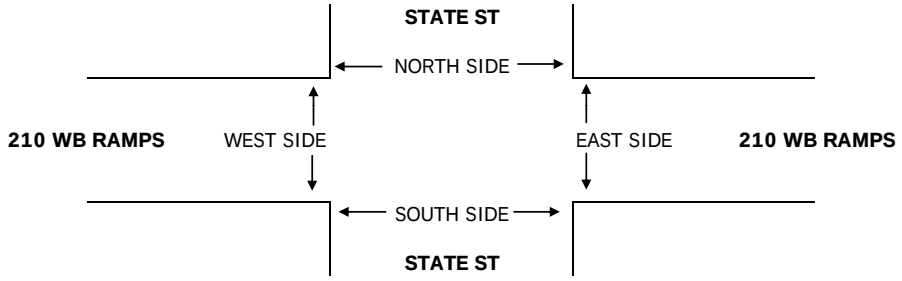
CLASS 6: BUSSES

NOTES:

AM
PM
MD
OTHER
OTHER

▲ N
◄ W
E ►
S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 WB RAMPS			WESTBOUND 210 WB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR X	SL X	ST 1.5	SR 1.5	EL X	ET X	ER X	WL 1.33	WT 0.33	WR 1.33	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0			0	0				0	0	0	0					0
	6:15 AM	0	1			0	0				0	0	0	1					0
	6:30 AM	0	2			0	0				0	0	5	7					0
	6:45 AM	0	0			2	0				0	0	3	5					0
	7:00 AM	0	0			4	3				1	0	0	8					0
	7:15 AM	0	0			1	1				0	0	0	2					0
	7:30 AM	1	1			1	0				0	0	0	3					0
	7:45 AM	0	1			0	0				0	0	2	3					0
	8:00 AM	0	2			2	1				0	0	1	6					0
	8:15 AM	0	1			0	0				0	0	3	4					0
	8:30 AM	0	0			1	0				0	0	0	1					0
	8:45 AM	1	0			2	0				1	0	0	4					0
	VOLUMES	2	8	0	0	13	5	0	0	0	2	0	14	44	0	0	0	0	0
	APPROACH %	20%	80%	0%	0%	72%	28%	0%	0%	0%	13%	0%	88%						
	APP/DEPART	10	/	22	18	/	15	0	/	0	16	/	7	0					
	BEGIN PEAK HR		6:30 AM																
	VOLUMES	0	2	0	0	7	4	0	0	0	1	0	8	22					
	APPROACH %	0%	100%	0%	0%	64%	36%	0%	0%	0%	11%	0%	89%						
	PEAK HR FACTOR		0.250			0.393			0.000			0.450		0.688					
	APP/DEPART	2	/	10	11	/	8	0	/	0	9	/	4	0					
PM	4:00 PM	0	0			0	0				0	0	0	0					0
	4:15 PM	0	1			2	0				1	0	0	4					0
	4:30 PM	0	1			1	0				0	0	0	2					0
	4:45 PM	0	1			1	0				0	0	0	2					0
	5:00 PM	0	0			0	0				0	0	0	0					0
	5:15 PM	0	0			0	0				0	0	1	1					0
	5:30 PM	0	0			1	0				0	0	0	1					0
	5:45 PM	0	0			1	0				0	0	0	1					0
	6:00 PM	0	0			0	0				0	0	0	0					0
	6:15 PM	0	0			0	0				0	0	0	0					0
	6:30 PM	0	0			0	0				0	0	0	0					0
	6:45 PM	0	0			0	0				0	0	0	0					0
	VOLUMES	0	3	0	0	6	0	0	0	0	1	0	1	11	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	100%	0%	0%	0%	0%	50%	0%	50%						
	APP/DEPART	3	/	4	6	/	7	0	/	0	2	/	0	0					
	BEGIN PEAK HR		4:15 PM																
	VOLUMES	0	3	0	0	4	0	0	0	0	1	0	0	8					
	APPROACH %	0%	100%	0%	0%	100%	0%	0%	0%	0%	100%	0%	0%						
	PEAK HR FACTOR		0.750			0.500			0.000			0.250		0.500					
	APP/DEPART	3	/	3	4	/	5	0	/	0	1	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

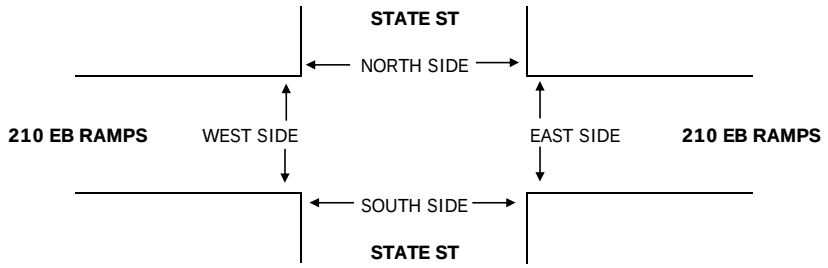
ALL CLASSES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

	NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM																		
6:00 AM	5	22	0	4	19	11	29	12	6	0	9	14	131	0	0	0	0	0
6:15 AM	6	32	1	2	18	11	33	18	10	0	9	14	154	0	0	0	0	0
6:30 AM	11	32	1	6	28	21	32	27	12	0	6	20	196	0	0	0	0	0
6:45 AM	12	41	0	8	63	17	48	44	26	0	9	26	294	0	0	0	0	0
7:00 AM	23	65	0	9	103	27	57	27	32	0	13	17	373	0	0	0	0	0
7:15 AM	23	62	3	6	86	23	79	27	49	0	17	33	408	0	0	0	0	0
7:30 AM	29	72	2	11	52	28	92	21	53	0	13	34	407	0	0	0	0	0
7:45 AM	17	33	0	3	41	40	79	40	47	1	7	25	333	0	0	0	0	0
8:00 AM	8	35	2	11	43	19	55	33	38	0	13	18	275	0	0	0	0	0
8:15 AM	9	30	6	6	27	22	51	29	30	5	10	12	237	0	0	0	0	0
8:30 AM	15	22	6	9	38	27	65	26	28	1	8	10	255	0	0	0	0	0
8:45 AM	13	27	0	8	36	39	63	37	25	2	9	7	266	0	0	0	0	0
VOLUMES	171	473	21	83	554	285	683	341	356	9	123	230	3,329	0	0	0	0	0
APPROACH %	26%	71%	3%	9%	60%	31%	49%	25%	26%	2%	34%	64%						
APP/DEPART	665	/	1,386	922	/	919	1,380	/	445	362	/	579	0					
BEGIN PEAK HR		7:00 AM																
VOLUMES	92	232	5	29	282	118	307	115	181	1	50	109	1,521					
APPROACH %	28%	71%	2%	7%	66%	28%	51%	19%	30%	1%	31%	68%						
PEAK HR FACTOR		0.799			0.772			0.908			0.800		0.932					
APP/DEPART	329	/	648	429	/	464	603	/	149	160	/	260	0					
PM																		
4:00 PM	27	34	1	19	59	45	67	34	34	1	19	23	363	0	0	0	0	0
4:15 PM	23	46	1	10	38	30	83	32	53	1	23	28	368	0	0	0	0	0
4:30 PM	30	55	1	11	37	35	87	36	49	4	31	26	402	0	0	0	0	0
4:45 PM	13	46	0	11	39	38	96	47	66	2	23	25	406	0	0	0	0	0
5:00 PM	18	46	1	8	55	34	79	39	48	0	21	26	375	0	0	0	0	0
5:15 PM	25	51	1	5	52	41	95	44	50	2	31	22	419	0	0	0	0	0
5:30 PM	16	37	1	9	37	25	84	30	52	0	16	25	332	0	0	0	0	0
5:45 PM	24	44	1	4	52	22	78	40	44	3	18	23	353	0	0	0	0	0
6:00 PM	17	59	2	5	48	34	75	26	47	1	20	23	357	0	0	0	0	0
6:15 PM	19	43	1	10	50	23	68	30	31	5	21	18	319	0	0	0	0	0
6:30 PM	18	38	0	5	30	17	73	36	34	0	15	12	278	0	0	0	0	0
6:45 PM	13	34	2	12	35	18	57	35	37	0	9	13	265	0	0	0	0	0
VOLUMES	243	533	12	109	532	362	942	429	545	19	247	264	4,237	0	0	0	0	0
APPROACH %	31%	68%	2%	11%	53%	36%	49%	22%	28%	4%	47%	50%						
APP/DEPART	788	/	1,739	1,003	/	1,096	1,916	/	550	530	/	852	0					
BEGIN PEAK HR		4:30 PM																
VOLUMES	86	198	3	35	183	148	357	166	213	8	106	99	1,602					
APPROACH %	30%	69%	1%	10%	50%	40%	49%	23%	29%	4%	50%	46%						
PEAK HR FACTOR		0.834			0.934			0.880			0.873		0.956					
APP/DEPART	287	/	654	366	/	404	736	/	204	213	/	340	0					



	PEDESTRIAN + BIKE CROSSINGS					PEDESTRIAN CROSSINGS					BICYCLE CROSSINGS				
	N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	N SIDE	S SIDE	E SIDE	W SIDE	TOTAL	NS	SS	ES	WS	TOTAL
AM															
6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM															
4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

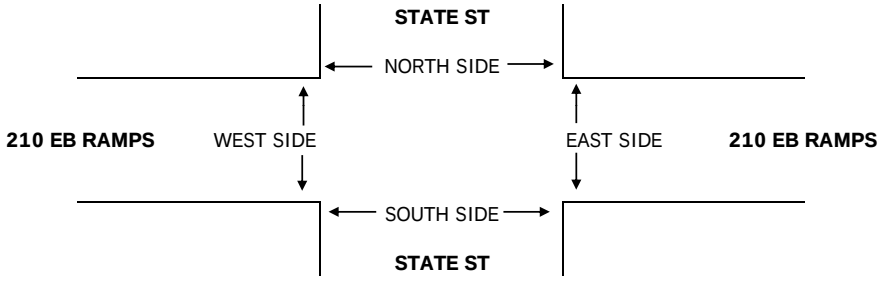
CLASS 1: PASSENGER VEHICLES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	5	22	0	3	19	9	28	11	6	0	8	14	125					0
	6:15 AM	6	31	1	2	17	11	30	18	10	0	9	14	149					0
	6:30 AM	10	29	1	6	27	20	30	26	11	0	5	20	185					0
	6:45 AM	12	40	0	8	61	14	44	44	26	0	8	24	281					0
	7:00 AM	23	64	0	9	99	24	55	27	32	0	13	17	363					0
	7:15 AM	23	61	3	6	86	21	73	27	48	0	17	32	397					0
	7:30 AM	29	69	2	11	51	25	87	21	53	0	12	32	392					0
	7:45 AM	17	32	0	3	41	38	78	38	47	1	7	24	326					0
	8:00 AM	8	34	2	11	41	13	52	32	38	0	13	17	261					0
	8:15 AM	9	30	6	6	26	19	49	28	30	5	10	11	229					0
	8:30 AM	15	21	6	9	37	25	61	24	28	1	7	10	244					0
	8:45 AM	12	24	0	7	33	37	59	34	25	2	9	7	249					0
	VOLUMES	169	457	21	81	538	256	646	330	354	9	118	222	3,201	0	0	0	0	0
	APPROACH %	26%	71%	3%	9%	61%	29%	49%	25%	27%	3%	34%	64%						
	APP/DEPART	647	/	1,325	875	/	901	1,330	/	432	349	/	543	0					
	BEGIN PEAK HR		7:00 AM																
	VOLUMES	92	226	5	29	277	108	293	113	180	1	49	105	1,478					
	APPROACH %	28%	70%	2%	7%	67%	26%	50%	19%	31%	1%	32%	68%						
	PEAK HR FACTOR		0.808			0.784			0.899			0.791		0.931					
	APP/DEPART	323	/	624	414	/	458	586	/	147	155	/	249	0					
PM	4:00 PM	25	33	1	19	58	44	62	34	34	1	19	23	353					0
	4:15 PM	23	46	1	9	37	28	82	30	51	1	22	27	357					0
	4:30 PM	30	55	1	11	37	34	82	32	49	4	31	26	392					0
	4:45 PM	13	45	0	10	39	35	93	47	62	2	23	25	394					0
	5:00 PM	18	46	1	8	55	32	75	39	48	0	21	25	368					0
	5:15 PM	25	51	1	5	52	37	87	43	49	2	30	22	404					0
	5:30 PM	16	37	1	8	36	25	82	29	52	0	16	25	327					0
	5:45 PM	24	43	1	4	51	21	76	39	43	3	18	23	346					0
	6:00 PM	16	56	2	5	47	34	72	25	47	1	20	23	348					0
	6:15 PM	19	43	1	10	49	22	66	30	31	5	19	18	313					0
	6:30 PM	18	38	0	5	29	17	72	36	34	0	15	12	276					0
	6:45 PM	13	34	2	12	35	18	53	35	37	0	9	12	260					0
	VOLUMES	240	527	12	106	525	347	902	419	537	19	243	261	4,138	0	0	0	0	0
	APPROACH %	31%	68%	2%	11%	54%	35%	49%	23%	29%	4%	46%	50%						
	APP/DEPART	779	/	1,690	978	/	1,081	1,858	/	537	523	/	830	0					
	BEGIN PEAK HR		4:30 PM																
	VOLUMES	86	197	3	34	183	138	337	161	208	8	105	98	1,558					
	APPROACH %	30%	69%	1%	10%	52%	39%	48%	23%	29%	4%	50%	46%						
	PEAK HR FACTOR		0.831			0.934			0.874			0.865		0.964					
	APP/DEPART	286	/	632	355	/	399	706	/	198	211	/	329	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

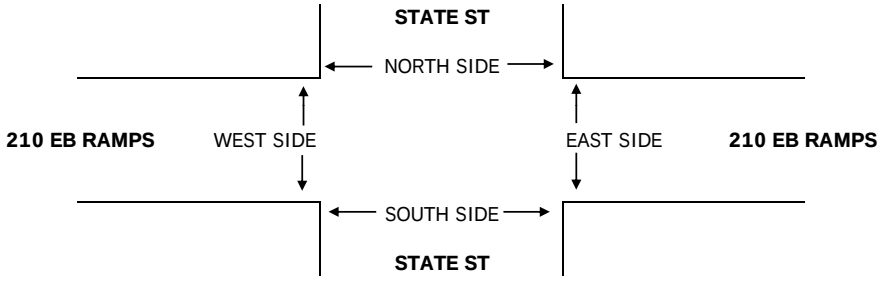
CLASS 2: 2-AXLE WORK VEHICLES/ TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

◄ W ▲ N S ▼ E ►

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0	0	0	0	0	0	1	0	0	0	0	1					0
	6:15 AM	0	0	0	0	1	0	2	0	0	0	0	0	3					0
	6:30 AM	0	0	0	0	0	0	1	1	0	0	0	0	2					0
	6:45 AM	0	1	0	0	0	1	3	0	0	0	1	2	8					0
	7:00 AM	0	1	0	0	0	1	1	0	0	0	0	0	3					0
	7:15 AM	0	1	0	0	0	1	4	0	1	0	0	0	7					0
	7:30 AM	0	2	0	0	1	1	3	0	0	0	0	0	7					0
	7:45 AM	0	0	0	0	0	2	0	1	0	0	0	1	4					0
	8:00 AM	0	0	0	0	1	2	1	1	0	0	0	0	5					0
	8:15 AM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	8:30 AM	0	0	0	0	0	1	1	2	0	0	0	0	4					0
	8:45 AM	1	0	0	0	0	0	3	2	0	0	0	0	6					0
	VOLUMES	1	5	0	0	3	9	20	8	1	0	1	3	51	0	0	0	0	0
	APPROACH %	17%	83%	0%	0%	25%	75%	69%	28%	3%	0%	25%	75%						
	APP/DEPART	6	/	28	12	/	4	29	/	8	4	/	11	0					
	BEGIN PEAK HR		6:45 AM																
	VOLUMES	0	5	0	0	1	4	11	0	1	0	1	2	25					
	APPROACH %	0%	100%	0%	0%	20%	80%	92%	0%	8%	0%	33%	67%						
	PEAK HR FACTOR		0.625			0.625			0.600			0.250		0.781					
	APP/DEPART	5	/	18	5	/	2	12	/	0	3	/	5	0					
PM	4:00 PM	0	0	0	0	0	0	3	0	0	0	0	0	3					0
	4:15 PM	0	0	0	1	0	0	1	2	2	0	0	0	6					0
	4:30 PM	0	0	0	0	0	0	3	4	0	0	0	0	7					0
	4:45 PM	0	1	0	1	0	0	2	0	3	0	0	0	7					0
	5:00 PM	0	0	0	0	0	0	2	0	0	0	0	1	3					0
	5:15 PM	0	0	0	0	0	1	1	0	0	0	1	0	3					0
	5:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	5:45 PM	0	0	0	0	1	0	1	1	0	0	0	0	3					0
	6:00 PM	1	3	0	0	1	0	1	0	0	0	0	0	6					0
	6:15 PM	0	0	0	0	1	1	1	0	0	0	0	0	3					0
	6:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	1					0
	6:45 PM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	VOLUMES	1	4	0	2	4	2	17	7	5	0	1	1	44	0	0	0	0	0
	APPROACH %	20%	80%	0%	25%	50%	25%	59%	24%	17%	0%	50%	50%						
	APP/DEPART	5	/	22	8	/	9	29	/	9	2	/	4	0					
	BEGIN PEAK HR		4:15 PM																
	VOLUMES	0	1	0	2	0	0	8	6	5	0	0	1	23					
	APPROACH %	0%	100%	0%	100%	0%	0%	42%	32%	26%	0%	0%	100%						
	PEAK HR FACTOR		0.250			0.500			0.679			0.250		0.821					
	APP/DEPART	1	/	10	2	/	5	19	/	8	1	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

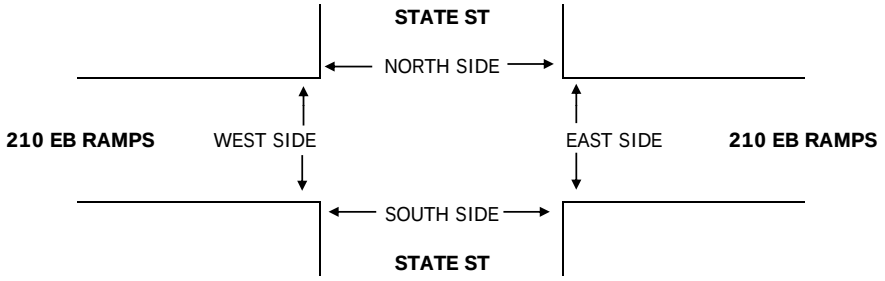
CLASS 3: 3-AXLE TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:30 AM	0	0	0	0	0	0	0	0	0	0	1	0	1					0
	6:45 AM	0	0	0	0	0	2	0	0	0	0	0	0	2					0
	7:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	1					0
	7:15 AM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	7:45 AM	0	0	0	0	0	0	0	1	0	0	0	0	1					0
	8:00 AM	0	0	0	0	0	1	1	0	0	0	0	0	2					0
	8:15 AM	0	0	0	0	1	2	0	0	0	0	0	1	4					0
	8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	8:45 AM	0	2	0	0	1	1	0	0	0	0	0	0	4					0
	VOLUMES	0	2	0	0	2	7	2	1	0	0	1	1	16	0	0	0	0	0
	APPROACH %	0%	100%	0%	0%	22%	78%	67%	33%	0%	0%	50%	50%						
	APP/DEPART	2	/	5	9	/	2	3	/	1	2	/	8	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	0	2	0	0	2	4	1	0	0	0	0	1	10					
	APPROACH %	0%	100%	0%	0%	33%	67%	100%	0%	0%	0%	0%	100%						
	PEAK HR FACTOR		0.250			0.500			0.250			0.250		0.625					
	APP/DEPART	2	/	4	6	/	2	1	/	0	1	/	4	0					
PM	4:00 PM	0	0	0	0	0	1	1	0	0	0	0	0	2					0
	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	4:45 PM	0	0	0	0	0	0	0	0	1	0	0	0	1					0
	5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:15 PM	0	0	0	0	0	0	0	0	1	0	0	0	1					0
	5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:00 PM	0	0	0	0	0	0	1	1	0	0	0	0	2					0
	6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:45 PM	0	0	0	0	0	0	2	0	0	0	0	0	2					0
	VOLUMES	0	0	0	0	0	1	4	1	2	0	0	0	8	0	0	0	0	0
	APPROACH %	0%	0%	0%	0%	0%	100%	57%	14%	29%	0%	0%	0%						
	APP/DEPART	0	/	4	1	/	2	7	/	1	0	/	1	0					
	BEGIN PEAK HR		6:00 PM																
	VOLUMES	0	0	0	0	0	0	3	1	0	0	0	0	4					
	APPROACH %	0%	0%	0%	0%	0%	0%	75%	25%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.000			0.500			0.000		0.500					
	APP/DEPART	0	/	3	0	/	0	4	/	1	0	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

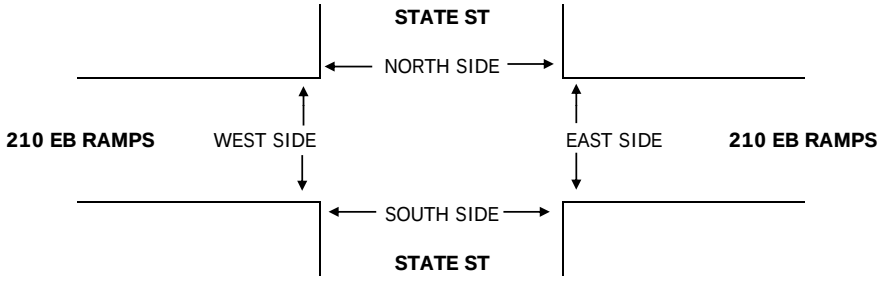
CLASS 4: 4 OR MORE AXLE TRUCKS

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0	0	1	0	2	1	0	0	0	1	0	5					0
	6:15 AM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	6:30 AM	0	1	0	0	1	1	1	0	1	0	0	0	5					0
	6:45 AM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	7:00 AM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	7:15 AM	0	0	0	0	0	0	1	0	0	0	0	1	2					0
	7:30 AM	0	0	0	0	0	1	2	0	0	0	1	1	5					0
	7:45 AM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	8:00 AM	0	0	0	0	0	2	1	0	0	0	0	0	3					0
	8:15 AM	0	0	0	0	0	1	1	1	0	0	0	0	3					0
	8:30 AM	0	0	0	0	0	1	3	0	0	0	0	0	4					0
	8:45 AM	0	0	0	0	0	1	1	1	0	0	0	0	3					0
	VOLUMES	0	1	0	1	1	9	15	2	1	0	2	2	34	0	0	0	0	0
	APPROACH %	0%	100%	0%	9%	9%	82%	83%	11%	6%	0%	50%	50%						
	APP/DEPART	1	/	18	11	/	2	18	/	3	4	/	11	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	0	0	0	0	0	5	6	2	0	0	0	0	13					
	APPROACH %	0%	0%	0%	0%	0%	100%	75%	25%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.625			0.667			0.000		0.813					
	APP/DEPART	0	/	6	5	/	0	8	/	2	0	/	5	0					
PM	4:00 PM	0	1	0	0	1	0	1	0	0	0	0	0	3					0
	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	4:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	4:45 PM	0	0	0	0	0	2	0	0	0	0	0	0	2					0
	5:00 PM	0	0	0	0	0	2	2	0	0	0	0	0	4					0
	5:15 PM	0	0	0	0	0	3	7	0	0	0	0	0	10					0
	5:30 PM	0	0	0	1	0	0	1	1	0	0	0	0	3					0
	5:45 PM	0	1	0	0	0	0	1	0	1	0	0	0	3					0
	6:00 PM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	6:15 PM	0	0	0	0	0	0	1	0	0	0	1	0	2					0
	6:30 PM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	6:45 PM	0	0	0	0	0	0	1	0	0	0	0	0	1					0
	VOLUMES	0	2	0	1	1	7	17	1	1	0	1	0	31	0	0	0	0	0
	APPROACH %	0%	100%	0%	11%	11%	78%	89%	5%	5%	0%	100%	0%						
	APP/DEPART	2	/	19	9	/	2	19	/	2	1	/	8	0					
	BEGIN PEAK HR		5:00 PM																
	VOLUMES	0	1	0	1	0	5	11	1	1	0	0	0	20					
	APPROACH %	0%	100%	0%	17%	0%	83%	85%	8%	8%	0%	0%	0%						
	PEAK HR FACTOR		0.250			0.500			0.464			0.000		0.500					
	APP/DEPART	1	/	12	6	/	1	13	/	2	0	/	5	0					



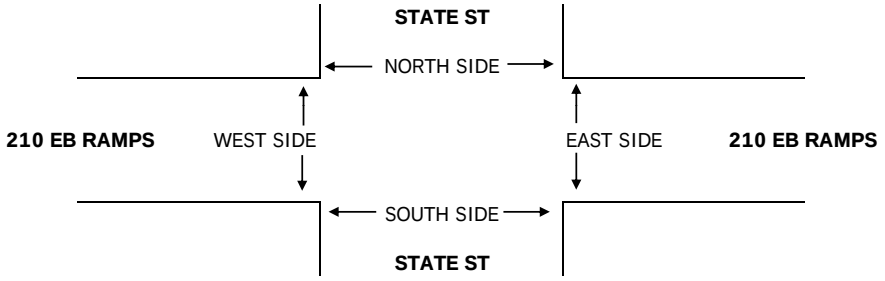
INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

CLASS 5:	NOTES:	AM		▲	
RECREATIONAL VEHICLES		PM		N	
		MD	◄ W		E ►
		OTHER		S	
		OTHER		▼	

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	APP/DEPART	0	/	0	0	/	0	0	/	0	0	/	0	0					
	BEGIN PEAK HR		8:45 AM																
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	0	0					
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%						
	PEAK HR FACTOR		0.000			0.000			0.000			0.000		0.000					
	APP/DEPART	0	/	0	0	/	0	0	/	0	0	/	0	0					
PM	4:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	4:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	4:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	1					0
	VOLUMES	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
	APPROACH %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%						
	APP/DEPART	0	/	1	0	/	0	0	/	0	1	/	0	0					
	BEGIN PEAK HR		6:45 PM																
	VOLUMES	0	0	1	0	0	0	0	0	0	1	0	3	5					
	APPROACH %	0%	0%	100%	0%	0%	0%	0%	0%	0%	25%	0%	75%						
	PEAK HR FACTOR		#DIV/0!			0.000			0.000			1.000		1.250					
	APP/DEPART	1	/	3	0	/	1	0	/	1	4	/	0	0					



INTERSECTION TURNING MOVEMENT COUNTS

PREPARED BY: PACIFIC TRAFFIC DATA SERVICES

DATE:	LOCATION:	RIALTO	PROJECT #:	CA11-0429-03
4/26/11	NORTH & SOUTH:	STATE ST	LOCATION #:	4
TUESDAY	EAST & WEST:	210 EB RAMPS	CONTROL:	SIGNAL

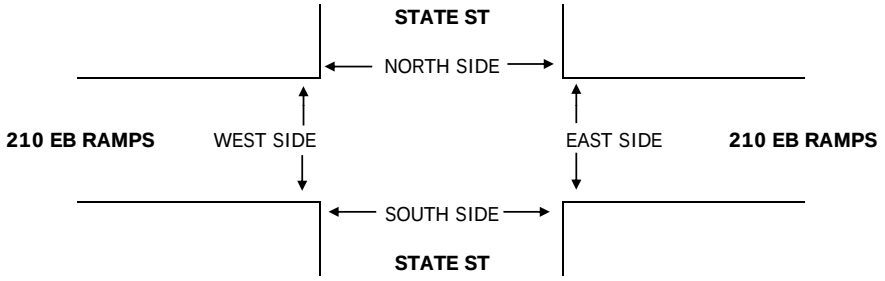
CLASS 6: BUSSES

NOTES:

AM / PM / MD / OTHER / OTHER

▲ N ◄ W E ► S ▼

		NORTHBOUND STATE ST			SOUTHBOUND STATE ST			EASTBOUND 210 EB RAMPS			WESTBOUND 210 EB RAMPS				U-TURNS				
	LANES:	NL 2	NT 2	NR 0	SL 1	ST 1.5	SR 1.5	EL 1.33	ET 0.33	ER 1.33	WL 1	WT 0.5	WR 0.5	TOTAL	NB	SB	EB	WB	TTL
AM	6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:15 AM	0	1	0	0	0	0	0	0	0	0	0	0	1					0
	6:30 AM	1	2	0	0	0	0	0	0	0	0	0	0	3					0
	6:45 AM	0	0	0	0	2	0	0	0	0	0	0	0	2					0
	7:00 AM	0	0	0	0	4	1	0	0	0	0	0	0	5					0
	7:15 AM	0	0	0	0	0	1	0	0	0	0	0	0	1					0
	7:30 AM	0	1	0	0	0	1	0	0	0	0	0	1	3					0
	7:45 AM	0	1	0	0	0	0	0	0	0	0	0	0	1					0
	8:00 AM	0	1	0	0	1	1	0	0	0	0	0	1	4					0
	8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	8:30 AM	0	1	0	0	1	0	0	0	0	0	1	0	3					0
	8:45 AM	0	1	0	1	2	0	0	0	0	0	0	0	4					0
	VOLUMES	1	8	0	1	10	4	0	0	0	0	1	2	27	0	0	0	0	0
	APPROACH %	11%	89%	0%	7%	67%	27%	0%	0%	0%	0%	33%	67%						
	APP/DEPART	9	/	10	15	/	10	0	/	1	3	/	6	0					
	BEGIN PEAK HR		8:00 AM																
	VOLUMES	0	3	0	1	4	1	0	0	0	0	1	1	11					
	APPROACH %	0%	100%	0%	17%	67%	17%	0%	0%	0%	0%	50%	50%						
	PEAK HR FACTOR		0.250			0.300			0.000			0.500		0.550					
	APP/DEPART	3	/	4	6	/	4	0	/	1	2	/	2	0					
PM	4:00 PM	2	0	0	0	0	0	0	0	0	0	0	0	2					0
	4:15 PM	0	0	0	0	1	2	0	0	0	0	1	1	5					0
	4:30 PM	0	0	0	0	0	1	1	0	0	0	0	0	2					0
	4:45 PM	0	0	0	0	0	1	1	0	0	0	0	0	2					0
	5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	5:15 PM	0	0	0	0	0	0	0	1	0	0	0	0	1					0
	5:30 PM	0	0	0	0	1	0	0	0	0	0	0	0	1					0
	5:45 PM	0	0	0	0	0	1	0	0	0	0	0	0	1					0
	6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	1					0
	6:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	6:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0					0
	VOLUMES	2	0	0	0	2	5	2	1	0	0	2	1	15	0	0	0	0	0
	APPROACH %	100%	0%	0%	0%	29%	71%	67%	33%	0%	0%	67%	33%						
	APP/DEPART	2	/	3	7	/	2	3	/	1	3	/	9	0					
	BEGIN PEAK HR		4:00 PM																
	VOLUMES	2	0	0	0	1	4	2	0	0	0	1	1	11					
	APPROACH %	100%	0%	0%	0%	20%	80%	100%	0%	0%	0%	50%	50%						
	PEAK HR FACTOR		0.250			0.417			0.500			0.250		0.550					
	APP/DEPART	2	/	3	5	/	1	2	/	0	2	/	7	0					



Class 1: Passenger Vehicles

- All 2-axle cars regardless of size, weight and signage.
- Vans that are not clearly identified as work vehicles will be considered passenger vehicles.

- Small pick-up trucks regardless of size, weight and signage, with the exception of a small pick-up truck that has a flat bed.
- Midsize or larger pick-up trucks that are not clearly identified as work vehicles will be considered passenger vehicles.

Class 2: Box Trucks, Flat Beds, Work Vans & Work Pick-Up Trucks.

A. Standard small 2-axle pick-up trucks are to be included in Class 1, regardless of any signage, equipment, supplies and side mounted tool box. The only exception is a small pick-up truck that has been modified to include a flat bed as indicated in "4."

B. Midsize or larger pick-up trucks that are clearly & easily identified as work vehicles. Do not include pick-up trucks with signage alone, regardless of the coverage of the markings. We are looking for vehicles with more weight and other factors. The pick-up truck must be easily & specifically identified by any one or more of the following:

1. A ladder with other work related equipment/supplies filling at least 50% of the bed. A ladder with signage will not qualify for 2, unless the bed is at least 50% filled with equipment/supplies.
2. Permanently attached side tool box.
3. Bucket lift.
4. All flatbed, such as a landscape company vehicle. This category may include a small pick-up truck

C. Vans that are clearly & easily identified as work vehicles. The van must be easily & specifically identified by any one or more of the following:

1. Ladder with signage covering the entire vehicle, such as the look as ATT(a ladder alone will not qualify the van as a class 2 vehicle).
2. Bucket lift.

D. All box type of trucks regardless of size & signage, including USPS, UPS & Fedex type of trucks.

Class 3: All 3 axle trucks, to include a 2-axle truck with a 1 axle trailer

Class 4: All 4 or more axle trucks, to include a 2-axle truck with a 2 or more axle trailer & a 3-axle truck with 1 or more axle trailer.

Class 5: All RV's regardless of the number of axles.

Class 6: All bus or extra large passage vans regardless of the number of axles.

APPENDIX B

METHODOLOGIES AND ASSUMPTIONS

1. METHODOLOGY

The study consists of seven study intersections, including four existing intersections and three proposed intersections. The seven project study intersections are:

1. SR-210 WB Ramps & Riverside Avenue
2. SR-210 EB Ramps & Riverside Avenue
3. Pepper Avenue & Highland Avenue *(Future and With Project Conditions Only)*
4. SR-210 WB Ramps & Pepper Avenue *(With Project Conditions Only)*
5. SR-210 EB Ramps & Pepper Avenue *(With Project Conditions Only)*
6. SR-210 WB Ramps & State Street/University Parkway
7. SR-210 EB Ramps & State Street/University Parkway

1.1 Analysis Years

The analysis years and scenarios examined in this report include:

- Existing Year (2011) No Project
- Opening Year (2016) No Project
- Opening Year (2016) With Project
- Horizon Year (2036) No Project
- Horizon Year (2036) With Project

1.2 Intersection Level of Service

The traffic impact analysis is consistent with the guidelines and procedures in the Caltrans *Guide for the Preparation of Traffic Impact Studies*, 2002 and the San Bernardino Associated Governments (SANBAG) *Guidelines for Congestion Management Program (CMP) Traffic Impact Analysis Reports in San Bernardino County,* 2005.

Traffic operations are analyzed using the capacity analysis methodology published in the 2000 Highway Capacity Manual (HCM 2000) using Synchro software. Synchro is a network-based interactive computer program that enables calculation of levels of service at signalized and unsignalized intersections for multiple locations and scenarios. Synchro also calculates signal timing and maximum queue lengths to assist in evaluating signalized intersections.

1.2.1 SIGNALIZED INTERSECTIONS

Traffic conditions at signalized intersections are evaluated using the operations methodology from Chapter 17 of the HCM 2000, which evaluates capacity in terms of the volume-to-capacity (v/c) ratio and evaluates LOS based on controlled delay per vehicle. The relationship between controlled delay per vehicle and LOS for signalized intersections is summarized in Table 1-1.

Table 1-1: Caltrans Intersection Level of Service Criteria

LOS	Description of Traffic Conditions	Controlled Delay (sec/veh)
A	Insignificant delays: no approach phase is fully utilized and no vehicle waits longer than one red indication.	≤ 10
B	Minimal delays: an occasional approach phase is fully utilized. Drivers begin to feel restricted.	> 10 – 20
C	Acceptable delays: major approach phase may become fully utilized. Most drivers feel somewhat restricted.	> 20 – 35
D	Tolerable delays: drivers may wait through more than one red indication. Queues may develop but dissipate rapidly, without excessive delays.	> 35 – 55
E	Significant delays: volumes approaching capacity. Vehicles may wait through several cycles and long vehicle queues form upstream.	> 55 – 80
F	Excessive delays: represents conditions at capacity, with extremely long delays. Queues may block upstream intersections.	> 80

Source: Highway Capacity Manual, Transportation Research Board, 2000

1.2.2 UNSIGNALIZED INTERSECTIONS

Traffic conditions at unsignalized intersections are evaluated using the operations methodology from Chapter 16 of the HCM 2000, which evaluates level of service (LOS) based on controlled delay per vehicle. Controlled delay is defined as the portion of the total delay attributed to the traffic signal operation including deceleration delay, queue move-up time, stopped delay, and final acceleration delay. The relationship between controlled delay per vehicle and LOS for unsignalized intersections is described in Table 1-2.

Table 1-2: Caltrans Intersection Level of Service Criteria

Level of Service	Description of Traffic Conditions	Controlled Delay (sec/veh)
A	No delay for stop-controlled approaches.	0 – 10
B	Operations with minor delay.	> 10 – 15
C	Operations with moderate delays.	> 15 – 25
D	Operations with some delays.	> 25 – 35
E	Operations with high delays and long queues.	> 35 – 50
F	Operation with extreme congestion, with very high delays and long queues unacceptable to most drivers.	> 50

Source: Highway Capacity Manual, Transportation Research Board, 2000

1.3 Freeway Mainline and Ramp Analysis

The freeway mainline and freeway ramp criteria are based on peak hour HCM density analysis. The capacities are based on information contained in the HCM and the Caltrans Ramp Meter Design Manual. Existing count data was provided by Caltrans for the freeway mainline volumes.

The Highway Capacity Software (HCS) was used for the ramp merge and diverge analysis. Per the HCM methodology, the ramp merge and diverge areas focus on an influential area of 1,500 feet, including the acceleration or deceleration lane and adjacent freeway lanes. The methodology incorporates three fundamental steps:

- Determination of the traffic entering the freeway lanes upstream of the merge or at the beginning of the deceleration lane at diverge;
- Determination of the capacity for the segment; and
- Determination of the density of traffic flow within the ramp influence area and its level of service

The LOS for freeway ramps is determined by traffic density based on criteria outlined in the HCM. Freeway mainline LOS is similarly determined from segment density. Table 2-3 summarizes the correlation between LOS and density in terms of passenger cars per mile per lane (pc/mi/ln) for both freeway ramps and basic freeway segments. Level of service E has been agreed upon with Caltrans District 8 as the operating standard for freeway mainline segments and freeway ramps.

Table 1-3: Caltrans Freeway Mainline and Ramp HCM LOS Criteria

LOS	Freeway Ramp Density (pc/mi/ln)	Basic Freeway Segment Density (pc/mi/ln)
A	≤ 10.0	0-11.0
B	> 10.0 and ≤ 20.0	11.0-18.0
C	> 20.0 and ≤ 28.0	18.0-26.0
D	> 28.0 and ≤ 35.0	26.0-35.0
E	> 35.0	35.0-45.0
F	Exceeds Capacity	>45.0

Source: Highway Capacity Manual, Transportation Research Board, 2000

1.4 Freeway Weaving Analysis

Freeway weaving is defined as the crossing of two streams of traffic traveling in the same direction along a significant length of highway without the aid of traffic control devices. The weaving analysis conducted in this study follows the guidelines in the Highway Capacity Manual, 2000. The relationship between LOS and associated freeway weaving densities is summarized in Table 1-4.

Table 1-4: Caltrans Weaving HCM LOS Criteria

LOS	Freeway Weaving Segment Density (pc/mi/ln)	Multilane and Collector-Distributor Weaving Segments Density (pc/mi/ln)
A	≤ 10.0	≤ 12.0
B	> 10.0 and ≤ 20.0	> 12.0 and ≤ 24.0
C	> 20.0 and ≤ 28.0	> 24.0 and ≤ 32.0
D	> 28.0 and ≤ 35.0	> 32.0 and ≤ 36.0
E	> 35.0 and≤ 43.0	> 36.0 and≤ 40.0
F	>43.0	>40.0

Source: Highway Capacity Manual, Transportation Research Board, 2000

1.5 MUTCD Section 4C.04 Warrant 3, Peak Hour

Support:
The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street.

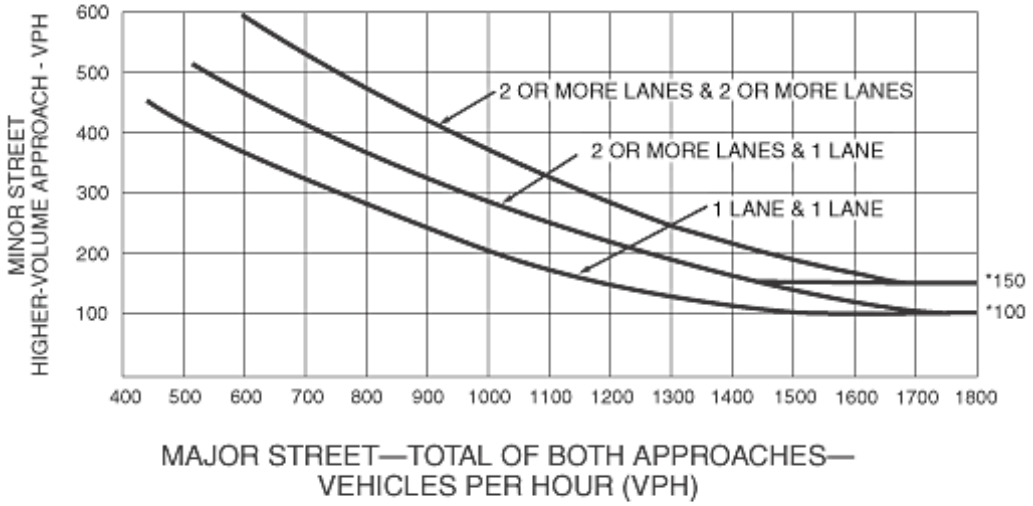
Standard:

The need for a traffic control signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:

A. If all three of the following conditions exist for the same 1 hour (any four consecutive 15-minute periods) of an average day:
    1. The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle-hours for a one-lane approach; or 5 vehicle-hours for a two-lane approach, and
    2. The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes, and
    3. The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.
B. The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 for the existing combination of approach lanes.

Option:
If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 70 km/h or exceeds 40 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-4 may be used in place of Figure 4C-3 to satisfy the criteria in the second category of the Standard.

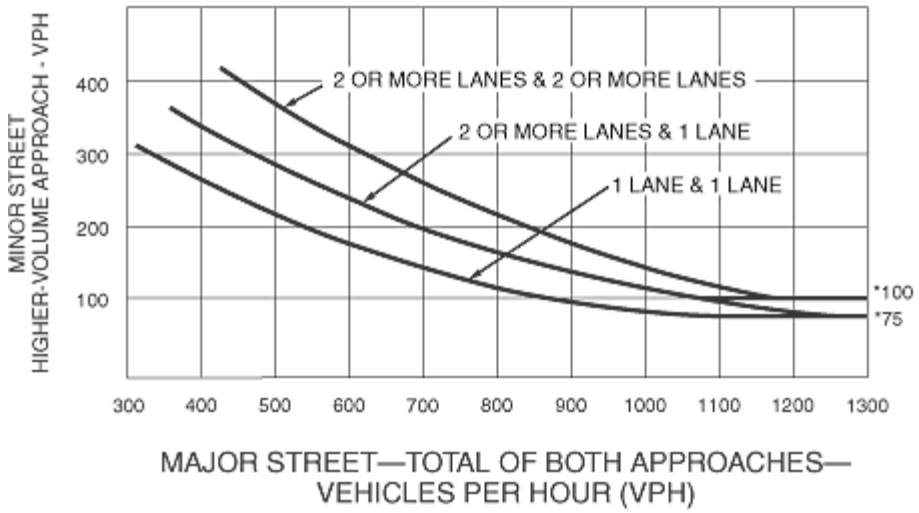
Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

APPENDIX C

ANALYSIS WORKSHEETS – INTERSECTION LEVEL OF SERVICE

APPENDIX C

SYNCHRO ANALYSIS

EXISTING YEAR (2011) NO PROJECT – AM PEAK HOUR

1: WB 210 On Ramp & Riverside Avenue

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	335	330	273	523	550	812	97
v/c Ratio	0.79	0.80	0.47	0.82	0.43	0.35	0.15
Control Delay	36.0	37.4	5.8	26.2	8.9	14.7	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.0	37.4	5.8	26.2	8.9	14.7	4.3
Queue Length 50th (ft)	115	117	0	104	28	61	0
Queue Length 95th (ft)	#234	#246	50	#178	56	84	25
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	457	441	608	642	1265	2290	628
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.73	0.75	0.45	0.81	0.43	0.35	0.15

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	582	2	279	481	506	0	0	747	89
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.99	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1600	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1600	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	633	2	303	523	550	0	0	812	97
RTOR Reduction (vph)	0	0	0	0	6	204	0	0	0	0	0	62
Lane Group Flow (vph)	0	0	0	335	324	69	523	550	0	0	812	35
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.9	14.9	14.9	10.9	21.0			21.0	21.0
Effective Green, g (s)				14.9	14.9	14.9	10.9	21.0			21.0	21.0
Actuated g/C Ratio				0.25	0.25	0.25	0.19	0.36			0.36	0.36
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				426	405	381	636	1264			2289	565
v/s Ratio Prot				0.20	c0.20		c0.15	c0.16			0.13	0.02
v/s Ratio Perm						0.05						
v/c Ratio				0.79	0.80	0.18	0.82	0.44			0.35	0.06
Uniform Delay, d1				20.5	20.6	17.2	23.0	14.4			13.9	12.4
Progression Factor				1.00	1.00	1.00	0.60	0.53			1.00	1.00
Incremental Delay, d2				9.3	10.8	0.2	7.3	0.9			0.4	0.2
Delay (s)				29.7	31.4	17.4	21.2	8.6			14.3	12.6
Level of Service				C	C	B	C	A			B	B
Approach Delay (s)		0.0			26.7			14.8			14.2	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	18.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	58.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	53.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

2: EB 210 Off Ramp & Riverside Avenue

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	54	247	245	1199	261	386	1060
v/c Ratio	0.12	0.44	0.43	0.55	0.42	0.61	0.84
Control Delay	17.6	5.7	5.7	15.4	4.6	24.5	14.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	5.7	5.7	15.4	4.6	24.5	14.9
Queue Length 50th (ft)	15	0	0	97	0	77	118
Queue Length 95th (ft)	38	48	48	129	51	m114	#282
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	482	589	588	2161	626	642	1265
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.42	0.42	0.55	0.42	0.60	0.84

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	1	452	0	0	0	0	936	408	355	975	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5898	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5898	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	1	491	0	0	0	0	1017	443	386	1060	0
RTOR Reduction (vph)	0	184	183	0	0	0	0	53	168	0	0	0
Lane Group Flow (vph)	54	63	62	0	0	0	0	1146	93	386	1060	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	14.9	14.9	14.9					21.0	21.0	10.9	21.0	
Effective Green, g (s)	14.9	14.9	14.9					21.0	21.0	10.9	21.0	
Actuated g/C Ratio	0.25	0.25	0.25					0.36	0.36	0.19	0.36	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	449	381	381					2106	458	636	1264	
v/s Ratio Prot	0.03	c0.04						0.19		c0.11	c0.30	
v/s Ratio Perm			0.04						0.07			
v/c Ratio	0.12	0.17	0.16					0.54	0.20	0.61	0.84	
Uniform Delay, d1	16.9	17.1	17.1					15.1	13.1	22.0	17.3	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.92	0.43	
Incremental Delay, d2	0.1	0.2	0.2					1.0	1.0	1.4	5.9	
Delay (s)	17.0	17.3	17.3					16.1	14.1	21.6	13.3	
Level of Service	B	B	B					B	B	C	B	
Approach Delay (s)		17.3			0.0			15.7			15.5	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	58.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	53.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	250	0	0	291	5	0	0	0	5	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	272	0	0	316	5	0	0	0	5	0	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	322			272			446	604	136	466	602	161
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	322			272			446	604	136	466	602	161
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	99	100	99
cM capacity (veh/h)	1235			1289			491	409	888	478	410	856

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	5	181	91	0	211	111	0	11
Volume Left	5	0	0	0	0	0	0	5
Volume Right	0	0	0	0	0	5	0	5
cSH	1235	1700	1700	1700	1700	1700	1700	614
Volume to Capacity	0.00	0.11	0.05	0.00	0.12	0.07	0.00	0.02
Queue Length 95th (ft)	0	0	0	0	0	0	0	1
Control Delay (s)	7.9	0.0	0.0	0.0	0.0	0.0	0.0	11.0
Lane LOS	A						A	B
Approach Delay (s)	0.2			0.0			0.0	11.0
Approach LOS							A	B

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	18.2%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	177	169	162	149	538	481	214
v/c Ratio	0.38	0.34	0.30	0.38	0.32	0.36	0.31
Control Delay	16.1	8.5	4.6	18.7	8.3	10.2	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.1	8.5	4.6	18.7	8.3	10.2	3.8
Queue Length 50th (ft)	41	15	0	20	15	42	0
Queue Length 95th (ft)	83	53	32	37	53	78	37
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	610	613	649	389	1688	1334	695
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.28	0.25	0.38	0.32	0.36	0.31

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	226	1	240	137	495	0	0	332	307
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.91	0.85	1.00	1.00			0.96	0.85
Flt Protected				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1515	1504	3433	3539			3263	1441
Flt Permitted				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1515	1504	3433	3539			3263	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	246	1	261	149	538	0	0	361	334
RTOR Reduction (vph)	0	0	0	0	73	119	0	0	0	0	57	134
Lane Group Flow (vph)	0	0	0	177	96	43	149	538	0	0	424	80
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				12.5	12.5	12.5	5.3	21.6			17.7	17.7
Effective Green, g (s)				12.5	12.5	12.5	5.3	21.6			17.7	17.7
Actuated g/C Ratio				0.26	0.26	0.26	0.11	0.45			0.37	0.37
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				442	399	396	383	1609			1216	537
v/s Ratio Prot				c0.11	0.06		c0.04	c0.15			0.13	0.06
v/s Ratio Perm						0.03						
v/c Ratio				0.40	0.24	0.11	0.39	0.33			0.35	0.15
Uniform Delay, d1				14.4	13.8	13.3	19.6	8.3			10.7	9.9
Progression Factor				1.00	1.00	1.00	0.76	0.85			1.00	1.00
Incremental Delay, d2				0.6	0.3	0.1	0.6	0.5			0.8	0.6
Delay (s)				15.0	14.1	13.4	15.5	7.6			11.5	10.5
Level of Service				B	B	B	B	A			B	B
Approach Delay (s)		0.0			14.2			9.3			11.2	
Approach LOS		A			B			A			B	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	47.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	35.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	258	261	164	1	143	87	242	50	392	160
v/c Ratio	0.55	0.56	0.31	0.00	0.27	0.22	0.14	0.31	0.30	0.24
Control Delay	19.2	19.0	4.6	12.0	6.9	22.0	8.8	20.4	15.5	7.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.2	19.0	4.6	12.0	6.9	22.0	8.8	20.4	15.5	7.9
Queue Length 50th (ft)	62	63	0	0	9	11	14	10	41	0
Queue Length 95th (ft)	120	125	32	3	39	28	43	28	69	42
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	610	604	650	642	668	389	1686	161	1324	662
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.43	0.25	0.00	0.21	0.22	0.14	0.31	0.30	0.24

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	321	140	167	1	40	92	80	218	5	46	344	164
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.99	0.85	1.00	0.90		1.00	1.00		1.00	0.99	0.85
Flt Protected	0.95	0.98	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1649	1504	1770	1667		3433	3528		1770	3367	1441
Flt Permitted	0.95	0.98	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1649	1504	1770	1667		3433	3528		1770	3367	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	349	152	182	1	43	100	87	237	5	50	374	178
RTOR Reduction (vph)	0	6	121	0	74	0	0	3	0	0	6	100
Lane Group Flow (vph)	258	255	43	1	69	0	87	239	0	50	386	60
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	12.5	12.5	12.5	12.5	12.5		5.3	21.6		1.4	17.7	17.7
Effective Green, g (s)	12.5	12.5	12.5	12.5	12.5		5.3	21.6		1.4	17.7	17.7
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26		0.11	0.45		0.03	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	442	434	396	466	439		383	1604		52	1255	537
v/s Ratio Prot	0.15	c0.15		0.00	0.04		c0.03	0.07		c0.03	c0.11	
v/s Ratio Perm			0.03									0.04
v/c Ratio	0.58	0.59	0.11	0.00	0.16		0.23	0.15		0.96	0.31	0.11
Uniform Delay, d1	15.2	15.3	13.3	12.9	13.5		19.2	7.6		23.0	10.6	9.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.71	1.34	2.40
Incremental Delay, d2	2.0	2.0	0.1	0.0	0.2		0.3	0.2		107.5	0.6	0.4
Delay (s)	17.2	17.3	13.4	12.9	13.6		19.5	7.8		123.9	14.8	23.8
Level of Service	B	B	B	B	B		B	A		F	B	C
Approach Delay (s)		16.3			13.6			10.9			26.2	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	47.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

EXISTING YEAR (2011) NO PROJECT – PM PEAK HOUR

1: WB 210 On Ramp & Riverside Avenue

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	289	280	256	388	684	645	132
v/c Ratio	0.66	0.65	0.44	0.74	0.48	0.28	0.20
Control Delay	25.5	22.7	5.3	23.0	8.4	12.8	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.5	22.7	5.3	23.0	8.4	12.8	4.0
Queue Length 50th (ft)	84	73	0	64	40	43	0
Queue Length 95th (ft)	154	146	45	#124	69	62	28
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	511	501	635	522	1412	2314	656
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.56	0.40	0.74	0.48	0.28	0.20

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	451	2	306	357	629	0	0	593	121
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.96	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1569	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1569	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	490	2	333	388	684	0	0	645	132
RTOR Reduction (vph)	0	0	0	0	26	190	0	0	0	0	0	84
Lane Group Flow (vph)	0	0	0	289	254	66	388	684	0	0	645	48
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				13.7	13.7	13.7	8.0	21.1			19.1	19.1
Effective Green, g (s)				13.7	13.7	13.7	8.0	21.1			19.1	19.1
Actuated g/C Ratio				0.26	0.26	0.26	0.15	0.40			0.36	0.36
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				436	407	390	520	1414			2318	573
v/s Ratio Prot				c0.17	0.16		c0.11	c0.19			0.10	0.03
v/s Ratio Perm						0.04						
v/c Ratio				0.66	0.62	0.17	0.75	0.48			0.28	0.08
Uniform Delay, d1				17.5	17.3	15.1	21.4	11.8			12.0	11.1
Progression Factor				1.00	1.00	1.00	0.57	0.59			1.00	1.00
Incremental Delay, d2				3.8	3.0	0.2	5.0	1.0			0.3	0.3
Delay (s)				21.3	20.3	15.4	17.2	7.9			12.3	11.4
Level of Service				C	C	B	B	A			B	B
Approach Delay (s)		0.0			19.1			11.3			12.1	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	52.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

2: EB 210 Off Ramp & Riverside Avenue

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	87	240	239	1342	357	222	913
v/c Ratio	0.19	0.42	0.42	0.55	0.49	0.57	0.71
Control Delay	16.0	5.3	5.3	11.7	4.4	25.1	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	5.3	5.3	11.7	4.4	25.1	10.5
Queue Length 50th (ft)	21	0	0	86	0	40	90
Queue Length 95th (ft)	49	44	44	118	54	#71	105
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	538	625	624	2428	726	392	1278
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.38	0.38	0.55	0.49	0.57	0.71

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	80	1	440	0	0	0	0	905	658	204	840	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.96	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5794	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5794	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	1	478	0	0	0	0	984	715	222	913	0
RTOR Reduction (vph)	0	177	177	0	0	0	0	116	214	0	0	0
Lane Group Flow (vph)	87	63	62	0	0	0	0	1226	143	222	913	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	13.7	13.7	13.7					21.1	21.1	6.0	19.1	
Effective Green, g (s)	13.7	13.7	13.7					21.1	21.1	6.0	19.1	
Actuated g/C Ratio	0.26	0.26	0.26					0.40	0.40	0.11	0.36	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	459	391	390					2315	512	390	1280	
v/s Ratio Prot	c0.05	0.04						0.21		c0.06	c0.26	
v/s Ratio Perm			0.04						0.11			
v/c Ratio	0.19	0.16	0.16					0.53	0.28	0.57	0.71	
Uniform Delay, d1	15.2	15.1	15.1					12.1	10.7	22.2	14.5	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.84	0.47	
Incremental Delay, d2	0.2	0.2	0.2					0.9	1.4	1.8	3.2	
Delay (s)	15.4	15.3	15.3					12.9	12.1	20.5	10.0	
Level of Service	B	B	B					B	B	C	B	
Approach Delay (s)		15.3			0.0			12.8			12.1	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	13.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	52.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	301	0	0	303	5	0	0	0	5	0	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	327	0	0	329	5	0	0	0	5	0	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	335			327			508	673	164	507	670	167
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	335			327			508	673	164	507	670	167
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	99	100	99
cM capacity (veh/h)	1221			1229			443	373	852	447	375	847

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	5	218	109	0	220	115	0	11
Volume Left	5	0	0	0	0	0	0	5
Volume Right	0	0	0	0	0	5	0	5
cSH	1221	1700	1700	1700	1700	1700	1700	586
Volume to Capacity	0.00	0.13	0.06	0.00	0.13	0.07	0.00	0.02
Queue Length 95th (ft)	0	0	0	0	0	0	0	1
Control Delay (s)	8.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3
Lane LOS	A						A	B
Approach Delay (s)	0.1			0.0			0.0	11.3
Approach LOS							A	B

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	133	125	121	80	578	519	225
v/c Ratio	0.29	0.27	0.24	0.21	0.34	0.38	0.32
Control Delay	15.0	7.2	4.7	15.8	10.4	12.0	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.0	7.2	4.7	15.8	10.4	12.0	3.7
Queue Length 50th (ft)	29	7	0	9	20	55	0
Queue Length 95th (ft)	64	39	28	m20	90	96	38
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	608	596	621	388	1689	1349	711
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.21	0.19	0.21	0.34	0.38	0.32

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	156	0	192	74	532	0	0	432	252
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.89	0.85	1.00	1.00			0.99	0.85
Flt Protected				0.95	0.99	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1494	1504	3433	3539			3342	1441
Flt Permitted				0.95	0.99	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1494	1504	3433	3539			3342	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	170	0	209	80	578	0	0	470	274
RTOR Reduction (vph)	0	0	0	0	65	90	0	0	0	0	14	139
Lane Group Flow (vph)	0	0	0	133	60	31	80	578	0	0	505	86
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				12.2	12.2	12.2	5.3	21.6			18.1	18.1
Effective Green, g (s)				12.2	12.2	12.2	5.3	21.6			18.1	18.1
Actuated g/C Ratio				0.26	0.26	0.26	0.11	0.45			0.38	0.38
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				431	383	385	382	1606			1271	548
v/s Ratio Prot				c0.08	0.04		c0.02	0.16			c0.15	0.06
v/s Ratio Perm						0.02						
v/c Ratio				0.31	0.16	0.08	0.21	0.36			0.40	0.16
Uniform Delay, d1				14.3	13.7	13.4	19.2	8.5			10.8	9.7
Progression Factor				1.00	1.00	1.00	0.71	1.02			1.00	1.00
Incremental Delay, d2				0.4	0.2	0.1	0.3	0.6			0.9	0.6
Delay (s)				14.7	13.9	13.5	13.9	9.3			11.7	10.3
Level of Service				B	B	B	B	A			B	B
Approach Delay (s)		0.0			14.1			9.8			11.3	
Approach LOS		A			B			A			B	

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	47.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	130	130	65	11	348	134	301	57	402	183
v/c Ratio	0.29	0.29	0.14	0.02	0.64	0.35	0.18	0.28	0.29	0.27
Control Delay	14.9	14.4	5.0	12.0	16.1	23.3	9.3	17.4	16.1	12.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.9	14.4	5.0	12.0	16.1	23.3	9.3	17.4	16.1	12.1
Queue Length 50th (ft)	28	28	0	2	55	18	18	8	42	0
Queue Length 95th (ft)	63	64	21	10	120	40	55	m26	75	69
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	608	598	585	639	690	388	1688	200	1367	685
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.21	0.22	0.11	0.02	0.50	0.35	0.18	0.28	0.29	0.27

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	176	57	66	10	161	159	123	272	5	52	237	301
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.99	0.85	1.00	0.93		1.00	1.00		1.00	0.95	0.85
Flt Protected	0.95	0.98	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1643	1504	1770	1724		3433	3530		1770	3208	1441
Flt Permitted	0.95	0.98	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1643	1504	1770	1724		3433	3530		1770	3208	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	191	62	72	11	175	173	134	296	5	57	258	327
RTOR Reduction (vph)	0	4	48	0	78	0	0	2	0	0	89	113
Lane Group Flow (vph)	130	126	17	11	270	0	134	299	0	57	313	70
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	12.2	12.2	12.2	12.2	12.2		5.3	21.6		1.8	18.1	18.1
Effective Green, g (s)	12.2	12.2	12.2	12.2	12.2		5.3	21.6		1.8	18.1	18.1
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26		0.11	0.45		0.04	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	431	421	385	454	442		382	1602		67	1220	548
v/s Ratio Prot	0.08	0.08		0.01	c0.16		c0.04	0.08		c0.03	c0.10	
v/s Ratio Perm			0.01									0.05
v/c Ratio	0.30	0.30	0.04	0.02	0.61		0.35	0.19		0.85	0.26	0.13
Uniform Delay, d1	14.3	14.3	13.3	13.2	15.6		19.6	7.8		22.8	10.1	9.6
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.66	2.09	3.99
Incremental Delay, d2	0.4	0.4	0.0	0.0	2.5		0.6	0.3		59.1	0.5	0.5
Delay (s)	14.7	14.7	13.4	13.3	18.1		20.1	8.0		74.2	21.7	38.8
Level of Service	B	B	B	B	B		C	A		E	C	D
Approach Delay (s)		14.4			18.0			11.7			31.2	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	47.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

OPENING YEAR (2016) NO PROJECT – AM PEAK HOUR

1: WB 210 On Ramp & Riverside Avenue

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	344	339	309	504	568	888	121
v/c Ratio	0.81	0.82	0.50	0.87	0.47	0.37	0.18
Control Delay	37.7	38.1	5.9	31.7	11.0	14.2	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.7	38.1	5.9	31.7	11.0	14.2	3.9
Queue Length 50th (ft)	120	118	0	104	29	66	0
Queue Length 95th (ft)	#244	#252	53	#182	71	89	27
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	456	442	634	582	1201	2392	667
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.77	0.49	0.87	0.47	0.37	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	575	3	335	464	523	0	0	817	111
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.98	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1588	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1588	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	625	3	364	504	568	0	0	888	121
RTOR Reduction (vph)	0	0	0	0	12	230	0	0	0	0	0	76
Lane Group Flow (vph)	0	0	0	344	327	79	504	568	0	0	888	45
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				15.0	15.0	15.0	10.0	20.0			22.0	22.0
Effective Green, g (s)				15.0	15.0	15.0	10.0	20.0			22.0	22.0
Actuated g/C Ratio				0.25	0.25	0.25	0.17	0.34			0.37	0.37
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				427	404	382	582	1200			2389	590
v/s Ratio Prot				0.20	c0.21		c0.15	c0.16			0.14	0.03
v/s Ratio Perm						0.05						
v/c Ratio				0.81	0.81	0.21	0.87	0.47			0.37	0.08
Uniform Delay, d1				20.6	20.7	17.3	23.8	15.4			13.5	11.9
Progression Factor				1.00	1.00	1.00	0.62	0.62			1.00	1.00
Incremental Delay, d2				10.6	11.4	0.3	10.9	1.1			0.4	0.3
Delay (s)				31.2	32.0	17.6	25.7	10.6			13.9	12.2
Level of Service				C	C	B	C	B			B	B
Approach Delay (s)		0.0			27.3			17.7			13.7	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	54	267	266	1220	269	398	1114
v/c Ratio	0.12	0.46	0.46	0.59	0.44	0.57	0.84
Control Delay	17.6	5.8	5.7	16.5	4.9	22.0	14.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.6	5.8	5.7	16.5	4.9	22.0	14.7
Queue Length 50th (ft)	15	0	0	102	0	78	120
Queue Length 95th (ft)	38	50	50	136	54	m114	#298
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	480	603	602	2055	613	699	1321
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.44	0.44	0.59	0.44	0.57	0.84

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	1	489	0	0	0	0	936	434	366	1025	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5885	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5885	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	1	532	0	0	0	0	1017	472	398	1114	0
RTOR Reduction (vph)	0	198	198	0	0	0	0	59	178	0	0	0
Lane Group Flow (vph)	54	69	68	0	0	0	0	1161	91	398	1114	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	15.0	15.0	15.0					20.0	20.0	12.0	22.0	
Effective Green, g (s)	15.0	15.0	15.0					20.0	20.0	12.0	22.0	
Actuated g/C Ratio	0.25	0.25	0.25					0.34	0.34	0.20	0.37	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	450	383	382					1995	435	698	1320	
v/s Ratio Prot	0.03	c0.05						0.20		c0.12	c0.31	
v/s Ratio Perm			0.04						0.07			
v/c Ratio	0.12	0.18	0.18					0.58	0.21	0.57	0.84	
Uniform Delay, d1	16.9	17.2	17.2					16.1	13.9	21.2	16.9	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.88	0.44	
Incremental Delay, d2	0.1	0.2	0.2					1.2	1.1	1.0	5.8	
Delay (s)	17.0	17.4	17.4					17.3	15.0	19.5	13.2	
Level of Service	B	B	B					B	B	B	B	
Approach Delay (s)		17.4			0.0			16.9			14.9	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	16.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	7	290	9	340	14	7	7	21
v/c Ratio	0.03	0.32	0.03	0.37	0.02	0.01	0.01	0.02
Control Delay	8.8	10.0	8.9	10.8	5.1	5.0	3.5	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	10.0	8.9	10.8	5.1	5.0	3.5	4.4
Queue Length 50th (ft)	1	19	1	24	1	1	0	1
Queue Length 95th (ft)	6	36	7	43	6	4	3	8
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	500	1729	524	1733	689	927	791	850
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.17	0.02	0.20	0.02	0.01	0.01	0.02

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	253	14	8	306	6	13	6	6	6	6	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3512		1770	3528		1770	1863	1583		1750	
Flt Permitted	0.55	1.00		0.57	1.00		0.74	1.00	1.00		0.96	
Satd. Flow (perm)	1019	3512		1070	3528		1385	1863	1583		1701	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	275	15	9	333	7	14	7	7	7	7	7
RTOR Reduction (vph)	0	11	0	0	4	0	0	0	4	0	4	0
Lane Group Flow (vph)	7	279	0	9	336	0	14	7	3	0	17	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	8.4	8.4		8.4	8.4		16.3	16.3	16.3		16.3	
Effective Green, g (s)	8.4	8.4		8.4	8.4		16.3	16.3	16.3		16.3	
Actuated g/C Ratio	0.26	0.26		0.26	0.26		0.50	0.50	0.50		0.50	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	262	902		275	906		690	929	789		848	
v/s Ratio Prot		0.08			c0.10			0.00				
v/s Ratio Perm	0.01			0.01			0.01		0.00		c0.01	
v/c Ratio	0.03	0.31		0.03	0.37		0.02	0.01	0.00		0.02	
Uniform Delay, d1	9.1	9.8		9.1	10.0		4.2	4.1	4.1		4.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.2		0.0	0.3		0.1	0.0	0.0		0.0	
Delay (s)	9.1	10.0		9.2	10.2		4.2	4.1	4.1		4.2	
Level of Service	A	B		A	B		A	A	A		A	
Approach Delay (s)		10.0			10.2			4.2			4.2	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.14		
Actuated Cycle Length (s)	32.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	24.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	197	190	185	130	638	458	202
v/c Ratio	0.44	0.39	0.34	0.33	0.35	0.34	0.29
Control Delay	17.1	8.2	4.7	18.3	7.6	10.8	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.1	8.2	4.7	18.3	7.6	10.8	3.7
Queue Length 50th (ft)	46	15	0	15	22	42	0
Queue Length 95th (ft)	91	54	34	30	106	80	36
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	619	632	671	395	1829	1344	695
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.30	0.28	0.33	0.35	0.34	0.29

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	242	1	283	120	587	0	0	346	261
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.90	0.85	1.00	1.00			0.97	0.85
Flt Protected				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1504	1504	3433	3539			3299	1441
Flt Permitted				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1504	1504	3433	3539			3299	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	263	1	308	130	638	0	0	376	284
RTOR Reduction (vph)	0	0	0	0	92	139	0	0	0	0	33	127
Lane Group Flow (vph)	0	0	0	197	98	46	130	638	0	0	425	75
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				11.9	11.9	11.9	6.1	23.1			17.7	17.7
Effective Green, g (s)				11.9	11.9	11.9	6.1	23.1			17.7	17.7
Actuated g/C Ratio				0.25	0.25	0.25	0.13	0.48			0.37	0.37
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				419	375	375	439	1714			1224	535
v/s Ratio Prot				c0.12	0.06		c0.04	c0.18			0.13	0.05
v/s Ratio Perm						0.03						
v/c Ratio				0.47	0.26	0.12	0.30	0.37			0.35	0.14
Uniform Delay, d1				15.2	14.4	13.9	18.9	7.7			10.8	10.0
Progression Factor				1.00	1.00	1.00	0.78	0.89			1.00	1.00
Incremental Delay, d2				0.8	0.4	0.1	0.4	0.6			0.8	0.5
Delay (s)				16.1	14.7	14.0	15.1	7.5			11.6	10.5
Level of Service				B	B	B	B	A			B	B
Approach Delay (s)		0.0			15.0			8.8			11.3	
Approach LOS		A			B			A			B	

Intersection Summary			
HCM Average Control Delay	11.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	47.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	35.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	190	193	161	1	244	153	326	28	428	184
v/c Ratio	0.42	0.44	0.31	0.00	0.43	0.39	0.18	0.17	0.32	0.27
Control Delay	16.9	16.3	4.7	12.0	8.3	23.7	7.6	16.8	15.7	8.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.9	16.3	4.7	12.0	8.3	23.7	7.6	16.8	15.7	8.2
Queue Length 50th (ft)	44	43	0	0	19	20	20	5	45	0
Queue Length 95th (ft)	88	91	32	3	61	44	57	m17	78	49
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	619	606	656	652	718	395	1827	163	1344	684
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.32	0.25	0.00	0.34	0.39	0.18	0.17	0.32	0.27

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	269	67	165	1	83	142	141	296	4	26	371	192
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.99	0.85	1.00	0.91		1.00	1.00		1.00	0.99	0.85
Flt Protected	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1628	1504	1770	1686		3433	3533		1770	3360	1441
Flt Permitted	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1628	1504	1770	1686		3433	3533		1770	3360	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	292	73	179	1	90	154	153	322	4	28	403	209
RTOR Reduction (vph)	0	8	121	0	116	0	0	2	0	0	8	116
Lane Group Flow (vph)	190	185	40	1	128	0	153	324	0	28	420	68
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	11.9	11.9	11.9	11.9	11.9		6.1	23.1		0.7	17.7	17.7
Effective Green, g (s)	11.9	11.9	11.9	11.9	11.9		6.1	23.1		0.7	17.7	17.7
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25		0.13	0.48		0.01	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	419	406	375	442	421		439	1711		26	1247	535
v/s Ratio Prot	0.11	c0.11		0.00	0.08		c0.04	0.09		0.02	c0.12	
v/s Ratio Perm			0.03									0.05
v/c Ratio	0.45	0.46	0.11	0.00	0.31		0.35	0.19		1.08	0.34	0.13
Uniform Delay, d1	15.1	15.2	13.8	13.4	14.5		19.0	7.0		23.5	10.8	9.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.68	1.38	2.60
Incremental Delay, d2	0.8	0.8	0.1	0.0	0.4		0.5	0.2		197.4	0.7	0.5
Delay (s)	15.9	16.0	13.9	13.4	15.0		19.5	7.2		213.3	15.6	26.2
Level of Service	B	B	B	B	B		B	A		F	B	C
Approach Delay (s)		15.4			14.9			11.1			27.3	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	47.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	53.6%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

OPENING YEAR (2016) NO PROJECT – PM PEAK HOUR

1: WB 210 On Ramp & Riverside Avenue

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	304	300	276	432	754	738	159
v/c Ratio	0.73	0.73	0.48	0.75	0.52	0.30	0.23
Control Delay	31.9	29.6	5.9	23.5	7.9	13.5	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.9	29.6	5.9	23.5	7.9	13.5	3.7
Queue Length 50th (ft)	103	93	0	81	45	53	0
Queue Length 95th (ft)	#204	#202	50	#142	66	74	31
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	462	455	613	590	1460	2422	697
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.66	0.45	0.73	0.52	0.30	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	474	2	334	397	694	0	0	679	146
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.96	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1566	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1566	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	515	2	363	432	754	0	0	738	159
RTOR Reduction (vph)	0	0	0	0	25	207	0	0	0	0	0	99
Lane Group Flow (vph)	0	0	0	304	275	69	432	754	0	0	738	60
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.5	14.5	14.5	9.8	24.1			22.1	22.1
Effective Green, g (s)				14.5	14.5	14.5	9.8	24.1			22.1	22.1
Actuated g/C Ratio				0.25	0.25	0.25	0.17	0.41			0.38	0.38
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				417	389	373	576	1460			2425	599
v/s Ratio Prot				c0.18	0.18		c0.13	c0.21			0.12	0.04
v/s Ratio Perm						0.05						
v/c Ratio				0.73	0.71	0.18	0.75	0.52			0.30	0.10
Uniform Delay, d1				20.1	20.0	17.3	23.1	12.8			12.7	11.7
Progression Factor				1.00	1.00	1.00	0.62	0.50			1.00	1.00
Incremental Delay, d2				6.3	5.8	0.2	4.7	1.1			0.3	0.3
Delay (s)				26.4	25.8	17.5	19.0	7.5			13.1	12.1
Level of Service				C	C	B	B	A			B	B
Approach Delay (s)		0.0			23.4			11.7			12.9	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	15.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	58.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	107	246	245	1420	342	250	1003
v/c Ratio	0.24	0.44	0.44	0.57	0.47	0.54	0.75
Control Delay	19.0	5.8	5.8	13.0	4.1	26.2	11.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.0	5.8	5.8	13.0	4.1	26.2	11.3
Queue Length 50th (ft)	30	0	0	104	0	50	105
Queue Length 95th (ft)	65	48	48	138	53	m81	121
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	486	592	591	2493	730	472	1338
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.42	0.41	0.57	0.47	0.53	0.75

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	98	1	451	0	0	0	0	992	629	230	923	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.96	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5817	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5817	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	107	1	490	0	0	0	0	1078	684	250	1003	0
RTOR Reduction (vph)	0	184	184	0	0	0	0	93	201	0	0	0
Lane Group Flow (vph)	107	62	61	0	0	0	0	1327	141	250	1003	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	14.5	14.5	14.5					24.1	24.1	7.8	22.1	
Effective Green, g (s)	14.5	14.5	14.5					24.1	24.1	7.8	22.1	
Actuated g/C Ratio	0.25	0.25	0.25					0.41	0.41	0.13	0.38	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	439	374	373					2401	529	459	1339	
v/s Ratio Prot	c0.06	0.04						0.23		c0.07	c0.28	
v/s Ratio Perm			0.04						0.11			
v/c Ratio	0.24	0.17	0.16					0.55	0.27	0.54	0.75	
Uniform Delay, d1	17.6	17.2	17.2					13.0	11.3	23.6	15.7	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.90	0.45	
Incremental Delay, d2	0.3	0.2	0.2					0.9	1.2	1.2	3.5	
Delay (s)	17.9	17.4	17.4					14.0	12.6	22.5	10.7	
Level of Service	B	B	B					B	B	C	B	
Approach Delay (s)		17.5			0.0			13.7			13.0	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	14.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	58.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	5	345	16	365	16	5	12	15
v/c Ratio	0.02	0.36	0.06	0.38	0.02	0.01	0.02	0.02
Control Delay	8.4	10.1	8.9	10.6	5.6	5.6	3.6	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.4	10.1	8.9	10.6	5.6	5.6	3.6	4.9
Queue Length 50th (ft)	1	24	2	26	1	1	0	1
Queue Length 95th (ft)	5	43	9	46	8	4	5	7
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	482	1711	492	1714	675	903	773	829
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.20	0.03	0.21	0.02	0.01	0.02	0.02

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	302	16	15	331	5	15	5	11	5	5	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3513		1770	3532		1770	1863	1583		1750	
Flt Permitted	0.53	1.00		0.54	1.00		0.75	1.00	1.00		0.96	
Satd. Flow (perm)	995	3513		1014	3532		1393	1863	1583		1705	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	328	17	16	360	5	16	5	12	5	5	5
RTOR Reduction (vph)	0	11	0	0	3	0	0	0	6	0	3	0
Lane Group Flow (vph)	5	334	0	16	362	0	16	5	6	0	12	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	9.1	9.1		9.1	9.1		16.1	16.1	16.1		16.1	
Effective Green, g (s)	9.1	9.1		9.1	9.1		16.1	16.1	16.1		16.1	
Actuated g/C Ratio	0.27	0.27		0.27	0.27		0.48	0.48	0.48		0.48	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	273	963		278	968		676	903	768		827	
v/s Ratio Prot		0.10			c0.10			0.00				
v/s Ratio Perm	0.01			0.02			c0.01		0.00		0.01	
v/c Ratio	0.02	0.35		0.06	0.37		0.02	0.01	0.01		0.02	
Uniform Delay, d1	8.8	9.7		8.9	9.7		4.5	4.4	4.4		4.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.2		0.1	0.2		0.1	0.0	0.0		0.0	
Delay (s)	8.8	9.9		9.0	10.0		4.5	4.4	4.4		4.5	
Level of Service	A	A		A	A		A	A	A		A	
Approach Delay (s)		9.9			9.9			4.5			4.5	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.15		
Actuated Cycle Length (s)	33.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	25.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	136	200	201	47	591	582	254
v/c Ratio	0.30	0.38	0.37	0.12	0.39	0.43	0.35
Control Delay	15.2	5.6	4.7	14.3	12.0	11.9	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	5.6	4.7	14.3	12.0	11.9	3.8
Queue Length 50th (ft)	30	3	0	5	45	59	0
Queue Length 95th (ft)	65	41	35	m14	76	106	40
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	627	658	687	400	1506	1338	724
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.30	0.29	0.12	0.39	0.43	0.35

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	139	0	355	43	544	0	0	454	316
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.86	0.85	1.00	1.00			0.98	0.85
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1454	1504	3433	3539			3312	1441
Flt Permitted				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1454	1504	3433	3539			3312	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	151	0	386	47	591	0	0	493	343
RTOR Reduction (vph)	0	0	0	0	138	150	0	0	0	0	26	157
Lane Group Flow (vph)	0	0	0	136	62	51	47	591	0	0	556	97
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				11.7	11.7	11.7	4.6	18.8			17.5	17.5
Effective Green, g (s)				11.7	11.7	11.7	4.6	18.8			17.5	17.5
Actuated g/C Ratio				0.26	0.26	0.26	0.10	0.41			0.38	0.38
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				429	371	384	345	1453			1266	551
v/s Ratio Prot				c0.08	0.04		c0.01	0.17			c0.17	0.07
v/s Ratio Perm						0.03						
v/c Ratio				0.32	0.17	0.13	0.14	0.41			0.44	0.18
Uniform Delay, d1				13.8	13.3	13.1	18.8	9.6			10.5	9.4
Progression Factor				1.00	1.00	1.00	0.68	0.98			1.00	1.00
Incremental Delay, d2				0.4	0.2	0.2	0.2	0.8			1.1	0.7
Delay (s)				14.2	13.5	13.3	12.9	10.2			11.6	10.1
Level of Service				B	B	B	B	B			B	B
Approach Delay (s)		0.0			13.6			10.4			11.1	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	36.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	197	203	165	15	270	147	275	61	405	179
v/c Ratio	0.44	0.46	0.32	0.03	0.51	0.37	0.18	0.25	0.30	0.26
Control Delay	17.2	16.8	4.7	12.1	13.3	23.4	10.8	16.9	18.1	12.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.2	16.8	4.7	12.1	13.3	23.4	10.8	16.9	18.1	12.1
Queue Length 50th (ft)	46	47	0	3	40	19	26	8	47	0
Queue Length 95th (ft)	91	95	32	13	90	43	52	m27	89	70
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	627	622	664	660	702	400	1503	247	1341	679
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.33	0.25	0.02	0.38	0.37	0.18	0.25	0.30	0.26

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	230	121	168	14	136	112	135	245	8	56	295	242
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.99	0.85	1.00	0.93		1.00	1.00		1.00	0.97	0.85
Flt Protected	0.95	0.99	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1651	1504	1770	1736		3433	3522		1770	3285	1441
Flt Permitted	0.95	0.99	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1651	1504	1770	1736		3433	3522		1770	3285	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	250	132	183	15	148	122	147	266	9	61	321	263
RTOR Reduction (vph)	0	7	123	0	65	0	0	4	0	0	41	111
Lane Group Flow (vph)	197	196	42	15	205	0	147	271	0	61	364	68
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	11.7	11.7	11.7	11.7	11.7		4.6	18.8		3.3	17.5	17.5
Effective Green, g (s)	11.7	11.7	11.7	11.7	11.7		4.6	18.8		3.3	17.5	17.5
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26		0.10	0.41		0.07	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	429	422	384	452	443		345	1446		128	1255	551
v/s Ratio Prot	0.12	c0.12		0.01	0.12		c0.04	0.08		0.03	c0.11	
v/s Ratio Perm			0.03									0.05
v/c Ratio	0.46	0.46	0.11	0.03	0.46		0.43	0.19		0.48	0.29	0.12
Uniform Delay, d1	14.4	14.4	13.1	12.8	14.4		19.4	8.6		20.4	9.8	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.73	1.87	3.96
Incremental Delay, d2	0.8	0.8	0.1	0.0	0.8		0.8	0.3		2.6	0.5	0.4
Delay (s)	15.2	15.2	13.2	12.8	15.2		20.2	8.9		17.5	18.9	36.8
Level of Service	B	B	B	B	B		C	A		B	B	D
Approach Delay (s)		14.6			15.0			12.8			23.7	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	17.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	45.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.2%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

OPENING YEAR (2016) WITH PROJECT – AM PEAK HOUR

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	333	325	299	475	572	882	116
v/c Ratio	0.78	0.78	0.50	0.76	0.47	0.38	0.18
Control Delay	35.6	34.8	5.9	22.4	10.6	14.9	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	34.8	5.9	22.4	10.6	14.9	4.2
Queue Length 50th (ft)	115	110	0	95	30	68	0
Queue Length 95th (ft)	#233	#236	52	#155	68	91	28
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	460	447	628	645	1211	2301	642
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.73	0.48	0.74	0.47	0.38	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	547	2	331	437	526	0	0	811	107
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.97	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1584	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.96	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1584	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	595	2	360	475	572	0	0	882	116
RTOR Reduction (vph)	0	0	0	0	14	223	0	0	0	0	0	74
Lane Group Flow (vph)	0	0	0	333	311	76	475	572	0	0	882	42
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.8	14.8	14.8	10.7	20.0			21.1	21.1
Effective Green, g (s)				14.8	14.8	14.8	10.7	20.0			21.1	21.1
Actuated g/C Ratio				0.25	0.25	0.25	0.18	0.34			0.36	0.36
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				425	400	380	627	1208			2307	570
v/s Ratio Prot				c0.20	0.20		c0.14	c0.16			0.14	0.03
v/s Ratio Perm						0.05						
v/c Ratio				0.78	0.78	0.20	0.76	0.47			0.38	0.07
Uniform Delay, d1				20.4	20.4	17.2	22.7	15.2			13.9	12.3
Progression Factor				1.00	1.00	1.00	0.61	0.60			1.00	1.00
Incremental Delay, d2				9.1	9.2	0.3	4.4	1.1			0.5	0.2
Delay (s)				29.5	29.5	17.5	18.2	10.2			14.4	12.6
Level of Service				C	C	B	B	B			B	B
Approach Delay (s)		0.0			25.8			13.9			14.2	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	58.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	52	247	245	1190	258	392	1084
v/c Ratio	0.12	0.44	0.43	0.57	0.42	0.57	0.85
Control Delay	17.5	5.7	5.7	16.2	4.9	22.0	15.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.5	5.7	5.7	16.2	4.9	22.0	15.6
Queue Length 50th (ft)	14	0	0	99	0	78	114
Queue Length 95th (ft)	37	48	48	132	53	m115	#283
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	484	591	590	2070	608	705	1271
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.42	0.42	0.57	0.42	0.56	0.85

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	48	1	452	0	0	0	0	915	417	361	997	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5887	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5887	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	52	1	491	0	0	0	0	995	453	392	1084	0
RTOR Reduction (vph)	0	184	183	0	0	0	0	58	170	0	0	0
Lane Group Flow (vph)	52	63	62	0	0	0	0	1132	88	392	1084	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	14.8	14.8	14.8					20.0	20.0	11.8	21.1	
Effective Green, g (s)	14.8	14.8	14.8					20.0	20.0	11.8	21.1	
Actuated g/C Ratio	0.25	0.25	0.25					0.34	0.34	0.20	0.36	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	447	380	380					2009	438	691	1274	
v/s Ratio Prot	0.03	c0.04						0.19		c0.11	c0.31	
v/s Ratio Perm			0.04						0.07			
v/c Ratio	0.12	0.17	0.16					0.56	0.20	0.57	0.85	
Uniform Delay, d1	16.9	17.1	17.1					15.7	13.6	21.1	17.3	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.87	0.42	
Incremental Delay, d2	0.1	0.2	0.2					1.1	1.0	0.9	6.4	
Delay (s)	17.0	17.3	17.3					16.9	14.7	19.4	13.6	
Level of Service	B	B	B					B	B	B	B	
Approach Delay (s)		17.3			0.0			16.5			15.1	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	58.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	7	307	37	333	41	5	75	21
v/c Ratio	0.03	0.39	0.16	0.42	0.05	0.00	0.08	0.02
Control Delay	13.3	16.5	15.6	17.4	8.5	9.4	4.4	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.3	16.5	15.6	17.4	8.5	9.4	4.4	8.5
Queue Length 50th (ft)	2	38	9	44	3	0	0	2
Queue Length 95th (ft)	8	57	24	63	26	7	24	14
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	323	1131	337	1132	813	1093	959	874
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.27	0.11	0.29	0.05	0.00	0.08	0.02

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	266	17	34	300	6	38	5	69	6	6	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3508		1770	3528		1770	1863	1583		1750	
Flt Permitted	0.54	1.00		0.56	1.00		0.74	1.00	1.00		0.96	
Satd. Flow (perm)	1008	3508		1052	3528		1385	1863	1583		1707	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	289	18	37	326	7	41	5	75	7	7	7
RTOR Reduction (vph)	0	10	0	0	3	0	0	0	36	0	4	0
Lane Group Flow (vph)	7	297	0	37	330	0	41	5	39	0	17	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	11.1	11.1		11.1	11.1		26.1	26.1	26.1		22.3	
Effective Green, g (s)	11.1	11.1		11.1	11.1		26.1	26.1	26.1		22.3	
Actuated g/C Ratio	0.22	0.22		0.22	0.22		0.52	0.52	0.52		0.45	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	224	779		234	783		723	972	826		761	
v/s Ratio Prot		0.08			c0.09			0.00				
v/s Ratio Perm	0.01			0.04			c0.03		0.02		0.01	
v/c Ratio	0.03	0.38		0.16	0.42		0.06	0.01	0.05		0.02	
Uniform Delay, d1	15.2	16.5		15.7	16.7		5.9	5.7	5.9		7.8	
Progression Factor	1.00	1.00		1.00	1.00		1.13	1.21	1.39		1.00	
Incremental Delay, d2	0.1	0.3		0.3	0.4		0.1	0.0	0.1		0.1	
Delay (s)	15.3	16.8		16.0	17.1		6.8	6.9	8.3		7.8	
Level of Service	B	B		B	B		A	A	A		A	
Approach Delay (s)		16.8			17.0			7.7			7.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.8
Intersection Capacity Utilization	28.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	49	58	64	63	62
v/c Ratio	0.12	0.15	0.36	0.03	0.04
Control Delay	14.6	5.5	24.5	4.9	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	14.6	5.5	24.5	4.9	6.2
Queue Length 50th (ft)	12	0	19	2	6
Queue Length 95th (ft)	28	19	49	11	20
Internal Link Dist (ft)	1369			403	263
Turn Bay Length (ft)					
Base Capacity (vph)	566	546	177	2075	1683
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.09	0.11	0.36	0.03	0.04

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	45	0	53	59	58	0	0	28	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	
Frt					1.00	0.85	1.00	1.00			0.92	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1770	1583	1770	3539			3265	
Flt Permitted					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (perm)					1770	1583	1770	3539			3265	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	49	0	58	64	63	0	0	30	32
RTOR Reduction (vph)	0	0	0	0	0	45	0	0	0	0	18	0
Lane Group Flow (vph)	0	0	0	0	49	13	64	63	0	0	44	0
Turn Type				Perm		Perm	Prot					
Protected Phases					8		5	2			6	
Permitted Phases				8		8						
Actuated Green, G (s)					11.1	11.1	4.6	26.1			22.3	
Effective Green, g (s)					11.1	11.1	4.6	26.1			22.3	
Actuated g/C Ratio					0.22	0.22	0.09	0.52			0.45	
Clearance Time (s)					4.0	4.0	4.0	4.0			4.0	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					393	351	163	1847			1456	
v/s Ratio Prot							c0.04	c0.02			0.01	
v/s Ratio Perm					0.03	0.01						
v/c Ratio					0.12	0.04	0.39	0.03			0.03	
Uniform Delay, d1					15.6	15.3	21.4	5.8			7.8	
Progression Factor					1.00	1.00	0.87	0.71			0.97	
Incremental Delay, d2					0.1	0.0	1.6	0.0			0.0	
Delay (s)					15.7	15.3	20.2	4.2			7.6	
Level of Service					B	B	C	A			A	
Approach Delay (s)		0.0			15.5			12.3			7.6	
Approach LOS		A			B			B			A	

Intersection Summary			
HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.11		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	20.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	SBL	SBT
Lane Group Flow (vph)	28	71	141	11	68
v/c Ratio	0.07	0.17	0.07	0.08	0.04
Control Delay	13.9	5.4	5.3	23.7	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	13.9	5.4	5.3	23.7	3.7
Queue Length 50th (ft)	7	0	4	4	0
Queue Length 95th (ft)	19	21	23	17	15
Internal Link Dist (ft)	907		1985		403
Turn Bay Length (ft)					
Base Capacity (vph)	566	555	1999	142	1806
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.05	0.13	0.07	0.08	0.04

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	0	65	0	0	0	0	91	39	10	63	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					0.95		1.00	0.95	
Frt		1.00	0.85					0.96		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583					3381		1770	3539	
Flt Permitted		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (perm)		1770	1583					3381		1770	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	28	0	71	0	0	0	0	99	42	11	68	0
RTOR Reduction (vph)	0	0	55	0	0	0	0	20	0	0	0	0
Lane Group Flow (vph)	0	28	16	0	0	0	0	121	0	11	68	0
Turn Type	Perm		Perm							Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4		4									
Actuated Green, G (s)		11.1	11.1					26.1		0.8	22.3	
Effective Green, g (s)		11.1	11.1					26.1		0.8	22.3	
Actuated g/C Ratio		0.22	0.22					0.52		0.02	0.45	
Clearance Time (s)		4.0	4.0					4.0		4.0	4.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		393	351					1765		28	1578	
v/s Ratio Prot								c0.04		c0.01	0.02	
v/s Ratio Perm		0.02	0.01									
v/c Ratio		0.07	0.04					0.07		0.39	0.04	
Uniform Delay, d1		15.4	15.3					5.9		24.4	7.8	
Progression Factor		1.00	1.00					1.00		1.05	0.39	
Incremental Delay, d2		0.1	0.1					0.1		8.9	0.1	
Delay (s)		15.5	15.3					6.0		34.4	3.1	
Level of Service		B	B					A		C	A	
Approach Delay (s)		15.4			0.0			6.0			7.5	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.07		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	20.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	185	176	168	118	615	449	197
v/c Ratio	0.42	0.36	0.32	0.37	0.34	0.32	0.28
Control Delay	16.8	7.9	4.7	20.3	7.6	10.1	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.8	7.9	4.7	20.3	7.6	10.1	3.5
Queue Length 50th (ft)	43	13	0	14	21	40	0
Queue Length 95th (ft)	86	51	33	28	102	76	35
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	621	628	662	317	1835	1403	714
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.28	0.25	0.37	0.34	0.32	0.28

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	224	1	262	109	566	0	0	346	248
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.90	0.85	1.00	1.00			0.98	0.85
Flt Protected				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1501	1504	3433	3539			3308	1441
Flt Permitted				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1501	1504	3433	3539			3308	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	243	1	285	118	615	0	0	376	270
RTOR Reduction (vph)	0	0	0	0	88	126	0	0	0	0	29	120
Lane Group Flow (vph)	0	0	0	185	88	42	118	615	0	0	420	77
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				11.8	11.8	11.8	5.3	23.1			18.5	18.5
Effective Green, g (s)				11.8	11.8	11.8	5.3	23.1			18.5	18.5
Actuated g/C Ratio				0.25	0.25	0.25	0.11	0.49			0.39	0.39
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				417	372	373	382	1717			1286	560
v/s Ratio Prot				c0.11	0.06		c0.03	c0.17			0.13	0.05
v/s Ratio Perm						0.03						
v/c Ratio				0.44	0.24	0.11	0.31	0.36			0.33	0.14
Uniform Delay, d1				15.1	14.3	13.8	19.5	7.6			10.2	9.4
Progression Factor				1.00	1.00	1.00	0.79	0.90			1.00	1.00
Incremental Delay, d2				0.8	0.3	0.1	0.5	0.6			0.7	0.5
Delay (s)				15.9	14.6	14.0	15.8	7.5			10.9	9.9
Level of Service				B	B	B	B	A			B	A
Approach Delay (s)		0.0			14.9			8.8			10.6	
Approach LOS		A			B			A			B	

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	47.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	34.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	175	179	145	1	249	149	312	28	415	178
v/c Ratio	0.39	0.41	0.29	0.00	0.44	0.47	0.17	0.17	0.30	0.25
Control Delay	16.4	15.9	4.7	12.0	8.4	27.0	7.5	16.8	15.8	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.4	15.9	4.7	12.0	8.4	27.0	7.5	16.8	15.8	8.5
Queue Length 50th (ft)	40	40	0	0	19	20	18	5	43	0
Queue Length 95th (ft)	82	84	30	3	61	#49	55	m17	77	49
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	621	608	647	654	722	317	1833	164	1404	703
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.29	0.22	0.00	0.34	0.47	0.17	0.17	0.30	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	248	63	148	1	85	144	137	283	4	26	355	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.99	0.85	1.00	0.91		1.00	1.00		1.00	0.99	0.85
Flt Protected	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1629	1504	1770	1687		3433	3532		1770	3355	1441
Flt Permitted	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1629	1504	1770	1687		3433	3532		1770	3355	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	270	68	161	1	92	157	149	308	4	28	386	207
RTOR Reduction (vph)	0	8	109	0	118	0	0	2	0	0	10	109
Lane Group Flow (vph)	175	171	36	1	131	0	149	310	0	28	405	69
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	11.8	11.8	11.8	11.8	11.8		5.3	23.1		0.7	18.5	18.5
Effective Green, g (s)	11.8	11.8	11.8	11.8	11.8		5.3	23.1		0.7	18.5	18.5
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25		0.11	0.49		0.01	0.39	0.39
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	417	404	373	439	418		382	1714		26	1304	560
v/s Ratio Prot	0.10	c0.11		0.00	0.08		c0.04	0.09		0.02	c0.12	
v/s Ratio Perm			0.02									0.05
v/c Ratio	0.42	0.42	0.10	0.00	0.31		0.39	0.18		1.08	0.31	0.12
Uniform Delay, d1	15.0	15.0	13.8	13.5	14.6		19.6	6.9		23.4	10.1	9.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.68	1.50	2.90
Incremental Delay, d2	0.7	0.7	0.1	0.0	0.4		0.7	0.2		198.0	0.6	0.4
Delay (s)	15.7	15.8	13.9	13.5	15.0		20.3	7.1		213.9	15.8	27.5
Level of Service	B	B	B	B	B		C	A		F	B	C
Approach Delay (s)		15.2			15.0			11.4			28.1	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	18.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	47.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

OPENING YEAR (2016) WITH PROJECT – PM PEAK HOUR

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	290	283	264	389	755	732	158
v/c Ratio	0.68	0.66	0.46	0.73	0.53	0.30	0.22
Control Delay	28.0	23.7	5.6	23.8	8.6	13.3	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.0	23.7	5.6	23.8	8.6	13.3	3.7
Queue Length 50th (ft)	94	78	0	74	46	53	0
Queue Length 95th (ft)	169	154	48	#131	74	73	31
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	496	493	630	537	1415	2449	703
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.58	0.57	0.42	0.72	0.53	0.30	0.22

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	431	2	338	358	695	0	0	673	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.95	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1554	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1554	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	468	2	367	389	755	0	0	732	158
RTOR Reduction (vph)	0	0	0	0	36	197	0	0	0	0	0	97
Lane Group Flow (vph)	0	0	0	290	247	67	389	755	0	0	732	61
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.7	14.7	14.7	8.9	23.1			22.1	22.1
Effective Green, g (s)				14.7	14.7	14.7	8.9	23.1			22.1	22.1
Actuated g/C Ratio				0.25	0.25	0.25	0.15	0.40			0.38	0.38
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				428	396	383	530	1417			2454	606
v/s Ratio Prot				c0.17	0.16		c0.11	c0.21			0.11	0.04
v/s Ratio Perm						0.04						
v/c Ratio				0.68	0.62	0.18	0.73	0.53			0.30	0.10
Uniform Delay, d1				19.4	19.1	16.8	23.3	13.2			12.4	11.4
Progression Factor				1.00	1.00	1.00	0.61	0.53			1.00	1.00
Incremental Delay, d2				4.2	3.1	0.2	4.5	1.2			0.3	0.3
Delay (s)				23.6	22.1	17.0	18.7	8.2			12.7	11.7
Level of Service				C	C	B	B	A			B	B
Approach Delay (s)		0.0			21.0			11.7			12.5	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	14.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	57.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	103	223	221	1389	347	261	939
v/c Ratio	0.23	0.41	0.40	0.57	0.48	0.55	0.69
Control Delay	18.1	5.5	5.4	13.3	4.4	25.3	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.1	5.5	5.4	13.3	4.4	25.3	10.2
Queue Length 50th (ft)	28	0	0	104	0	52	94
Queue Length 95th (ft)	61	45	44	138	55	86	109
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	523	601	600	2418	720	477	1353
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.37	0.37	0.57	0.48	0.55	0.69

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	95	1	408	0	0	0	0	958	639	240	864	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.96	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5808	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5808	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	103	1	443	0	0	0	0	1041	695	261	939	0
RTOR Reduction (vph)	0	165	165	0	0	0	0	98	208	0	0	0
Lane Group Flow (vph)	103	58	56	0	0	0	0	1291	139	261	939	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	14.7	14.7	14.7					23.1	23.1	7.9	22.1	
Effective Green, g (s)	14.7	14.7	14.7					23.1	23.1	7.9	22.1	
Actuated g/C Ratio	0.25	0.25	0.25					0.40	0.40	0.14	0.38	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	451	383	383					2325	513	470	1355	
v/s Ratio Prot	c0.06	0.04						0.22		c0.08	c0.27	
v/s Ratio Perm			0.04						0.11			
v/c Ratio	0.23	0.15	0.15					0.56	0.27	0.56	0.69	
Uniform Delay, d1	17.0	16.7	16.6					13.3	11.6	23.3	15.0	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.86	0.47	
Incremental Delay, d2	0.3	0.2	0.2					1.0	1.3	1.3	2.7	
Delay (s)	17.3	16.8	16.8					14.3	12.9	21.4	9.7	
Level of Service	B	B	B					B	B	C	A	
Approach Delay (s)		16.9			0.0			14.0			12.2	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	57.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	5	354	51	384	70	5	95	15
v/c Ratio	0.02	0.42	0.22	0.45	0.09	0.01	0.11	0.02
Control Delay	12.6	15.9	16.2	17.2	8.9	9.2	3.5	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.6	15.9	16.2	17.2	8.9	9.2	3.5	8.6
Queue Length 50th (ft)	1	42	12	49	6	0	0	1
Queue Length 95th (ft)	6	64	31	72	38	m6	27	11
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	292	1133	311	1132	748	1000	894	909
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.31	0.16	0.34	0.09	0.01	0.11	0.02

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	299	27	47	349	5	64	5	87	5	5	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3496		1770	3532		1770	1863	1583		1750	
Flt Permitted	0.49	1.00		0.52	1.00		0.75	1.00	1.00		0.96	
Satd. Flow (perm)	911	3496		973	3532		1393	1863	1583		1716	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	325	29	51	379	5	70	5	95	5	5	5
RTOR Reduction (vph)	0	15	0	0	2	0	0	0	49	0	3	0
Lane Group Flow (vph)	5	339	0	51	382	0	70	5	46	0	12	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	12.0	12.0		12.0	12.0		24.4	24.4	24.4		24.0	
Effective Green, g (s)	12.0	12.0		12.0	12.0		24.4	24.4	24.4		24.0	
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.49	0.49	0.49		0.48	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	219	839		234	848		680	909	773		824	
v/s Ratio Prot		0.10			c0.11			0.00				
v/s Ratio Perm	0.01			0.05			c0.05		0.03		0.01	
v/c Ratio	0.02	0.40		0.22	0.45		0.10	0.01	0.06		0.02	
Uniform Delay, d1	14.5	16.0		15.2	16.2		6.9	6.6	6.8		6.8	
Progression Factor	1.00	1.00		1.00	1.00		0.96	0.98	1.01		1.00	
Incremental Delay, d2	0.0	0.3		0.5	0.4		0.3	0.0	0.1		0.0	
Delay (s)	14.6	16.3		15.7	16.6		7.0	6.5	7.0		6.8	
Level of Service	B	B		B	B		A	A	A		A	
Approach Delay (s)		16.3			16.5			6.9			6.8	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	13.6
Intersection Capacity Utilization	32.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	100	111	49	59	87
v/c Ratio	0.24	0.24	0.28	0.03	0.05
Control Delay	15.4	4.9	23.4	5.7	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	15.4	4.9	23.4	5.7	6.8
Queue Length 50th (ft)	23	0	15	2	11
Queue Length 95th (ft)	48	26	41	11	26
Internal Link Dist (ft)	1369			403	263
Turn Bay Length (ft)					
Base Capacity (vph)	566	582	177	1900	1761
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.18	0.19	0.28	0.03	0.05

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	92	0	102	45	54	0	0	43	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	
Frt					1.00	0.85	1.00	1.00			0.93	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1770	1583	1770	3539			3295	
Flt Permitted					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (perm)					1770	1583	1770	3539			3295	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	100	0	111	49	59	0	0	47	40
RTOR Reduction (vph)	0	0	0	0	0	84	0	0	0	0	21	0
Lane Group Flow (vph)	0	0	0	0	100	27	49	59	0	0	66	0
Turn Type				Perm		Perm	Prot					
Protected Phases					8		5	2			6	
Permitted Phases				8		8						
Actuated Green, G (s)					12.0	12.0	2.0	24.4			24.0	
Effective Green, g (s)					12.0	12.0	2.0	24.4			24.0	
Actuated g/C Ratio					0.24	0.24	0.04	0.49			0.48	
Clearance Time (s)					4.0	4.0	4.0	4.0			4.0	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					425	380	71	1727			1582	
v/s Ratio Prot							c0.03	0.02			c0.02	
v/s Ratio Perm					0.06	0.02						
v/c Ratio					0.24	0.07	0.69	0.03			0.04	
Uniform Delay, d1					15.3	14.7	23.7	6.7			6.9	
Progression Factor					1.00	1.00	0.92	0.67			1.08	
Incremental Delay, d2					0.3	0.1	25.1	0.0			0.0	
Delay (s)					15.6	14.8	46.8	4.5			7.5	
Level of Service					B	B	D	A			A	
Approach Delay (s)		0.0			15.2			23.7			7.5	
Approach LOS		A			B			C			A	

Intersection Summary			
HCM Average Control Delay	15.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.12		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	SBL	SBT
Lane Group Flow (vph)	35	80	105	30	116
v/c Ratio	0.08	0.18	0.06	0.21	0.06
Control Delay	13.5	5.0	6.7	28.6	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	13.5	5.0	6.7	28.6	3.9
Queue Length 50th (ft)	8	0	4	10	0
Queue Length 95th (ft)	22	22	19	33	24
Internal Link Dist (ft)	907		1985		403
Turn Bay Length (ft)					
Base Capacity (vph)	566	561	1827	142	1871
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.14	0.06	0.21	0.06

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	32	0	74	0	0	0	0	67	29	28	107	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					0.95		1.00	0.95	
Frt		1.00	0.85					0.95		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583					3377		1770	3539	
Flt Permitted		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (perm)		1770	1583					3377		1770	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	35	0	80	0	0	0	0	73	32	30	116	0
RTOR Reduction (vph)	0	0	61	0	0	0	0	16	0	0	0	0
Lane Group Flow (vph)	0	35	19	0	0	0	0	89	0	30	116	0
Turn Type	Perm		Perm							Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4		4									
Actuated Green, G (s)		12.0	12.0					24.4		1.6	24.0	
Effective Green, g (s)		12.0	12.0					24.4		1.6	24.0	
Actuated g/C Ratio		0.24	0.24					0.49		0.03	0.48	
Clearance Time (s)		4.0	4.0					4.0		4.0	4.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		425	380					1648		57	1699	
v/s Ratio Prot								0.03		c0.02	c0.03	
v/s Ratio Perm		0.02	0.01									
v/c Ratio		0.08	0.05					0.05		0.53	0.07	
Uniform Delay, d1		14.7	14.6					6.7		23.8	7.0	
Progression Factor		1.00	1.00					1.00		1.15	0.44	
Incremental Delay, d2		0.1	0.1					0.1		8.5	0.1	
Delay (s)		14.8	14.7					6.8		35.8	3.2	
Level of Service		B	B					A		D	A	
Approach Delay (s)		14.7			0.0			6.8			9.9	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM Average Control Delay	10.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.09		
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	21.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	104	161	161	47	566	584	254
v/c Ratio	0.23	0.33	0.31	0.12	0.34	0.44	0.35
Control Delay	14.4	5.5	4.7	14.6	10.0	11.6	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.4	5.5	4.7	14.6	10.0	11.6	3.8
Queue Length 50th (ft)	23	2	0	5	16	56	0
Queue Length 95th (ft)	52	37	32	m14	75	104	40
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	628	637	663	401	1660	1342	725
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.17	0.25	0.24	0.12	0.34	0.44	0.35

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	107	0	285	43	521	0	0	437	334
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.86	0.85	1.00	1.00			0.97	0.85
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1454	1504	3433	3539			3295	1441
Flt Permitted				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1454	1504	3433	3539			3295	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	116	0	310	47	566	0	0	475	363
RTOR Reduction (vph)	0	0	0	0	112	120	0	0	0	0	35	158
Lane Group Flow (vph)	0	0	0	104	49	41	47	566	0	0	549	96
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				11.7	11.7	11.7	5.3	20.7			17.5	17.5
Effective Green, g (s)				11.7	11.7	11.7	5.3	20.7			17.5	17.5
Actuated g/C Ratio				0.25	0.25	0.25	0.11	0.45			0.38	0.38
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				423	366	378	391	1575			1240	542
v/s Ratio Prot				c0.06	0.03		c0.01	0.16			c0.17	0.07
v/s Ratio Perm						0.03						
v/c Ratio				0.25	0.14	0.11	0.12	0.36			0.44	0.18
Uniform Delay, d1				13.9	13.5	13.4	18.5	8.5			10.9	9.7
Progression Factor				1.00	1.00	1.00	0.69	0.95			1.00	1.00
Incremental Delay, d2				0.3	0.2	0.1	0.1	0.6			1.1	0.7
Delay (s)				14.2	13.6	13.5	12.9	8.7			12.0	10.4
Level of Service				B	B	B	B	A			B	B
Approach Delay (s)		0.0			13.7			9.0			11.5	
Approach LOS		A			B			A			B	

Intersection Summary			
HCM Average Control Delay	11.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	46.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	33.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	177	179	139	15	286	149	271	57	370	164
v/c Ratio	0.40	0.40	0.28	0.03	0.55	0.37	0.16	0.24	0.27	0.24
Control Delay	16.5	15.8	4.7	12.1	14.3	23.4	9.5	16.5	18.1	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.5	15.8	4.7	12.1	14.3	23.4	9.5	16.5	18.1	12.9
Queue Length 50th (ft)	41	40	0	3	45	19	15	7	42	0
Queue Length 95th (ft)	83	84	30	13	98	43	52	m25	83	69
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	628	623	649	661	702	401	1657	248	1346	671
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.29	0.21	0.02	0.41	0.37	0.16	0.23	0.27	0.24

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	206	107	143	14	147	116	137	242	7	52	263	228
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.99	0.85	1.00	0.93		1.00	1.00		1.00	0.97	0.85
Flt Protected	0.95	0.99	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1651	1504	1770	1740		3433	3524		1770	3275	1441
Flt Permitted	0.95	0.99	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1651	1504	1770	1740		3433	3524		1770	3275	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	224	116	155	15	160	126	149	263	8	57	286	248
RTOR Reduction (vph)	0	7	104	0	62	0	0	3	0	0	48	102
Lane Group Flow (vph)	177	172	35	15	224	0	149	268	0	57	322	62
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	11.7	11.7	11.7	11.7	11.7		5.3	20.7		2.1	17.5	17.5
Effective Green, g (s)	11.7	11.7	11.7	11.7	11.7		5.3	20.7		2.1	17.5	17.5
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25		0.11	0.45		0.05	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	423	415	378	445	438		391	1569		80	1233	542
v/s Ratio Prot	0.11	0.10		0.01	c0.13		c0.04	0.08		0.03	c0.10	
v/s Ratio Perm			0.02									0.04
v/c Ratio	0.42	0.41	0.09	0.03	0.51		0.38	0.17		0.71	0.26	0.11
Uniform Delay, d1	14.6	14.5	13.3	13.1	14.9		19.1	7.7		21.9	10.0	9.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.72	2.00	4.10
Incremental Delay, d2	0.7	0.7	0.1	0.0	1.0		0.6	0.2		24.3	0.5	0.4
Delay (s)	15.2	15.2	13.4	13.2	16.0		19.7	8.0		40.1	20.5	39.2
Level of Service	B	B	B	B	B		B	A		D	C	D
Approach Delay (s)		14.7			15.8			12.1			27.6	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	46.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

HORIZON YEAR (2036) NO PROJECT – AM PEAK HOUR

1: WB 210 On Ramp & Riverside Avenue

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	415	407	377	486	763	1178	170
v/c Ratio	0.94	0.92	0.56	0.92	0.61	0.46	0.23
Control Delay	57.9	49.8	6.4	42.1	10.3	15.1	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.9	49.8	6.4	42.1	10.3	15.1	3.3
Queue Length 50th (ft)	169	150	1	111	41	96	0
Queue Length 95th (ft)	#337	#326	63	#193	81	123	32
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	440	444	669	528	1252	2563	735
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.94	0.92	0.56	0.92	0.61	0.46	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	597	3	503	447	702	0	0	1084	156
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.94	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1544	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1544	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	649	3	547	486	763	0	0	1178	170
RTOR Reduction (vph)	0	0	0	0	40	275	0	0	0	0	0	102
Lane Group Flow (vph)	0	0	0	415	367	102	486	763	0	0	1178	68
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				17.0	17.0	17.0	10.0	23.0			26.0	26.0
Effective Green, g (s)				17.0	17.0	17.0	10.0	23.0			26.0	26.0
Actuated g/C Ratio				0.26	0.26	0.26	0.15	0.35			0.40	0.40
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				440	404	393	528	1252			2563	633
v/s Ratio Prot				c0.25	0.24		c0.14	c0.22			0.18	0.04
v/s Ratio Perm						0.07						
v/c Ratio				0.94	0.91	0.26	0.92	0.61			0.46	0.11
Uniform Delay, d1				23.5	23.2	19.0	27.1	17.3			14.3	12.2
Progression Factor				1.00	1.00	1.00	0.67	0.48			1.00	1.00
Incremental Delay, d2				28.8	23.6	0.4	18.4	1.8			0.6	0.3
Delay (s)				52.4	46.9	19.4	36.7	10.1			14.9	12.6
Level of Service				D	D	B	D	B			B	B
Approach Delay (s)		0.0			40.1			20.5			14.6	
Approach LOS		A			D			C			B	

Intersection Summary			
HCM Average Control Delay	24.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

2: EB 210 Off Ramp & Riverside Avenue

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	89	347	346	1321	287	505	1322
v/c Ratio	0.19	0.54	0.54	0.62	0.45	0.74	0.93
Control Delay	20.1	6.4	6.4	18.1	4.8	27.0	20.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.1	6.4	6.4	18.1	4.8	27.0	20.9
Queue Length 50th (ft)	27	2	2	124	0	109	138
Queue Length 95th (ft)	60	62	62	160	55	m144	m#372
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	463	644	644	2133	639	687	1416
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.54	0.54	0.62	0.45	0.74	0.93

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	82	1	637	0	0	0	0	1067	412	465	1216	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5925	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5925	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	89	1	692	0	0	0	0	1160	448	505	1322	0
RTOR Reduction (vph)	0	250	250	0	0	0	0	36	185	0	0	0
Lane Group Flow (vph)	89	97	96	0	0	0	0	1285	102	505	1322	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	17.0	17.0	17.0					23.0	23.0	13.0	26.0	
Effective Green, g (s)	17.0	17.0	17.0					23.0	23.0	13.0	26.0	
Actuated g/C Ratio	0.26	0.26	0.26					0.35	0.35	0.20	0.40	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	463	394	393					2097	454	687	1416	
v/s Ratio Prot	0.05	c0.06						0.22		c0.15	c0.37	
v/s Ratio Perm			0.06						0.08			
v/c Ratio	0.19	0.25	0.24					0.61	0.22	0.74	0.93	
Uniform Delay, d1	18.7	18.9	18.9					17.3	14.7	24.4	18.7	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.85	0.44	
Incremental Delay, d2	0.2	0.3	0.3					1.3	1.1	3.2	10.3	
Delay (s)	18.9	19.3	19.3					18.7	15.9	24.0	18.6	
Level of Service	B	B	B					B	B	C	B	
Approach Delay (s)		19.2			0.0			18.2			20.1	
Approach LOS		B			A			B			C	

Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	7	370	42	405	75	7	30	21
v/c Ratio	0.03	0.36	0.15	0.41	0.11	0.01	0.04	0.03
Control Delay	8.5	8.4	10.0	10.8	6.2	5.7	3.1	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.5	8.4	10.0	10.8	6.2	5.7	3.1	5.0
Queue Length 50th (ft)	1	21	6	30	6	1	0	1
Queue Length 95th (ft)	6	41	19	51	23	5	8	9
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	459	1683	475	1694	664	893	774	818
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.22	0.09	0.24	0.11	0.01	0.04	0.03

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	269	72	39	366	6	69	6	28	6	6	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.97		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3427		1770	3530		1770	1863	1583		1750	
Flt Permitted	0.51	1.00		0.53	1.00		0.74	1.00	1.00		0.96	
Satd. Flow (perm)	957	3427		990	3530		1385	1863	1583		1700	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	292	78	42	398	7	75	7	30	7	7	7
RTOR Reduction (vph)	0	56	0	0	4	0	0	0	16	0	4	0
Lane Group Flow (vph)	7	314	0	42	401	0	75	7	14	0	17	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	9.4	9.4		9.4	9.4		16.1	16.1	16.1		16.1	
Effective Green, g (s)	9.4	9.4		9.4	9.4		16.1	16.1	16.1		16.1	
Actuated g/C Ratio	0.28	0.28		0.28	0.28		0.48	0.48	0.48		0.48	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	269	962		278	991		666	895	761		817	
v/s Ratio Prot		0.09			c0.11			0.00				
v/s Ratio Perm	0.01			0.04			c0.05		0.01		0.01	
v/c Ratio	0.03	0.33		0.15	0.41		0.11	0.01	0.02		0.02	
Uniform Delay, d1	8.7	9.5		9.1	9.8		4.8	4.5	4.6		4.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.2		0.3	0.3		0.3	0.0	0.0		0.0	
Delay (s)	8.8	9.7		9.3	10.1		5.1	4.6	4.6		4.6	
Level of Service	A	A		A	B		A	A	A		A	
Approach Delay (s)		9.7			10.0			4.9			4.6	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	33.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	33.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	289	275	267	75	1148	387	75
v/c Ratio	0.64	0.55	0.49	0.23	0.59	0.28	0.12
Control Delay	24.6	13.2	9.0	20.4	7.9	11.4	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.6	13.2	9.0	20.4	7.9	11.4	3.8
Queue Length 50th (ft)	84	39	20	11	44	44	0
Queue Length 95th (ft)	154	103	71	m21	200	72	20
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	505	549	585	322	1959	1399	639
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.50	0.46	0.23	0.59	0.28	0.12

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	369	0	396	69	1056	0	0	349	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.91	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1514	1504	3433	3539			3380	1441
Flt Permitted				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1514	1504	3433	3539			3380	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	401	0	430	75	1148	0	0	379	83
RTOR Reduction (vph)	0	0	0	0	100	142	0	0	0	0	2	46
Lane Group Flow (vph)	0	0	0	289	175	125	75	1148	0	0	385	29
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.3	14.3	14.3	8.2	29.5			22.1	22.1
Effective Green, g (s)				14.3	14.3	14.3	8.2	29.5			22.1	22.1
Actuated g/C Ratio				0.25	0.25	0.25	0.14	0.52			0.39	0.39
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				425	383	380	497	1845			1320	563
v/s Ratio Prot				c0.17	0.12		c0.02	c0.32			0.11	0.02
v/s Ratio Perm						0.08						
v/c Ratio				0.68	0.46	0.33	0.15	0.62			0.29	0.05
Uniform Delay, d1				19.1	17.9	17.2	21.2	9.6			11.9	10.7
Progression Factor				1.00	1.00	1.00	0.81	0.70			1.00	1.00
Incremental Delay, d2				4.4	0.9	0.5	0.1	1.4			0.6	0.2
Delay (s)				23.5	18.7	17.7	17.2	8.2			12.4	10.9
Level of Service				C	B	B	B	A			B	B
Approach Delay (s)		0.0			20.1			8.8			12.2	
Approach LOS		A			C			A			B	

Intersection Summary			
HCM Average Control Delay	13.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	56.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	319	309	288	3	327	230	528	3	602	176
v/c Ratio	0.71	0.67	0.47	0.01	0.57	0.71	0.27	0.02	0.43	0.25
Control Delay	27.5	21.3	5.3	14.0	12.3	39.2	7.8	17.3	9.2	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.5	21.3	5.3	14.0	12.3	39.2	7.8	17.3	9.2	2.6
Queue Length 50th (ft)	94	72	0	1	39	38	41	1	34	0
Queue Length 95th (ft)	#177	151	47	5	102	#85	90	m2	59	m0
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	505	512	654	532	626	322	1959	133	1398	699
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.63	0.60	0.44	0.01	0.52	0.71	0.27	0.02	0.43	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	444	14	385	3	105	196	212	485	1	3	535	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.94	0.85	1.00	0.90		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1547	1504	1770	1681		3433	3538		1770	3373	1441
Flt Permitted	0.95	0.97	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1547	1504	1770	1681		3433	3538		1770	3373	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	483	15	418	3	114	213	230	527	1	3	582	196
RTOR Reduction (vph)	0	50	215	0	129	0	0	0	0	0	4	107
Lane Group Flow (vph)	319	259	73	3	198	0	230	528	0	3	598	69
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	14.3	14.3	14.3	14.3	14.3		8.2	29.5		0.8	22.1	22.1
Effective Green, g (s)	14.3	14.3	14.3	14.3	14.3		8.2	29.5		0.8	22.1	22.1
Actuated g/C Ratio	0.25	0.25	0.25	0.25	0.25		0.14	0.52		0.01	0.39	0.39
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	425	391	380	447	425		497	1844		25	1317	563
v/s Ratio Prot	c0.19	0.17		0.00	0.12		c0.07	0.15		0.00	c0.18	
v/s Ratio Perm			0.05									0.05
v/c Ratio	0.75	0.66	0.19	0.01	0.47		0.46	0.29		0.12	0.45	0.12
Uniform Delay, d1	19.5	19.0	16.6	15.8	17.9		22.2	7.6		27.6	12.8	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.71	0.71	0.73
Incremental Delay, d2	7.3	4.2	0.2	0.0	0.8		0.7	0.4		2.0	1.0	0.4
Delay (s)	26.8	23.2	16.9	15.8	18.7		22.9	8.0		21.6	10.1	8.4
Level of Service	C	C	B	B	B		C	A		C	B	A
Approach Delay (s)		22.4			18.7			12.5			9.8	
Approach LOS		C			B			B			A	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	56.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		

! Phase conflict between lane groups.
c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

HORIZON YEAR (2036) NO PROJECT – PM PEAK HOUR

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	373	366	339	572	1043	1139	253
v/c Ratio	0.93	0.93	0.57	0.95	0.62	0.41	0.30
Control Delay	63.7	60.4	9.1	51.3	7.3	15.9	3.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.7	60.4	9.1	51.3	7.3	16.0	3.0
Queue Length 50th (ft)	192	182	13	158	65	109	0
Queue Length 95th (ft)	#364	#362	89	#258	78	136	39
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	399	394	590	601	1681	2804	835
Starvation Cap Reductn	0	0	0	0	10	0	0
Spillback Cap Reductn	0	0	0	0	0	96	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.93	0.93	0.57	0.95	0.62	0.42	0.30

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	562	3	427	526	960	0	0	1048	233
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.95	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1558	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.97	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1558	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	611	3	464	572	1043	0	0	1139	253
RTOR Reduction (vph)	0	0	0	0	24	233	0	0	0	0	0	142
Lane Group Flow (vph)	0	0	0	373	342	106	572	1043	0	0	1139	111
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				19.0	19.0	19.0	14.0	38.0			35.0	35.0
Effective Green, g (s)				19.0	19.0	19.0	14.0	38.0			35.0	35.0
Actuated g/C Ratio				0.24	0.24	0.24	0.18	0.48			0.44	0.44
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				399	370	357	601	1681			2804	693
v/s Ratio Prot				c0.22	0.22		c0.17	c0.29			0.18	0.07
v/s Ratio Perm						0.07						
v/c Ratio				0.93	0.93	0.30	0.95	0.62			0.41	0.16
Uniform Delay, d1				29.9	29.8	25.0	32.7	15.6			15.4	13.6
Progression Factor				1.00	1.00	1.00	0.77	0.37			1.00	1.00
Incremental Delay, d2				28.9	28.5	0.5	22.4	1.4			0.4	0.5
Delay (s)				58.8	58.3	25.5	47.5	7.2			15.8	14.1
Level of Service				E	E	C	D	A			B	B
Approach Delay (s)		0.0			48.2			21.5			15.5	
Approach LOS		A			D			C			B	

Intersection Summary			
HCM Average Control Delay	26.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	152	245	244	1656	358	303	1446
v/c Ratio	0.36	0.45	0.45	0.58	0.45	0.64	0.93
Control Delay	28.4	6.7	6.6	15.7	3.5	38.8	22.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.4	6.7	6.6	15.7	3.5	38.8	22.5
Queue Length 50th (ft)	64	0	0	170	0	85	383
Queue Length 95th (ft)	116	57	56	208	53	m114	m#487
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	420	544	543	2845	797	472	1548
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.45	0.45	0.58	0.45	0.64	0.93

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	140	1	449	0	0	0	0	1346	507	279	1330	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5930	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5930	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	152	1	488	0	0	0	0	1463	551	303	1446	0
RTOR Reduction (vph)	0	186	186	0	0	0	0	27	188	0	0	0
Lane Group Flow (vph)	152	59	58	0	0	0	0	1629	170	303	1446	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	19.0	19.0	19.0					38.0	38.0	11.0	35.0	
Effective Green, g (s)	19.0	19.0	19.0					38.0	38.0	11.0	35.0	
Actuated g/C Ratio	0.24	0.24	0.24					0.48	0.48	0.14	0.44	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	420	357	357					2817	609	472	1548	
v/s Ratio Prot	c0.09	0.04						0.27		c0.09	c0.41	
v/s Ratio Perm			0.04						0.13			
v/c Ratio	0.36	0.17	0.16					0.58	0.28	0.64	0.93	
Uniform Delay, d1	25.4	24.2	24.2					15.2	12.7	32.6	21.4	
Progression Factor	1.00	1.00	1.00					1.00	1.00	1.01	0.51	
Incremental Delay, d2	0.5	0.2	0.2					0.9	1.1	2.4	10.0	
Delay (s)	26.0	24.4	24.4					16.1	13.9	35.5	20.9	
Level of Service	C	C	C					B	B	D	C	
Approach Delay (s)		24.8			0.0			15.7			23.4	
Approach LOS		C			A			B			C	

Intersection Summary			
HCM Average Control Delay	20.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	5	408	83	478	84	5	58	15
v/c Ratio	0.02	0.37	0.28	0.44	0.13	0.01	0.08	0.02
Control Delay	7.8	8.1	11.4	10.7	7.3	6.6	3.1	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	7.8	8.1	11.4	10.7	7.3	6.6	3.1	5.9
Queue Length 50th (ft)	1	23	11	36	8	1	0	1
Queue Length 95th (ft)	5	44	32	61	30	5	14	8
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	411	1625	440	1630	642	859	761	788
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.25	0.19	0.29	0.13	0.01	0.08	0.02

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	299	76	76	435	5	77	5	53	5	5	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.97		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3431		1770	3534		1770	1863	1583		1750	
Flt Permitted	0.48	1.00		0.51	1.00		0.75	1.00	1.00		0.96	
Satd. Flow (perm)	892	3431		954	3534		1393	1863	1583		1705	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	325	83	83	473	5	84	5	58	5	5	5
RTOR Reduction (vph)	0	57	0	0	2	0	0	0	31	0	3	0
Lane Group Flow (vph)	5	351	0	83	476	0	84	5	27	0	12	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	10.8	10.8		10.8	10.8		16.1	16.1	16.1		16.1	
Effective Green, g (s)	10.8	10.8		10.8	10.8		16.1	16.1	16.1		16.1	
Actuated g/C Ratio	0.31	0.31		0.31	0.31		0.46	0.46	0.46		0.46	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	276	1062		295	1094		643	859	730		787	
v/s Ratio Prot		0.10			c0.13			0.00				
v/s Ratio Perm	0.01			0.09			c0.06		0.02		0.01	
v/c Ratio	0.02	0.33		0.28	0.44		0.13	0.01	0.04		0.02	
Uniform Delay, d1	8.4	9.3		9.1	9.6		5.4	5.1	5.2		5.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.0	0.2		0.5	0.3		0.4	0.0	0.1		0.0	
Delay (s)	8.4	9.5		9.6	9.9		5.8	5.1	5.2		5.1	
Level of Service	A	A		A	A		A	A	A		A	
Approach Delay (s)		9.4			9.9			5.6			5.1	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	34.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	36.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	149	487	489	14	560	974	419
v/c Ratio	0.37	0.76	0.75	0.03	0.33	0.67	0.49
Control Delay	21.0	14.1	13.3	17.5	6.2	16.4	3.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.0	14.1	13.3	17.5	6.2	16.4	3.7
Queue Length 50th (ft)	45	31	31	2	25	150	0
Queue Length 95th (ft)	91	#157	#136	m8	36	214	49
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	463	678	693	415	1674	1456	860
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.72	0.71	0.03	0.33	0.67	0.49

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	153	0	882	13	515	0	0	853	429
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.86	0.85	1.00	1.00			0.99	0.85
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1447	1504	3433	3539			3366	1441
Flt Permitted				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1447	1504	3433	3539			3366	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	166	0	959	14	560	0	0	927	466
RTOR Reduction (vph)	0	0	0	0	294	294	0	0	0	0	6	241
Lane Group Flow (vph)	0	0	0	149	193	195	14	560	0	0	968	178
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.0	14.0	14.0	7.9	27.5			25.1	25.1
Effective Green, g (s)				14.0	14.0	14.0	7.9	27.5			25.1	25.1
Actuated g/C Ratio				0.24	0.24	0.24	0.13	0.47			0.43	0.43
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				399	343	357	460	1650			1432	613
v/s Ratio Prot				0.09	c0.13		c0.00	0.16			c0.29	0.12
v/s Ratio Perm						0.13						
v/c Ratio				0.37	0.56	0.55	0.03	0.34			0.68	0.29
Uniform Delay, d1				18.8	19.8	19.7	22.2	10.0			13.7	11.1
Progression Factor				1.00	1.00	1.00	0.74	0.51			1.00	1.00
Incremental Delay, d2				0.6	2.1	1.7	0.0	0.5			2.6	1.2
Delay (s)				19.4	21.9	21.4	16.4	5.6			16.3	12.3
Level of Service				B	C	C	B	A			B	B
Approach Delay (s)		0.0			21.4			5.9			15.1	
Approach LOS		A			C			A			B	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	129	209	190	27	236	292	366	86	709	299
v/c Ratio	0.32	0.50	0.37	0.06	0.51	0.70	0.22	0.42	0.49	0.38
Control Delay	20.2	19.5	5.7	17.0	19.5	36.4	10.7	20.1	18.0	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	19.5	5.7	17.0	19.5	36.4	10.7	20.1	18.0	8.0
Queue Length 50th (ft)	38	54	0	7	57	53	42	20	101	14
Queue Length 95th (ft)	80	114	43	23	115	#103	67	m35	156	m83
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	463	473	552	488	519	415	1668	214	1456	791
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.44	0.34	0.06	0.45	0.70	0.22	0.40	0.49	0.38

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	132	115	239	25	141	76	269	320	17	79	622	305
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.95	0.85	1.00	0.95		1.00	0.99		1.00	0.99	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1605	1504	1770	1764		3433	3513		1770	3367	1441
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1605	1504	1770	1764		3433	3513		1770	3367	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	143	125	260	27	153	83	292	348	18	86	676	332
RTOR Reduction (vph)	0	31	145	0	34	0	0	6	0	0	6	172
Lane Group Flow (vph)	129	178	45	27	202	0	292	360	0	86	703	127
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	14.0	14.0	14.0	14.0	14.0		7.9	27.5		5.5	25.1	25.1
Effective Green, g (s)	14.0	14.0	14.0	14.0	14.0		7.9	27.5		5.5	25.1	25.1
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24		0.13	0.47		0.09	0.43	0.43
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	399	381	357	420	419		460	1637		165	1432	613
v/s Ratio Prot	0.08	0.11		0.02	c0.11		c0.09	0.10		0.05	c0.21	
v/s Ratio Perm			0.03									0.09
v/c Ratio	0.32	0.47	0.13	0.06	0.48		0.63	0.22		0.52	0.49	0.21
Uniform Delay, d1	18.6	19.3	17.7	17.4	19.4		24.2	9.4		25.5	12.3	10.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.60	1.37	3.61
Incremental Delay, d2	0.5	0.9	0.2	0.1	0.9		2.9	0.3		2.3	0.9	0.6
Delay (s)	19.1	20.2	17.9	17.5	20.3		27.0	9.7		17.6	17.8	39.2
Level of Service	B	C	B	B	C		C	A		B	B	D
Approach Delay (s)		19.1			20.0			17.4			23.7	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	20.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

HORIZON YEAR (2036) WITH PROJECT – AM PEAK HOUR

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	357	341	325	335	760	1175	146
v/c Ratio	0.78	0.68	0.50	0.72	0.70	0.47	0.21
Control Delay	34.4	20.4	5.6	24.5	18.3	14.4	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.4	20.4	5.6	24.5	18.3	14.4	3.5
Queue Length 50th (ft)	122	73	0	69	65	90	0
Queue Length 95th (ft)	#245	#165	53	#120	118	117	29
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	484	522	665	466	1080	2499	707
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.65	0.49	0.72	0.70	0.47	0.21

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	456	2	483	308	699	0	0	1081	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.91	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1515	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1515	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	496	2	525	335	760	0	0	1175	146
RTOR Reduction (vph)	0	0	0	0	87	237	0	0	0	0	0	89
Lane Group Flow (vph)	0	0	0	357	254	88	335	760	0	0	1175	57
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				16.0	16.0	16.0	8.0	18.0			23.0	23.0
Effective Green, g (s)				16.0	16.0	16.0	8.0	18.0			23.0	23.0
Actuated g/C Ratio				0.27	0.27	0.27	0.14	0.31			0.39	0.39
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				456	411	408	465	1080			2498	617
v/s Ratio Prot				c0.21	0.17		c0.10	c0.21			c0.18	0.04
v/s Ratio Perm						0.06						
v/c Ratio				0.78	0.62	0.22	0.72	0.70			0.47	0.09
Uniform Delay, d1				19.9	18.8	16.6	24.4	18.1			13.4	11.4
Progression Factor				1.00	1.00	1.00	0.62	0.81			1.00	1.00
Incremental Delay, d2				8.5	2.8	0.3	4.4	3.1			0.6	0.3
Delay (s)				28.4	21.6	16.9	19.5	17.8			14.1	11.7
Level of Service				C	C	B	B	B			B	B
Approach Delay (s)		0.0			22.5			18.3			13.8	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	77	251	250	1180	255	548	1123
v/c Ratio	0.16	0.43	0.42	0.64	0.45	0.72	0.81
Control Delay	17.2	5.3	5.3	18.7	5.5	21.2	13.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.2	5.3	5.3	18.7	5.5	21.2	13.1
Queue Length 50th (ft)	21	0	0	105	0	105	95
Queue Length 95th (ft)	48	47	47	141	55	m#160	#119
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	511	612	611	1851	568	757	1381
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.41	0.41	0.64	0.45	0.72	0.81

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	71	1	460	0	0	0	0	936	385	504	1033	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1505	1504					5910	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1505	1504					5910	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	77	1	500	0	0	0	0	1017	418	548	1123	0
RTOR Reduction (vph)	0	182	182	0	0	0	0	48	177	0	0	0
Lane Group Flow (vph)	77	69	68	0	0	0	0	1132	78	548	1123	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	16.0	16.0	16.0					18.0	18.0	13.0	23.0	
Effective Green, g (s)	16.0	16.0	16.0					18.0	18.0	13.0	23.0	
Actuated g/C Ratio	0.27	0.27	0.27					0.31	0.31	0.22	0.39	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	480	408	408					1803	391	756	1380	
v/s Ratio Prot	0.04	c0.05						0.19		c0.16	c0.32	
v/s Ratio Perm			0.05						0.06			
v/c Ratio	0.16	0.17	0.17					0.63	0.20	0.72	0.81	
Uniform Delay, d1	16.4	16.4	16.4					17.6	15.2	21.3	16.1	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.71	0.46	
Incremental Delay, d2	0.2	0.2	0.2					1.7	1.1	3.0	4.6	
Delay (s)	16.5	16.6	16.6					19.3	16.3	18.0	12.0	
Level of Service	B	B	B					B	B	B	B	
Approach Delay (s)		16.6			0.0			18.8			14.0	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	16.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	59.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	7	456	179	382	205	7	372	21
v/c Ratio	0.03	0.47	0.85	0.40	0.30	0.01	0.39	0.04
Control Delay	14.5	15.8	56.7	17.3	11.3	10.0	3.2	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.5	15.8	56.7	17.3	11.3	10.0	3.2	11.8
Queue Length 50th (ft)	2	53	53	51	33	1	0	3
Queue Length 95th (ft)	9	88	#147	83	78	m5	12	16
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	264	1041	226	1029	674	906	961	531
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.44	0.79	0.37	0.30	0.01	0.39	0.04

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	330	89	165	345	6	189	6	342	6	6	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.97		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3426		1770	3529		1770	1863	1583		1750	
Flt Permitted	0.49	1.00		0.42	1.00		0.74	1.00	1.00		0.95	
Satd. Flow (perm)	909	3426		777	3529		1385	1863	1583		1689	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	359	97	179	375	7	205	7	372	7	7	7
RTOR Reduction (vph)	0	46	0	0	2	0	0	0	202	0	5	0
Lane Group Flow (vph)	7	410	0	179	380	0	205	7	170	0	16	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	14.8	14.8		14.8	14.8		25.2	25.2	25.2		15.6	
Effective Green, g (s)	14.8	14.8		14.8	14.8		25.2	25.2	25.2		15.6	
Actuated g/C Ratio	0.27	0.27		0.27	0.27		0.46	0.46	0.46		0.28	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	245	922		209	950		635	854	725		479	
v/s Ratio Prot		0.12			0.11			0.00				
v/s Ratio Perm	0.01			c0.23			c0.15		0.11		0.01	
v/c Ratio	0.03	0.44		0.86	0.40		0.32	0.01	0.24		0.03	
Uniform Delay, d1	14.8	16.7		19.1	16.5		9.5	8.1	9.0		14.2	
Progression Factor	1.00	1.00		1.00	1.00		0.92	0.99	1.17		1.00	
Incremental Delay, d2	0.0	0.3		27.4	0.3		1.3	0.0	0.7		0.1	
Delay (s)	14.9	17.0		46.5	16.7		10.0	8.1	11.4		14.4	
Level of Service	B	B		D	B		A	A	B		B	
Approach Delay (s)		17.0			26.2			10.8			14.4	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	48.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	246	286	317	297	282
v/c Ratio	0.51	0.45	0.90	0.17	0.25
Control Delay	20.9	5.0	48.2	6.3	7.2
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	20.9	5.0	48.2	6.3	7.2
Queue Length 50th (ft)	66	0	107	23	36
Queue Length 95th (ft)	122	45	#236	33	m48
Internal Link Dist (ft)	1369			403	263
Turn Bay Length (ft)					
Base Capacity (vph)	515	663	354	1722	1120
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.48	0.43	0.90	0.17	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	226	0	263	292	273	0	0	117	143
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	
Frt					1.00	0.85	1.00	1.00			0.92	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1770	1583	1770	3539			3247	
Flt Permitted					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (perm)					1770	1583	1770	3539			3247	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	246	0	286	317	297	0	0	127	155
RTOR Reduction (vph)	0	0	0	0	0	209	0	0	0	0	111	0
Lane Group Flow (vph)	0	0	0	0	246	77	317	297	0	0	171	0
Turn Type				Perm		Perm	Prot					
Protected Phases					8		5	2			6	
Permitted Phases				8		8						
Actuated Green, G (s)					14.8	14.8	12.6	25.2			15.6	
Effective Green, g (s)					14.8	14.8	12.6	25.2			15.6	
Actuated g/C Ratio					0.27	0.27	0.23	0.46			0.28	
Clearance Time (s)					4.0	4.0	4.0	4.0			4.0	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					476	426	405	1622			921	
v/s Ratio Prot							c0.18	c0.08			0.05	
v/s Ratio Perm					0.14	0.05						
v/c Ratio					0.52	0.18	0.78	0.18			0.19	
Uniform Delay, d1					17.1	15.4	19.9	8.8			14.9	
Progression Factor					1.00	1.00	0.79	0.63			0.94	
Incremental Delay, d2					1.0	0.2	9.0	0.2			0.3	
Delay (s)					18.0	15.6	24.7	5.8			14.4	
Level of Service					B	B	C	A			B	
Approach Delay (s)		0.0			16.7			15.5			14.4	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	SBL	SBT
Lane Group Flow (vph)	137	351	690	54	318
v/c Ratio	0.29	0.51	0.40	0.34	0.29
Control Delay	17.1	5.2	8.9	30.6	5.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	17.1	5.2	8.9	30.6	5.8
Queue Length 50th (ft)	34	0	62	21	32
Queue Length 95th (ft)	71	49	102	m46	41
Internal Link Dist (ft)	907		1985		403
Turn Bay Length (ft)					
Base Capacity (vph)	515	709	1722	161	1105
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.27	0.50	0.40	0.34	0.29

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	126	0	323	0	0	0	0	439	196	50	293	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					0.95		1.00	0.95	
Frt		1.00	0.85					0.95		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583					3375		1770	3539	
Flt Permitted		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (perm)		1770	1583					3375		1770	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	137	0	351	0	0	0	0	477	213	54	318	0
RTOR Reduction (vph)	0	0	257	0	0	0	0	84	0	0	0	0
Lane Group Flow (vph)	0	137	94	0	0	0	0	606	0	54	318	0
Turn Type	Perm		Perm							Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4		4									
Actuated Green, G (s)		14.8	14.8					25.2		3.0	15.6	
Effective Green, g (s)		14.8	14.8					25.2		3.0	15.6	
Actuated g/C Ratio		0.27	0.27					0.46		0.05	0.28	
Clearance Time (s)		4.0	4.0					4.0		4.0	4.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		476	426					1546		97	1004	
v/s Ratio Prot								c0.18		c0.03	0.09	
v/s Ratio Perm		0.08	0.06									
v/c Ratio		0.29	0.22					0.39		0.56	0.32	
Uniform Delay, d1		15.9	15.6					9.8		25.4	15.5	
Progression Factor		1.00	1.00					1.00		1.06	0.34	
Incremental Delay, d2		0.3	0.3					0.7		6.3	0.8	
Delay (s)		16.3	15.9					10.6		33.2	6.1	
Level of Service		B	B					B		C	A	
Approach Delay (s)		16.0			0.0			10.6			10.0	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	12.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	55.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	215	208	197	8	1026	389	8
v/c Ratio	0.48	0.43	0.36	0.02	0.59	0.26	0.01
Control Delay	20.3	10.5	5.2	16.7	9.8	11.0	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.3	10.5	5.2	16.7	9.8	11.0	6.4
Queue Length 50th (ft)	60	23	0	1	57	45	0
Queue Length 95th (ft)	113	72	40	m2	142	73	6
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	535	564	613	342	1731	1503	643
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.37	0.32	0.02	0.59	0.26	0.01

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	279	0	292	7	944	0	0	357	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.91	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1516	1504	3433	3539			3389	1441
Flt Permitted				0.95	0.98	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1516	1504	3433	3539			3389	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	303	0	317	8	1026	0	0	388	9
RTOR Reduction (vph)	0	0	0	0	89	147	0	0	0	0	1	5
Lane Group Flow (vph)	0	0	0	215	119	50	8	1026	0	0	388	3
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				13.5	13.5	13.5	4.6	25.0			22.6	22.6
Effective Green, g (s)				13.5	13.5	13.5	4.6	25.0			22.6	22.6
Actuated g/C Ratio				0.26	0.26	0.26	0.09	0.47			0.43	0.43
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				431	388	385	300	1679			1453	618
v/s Ratio Prot				c0.13	0.08		c0.00	c0.29			0.11	0.00
v/s Ratio Perm						0.03						
v/c Ratio				0.50	0.31	0.13	0.03	0.61			0.27	0.01
Uniform Delay, d1				16.7	15.8	15.1	22.0	10.3			9.7	8.6
Progression Factor				1.00	1.00	1.00	0.73	0.74			1.00	1.00
Incremental Delay, d2				0.9	0.4	0.2	0.0	1.5			0.5	0.0
Delay (s)				17.6	16.3	15.2	16.0	9.1			10.2	8.6
Level of Service				B	B	B	B	A			B	A
Approach Delay (s)		0.0			16.4			9.2			10.1	
Approach LOS		A			B			A			B	

Intersection Summary			
HCM Average Control Delay	11.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	52.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	44.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	276	293	255	4	369	187	499	59	512	121
v/c Ratio	0.62	0.65	0.44	0.01	0.63	0.55	0.29	0.42	0.34	0.17
Control Delay	23.8	23.8	5.3	14.0	13.7	30.8	9.7	28.1	9.8	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.8	23.8	5.3	14.0	13.7	30.8	9.7	28.1	9.8	3.5
Queue Length 50th (ft)	80	83	0	1	45	31	53	19	32	0
Queue Length 95th (ft)	147	158	45	7	116	#64	84	m#58	60	20
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	535	536	653	564	664	342	1726	141	1500	706
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.55	0.39	0.01	0.56	0.55	0.29	0.42	0.34	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	282	200	276	4	110	229	172	440	19	54	458	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.98	0.85	1.00	0.90		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	0.99	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1647	1504	1770	1674		3433	3517		1770	3376	1441
Flt Permitted	0.95	0.99	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1647	1504	1770	1674		3433	3517		1770	3376	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	307	217	300	4	120	249	187	478	21	59	498	135
RTOR Reduction (vph)	0	13	190	0	143	0	0	5	0	0	3	69
Lane Group Flow (vph)	276	280	65	4	226	0	187	494	0	59	509	52
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	13.5	13.5	13.5	13.5	13.5		4.6	25.0		2.2	22.6	22.6
Effective Green, g (s)	13.5	13.5	13.5	13.5	13.5		4.6	25.0		2.2	22.6	22.6
Actuated g/C Ratio	0.26	0.26	0.26	0.26	0.26		0.09	0.47		0.04	0.43	0.43
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	431	422	385	453	429		300	1668		74	1448	618
v/s Ratio Prot	0.16	c0.17		0.00	0.14		c0.05	0.14		0.03	c0.15	
v/s Ratio Perm			0.04									0.04
v/c Ratio	0.64	0.66	0.17	0.01	0.53		0.62	0.30		0.80	0.35	0.08
Uniform Delay, d1	17.4	17.6	15.2	14.6	16.9		23.2	8.5		25.0	10.1	8.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.73	0.85	1.05
Incremental Delay, d2	3.2	3.9	0.2	0.0	1.2		4.0	0.5		42.0	0.6	0.3
Delay (s)	20.7	21.5	15.5	14.6	18.0		27.2	8.9		60.4	9.3	9.6
Level of Service	C	C	B	B	B		C	A		E	A	A
Approach Delay (s)		19.3			18.0			13.9			13.7	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	16.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	52.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX C

SYNCHRO ANALYSIS

HORIZON YEAR (2036) WITH PROJECT – PM PEAK HOUR

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	303	292	282	370	1049	1091	257
v/c Ratio	0.73	0.57	0.48	0.70	0.72	0.43	0.33
Control Delay	32.0	12.2	5.9	21.5	11.0	13.9	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	12.2	5.9	21.5	11.0	13.9	3.4
Queue Length 50th (ft)	103	31	0	70	58	82	0
Queue Length 95th (ft)	#204	100	51	#123	109	108	38
Internal Link Dist (ft)		1020			379	765	
Turn Bay Length (ft)							
Base Capacity (vph)	460	547	617	529	1454	2522	779
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.53	0.46	0.70	0.72	0.43	0.33

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	358	2	447	340	965	0	0	1004	236
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.86	1.00
Frt				1.00	0.90	0.85	1.00	1.00			1.00	0.85
Flt Protected				0.95	0.99	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1495	1504	3433	3539			6408	1583
Flt Permitted				0.95	0.99	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1495	1504	3433	3539			6408	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	389	2	486	370	1049	0	0	1091	257
RTOR Reduction (vph)	0	0	0	0	143	212	0	0	0	0	0	156
Lane Group Flow (vph)	0	0	0	303	149	70	370	1049	0	0	1091	101
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				14.5	14.5	14.5	9.0	24.0			23.0	23.0
Effective Green, g (s)				14.5	14.5	14.5	9.0	24.0			23.0	23.0
Actuated g/C Ratio				0.25	0.25	0.25	0.15	0.41			0.39	0.39
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				417	371	373	528	1452			2519	622
v/s Ratio Prot				c0.18	0.10		c0.11	c0.30			0.17	0.06
v/s Ratio Perm						0.05						
v/c Ratio				0.73	0.40	0.19	0.70	0.72			0.43	0.16
Uniform Delay, d1				20.2	18.4	17.4	23.5	14.5			13.0	11.5
Progression Factor				1.00	1.00	1.00	0.59	0.55			1.00	1.00
Incremental Delay, d2				6.2	0.7	0.2	3.4	2.6			0.5	0.6
Delay (s)				26.4	19.1	17.6	17.2	10.6			13.5	12.1
Level of Service				C	B	B	B	B			B	B
Approach Delay (s)		0.0			21.1			12.3			13.2	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	58.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

2: EB 210 Off Ramp & Riverside Avenue

Lane Group	EBL	EBT	EBR	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	122	141	139	1541	336	382	1099
v/c Ratio	0.28	0.29	0.29	0.62	0.46	0.81	0.79
Control Delay	19.5	5.8	5.7	14.4	4.1	34.4	12.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.5	5.8	5.7	14.4	4.1	34.4	12.9
Queue Length 50th (ft)	35	0	0	124	0	76	85
Queue Length 95th (ft)	72	36	36	161	53	#142	#139
Internal Link Dist (ft)		850		970			379
Turn Bay Length (ft)							
Base Capacity (vph)	484	514	513	2474	724	470	1393
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.27	0.27	0.62	0.46	0.81	0.79

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	112	1	257	0	0	0	0	1193	534	351	1011	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	0.95					0.81	0.81	0.97	0.95	
Frt	1.00	0.85	0.85					0.98	0.85	1.00	1.00	
Flt Protected	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1506	1504					5892	1282	3433	3539	
Flt Permitted	0.95	1.00	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1506	1504					5892	1282	3433	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	122	1	279	0	0	0	0	1297	580	382	1099	0
RTOR Reduction (vph)	0	105	105	0	0	0	0	55	198	0	0	0
Lane Group Flow (vph)	122	36	34	0	0	0	0	1486	138	382	1099	0
Turn Type	Split		Perm						Perm	Prot		
Protected Phases	4	4						2		1	6	
Permitted Phases			4						2			
Actuated Green, G (s)	14.5	14.5	14.5					24.0	24.0	8.0	23.0	
Effective Green, g (s)	14.5	14.5	14.5					24.0	24.0	8.0	23.0	
Actuated g/C Ratio	0.25	0.25	0.25					0.41	0.41	0.14	0.39	
Clearance Time (s)	4.0	4.0	4.0					4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0					3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	439	373	373					2417	526	469	1391	
v/s Ratio Prot	c0.07	0.02						0.25		c0.11	c0.31	
v/s Ratio Perm			0.02						0.11			
v/c Ratio	0.28	0.10	0.09					0.61	0.26	0.81	0.79	
Uniform Delay, d1	17.8	16.9	16.9					13.6	11.4	24.5	15.6	
Progression Factor	1.00	1.00	1.00					1.00	1.00	0.76	0.50	
Incremental Delay, d2	0.3	0.1	0.1					1.2	1.2	9.4	4.1	
Delay (s)	18.1	17.1	17.0					14.8	12.6	28.0	12.0	
Level of Service	B	B	B					B	B	C	B	
Approach Delay (s)		17.4			0.0			14.4			16.1	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	58.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT
Lane Group Flow (vph)	5	456	274	559	338	5	426	15
v/c Ratio	0.02	0.35	0.91	0.43	0.61	0.01	0.48	0.03
Control Delay	13.4	12.4	57.9	16.7	18.4	11.8	3.2	15.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Total Delay	13.4	12.4	57.9	16.7	18.4	11.8	3.2	15.4
Queue Length 50th (ft)	1	51	100	84	70	1	0	3
Queue Length 95th (ft)	7	83	#235	124	191	m3	19	15
Internal Link Dist (ft)		1614		2608		263		977
Turn Bay Length (ft)								
Base Capacity (vph)	253	1315	303	1307	557	746	889	453
Starvation Cap Reductn	0	0	0	0	0	0	42	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.35	0.90	0.43	0.61	0.01	0.50	0.03

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	303	117	252	510	5	311	5	392	5	5	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frt	1.00	0.96		1.00	1.00		1.00	1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.98	
Satd. Flow (prot)	1770	3391		1770	3534		1770	1863	1583		1750	
Flt Permitted	0.37	1.00		0.44	1.00		0.75	1.00	1.00		0.95	
Satd. Flow (perm)	684	3391		822	3534		1393	1863	1583		1695	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	329	127	274	554	5	338	5	426	5	5	5
RTOR Reduction (vph)	0	63	0	0	1	0	0	0	261	0	4	0
Lane Group Flow (vph)	5	393	0	274	558	0	338	5	165	0	11	0
Turn Type	Perm			Perm			Perm		Perm	Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	23.8	23.8		23.8	23.8		25.2	25.2	25.2		16.4	
Effective Green, g (s)	23.8	23.8		23.8	23.8		25.2	25.2	25.2		16.4	
Actuated g/C Ratio	0.37	0.37		0.37	0.37		0.39	0.39	0.39		0.25	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)	250	1242		301	1294		540	722	614		428	
v/s Ratio Prot		0.12			0.16			0.00				
v/s Ratio Perm	0.01			c0.33			c0.24		0.10		0.01	
v/c Ratio	0.02	0.32		0.91	0.43		0.63	0.01	0.27		0.03	
Uniform Delay, d1	13.2	14.8		19.6	15.5		16.1	12.2	13.6		18.3	
Progression Factor	1.00	1.00		1.00	1.00		0.80	0.90	0.73		1.00	
Incremental Delay, d2	0.0	0.1		29.9	0.2		5.0	0.0	1.0		0.1	
Delay (s)	13.2	14.9		49.4	15.7		17.9	11.0	10.9		18.4	
Level of Service	B	B		D	B		B	B	B		B	
Approach Delay (s)		14.9			26.8			14.0			18.4	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	412	464	291	305	408
v/c Ratio	0.64	0.53	0.89	0.22	0.40
Control Delay	22.3	4.2	52.0	9.0	12.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	22.3	4.2	52.0	9.0	12.1
Queue Length 50th (ft)	131	0	120	30	68
Queue Length 95th (ft)	218	53	#250	45	m88
Internal Link Dist (ft)	1369			403	263
Turn Bay Length (ft)					
Base Capacity (vph)	654	877	327	1417	1019
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.63	0.53	0.89	0.22	0.40

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	379	0	427	268	281	0	0	183	192
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor					1.00	1.00	1.00	0.95			0.95	
Frt					1.00	0.85	1.00	1.00			0.92	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1770	1583	1770	3539			3267	
Flt Permitted					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (perm)					1770	1583	1770	3539			3267	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	412	0	464	291	305	0	0	199	209
RTOR Reduction (vph)	0	0	0	0	0	294	0	0	0	0	156	0
Lane Group Flow (vph)	0	0	0	0	412	170	291	305	0	0	252	0
Turn Type				Perm		Perm	Prot					
Protected Phases					8		5	2			6	
Permitted Phases				8		8						
Actuated Green, G (s)					23.8	23.8	12.8	25.2			16.4	
Effective Green, g (s)					23.8	23.8	12.8	25.2			16.4	
Actuated g/C Ratio					0.37	0.37	0.20	0.39			0.25	
Clearance Time (s)					4.0	4.0	4.0	4.0			4.0	
Vehicle Extension (s)					3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)					648	580	349	1372			824	
v/s Ratio Prot							c0.16	0.09			c0.08	
v/s Ratio Perm					0.23	0.11						
v/c Ratio					0.64	0.29	0.83	0.22			0.31	
Uniform Delay, d1					17.0	14.6	25.1	13.3			19.7	
Progression Factor					1.00	1.00	0.79	0.63			1.18	
Incremental Delay, d2					2.0	0.3	14.9	0.4			0.7	
Delay (s)					19.1	14.9	34.8	8.8			23.9	
Level of Service					B	B	C	A			C	
Approach Delay (s)		0.0			16.9			21.5			23.9	
Approach LOS		A			B			C			C	

Intersection Summary			
HCM Average Control Delay	19.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	EBR	NBT	SBL	SBT
Lane Group Flow (vph)	182	401	561	84	527
v/c Ratio	0.28	0.48	0.40	0.62	0.56
Control Delay	16.0	4.0	13.3	49.8	13.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	4.0	13.3	49.8	13.5
Queue Length 50th (ft)	49	0	70	38	82
Queue Length 95th (ft)	92	50	110	m#71	138
Internal Link Dist (ft)	907		1985		403
Turn Bay Length (ft)					
Base Capacity (vph)	654	837	1413	136	938
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.28	0.48	0.40	0.62	0.56

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	167	0	369	0	0	0	0	382	134	77	485	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00					0.95		1.00	0.95	
Frt		1.00	0.85					0.96		1.00	1.00	
Flt Protected		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1770	1583					3401		1770	3539	
Flt Permitted		0.95	1.00					1.00		0.95	1.00	
Satd. Flow (perm)		1770	1583					3401		1770	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	182	0	401	0	0	0	0	415	146	84	527	0
RTOR Reduction (vph)	0	0	254	0	0	0	0	53	0	0	0	0
Lane Group Flow (vph)	0	182	147	0	0	0	0	508	0	84	527	0
Turn Type	Perm		Perm							Prot		
Protected Phases		4						2		1	6	
Permitted Phases	4		4									
Actuated Green, G (s)		23.8	23.8					25.2		4.0	16.4	
Effective Green, g (s)		23.8	23.8					25.2		4.0	16.4	
Actuated g/C Ratio		0.37	0.37					0.39		0.06	0.25	
Clearance Time (s)		4.0	4.0					4.0		4.0	4.0	
Vehicle Extension (s)		3.0	3.0					3.0		3.0	3.0	
Lane Grp Cap (vph)		648	580					1319		109	893	
v/s Ratio Prot								c0.15		c0.05	c0.15	
v/s Ratio Perm		0.10	0.09									
v/c Ratio		0.28	0.25					0.39		0.77	0.59	
Uniform Delay, d1		14.6	14.4					14.3		30.0	21.3	
Progression Factor		1.00	1.00					1.00		1.05	0.55	
Incremental Delay, d2		0.2	0.2					0.9		24.1	2.4	
Delay (s)		14.8	14.6					15.2		55.6	14.1	
Level of Service		B	B					B		E	B	
Approach Delay (s)		14.7			0.0			15.2			19.8	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	16.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBL	WBT	WBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	12	345	343	1	451	902	387
v/c Ratio	0.03	0.57	0.56	0.00	0.29	0.65	0.47
Control Delay	14.4	6.6	6.2	13.0	15.3	15.5	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.4	6.6	6.2	13.0	15.3	15.5	3.8
Queue Length 50th (ft)	3	0	0	0	43	119	0
Queue Length 95th (ft)	12	54	51	m0	85	190	48
Internal Link Dist (ft)		1082			746	1943	
Turn Bay Length (ft)							
Base Capacity (vph)	528	688	708	404	1564	1393	821
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.50	0.48	0.00	0.29	0.65	0.47

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	12	0	632	1	415	0	0	790	396
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Lane Util. Factor				0.95	0.91	0.95	0.97	0.95			0.91	0.91
Frt				1.00	0.85	0.85	1.00	1.00			0.99	0.85
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (prot)				1681	1441	1504	3433	3539			3366	1441
Flt Permitted				0.95	1.00	1.00	0.95	1.00			1.00	1.00
Satd. Flow (perm)				1681	1441	1504	3433	3539			3366	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	13	0	687	1	451	0	0	859	430
RTOR Reduction (vph)	0	0	0	0	265	264	0	0	0	0	6	230
Lane Group Flow (vph)	0	0	0	12	80	79	1	451	0	0	896	157
Turn Type				Split		Perm	Prot					Prot
Protected Phases				8	8		5	2			6	6
Permitted Phases						8						
Actuated Green, G (s)				12.0	12.0	12.0	7.0	22.7			21.1	21.1
Effective Green, g (s)				12.0	12.0	12.0	7.0	22.7			21.1	21.1
Actuated g/C Ratio				0.23	0.23	0.23	0.13	0.44			0.40	0.40
Clearance Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	4.0
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	3.0
Lane Grp Cap (vph)				387	332	346	461	1542			1363	584
v/s Ratio Prot				0.01	c0.06		c0.00	0.13			c0.27	0.11
v/s Ratio Perm						0.05						
v/c Ratio				0.03	0.24	0.23	0.00	0.29			0.66	0.27
Uniform Delay, d1				15.5	16.3	16.3	19.5	9.5			12.6	10.3
Progression Factor				1.00	1.00	1.00	0.59	1.30			1.00	1.00
Incremental Delay, d2				0.0	0.4	0.3	0.0	0.5			2.5	1.1
Delay (s)				15.6	16.7	16.6	11.6	12.9			15.1	11.5
Level of Service				B	B	B	B	B			B	B
Approach Delay (s)		0.0			16.7			12.9			14.0	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	52.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	44.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	71	159	139	33	215	218	319	103	585	184
v/c Ratio	0.18	0.39	0.30	0.08	0.47	0.54	0.21	0.45	0.42	0.26
Control Delay	16.1	16.7	5.5	14.9	15.7	27.9	10.8	19.4	24.2	14.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.1	16.7	5.5	14.9	15.7	27.9	10.8	19.4	24.2	14.2
Queue Length 50th (ft)	17	37	0	8	40	34	32	7	98	18
Queue Length 95th (ft)	44	81	33	24	88	64	58	m28	151	m76
Internal Link Dist (ft)		1551			1236		1362		746	
Turn Bay Length (ft)										
Base Capacity (vph)	528	531	568	556	590	404	1555	243	1394	702
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.30	0.24	0.06	0.36	0.54	0.21	0.42	0.42	0.26

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	73	109	158	30	124	74	201	269	25	95	519	189
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.95	0.91	0.95	1.00	1.00		0.97	0.95		1.00	0.91	0.91
Frt	1.00	0.97	0.85	1.00	0.94		1.00	0.99		1.00	0.99	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1681	1638	1504	1770	1759		3433	3494		1770	3372	1441
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1681	1638	1504	1770	1759		3433	3494		1770	3372	1441
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	79	118	172	33	135	80	218	292	27	103	564	205
RTOR Reduction (vph)	0	18	107	0	42	0	0	11	0	0	4	109
Lane Group Flow (vph)	71	141	32	33	173	0	218	308	0	103	581	75
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4!	4!		8!	8!		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	12.0	12.0	12.0	12.0	12.0		7.0	22.7		5.4	21.1	21.1
Effective Green, g (s)	12.0	12.0	12.0	12.0	12.0		7.0	22.7		5.4	21.1	21.1
Actuated g/C Ratio	0.23	0.23	0.23	0.23	0.23		0.13	0.44		0.10	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	387	377	346	408	405		461	1522		183	1366	584
v/s Ratio Prot	0.04	0.09		0.02	c0.10		c0.06	0.09		0.06	c0.17	
v/s Ratio Perm			0.02									0.05
v/c Ratio	0.18	0.37	0.09	0.08	0.43		0.47	0.20		0.56	0.43	0.13
Uniform Delay, d1	16.1	16.9	15.8	15.7	17.1		20.8	9.1		22.2	11.1	9.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.66	2.02	5.30
Incremental Delay, d2	0.2	0.6	0.1	0.1	0.7		0.8	0.3		3.0	0.7	0.3
Delay (s)	16.3	17.5	15.9	15.8	17.8		21.6	9.4		17.6	23.3	51.9
Level of Service	B	B	B	B	B		C	A		B	C	D
Approach Delay (s)		16.7			17.6			14.4			28.7	
Approach LOS		B			B			B			C	

Intersection Summary			
HCM Average Control Delay	21.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	52.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.0%	ICU Level of Service	A
Analysis Period (min)	15		

! Phase conflict between lane groups.

c Critical Lane Group

APPENDIX D

HCS ANALYSIS - RAMPS

APPENDIX D

HCS ANALYSIS - RAMPS

EXISTING YEAR (2011) NO PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2918	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	469	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	712	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	2918		469		712		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	768		123		187		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3302	531	806	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.653 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2341 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3302	7050	No
$v_{FO} = v_F - v_R$	2771	7050	No
v_R	531	2000	No
v_3 or v_{av34}	961 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2341 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2341	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 22.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.476	
Space mean speed in ramp influence area,	S_R = 54.1	mph
Space mean speed in outer lanes,	S_O = 71.3	mph
Space mean speed for all vehicles,	S = 58.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/27/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2499	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	712	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	469	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2499	712	469	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	658	187	123	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2828	806	531	pcph

Estimation of V12 Merge Areas

L_{EQ} = 871.88 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1752 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3634	7050	No
v_3 or v_{av34}	1076 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 1752 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2558	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.266

Space mean speed in ramp influence area, S_R = 58.9 mph

Space mean speed in outer lanes, S_O = 62.9 mph

Space mean speed for all vehicles, S = 60.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3161	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	354	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	368	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3161		354		368		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	832		93		97		v
Trucks and buses	5		4		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		3.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3577	389	403	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1824 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3577	7050	No
$v_{FO} = v_F - v_R$	3188	7050	No
v_R	389	4000	No
v_3 or v_{av34}	1753 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 2044 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2044	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 5.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.463	
Space mean speed in ramp influence area,	S_R = 54.4	mph
Space mean speed in outer lanes,	S_O = 69.2	mph
Space mean speed for all vehicles,	S = 59.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2807	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	368	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	354	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2807	368	354	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	739	97	93	v
Trucks and buses	5	2	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	3.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.962	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3176	403	389	pcph

Estimation of V12 Merge Areas

L_{EQ} = 860.11 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1968 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3579	7050	No
v_3 or v_{av34}	1208 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 1968 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2371	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 14.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.258

Space mean speed in ramp influence area, S_R = 59.1 mph

Space mean speed in outer lanes, S_0 = 62.5 mph

Space mean speed for all vehicles, S = 60.2 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3315	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	432	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	417	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3315		432		417		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	872		114		110		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.4*		2.2*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.935	0.943	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3751	487	465	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.644 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2588 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3751	7050	No
$v_{FO} = v_F - v_R$	3264	7050	No
v_R	487	2000	No
v_3 or v_{av34}	1163 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2588 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2588	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 13.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.472	
Space mean speed in ramp influence area,	S_R = 54.1	mph
Space mean speed in outer lanes,	S_O = 70.7	mph
Space mean speed for all vehicles,	S = 58.4	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2883	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	417	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	432	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2883	417	432	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	759	110	114	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.2*	2.4*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.943	0.935	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3262	465	487	pcph

Estimation of V12 Merge Areas

L_{EQ} = 816.30 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2005 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3727	7050	No
v_3 or v_{av34}	1257 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2005 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2470	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.274

Space mean speed in ramp influence area, S_R = 58.7 mph

Space mean speed in outer lanes, S_0 = 62.3 mph

Space mean speed for all vehicles, S = 59.9 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3300	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	803	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	549	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3300		803		549		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	868		211		144		v
Trucks and buses	5		5		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3734	909	603	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2180 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3734	7050	No
$v_{FO} = v_F - v_R$	2825	7050	No
v_R	909	4000	No
v_3 or v_{av34}	1554 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2180 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2180	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = -4.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.510

Space mean speed in ramp influence area, S_R = 53.3 mph

Space mean speed in outer lanes, S_O = 69.1 mph

Space mean speed for all vehicles, S = 58.9 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2497	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	549	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	806	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2497	549	806	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	657	144	212	v
Trucks and buses	5	4	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	2826	603	912	pcph

Estimation of V12 Merge Areas

L_{EQ} = 828.01 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1751 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3429	7050	No
v_3 or v_{av34}	1075 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 1751 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2354	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 14.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.257

Space mean speed in ramp influence area, S_R = 59.1 mph

Space mean speed in outer lanes, S_0 = 62.9 mph

Space mean speed for all vehicles, S = 60.2 mph

APPENDIX D

HCS ANALYSIS - RAMPS

EXISTING YEAR (2011) NO PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2011
Description:	Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4010	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	512	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	846	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4010		512		846		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1055		135		223		v
Trucks and buses	5		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.9*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.982	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4538	549	910	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.621 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3027 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4538	7050	No
$v_{FO} = v_F - v_R$	3989	7050	No
v_R	549	2000	No
v_3 or v_{av34}	1511 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3027 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3027	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.0+ pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, D_S = 0.477

Space mean speed in ramp influence area, S_R = 54.0 mph

Space mean speed in outer lanes, S_O = 69.3 mph

Space mean speed for all vehicles, S = 58.3 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3498	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	846	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	512	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3498	846	512	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	921	223	135	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.9*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.982	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3958	910	549	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1135.95 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2452 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4868	7050	No
v_3 or v_{av34}	1506 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2452 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3362	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 21.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.329

Space mean speed in ramp influence area, S_R = 57.4 mph

Space mean speed in outer lanes, S_O = 61.4 mph

Space mean speed for all vehicles, S = 58.6 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4344	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	267	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	557	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4344		267		557		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1143		70		147		v
Trucks and buses	5		5		6		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		1.9*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.948	0.949	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4916	297	618	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2376 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4916	7050	No
$v_{FO} = v_F - v_R$	4619	7050	No
v_R	297	4000	No
v_3 or v_{av34}	2540 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 2809 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2809	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 12.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.455	
Space mean speed in ramp influence area,	S_R = 54.5	mph
Space mean speed in outer lanes,	S_O = 67.0	mph
Space mean speed for all vehicles,	S = 59.3	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4077	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	557	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	267	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4077	557	267	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1073	147	70	v
Trucks and buses	5	6	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	1.9*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.949	0.948	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4613	618	297	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1213.63 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2858 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5231	7050	No
v_3 or v_{av34}	1755 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2858 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3476	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 22.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.342

Space mean speed in ramp influence area, S_R = 57.1 mph

Space mean speed in outer lanes, S_O = 60.5 mph

Space mean speed for all vehicles, S = 58.2 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:
Agency/Co.: IBI Group
Date performed: 07/17/2013
Analysis time period: PM
Freeway/Dir of Travel: SR-210 WB
Junction: State Street
Jurisdiction: Caltrans District 8
Analysis Year: 2011
Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3456	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	333	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	317	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3456		333		317		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	909		88		83		v
Trucks and buses	5		5		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.8*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.962	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3911	365	341	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.645 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2654 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3911	7050	No
$v_{FO} = v_F - v_R$	3546	7050	No
v_R	365	2000	No
v_3 or v_{av34}	1257 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2654 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2654	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 13.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.461

Space mean speed in ramp influence area, S_R = 54.4 mph

Space mean speed in outer lanes, S_O = 70.3 mph

Space mean speed for all vehicles, S = 58.7 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3123	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	317	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	333	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3123	317	333	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	822	83	88	v
Trucks and buses	5	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.8*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3534	341	365	pcph

Estimation of V12 Merge Areas

L_{EQ} = 847.97 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2172 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3875	7050	No
v_3 or v_{av34}	1362 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2172 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2513	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 16.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.276

Space mean speed in ramp influence area, S_R = 58.7 mph

Space mean speed in outer lanes, S_0 = 61.9 mph

Space mean speed for all vehicles, S = 59.8 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3440	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	731	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	467	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3440		731		467		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	905		192		123		v
Trucks and buses	5		3		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		2.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.968	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3893	795	501	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2189 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3893	7050	No
$v_{FO} = v_F - v_R$	3098	7050	No
v_R	795	4000	No
v_3 or v_{av34}	1704 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12}/2	Yes	

If yes, v_{12A} = 2224 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2224	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = -3.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.500	
Space mean speed in ramp influence area,	S_R = 53.5	mph
Space mean speed in outer lanes,	S_O = 68.7	mph
Space mean speed for all vehicles,	S = 59.1	mph

APPENDIX D

HCS ANALYSIS - RAMPS

OPENING YEAR (2016) NO PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3245	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	502	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	748	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3245		502		748		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	854		132		197		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3672	568	846	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.642 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2561 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3672	7050	No
$v_{FO} = v_F - v_R$	3104	7050	No
v_R	568	2000	No
v_3 or v_{av34}	1111 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2561 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2561	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 24.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.479

Space mean speed in ramp influence area, S_R = 54.0 mph

Space mean speed in outer lanes, S_O = 70.9 mph

Space mean speed for all vehicles, S = 58.2 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2743	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	748	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	502	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2743	748	502	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	722	197	132	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3104	846	568	pcph

Estimation of V12 Merge Areas

L_{EQ} = 939.50 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1923 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3950	7050	No
v_3 or v_{av34}	1181 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 1923 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2769	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.278

Space mean speed in ramp influence area, S_R = 58.6 mph

Space mean speed in outer lanes, S_0 = 62.5 mph

Space mean speed for all vehicles, S = 59.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3467	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	457	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	401	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3467		457		401		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	912		120		106		v
Trucks and buses	5		4		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		3.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3923	502	439	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2041 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3923	7050	No
$v_{FO} = v_F - v_R$	3421	7050	No
v_R	502	4000	No
v_3 or v_{av34}	1882 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2241 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2241	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 7.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.473

Space mean speed in ramp influence area, S_R = 54.1 mph

Space mean speed in outer lanes, S_O = 68.6 mph

Space mean speed for all vehicles, S = 59.5 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3010	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	401	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	457	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3010	401	457	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	792	106	120	v
Trucks and buses	5	2	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	3.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.962	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3406	439	502	pcph

Estimation of V12 Merge Areas

L_{EQ} = 917.03 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2110 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3845	7050	No
v_3 or v_{av34}	1296 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2110 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2549	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.266

Space mean speed in ramp influence area, S_R = 58.9 mph

Space mean speed in outer lanes, S_0 = 62.1 mph

Space mean speed for all vehicles, S = 59.9 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:
Agency/Co.: IBI Group
Date performed: 07/17/2013
Analysis time period: AM
Freeway/Dir of Travel: SR-210 WB
Junction: State Street
Jurisdiction: Caltrans District 8
Analysis Year: 2016
Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3638	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	486	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	359	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3638		486		359	vph
Peak-hour factor, PHF	0.95		0.95		0.95	
Peak 15-min volume, v15	957		128		94	v
Trucks and buses	5		5		5	%
Recreational vehicles	0		0		0	%
Terrain type:	Level		Level		Level	
Grade	0.00	%	0.00	%	0.00	%
Length	0.00	mi	0.00	mi	0.00	mi
Trucks and buses PCE, ET	2.5*		2.4*		2.2*	
Recreational vehicle PCE, ER	1.2		1.2		1.2	

Heavy vehicle adjustment, fHV	0.930	0.935	0.943	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4117	547	401	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.632 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2803 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4117	7050	No
$v_{FO} = v_F - v_R$	3570	7050	No
v_R	547	2000	No
v_3 or v_{av34}	1314 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2803 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2803	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.477	
Space mean speed in ramp influence area,	S_R = 54.0	mph
Space mean speed in outer lanes,	S_O = 70.1	mph
Space mean speed for all vehicles,	S = 58.3	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3152	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	359	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	486	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3152	359	486	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	829	94	128	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.2*	2.4*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.943	0.935	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3567	401	547	pcph

Estimation of V12 Merge Areas

L_{EQ} = 867.87 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2193 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3968	7050	No
v_3 or v_{av34}	1374 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2193 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2594	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.280

Space mean speed in ramp influence area, S_R = 58.6 mph

Space mean speed in outer lanes, S_0 = 61.9 mph

Space mean speed for all vehicles, S = 59.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/26/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3511	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	842	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	554	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3511		842		554		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	924		222		146		v
Trucks and buses	5		5		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3973	953	609	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2312 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3973	7050	No
$v_{FO} = v_F - v_R$	3020	7050	No
v_R	953	4000	No
v_3 or v_{av34}	1661 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2312 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2312	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = -2.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.514	
Space mean speed in ramp influence area,	S_R = 53.2	mph
Space mean speed in outer lanes,	S_O = 68.7	mph
Space mean speed for all vehicles,	S = 58.7	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2669	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	554	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	845	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2669	554	845	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	702	146	222	v
Trucks and buses	5	4	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3020	609	956	pcph

Estimation of V12 Merge Areas

L_{EQ} = 870.81 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1871 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3629	7050	No
v_3 or v_{av34}	1149 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1871 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2480	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.263

Space mean speed in ramp influence area, S_R = 59.0 mph

Space mean speed in outer lanes, S_0 = 62.7 mph

Space mean speed for all vehicles, S = 60.1 mph

APPENDIX D

HCS ANALYSIS - RAMPS

OPENING YEAR (2016) NO PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4229	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	541	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	846	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4229		541		846		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1113		142		223		v
Trucks and buses	5		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.9*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.982	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4785	580	910	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.614 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3161 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4785	7050	No
$v_{FO} = v_F - v_R$	4205	7050	No
v_R	580	2000	No
v_3 or v_{av34}	1624 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3161 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3161	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 29.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.480	
Space mean speed in ramp influence area,	S_R = 54.0	mph
Space mean speed in outer lanes,	S_O = 68.9	mph
Space mean speed for all vehicles,	S = 58.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3688	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	846	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	541	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3688	846	541	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	971	223	142	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.9*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.982	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4173	910	580	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1181.96 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2585 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5083	7050	No
v_3 or v_{av34}	1588 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2585 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3495	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 22.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.345

Space mean speed in ramp influence area, S_R = 57.1 mph

Space mean speed in outer lanes, S_O = 61.1 mph

Space mean speed for all vehicles, S = 58.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4534	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	451	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	508	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4534		451		508		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1193		119		134		v
Trucks and buses	5		5		6		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		1.9*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.948	0.949	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5131	501	564	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2584 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5131	7050	No
$v_{FO} = v_F - v_R$	4630	7050	No
v_R	501	4000	No
v_3 or v_{av34}	2547 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2932 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2932	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 13.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.473

Space mean speed in ramp influence area, S_R = 54.1 mph

Space mean speed in outer lanes, S_O = 66.6 mph

Space mean speed for all vehicles, S = 58.9 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4083	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	508	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	451	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4083	508	451	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1074	134	119	v
Trucks and buses	5	6	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	1.9*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.949	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4620	564	496	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1203.58 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2862 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5184	7050	No
v_3 or v_{av34}	1758 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 2862 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3426	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 22.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.336

Space mean speed in ramp influence area, S_R = 57.3 mph

Space mean speed in outer lanes, S_0 = 60.5 mph

Space mean speed for all vehicles, S = 58.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4005	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	477	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	350	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4005		477		350		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1054		126		92		v
Trucks and buses	5		5		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.8*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.962	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4532	522	377	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.623 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3019 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4532	7050	No
$v_{FO} = v_F - v_R$	4010	7050	No
v_R	522	2000	No
v_3 or v_{av34}	1513 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3019 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3019	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 16.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.475

Space mean speed in ramp influence area, S_R = 54.1 mph

Space mean speed in outer lanes, S_O = 69.3 mph

Space mean speed for all vehicles, S = 58.4 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3528	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	350	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	477	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3528	350	477	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	928	92	126	v
Trucks and buses	5	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.8*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3992	377	522	pcph

Estimation of V12 Merge Areas

L_{EQ} = 953.69 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2454 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4369	7050	No
v_3 or v_{av34}	1538 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2454 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2831	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.294

Space mean speed in ramp influence area, S_R = 58.2 mph

Space mean speed in outer lanes, S_O = 61.3 mph

Space mean speed for all vehicles, S = 59.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/26/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4534	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1003	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	581	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4534		1003		581		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1193		264		153		v
Trucks and buses	5		5		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5131	1135	638	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2933 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5131	7050	No
$v_{FO} = v_F - v_R$	3996	7050	No
v_R	1135	4000	No
v_3 or v_{av34}	2198 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2933 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2933	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 2.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.530

Space mean speed in ramp influence area, S_R = 52.8 mph

Space mean speed in outer lanes, S_O = 66.6 mph

Space mean speed for all vehicles, S = 58.0 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3351	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	581	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1010	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3351	581	1010	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	882	153	266	v
Trucks and buses	5	4	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3792	638	1143	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1042.22 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2349 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4430	7050	No
v_3 or v_{av34}	1443 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2349 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2987	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.293

Space mean speed in ramp influence area, S_R = 58.3 mph

Space mean speed in outer lanes, S_0 = 61.6 mph

Space mean speed for all vehicles, S = 59.3 mph

APPENDIX D

HCS ANALYSIS - RAMPS

OPENING YEAR (2016) WITH PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3245	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	467	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	726	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3245		467		726		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	854		123		191		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3672	528	822	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.644 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2552 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3672	7050	No
$v_{FO} = v_F - v_R$	3144	7050	No
v_R	528	2000	No
v_3 or v_{av34}	1120 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2552 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2552	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 23.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.476	
Space mean speed in ramp influence area,	S_R = 54.1	mph
Space mean speed in outer lanes,	S_O = 70.8	mph
Space mean speed for all vehicles,	S = 58.3	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2778	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	726	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	467	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2778	726	467	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	731	191	123	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3144	822	528	pcph

Estimation of V12 Merge Areas

L_{EQ} = 942.92 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1948 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3966	7050	No
v_3 or v_{av34}	1196 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 1948 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2770	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.278

Space mean speed in ramp influence area, S_R = 58.6 mph

Space mean speed in outer lanes, S_0 = 62.5 mph

Space mean speed for all vehicles, S = 59.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3504	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	81	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	44	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3504		81		44		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	922		21		12		v
Trucks and buses	5		8		8		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.893	0.893	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3965	95	52	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.657 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2636 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3965	7050	No
$v_{FO} = v_F - v_R$	3870	7050	No
v_R	95	2000	No
v_3 or v_{av34}	1329 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2636 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2636	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 24.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.437	
Space mean speed in ramp influence area,	S_R = 55.0	mph
Space mean speed in outer lanes,	S_O = 70.0	mph
Space mean speed for all vehicles,	S = 59.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3423	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	44	vph
Length of first accel/decel lane	600	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	81	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3423	44	81	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	901	12	21	v
Trucks and buses	5	8	8	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.893	0.893	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3873	52	95	pcph

Estimation of V12 Merge Areas

L_{EQ} = 534.55 (Equation 13-6 or 13-7)

P_{FM} = 0.594 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2302 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3925	7050	No
v_3 or v_{av34}	1571 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2302 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2354	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 20.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.320

Space mean speed in ramp influence area, S_R = 57.6 mph

Space mean speed in outer lanes, S_0 = 61.1 mph

Space mean speed for all vehicles, S = 59.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/26/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3467	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	436	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	380	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3467		436		380		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	912		115		100		v
Trucks and buses	5		4		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		3.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3923	479	416	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2029 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3923	7050	No
$v_{FO} = v_F - v_R$	3444	7050	No
v_R	479	4000	No
v_3 or v_{av34}	1894 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 2241 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2241	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 7.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.471	
Space mean speed in ramp influence area,	S_R = 54.2	mph
Space mean speed in outer lanes,	S_O = 68.6	mph
Space mean speed for all vehicles,	S = 59.6	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/27/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3031	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	380	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	436	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3031	380	436	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	798	100	115	v
Trucks and buses	5	2	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	3.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.962	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3430	416	479	pcph

Estimation of V12 Merge Areas

L_{EQ} = 917.24 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2125 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3846	7050	No
v_3 or v_{av34}	1305 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2125 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2541	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.266

Space mean speed in ramp influence area, S_R = 58.9 mph

Space mean speed in outer lanes, S_0 = 62.1 mph

Space mean speed for all vehicles, S = 59.9 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3638	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	452	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	377	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3638		452		377		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	957		119		99		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.4*		2.2*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.935	0.943	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4117	509	421	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.634 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2795 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4117	7050	No
$v_{FO} = v_F - v_R$	3608	7050	No
v_R	509	2000	No
v_3 or v_{av34}	1322 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2795 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2795	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.474	
Space mean speed in ramp influence area,	S_R = 54.1	mph
Space mean speed in outer lanes,	S_O = 70.0	mph
Space mean speed for all vehicles,	S = 58.4	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3186	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	377	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	452	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3186	377	452	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	838	99	119	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.2*	2.4*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.943	0.935	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3605	421	509	pcph

Estimation of V12 Merge Areas

L_{EQ} = 880.28 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2216 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4026	7050	No
v_3 or v_{av34}	1389 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2216 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2637	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.282

Space mean speed in ramp influence area, S_R = 58.5 mph

Space mean speed in outer lanes, S_0 = 61.8 mph

Space mean speed for all vehicles, S = 59.6 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3523	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	90	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	78	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2400	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3523		90		78		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	927		24		21		v
Trucks and buses	5		8		8		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.2*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.893	0.912	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3987	106	90	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.655 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2650 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3987	7050	No
$v_{FO} = v_F - v_R$	3881	7050	No
v_R	106	2000	No
v_3 or v_{av34}	1337 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2650 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2650	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 24.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.438	
Space mean speed in ramp influence area,	S_R = 54.9	mph
Space mean speed in outer lanes,	S_O = 70.0	mph
Space mean speed for all vehicles,	S = 59.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	2700	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	523	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	811	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2700	523	811	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	711	138	213	v
Trucks and buses	5	4	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3055	575	918	pcph

Estimation of V12 Merge Areas

L_{EQ} = 871.02 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1893 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3630	7050	No
v_3 or v_{av34}	1162 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 1893 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2468	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 15.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.262

Space mean speed in ramp influence area, S_R = 59.0 mph

Space mean speed in outer lanes, S_0 = 62.6 mph

Space mean speed for all vehicles, S = 60.1 mph

APPENDIX D

HCS ANALYSIS - RAMPS

OPENING YEAR (2016) WITH PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4229	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	496	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	864	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4229		496		864		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1113		131		227		v
Trucks and buses	5		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.9*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.982	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4785	532	929	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.616 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3151 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4785	7050	No
$v_{FO} = v_F - v_R$	4253	7050	No
v_R	532	2000	No
v_3 or v_{av34}	1634 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3151 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3151	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 29.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, D_S = 0.476

Space mean speed in ramp influence area, S_R = 54.1 mph

Space mean speed in outer lanes, S_O = 68.8 mph

Space mean speed for all vehicles, S = 58.3 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3733	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	864	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	496	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3733	864	496	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	982	227	131	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.9*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.982	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4224	929	532	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1196.94 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2617 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5153	7050	No
v_3 or v_{av34}	1607 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2617 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3546	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 23.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.351

Space mean speed in ramp influence area, S_R = 56.9 mph

Space mean speed in outer lanes, S_0 = 61.0 mph

Space mean speed for all vehicles, S = 58.1 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4597	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	103	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	40	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4597		103		40		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1210		27		11		v
Trucks and buses	5		4		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5202	113	44	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.625 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3292 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5202	7050	No
$v_{FO} = v_F - v_R$	5089	7050	No
v_R	113	2000	No
v_3 or v_{av34}	1910 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3292 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3292	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 30.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.438	
Space mean speed in ramp influence area,	S_R = 54.9	mph
Space mean speed in outer lanes,	S_O = 67.8	mph
Space mean speed for all vehicles,	S = 59.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4494	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	40	vph
Length of first accel/decel lane	600	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	103	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4494	40	103	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1183	11	27	v
Trucks and buses	5	4	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5085	44	113	pcph

Estimation of V12 Merge Areas

L_{EQ} = 792.21 (Equation 13-6 or 13-7)

P_{FM} = 0.594 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3022 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5129	7050	No
v_3 or v_{av34}	2063 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3022 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3066	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 25.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.363

Space mean speed in ramp influence area, S_R = 56.7 mph

Space mean speed in outer lanes, S_O = 59.4 mph

Space mean speed for all vehicles, S = 57.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4534	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	421	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	478	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4534		421		478		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1193		111		126		v
Trucks and buses	5		5		6		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		1.9*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.948	0.949	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5131	468	530	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2566 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5131	7050	No
$v_{FO} = v_F - v_R$	4663	7050	No
v_R	468	4000	No
v_3 or v_{av34}	2565 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 2932 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2932	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 13.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.470	
Space mean speed in ramp influence area,	S_R = 54.2	mph
Space mean speed in outer lanes,	S_O = 66.6	mph
Space mean speed for all vehicles,	S = 58.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4113	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	478	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	421	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4113	478	421	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1082	126	111	v
Trucks and buses	5	6	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	1.9*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.949	0.948	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4654	530	468	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1203.58 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2883 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5184	7050	No
v_3 or v_{av34}	1771 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2883 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3413	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 22.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.334

Space mean speed in ramp influence area, S_R = 57.3 mph

Space mean speed in outer lanes, S_O = 60.4 mph

Space mean speed for all vehicles, S = 58.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4005	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	379	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	368	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4005		379		368		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1054		100		97		v
Trucks and buses	5		5		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.8*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.962	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4532	415	396	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.628 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2999 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4532	7050	No
$v_{FO} = v_F - v_R$	4117	7050	No
v_R	415	2000	No
v_3 or v_{av34}	1533 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2999 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2999	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 16.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.465	
Space mean speed in ramp influence area,	S_R = 54.3	mph
Space mean speed in outer lanes,	S_O = 69.2	mph
Space mean speed for all vehicles,	S = 58.6	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3626	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	368	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	379	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3626	368	379	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	954	97	100	v
Trucks and buses	5	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.8*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4103	396	415	pcph

Estimation of V12 Merge Areas

L_{EQ} = 981.51 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2522 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4499	7050	No
v_3 or v_{av34}	1581 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2522 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2918	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.300

Space mean speed in ramp influence area, S_R = 58.1 mph

Space mean speed in outer lanes, S_0 = 61.1 mph

Space mean speed for all vehicles, S = 59.1 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3994	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	186	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	70	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2400	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	3994		186		70		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1051		49		18		v
Trucks and buses	5		4		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4520	204	77	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.638 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2956 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4520	7050	No
$v_{FO} = v_F - v_R$	4316	7050	No
v_R	204	2000	No
v_3 or v_{av34}	1564 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2956 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2956	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.446	
Space mean speed in ramp influence area,	S_R = 54.7	mph
Space mean speed in outer lanes,	S_O = 69.1	mph
Space mean speed for all vehicles,	S = 59.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3128	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	495	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	750	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3128	495	750	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	823	130	197	v
Trucks and buses	5	2	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.980	0.968	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3540	531	816	pcph

Estimation of V12 Merge Areas

L_{EQ} = 965.39 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2193 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4071	7050	No
v_3 or v_{av34}	1347 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2193 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2724	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 17.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.275

Space mean speed in ramp influence area, S_R = 58.7 mph

Space mean speed in outer lanes, S_0 = 62.0 mph

Space mean speed for all vehicles, S = 59.7 mph

APPENDIX D

HCS ANALYSIS - RAMPS

HORIZON YEAR (2036) NO PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4552	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	673	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	813	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4552		673		813		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1198		177		214		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5151	762	920	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.596 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3379 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5151	7050	No
$v_{FO} = v_F - v_R$	4389	7050	No
v_R	762	2000	No
v_3 or v_{av34}	1772 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3379 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3379	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 31.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.497	
Space mean speed in ramp influence area,	S_R = 53.6	mph
Space mean speed in outer lanes,	S_O = 68.3	mph
Space mean speed for all vehicles,	S = 57.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3879	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	813	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	673	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3879	813	673	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1021	214	177	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4389	920	762	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1230.33 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2719 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5309	7050	No
v_3 or v_{av34}	1670 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2719 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3639	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 24.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.364

Space mean speed in ramp influence area, S_R = 56.6 mph

Space mean speed in outer lanes, S_O = 60.8 mph

Space mean speed for all vehicles, S = 57.9 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4692	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	805	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	466	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4692		805		466		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1235		212		123		v
Trucks and buses	5		4		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		3.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5309	885	510	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2876 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5309	7050	No
$v_{FO} = v_F - v_R$	4424	7050	No
v_R	885	4000	No
v_3 or v_{av34}	2433 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 3033 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3033	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.508	
Space mean speed in ramp influence area,	S_R = 53.3	mph
Space mean speed in outer lanes,	S_O = 66.3	mph
Space mean speed for all vehicles,	S = 58.2	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3887	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	466	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	805	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3887	466	805	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1023	123	212	v
Trucks and buses	5	2	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	3.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.962	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4398	510	885	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1144.51 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2725 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4908	7050	No
v_3 or v_{av34}	1673 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 2725 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3235	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 21.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.315

Space mean speed in ramp influence area, S_R = 57.8 mph

Space mean speed in outer lanes, S_0 = 60.8 mph

Space mean speed for all vehicles, S = 58.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	6200	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	710	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	136	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	6200		710		136		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1632		187		36		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.4*		2.2*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.935	0.943	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	7016	800	152	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.548 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4205 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7016	7050	No
$v_{FO} = v_F - v_R$	6216	7050	No
v_R	800	2000	No
v_3 or v_{av34}	2811 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 4316 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4316	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.500	
Space mean speed in ramp influence area,	S_R = 53.5	mph
Space mean speed in outer lanes,	S_O = 64.7	mph
Space mean speed for all vehicles,	S = 57.3	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4218	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	136	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	710	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4218	136	710	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1110	36	187	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.2*	2.4*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.943	0.935	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4773	152	800	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1072.67 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2934 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4925	7050	No
v_3 or v_{av34}	1839 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2934 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3086	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 21.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.313

Space mean speed in ramp influence area, S_R = 57.8 mph

Space mean speed in outer lanes, S_O = 60.2 mph

Space mean speed for all vehicles, S = 58.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/26/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4534	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1003	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	581	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4534		1003		581		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1193		264		153		v
Trucks and buses	5		5		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5131	1135	638	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2933 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5131	7050	No
$v_{FO} = v_F - v_R$	3996	7050	No
v_R	1135	4000	No
v_3 or v_{av34}	2198 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2933 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2933	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 2.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, D_S = 0.530

Space mean speed in ramp influence area, S_R = 52.8 mph

Space mean speed in outer lanes, S_O = 66.6 mph

Space mean speed for all vehicles, S = 58.0 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3351	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	581	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1010	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3351	581	1010	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	882	153	266	v
Trucks and buses	5	4	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3792	638	1143	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1042.22 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2349 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4430	7050	No
v_3 or v_{av34}	1443 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 2349 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2987	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 19.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.293

Space mean speed in ramp influence area, S_R = 58.3 mph

Space mean speed in outer lanes, S_0 = 61.6 mph

Space mean speed for all vehicles, S = 59.3 mph

APPENDIX D

HCS ANALYSIS - RAMPS

HORIZON YEAR (2036) NO PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5104	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	579	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	771	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5104		579		771		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1343		152		203		v
Trucks and buses	5		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.9*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.982	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5776	620	829	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.587 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3647 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5776	7050	No
$v_{FO} = v_F - v_R$	5156	7050	No
v_R	620	2000	No
v_3 or v_{av34}	2129 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3647 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3647	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 33.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.484	
Space mean speed in ramp influence area,	S_R = 53.9	mph
Space mean speed in outer lanes,	S_O = 66.9	mph
Space mean speed for all vehicles,	S = 58.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4525	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	771	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	579	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4525	771	579	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1191	203	152	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.9*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.982	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5120	829	620	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1367.29 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3172 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5949	7050	No
v_3 or v_{av34}	1948 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3172 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4001	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 26.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.429

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_O = 59.8 mph

Space mean speed for all vehicles, S = 56.6 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5296	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	453	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	656	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5296		453		656		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1394		119		173		v
Trucks and buses	5		5		6		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		1.9*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.948	0.949	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5993	503	728	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2973 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5993	7050	No
$v_{FO} = v_F - v_R$	5490	7050	No
v_R	503	4000	No
v_3 or v_{av34}	3020 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? Yes

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3424 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3424	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 17.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, D_S = 0.473

Space mean speed in ramp influence area, S_R = 54.1 mph

Space mean speed in outer lanes, S_O = 65.2 mph

Space mean speed for all vehicles, S = 58.4 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4843	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	656	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	453	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4843	656	453	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1274	173	119	v
Trucks and buses	5	6	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	1.9*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.949	0.948	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5480	728	503	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1422.71 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3395 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6208	7050	No
v_3 or v_{av34}	2085 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3395 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4123	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.457

Space mean speed in ramp influence area, S_R = 54.5 mph

Space mean speed in outer lanes, S_0 = 59.3 mph

Space mean speed for all vehicles, S = 56.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	6200	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1003	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	430	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	6200		1003		430		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1632		264		113		v
Trucks and buses	5		5		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.8*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.962	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	7016	1098	463	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.534 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4259 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7016	7050	No
$v_{FO} = v_F - v_R$	5918	7050	No
v_R	1098	2000	No
v_3 or v_{av34}	2757 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 4316 (Equation 13-15, 13-16, 18, or 19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4316	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.527	
Space mean speed in ramp influence area,	S_R = 52.9	mph
Space mean speed in outer lanes,	S_O = 64.7	mph
Space mean speed for all vehicles,	S = 56.9	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5197	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	430	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1003	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5197	430	1003	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1368	113	264	v
Trucks and buses	5	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.8*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5881	463	1098	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1376.34 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3615 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6344	7050	No
v_3 or v_{av34}	2266 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3615 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	4078	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.458

Space mean speed in ramp influence area, S_R = 54.5 mph

Space mean speed in outer lanes, S_O = 58.6 mph

Space mean speed for all vehicles, S = 55.9 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5629	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	963	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	744	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5629		963		744		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1481		253		196		v
Trucks and buses	5		3		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		2.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.968	0.980	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6370	1047	799	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3442 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6370	7050	No
$v_{FO} = v_F - v_R$	5323	7050	No
v_R	1047	4000	No
v_3 or v_{av34}	2928 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 3670 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3670	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 8.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.522	
Space mean speed in ramp influence area,	S_R = 53.0	mph
Space mean speed in outer lanes,	S_O = 64.7	mph
Space mean speed for all vehicles,	S = 57.4	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4666	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	744	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	963	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4666	744	963	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1228	196	253	v
Trucks and buses	5	2	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.980	0.968	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5280	799	1047	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1395.11 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3271 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6079	7050	No
v_3 or v_{av34}	2009 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3271 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4070	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.444

Space mean speed in ramp influence area, S_R = 54.8 mph

Space mean speed in outer lanes, S_O = 59.6 mph

Space mean speed for all vehicles, S = 56.3 mph

APPENDIX D

HCS ANALYSIS - RAMPS

HORIZON YEAR (2036) WITH PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4552	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	498	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	820	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4552		498		820		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1198		131		216		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5151	564	928	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.605 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3340 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5151	7050	No
$v_{FO} = v_F - v_R$	4587	7050	No
v_R	564	2000	No
v_3 or v_{av34}	1811 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3340 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3340	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 30.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, D_S = 0.479

Space mean speed in ramp influence area, S_R = 54.0 mph

Space mean speed in outer lanes, S_O = 68.1 mph

Space mean speed for all vehicles, S = 58.2 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4054	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	820	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	498	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4054	820	498	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1067	216	131	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.930	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4587	928	564	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1274.41 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2842 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5515	7050	No
v_3 or v_{av34}	1745 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 2842 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3770	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 25.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.385

Space mean speed in ramp influence area, S_R = 56.1 mph

Space mean speed in outer lanes, S_0 = 60.5 mph

Space mean speed for all vehicles, S = 57.5 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4874	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	403	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	221	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4874		403		221		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1283		106		58		v
Trucks and buses	5		8		8		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.5*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.893	0.893	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5515	475	261	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.600 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3500 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5515	7050	No
$v_{FO} = v_F - v_R$	5040	7050	No
v_R	475	2000	No
v_3 or v_{av34}	2015 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3500 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3500	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 32.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.471	
Space mean speed in ramp influence area,	S_R = 54.2	mph
Space mean speed in outer lanes,	S_O = 67.3	mph
Space mean speed for all vehicles,	S = 58.3	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4471	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	221	vph
Length of first accel/decel lane	600	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	403	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4471	221	403	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1177	58	106	v
Trucks and buses	5	8	8	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.893	0.893	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5059	261	475	pcph

Estimation of V12 Merge Areas

L_{EQ} = 833.08 (Equation 13-6 or 13-7)

P_{FM} = 0.594 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3007 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5320	7050	No
v_3 or v_{av34}	2052 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3007 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3268	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.381

Space mean speed in ramp influence area, S_R = 56.2 mph

Space mean speed in outer lanes, S_O = 59.4 mph

Space mean speed for all vehicles, S = 57.4 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/26/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4692	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	719	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	380	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4692		719		380		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1235		189		100		v
Trucks and buses	5		4		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		3.0*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5309	790	416	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2824 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5309	7050	No
$v_{FO} = v_F - v_R$	4519	7050	No
v_R	790	4000	No
v_3 or v_{av34}	2485 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 3033 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3033	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 14.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.499	
Space mean speed in ramp influence area,	S_R = 53.5	mph
Space mean speed in outer lanes,	S_O = 66.3	mph
Space mean speed for all vehicles,	S = 58.4	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	10/27/2011
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3973	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	380	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	719	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3973	380	719	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1046	100	189	v
Trucks and buses	5	2	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	3.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.962	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4496	416	790	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1145.37 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2785 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4912	7050	No
v_3 or v_{av34}	1711 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2785 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3201	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 20.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.312

Space mean speed in ramp influence area, S_R = 57.8 mph

Space mean speed in outer lanes, S_0 = 60.6 mph

Space mean speed for all vehicles, S = 58.8 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4928	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	15	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4928		530		15		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1297		139		4		v
Trucks and buses	5		5		5		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.4*		2.2*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.935	0.943	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5576	597	17	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.593 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3550 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5576	7050	No
$v_{FO} = v_F - v_R$	4979	7050	No
v_R	597	2000	No
v_3 or v_{av34}	2026 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3550 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3550	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 21.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.482	
Space mean speed in ramp influence area,	S_R = 53.9	mph
Space mean speed in outer lanes,	S_O = 67.3	mph
Space mean speed for all vehicles,	S = 58.1	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4398	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	15	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	530	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4398	15	530	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1157	4	139	v
Trucks and buses	5	5	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.2*	2.4*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.943	0.935	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4977	17	597	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1087.44 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3060 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4994	7050	No
v_3 or v_{av34}	1917 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3060 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3077	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 21.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.313

Space mean speed in ramp influence area, S_R = 57.8 mph

Space mean speed in outer lanes, S_O = 59.9 mph

Space mean speed for all vehicles, S = 58.6 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4413	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	448	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	389	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2400	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	4413		448		389		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1161		118		102		v
Trucks and buses	5		8		8		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.5*		2.2*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.893	0.912	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4994	528	449	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.611 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3256 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4994	7050	No
$v_{FO} = v_F - v_R$	4466	7050	No
v_R	528	2000	No
v_3 or v_{av34}	1738 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3256 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3256	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 30.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, D_S = 0.476

Space mean speed in ramp influence area, S_R = 54.1 mph

Space mean speed in outer lanes, S_O = 68.4 mph

Space mean speed for all vehicles, S = 58.3 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	AM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	3507	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	425	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	847	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3507	425	847	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	923	112	223	v
Trucks and buses	5	4	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.930	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	3968	467	958	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1043.29 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2458 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4435	7050	No
v_3 or v_{av34}	1510 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 2458 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	2925	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 18.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable, M_S = 0.289

Space mean speed in ramp influence area, S_R = 58.4 mph

Space mean speed in outer lanes, S_0 = 61.4 mph

Space mean speed for all vehicles, S = 59.3 mph

APPENDIX D

HCS ANALYSIS - RAMPS

HORIZON YEAR (2036) WITH PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Avenue
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	013.3With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5104	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	362	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	865	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5104		362		865		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1343		95		228		v
Trucks and buses	5		2		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.9*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.982	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5776	388	931	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.598 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3609 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5776	7050	No
$v_{FO} = v_F - v_R$	5388	7050	No
v_R	388	2000	No
v_3 or v_{av34}	2167 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3609 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3609	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 33.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.463	
Space mean speed in ramp influence area,	S_R = 54.4	mph
Space mean speed in outer lanes,	S_O = 66.8	mph
Space mean speed for all vehicles,	S = 58.4	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4742	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	865	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	362	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2600	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4742	865	362	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1248	228	95	v
Trucks and buses	5	2	2	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.9*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.982	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5366	931	388	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1441.76 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3324 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6297	7050	No
v_3 or v_{av34}	2042 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3324 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	4255	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.491

Space mean speed in ramp influence area, S_R = 53.7 mph

Space mean speed in outer lanes, S_O = 59.4 mph

Space mean speed for all vehicles, S = 55.4 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5607	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	513	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	202	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5607		513		202		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1476		135		53		v
Trucks and buses	5		4		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6345	564	222	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.575 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3891 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6345	7050	No
$v_{FO} = v_F - v_R$	5781	7050	No
v_R	564	2000	No
v_3 or v_{av34}	2454 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 3891 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3891	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 35.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable,	D_S = 0.479	
Space mean speed in ramp influence area,	S_R = 54.0	mph
Space mean speed in outer lanes,	S_O = 65.6	mph
Space mean speed for all vehicles,	S = 58.0	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5094	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	202	vph
Length of first accel/decel lane	600	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	513	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5094	202	513	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1341	53	135	v
Trucks and buses	5	4	4	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.958	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5764	222	564	pcph

Estimation of V12 Merge Areas

L_{EQ} = 975.60 (Equation 13-6 or 13-7)

P_{FM} = 0.594 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3426 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5986	7050	No
v_3 or v_{av34}	2338 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 Yes

If yes, v_{12A} = 3426 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3648	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 30.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.429

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = 58.2 mph

Space mean speed for all vehicles, S = 56.3 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5296	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	317	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane	0	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	470	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5296		317		470		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1394		83		124		v
Trucks and buses	5		5		6		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		1.9*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.948	0.949	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5993	352	521	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2890 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5993	7050	No
$v_{FO} = v_F - v_R$	5641	7050	No
v_R	352	4000	No
v_3 or v_{av34}	3103 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12}/2		Yes	

If yes, v_{12A} = 3424 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	3424	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 17.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.460	
Space mean speed in ramp influence area,	S_R = 54.4	mph
Space mean speed in outer lanes,	S_O = 65.2	mph
Space mean speed for all vehicles,	S = 58.6	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 EB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4979	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	470	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	317	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2300	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4979	470	317	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1310	124	83	v
Trucks and buses	5	6	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	1.9*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.949	0.948	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5634	521	352	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1411.37 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3490 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6155	7050	No
v_3 or v_{av34}	2144 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3490 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	4011	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.431

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_O = 59.1 mph

Space mean speed for all vehicles, S = 56.4 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State Street
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	6200	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	626	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	387	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	6200		626		387		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1632		165		102		v
Trucks and buses	5		5		2		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		1.8*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.962	0.978	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	7016	685	416	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.553 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4187 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7016	7050	No
$v_{FO} = v_F - v_R$	6331	7050	No
v_R	685	2000	No
v_3 or v_{av34}	2829 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		Yes	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 4316 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4316	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.490	
Space mean speed in ramp influence area,	S_R = 53.7	mph
Space mean speed in outer lanes,	S_O = 64.7	mph
Space mean speed for all vehicles,	S = 57.5	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	State St
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5574	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	387	vph
Length of first accel/decel lane	1330	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	626	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	3000	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5574	387	626	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1467	102	165	v
Trucks and buses	5	2	5	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.1*	1.8*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.978	0.962	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6307	416	685	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1457.44 (Equation 13-6 or 13-7)

P_{FM} = 0.615 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3877 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6723	7050	No
v_3 or v_{av34}	2430 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3877 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	4293	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 30.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable, M_S = 0.513

Space mean speed in ramp influence area, S_R = 53.2 mph

Space mean speed in outer lanes, S_0 = 57.7 mph

Space mean speed for all vehicles, S = 54.7 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Pepper Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	With Project Conditions SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	5961	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	773	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent ramp	441	vph
Position of adjacent ramp	Downstream	
Type of adjacent ramp	On	
Distance to adjacent ramp	2400	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp		
Volume, V (vph)	5961		773		441		vph
Peak-hour factor, PHF	0.95		0.95		0.95		
Peak 15-min volume, v15	1569		203		116		v
Trucks and buses	5		4		4		%
Recreational vehicles	0		0		0		%
Terrain type:	Level		Level		Level		
Grade	0.00	%	0.00	%	0.00	%	
Length	0.00	mi	0.00	mi	0.00	mi	
Trucks and buses PCE, ET	2.5*		2.1*		2.1*		
Recreational vehicle PCE, ER	1.2		1.2		1.2		

Heavy vehicle adjustment, fHV	0.930	0.958	0.958	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6745	849	485	pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = 0.552 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4105 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6745	7050	No
$v_{FO} = v_F - v_R$	5896	7050	No
v_R	849	2000	No
v_3 or v_{av34}	2640 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 4105 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	4105	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 37.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence E

Speed Estimation

Intermediate speed variable, D_S = 0.504

Space mean speed in ramp influence area, S_R = 53.4 mph

Space mean speed in outer lanes, S_O = 64.9 mph

Space mean speed for all vehicles, S = 57.4 mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	
Agency/Co.:	IBI Group
Date performed:	07/17/2013
Analysis time period:	PM
Freeway/Dir of Travel:	SR-210 WB
Junction:	Riverside Ave
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions - SR-210/Pepper Ave I/C

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	65.0	mph
Volume on freeway	4845	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	565	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	784	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2550	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4845	565	784	vph
Peak-hour factor, PHF	0.95	0.95	0.95	
Peak 15-min volume, v15	1275	149	206	v
Trucks and buses	5	2	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5*	2.0*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	

Heavy vehicle adjustment, fHV	0.930	0.980	0.968	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5482	607	852	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1397.25 (Equation 13-6 or 13-7)

P_{FM} = 0.619 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3396 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6089	7050	No
v_3 or v_{av34}	2086 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12}/2 No

If yes, v_{12A} = 3396 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	4003	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 27.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, M_S = 0.430

Space mean speed in ramp influence area, S_R = 55.1 mph

Space mean speed in outer lanes, S_0 = 59.3 mph

Space mean speed for all vehicles, S = 56.5 mph

APPENDIX E

HCS ANALYSIS – FREEWAY MAINLINE AND HOV LANE ANALYSIS

APPENDIX E

HCS ANALYSIS - FREEWAYS

EXISTING CONDITIONS – AM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2918	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	768	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1101	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1101	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.9	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2449	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	644	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	924	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	924	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	14.2	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Riverside to State
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3161	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	832	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1192	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1192	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2807	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	739	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1059	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1059	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.3	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3315	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	872	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1250	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1250	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.2	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2883	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	759	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1087	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1087	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.7	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	State to Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3300	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	868	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1245	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1245	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.2	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2497	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	657	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	942	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	942	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	14.5	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2011
Description:	Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3046	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	802	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1149	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1149	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	17.7	pc/mi/ln
Level of service, LOS	B	

APPENDIX E

HCS ANALYSIS - FREEWAYS

EXISTING CONDITIONS – PM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4010	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1055	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1513	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1513	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.8	mi/h
Number of lanes, N	3	
Density, D	23.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3498	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	921	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1319	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1319	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Riverside to State
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4344	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1143	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1639	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1639	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.2	mi/h
Number of lanes, N	3	
Density, D	25.5	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4077	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1073	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1538	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1538	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.7	mi/h
Number of lanes, N	3	
Density, D	23.8	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3456	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	909	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1304	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1304	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3123	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	822	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1178	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1178	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	State to Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3440	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	905	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1298	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1298	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.0	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2011

Description: Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2709	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	713	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1022	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1022	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	15.7	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2011
Description:	Existing Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3176	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	836	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1198	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1198	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.4	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

OPENING YEAR (2016) NO PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3245	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	854	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1224	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1224	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.8	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2743	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	722	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1035	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1035	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	15.9	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Riverside to State
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3467	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	912	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1308	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1308	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3010	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	792	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1135	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1135	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	17.5	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3638	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	957	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1372	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1372	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3152	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	829	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1189	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1189	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	State to Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3511	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	924	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1324	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1324	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.4	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2669	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	702	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1007	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1007	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	15.5	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3223	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	848	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1216	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1216	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.7	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

OPENING YEAR (2016) NO PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4229	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1113	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1595	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1595	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.5	mi/h
Number of lanes, N	3	
Density, D	24.7	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3688	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	971	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1391	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1391	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.4	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Riverside to State
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4534	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1193	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1710	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1710	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.6	mi/h
Number of lanes, N	3	
Density, D	26.9	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4083	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1074	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1540	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1540	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.7	mi/h
Number of lanes, N	3	
Density, D	23.8	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4005	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1054	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1511	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1511	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.8	mi/h
Number of lanes, N	3	
Density, D	23.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3528	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	928	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1331	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1331	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.5	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	State to Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3878	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1021	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1463	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1463	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	22.5	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3091	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	813	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1166	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1166	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	17.9	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3623	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	953	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1367	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1367	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.0	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

OPENING YEAR (2016) WITH PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3245	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	854	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1224	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1224	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.8	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2776	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	731	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1047	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1047	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	16.1	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3423	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	901	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1291	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1291	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.9	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3031	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	798	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1143	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1143	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	17.6	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3638	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	957	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1372	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1372	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3186	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	838	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1202	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1202	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.5	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3433	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	903	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1295	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1295	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.9	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2700	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	711	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1018	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1018	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	15.7	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3223	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	848	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1216	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1216	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.7	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

OPENING YEAR (2016) WITH PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4229	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1113	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1595	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1595	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.5	mi/h
Number of lanes, N	3	
Density, D	24.7	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3733	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	982	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1408	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1408	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.7	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4494	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1183	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1695	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1695	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.8	mi/h
Number of lanes, N	3	
Density, D	26.6	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4113	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1082	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1551	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1551	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.7	mi/h
Number of lanes, N	3	
Density, D	24.0	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4005	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1054	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1511	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1511	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.8	mi/h
Number of lanes, N	3	
Density, D	23.3	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3626	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	954	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1368	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1368	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.0	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3808	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1002	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1436	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1436	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	22.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2016

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3128	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	823	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1180	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1180	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	18.2	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2016
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3623	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	953	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1367	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1367	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	21.0	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

HORIZON YEAR (2036) NO PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4552	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1198	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1717	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1717	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.6	mi/h
Number of lanes, N	3	
Density, D	27.0	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3879	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1021	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1463	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1463	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	22.5	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	Riverside to State
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4692	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1235	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1770	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1770	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.1	mi/h
Number of lanes, N	3	
Density, D	28.1	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3887	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1023	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1466	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1466	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	22.6	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4928	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1297	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1859	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1859	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	62.0	mi/h
Number of lanes, N	3	
Density, D	30.0	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4218	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1110	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1591	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1591	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.5	mi/h
Number of lanes, N	3	
Density, D	24.7	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	State to Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4354	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1146	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1642	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1642	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.2	mi/h
Number of lanes, N	3	
Density, D	25.6	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3351	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	882	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1264	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1264	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	19.4	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3932	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1035	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1483	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1483	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	22.8	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

HORIZON YEAR (2036) NO PROJECT – PM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5104	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1343	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1925	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1925	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	61.1	mi/h
Number of lanes, N	3	
Density, D	31.5	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4525	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1191	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1707	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1707	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.7	mi/h
Number of lanes, N	3	
Density, D	26.8	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Riverside to State
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5296	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1394	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1998	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1998	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	59.9	mi/h
Number of lanes, N	3	
Density, D	33.3	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4843	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1274	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1827	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1827	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	62.4	mi/h
Number of lanes, N	3	
Density, D	29.3	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	6200	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1632	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2339	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	2339	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	52.5	mi/h
Number of lanes, N	3	
Density, D	44.6	pc/mi/ln
Level of service, LOS	E	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5197	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1368	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1960	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1960	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	60.6	mi/h
Number of lanes, N	3	
Density, D	32.4	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	State to Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5629	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1481	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2123	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	2123	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	57.6	mi/h
Number of lanes, N	3	
Density, D	36.9	pc/mi/ln
Level of service, LOS	E	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4666	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1228	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1760	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1760	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.2	mi/h
Number of lanes, N	3	
Density, D	27.9	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: No Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5410	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1424	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2041	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	2041	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	59.2	mi/h
Number of lanes, N	3	
Density, D	34.5	pc/mi/ln
Level of service, LOS	D	

APPENDIX E

HCS ANALYSIS - FREEWAYS

HORIZON YEAR (2036) WITH PROJECT – AM PEAK HOUR

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4552	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1198	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1717	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1717	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.6	mi/h
Number of lanes, N	3	
Density, D	27.0	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4054	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1067	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1529	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1529	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.8	mi/h
Number of lanes, N	3	
Density, D	23.6	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4471	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1177	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1686	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1686	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.8	mi/h
Number of lanes, N	3	
Density, D	26.4	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3973	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1046	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1499	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1499	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	23.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4928	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1297	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1859	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1859	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	62.0	mi/h
Number of lanes, N	3	
Density, D	30.0	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4398	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1157	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1659	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1659	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.0	mi/h
Number of lanes, N	3	
Density, D	25.9	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3965	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1043	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1496	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1496	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	23.1	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3507	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	923	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1323	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1323	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	20.4	pc/mi/ln
Level of service, LOS	C	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	3932	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1035	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1483	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1483	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	64.9	mi/h
Number of lanes, N	3	
Density, D	22.8	pc/mi/ln
Level of service, LOS	C	

APPENDIX E

HCS ANALYSIS - FREEWAYS

HORIZON YEAR (2036) WITH PROJECT – PM PEAK HOUR

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Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	Upstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5104	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1343	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1925	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1925	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	61.1	mi/h
Number of lanes, N	3	
Density, D	31.5	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4472	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1177	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1687	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1687	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	63.8	mi/h
Number of lanes, N	3	
Density, D	26.4	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5094	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1341	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1921	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1921	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	61.2	mi/h
Number of lanes, N	3	
Density, D	31.4	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 EB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4979	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1310	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1878	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1878	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	61.8	mi/h
Number of lanes, N	3	
Density, D	30.4	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Upstream State
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	6200	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1632	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2339	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	2339	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	52.5	mi/h
Number of lanes, N	3	
Density, D	44.6	pc/mi/ln
Level of service, LOS	E	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw State ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	2274	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	598	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	858	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	858	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	65.0	mi/h
Number of lanes, N	3	
Density, D	13.2	pc/mi/ln
Level of service, LOS	B	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Pepper ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5188	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1365	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1957	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1957	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	60.6	mi/h
Number of lanes, N	3	
Density, D	32.3	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	btw Riverside ramps
Jurisdiction:	Caltrans District 8
Analysis Year:	2036

Description: With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	4845	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1275	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	1827	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	1827	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	62.4	mi/h
Number of lanes, N	3	
Density, D	29.3	pc/mi/ln
Level of service, LOS	D	

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency or Company:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Direction:	SR-210 WB
From/To:	Downstream Riverside
Jurisdiction:	Caltrans District 8
Analysis Year:	2036
Description:	With Project Conditions SR-210/Pepper Ave I/C

Flow Inputs and Adjustments

Volume, V	5410	veh/h
Peak-hour factor, PHF	0.95	
Peak 15-min volume, v15	1424	v
Trucks and buses	5	%
Recreational vehicles	0	%
Terrain type:	Level	
Grade	-	%
Segment length	-	mi
Trucks and buses PCE, ET	2.5*	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.930	
Driver population factor, fp	1.00	
Flow rate, vp	2041	pc/h/ln

Speed Inputs and Adjustments

Lane width	-	ft
Right-side lateral clearance	-	ft
Total ramp density, TRD	-	ramps/mi
Number of lanes, N	3	
Free-flow speed:	Measured	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	-	mi/h
Lateral clearance adjustment, fLC	-	mi/h
TRD adjustment	-	mi/h
Free-flow speed, FFS	65.0	mi/h

LOS and Performance Measures

Flow rate, vp	2041	pc/h/ln
Free-flow speed, FFS	65.0	mi/h
Average passenger-car speed, S	59.2	mi/h
Number of lanes, N	3	
Density, D	34.5	pc/mi/ln
Level of service, LOS	D	

HOV Analysis - No Project Condition

	2011			2016			2036		
EB - AM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream Riverside	142	0.071	yes	247	0.1235	yes	669	0.3345	yes
Riverside - State	153	0.0765	yes	269	0.1345	yes	733	0.3665	yes
Downstream State	153	0.0765	yes	269	0.1345	yes	733	0.3665	yes

	2011			2016			2036		
EB - PM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream Riverside	525	0.2625	yes	576	0.288	yes	793	0.3965	yes
Riverside - State	564	0.282	yes	676	0.338	yes	1122	0.561	yes
Downstream State	567	0.2835	yes	679	0.3395	yes	1125	0.5625	yes

	2011			2016			2036		
WB - AM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream State	275	0.1375	yes	368	0.184	yes	740	0.37	yes
State - Riverside	274	0.137	yes	367	0.1835	yes	739	0.3695	yes
Downstream Riverside	252	0.126	yes	334	0.167	yes	661	0.3305	yes

	2011			2016			2036		
WB - PM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream State	301	0.1505	yes	482	0.241	yes	1202	0.601	yes
State - Riverside	300	0.15	yes	481	0.2405	yes	1201	0.6005	yes
Downstream Riverside	277	0.1385	yes	429	0.2145	yes	1038	0.519	yes

Volumes in PCE

HOV Analysis - With Project Condition

	2011			2016			2036		
EB - AM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream Riverside	142	0.071	yes	247	0.1235	yes	669	0.3345	yes
Riverside - Pepper	153	0.0765	yes	269	0.1345	yes	733	0.3665	yes
Pepper - State	153	0.0765	yes	269	0.1345	yes	733	0.3665	yes
Downstream State	153	0.0765	yes	269	0.1345	yes	733	0.3665	yes

	2011			2016			2036		
EB - PM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream Riverside	525	0.2625	yes	576	0.288	yes	793	0.3965	yes
Riverside - Pepper	564	0.282	yes	676	0.338	yes	1122	0.561	yes
Pepper - State	564	0.282	yes	676	0.338	yes	1122	0.561	yes
Downstream State	567	0.2835	yes	679	0.3395	yes	1125	0.5625	yes

	2011			2016			2036		
WB - AM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream State	275	0.1375	yes	368	0.184	yes	740	0.37	yes
State - Pepper	274	0.137	yes	367	0.1835	yes	739	0.3695	yes
Pepper - Riverside	274	0.137	yes	367	0.1835	yes	739	0.3695	yes
Downstream Riverside	252	0.126	yes	334	0.167	yes	661	0.3305	yes

	2011			2016			2036		
WB - PM	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?	Volume	V/C	< LOS C?
Upstream State	301	0.1505	yes	482	0.241	yes	1202	0.601	yes
State - Pepper	300	0.15	yes	481	0.2405	yes	1201	0.6005	yes
Pepper - Riverside	300	0.15	yes	481	0.2405	yes	1201	0.6005	yes
Downstream Riverside	277	0.1385	yes	429	0.2145	yes	1038	0.519	yes

Volumes in PCE

APPENDIX F

HCS ANALYSIS - WEAVING

OPENING YEAR (2016) WITH PROJECT – AM PEAK HOUR

HCS 2010: Freeway Weaving Release 6.50

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency/Co.:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Dir of Travel:	SR-210 WB
Weaving Location:	Pepper Ave - Riverside Ave
Analysis Year:	2016
Description:	Project Conditions - SR-210/Pepper Ave I/C

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	4	ln
Weaving segment length, LS	2502	ft
Freeway free-flow speed, FFS	65	mi/h
Minimum segment speed, SMIN	15	mi/h
Freeway maximum capacity, cIFL	2350	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	2622	78	811	0	veh/h
Peak hour factor, PHF	0.95	0.95	0.95	0.95	
Peak 15-min volume, v15	690	21	213	0	
Trucks and buses	5	8	5	4	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	2.5*	2.2*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.930	0.912	0.930	0.943	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	2967	90	918	0	pc/h

Volume ratio, VR 0.254

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	0.8	int/mi
Minimum RF lane changes, LCRF	1	lc/pc
Minimum FR lane changes, LCFR	1	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN	1008	lc/h
Weaving lane changes, LCW	1477	lc/h
Non-weaving vehicle index, INW	594	
Non-weaving lane change, LCNW	1197	lc/h
Total lane changes, LCALL	2674	lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.238

Average weaving speed, SW	55.4	mi/h
Average non-weaving speed, SNW	53.0	mi/h

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	53.6	mi/h
Weaving segment density, D	18.6	pc/mi/ln
Level of service, LOS	B	
Weaving segment v/c ratio	0.462	
Weaving segment flow rate, v	3698	veh/h
Weaving segment capacity, cW	8007	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	5091	2502	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2350	2152	c
		Maximum	Analyzed	
v/c ratio		1.00	0.462	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

APPENDIX F

HCS ANALYSIS - WEAVING

OPENING YEAR (2016) WITH PROJECT – PM PEAK HOUR

HCS 2010: Freeway Weaving Release 6.50

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency/Co.:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Dir of Travel:	SR-210 WB
Weaving Location:	Pepper Ave - Riverside Ave
Analysis Year:	2016
Description:	Project Conditions - SR-210/Pepper Ave I/C

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	4	ln
Weaving segment length, LS	2502	ft
Freeway free-flow speed, FFS	65	mi/h
Minimum segment speed, SMIN	15	mi/h
Freeway maximum capacity, cIFL	2350	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	3058	70	750	0	veh/h
Peak hour factor, PHF	0.95	0.95	0.95	0.95	
Peak 15-min volume, v15	805	18	197	0	
Trucks and buses	5	4	3	1	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	2.5*	2.1*	2.1*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.930	0.958	0.968	0.989	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	3460	77	816	0	pc/h

Volume ratio, VR 0.205

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	0.8	int/mi
Minimum RF lane changes, LCRF	1	lc/pc
Minimum FR lane changes, LCFR	1	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN	893	lc/h
Weaving lane changes, LCW	1362	lc/h
Non-weaving vehicle index, INW	693	
Non-weaving lane change, LCNW	1298	lc/h
Total lane changes, LCALL	2660	lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.237

Average weaving speed, SW	55.4	mi/h
Average non-weaving speed, SNW	53.3	mi/h

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	53.8	mi/h
Weaving segment density, D	20.2	pc/mi/ln
Level of service, LOS	C	
Weaving segment v/c ratio	0.497	
Weaving segment flow rate, v	4050	veh/h
Weaving segment capacity, cW	8149	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	4589	2502	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2350	2190	c
		Maximum	Analyzed	
v/c ratio		1.00	0.497	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

APPENDIX F

HCS ANALYSIS - WEAVING

HORIZON YEAR (2036) WITH PROJECT – AM PEAK HOUR

HCS 2010: Freeway Weaving Release 6.50

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency/Co.:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	AM
Freeway/Dir of Travel:	SR-210 WB
Weaving Location:	Pepper Ave - Riverside Ave
Analysis Year:	2036
Description:	Project Conditions - SR-210/Pepper Ave I/C

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	4	ln
Weaving segment length, LS	2502	ft
Freeway free-flow speed, FFS	65	mi/h
Minimum segment speed, SMIN	15	mi/h
Freeway maximum capacity, cIFL	2350	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	3118	389	847	0	veh/h
Peak hour factor, PHF	0.95	0.95	0.95	0.95	
Peak 15-min volume, v15	821	102	223	0	
Trucks and buses	5	8	5	4	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	2.5*	2.2*	2.5*	2.5*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.930	0.912	0.930	0.943	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	3528	449	958	0	pc/h

Volume ratio, VR 0.285

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	0.8	int/mi
Minimum RF lane changes, LCRF	1	lc/pc
Minimum FR lane changes, LCFR	1	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN		lc/h
Weaving lane changes, LCW		lc/h
Non-weaving vehicle index, INW	706	
Non-weaving lane change, LCNW	1312	lc/h
Total lane changes, LCALL		lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W

Average weaving speed, SW		mi/h
Average non-weaving speed, SNW		mi/h

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S		mi/h
Weaving segment density, D		pc/mi/ln
Level of service, LOS		
Weaving segment v/c ratio	0.586	
Weaving segment flow rate, v	4591	veh/h
Weaving segment capacity, cW	7831	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	5425	2502	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2350	2126	c
		Maximum	Analyzed	
v/c ratio		1.00	0.586	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

APPENDIX F

HCS ANALYSIS - WEAVING

HORIZON YEAR (2036) WITH PROJECT – PM PEAK HOUR

HCS 2010: Freeway Weaving Release 6.50

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	
Agency/Co.:	IBI Group
Date Performed:	07/17/2013
Analysis Time Period:	PM
Freeway/Dir of Travel:	SR-210 WB
Weaving Location:	Pepper Ave - Riverside Ave
Analysis Year:	2036
Description:	Project Conditions - SR-210/Pepper Ave I/C

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	4	ln
Weaving segment length, LS	2502	ft
Freeway free-flow speed, FFS	65	mi/h
Minimum segment speed, SMIN	15	mi/h
Freeway maximum capacity, cIFL	2350	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	4404	441	784	0	veh/h
Peak hour factor, PHF	0.95	0.95	0.95	0.95	
Peak 15-min volume, v15	1159	116	206	0	
Trucks and buses	5	4	3	1	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	2.5*	2.1*	2.1*	2.1*	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.930	0.958	0.968	0.989	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	4983	485	852	0	pc/h

Volume ratio, VR 0.212

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	0.8	int/mi
Minimum RF lane changes, LCRF	1	lc/pc
Minimum FR lane changes, LCFR	1	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN	1337	lc/h
Weaving lane changes, LCW	1806	lc/h
Non-weaving vehicle index, INW	997	
Non-weaving lane change, LCNW	1612	lc/h
Total lane changes, LCALL	3418	lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W 0.289

Average weaving speed, SW	53.8	mi/h
Average non-weaving speed, SNW	47.8	mi/h

Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	48.9	mi/h
Weaving segment density, D	32.3	pc/mi/ln
Level of service, LOS	D	
Weaving segment v/c ratio	0.723	
Weaving segment flow rate, v	5880	veh/h
Weaving segment capacity, cW	8130	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	4655	2502	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2350	2185	c
		Maximum	Analyzed	
v/c ratio		1.00	0.723	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

APPENDIX G

TRAFFIC VOLUME TECHNICAL MEMORANDUM

California Department of Transportation (Caltrans), District 8
San Bernardino Associated Governments (SANBAG)

STATE ROUTE 210/PEPPER AVENUE INTERCHANGE - TRAFFIC VOLUMES

TECHNICAL MEMORANDUM

UPDATED - JULY 16, 2013

IBI GROUP

DOCUMENT CONTROL

Client:	California Department of Transportation (Caltrans), District 8 San Bernardino Associated Governments
Project Name:	State Route 210/Pepper Avenue Interchange Project
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1. INTRODUCTION

This memorandum presents updated traffic volume data that will be used to update the traffic impact analysis prepared for the planned State Route 210/Pepper Avenue interchange project in Rialto, CA. The purpose of this update is to incorporate updated existing average daily traffic volumes on State Route 210 provided by Caltrans District 8.

The proposed interchange is located approximately one mile east of the existing SR-210/Riverside Avenue interchange and one mile west of the existing SR-210/State Street/University Parkway interchange.

The new interchange is proposed as a diamond configuration, with on and off-ramps provided in both directions on SR-210. This technical memorandum presents the following information for review:

- Existing peak hour intersection turning movement counts and 24-hour link volumes
- Forecast peak hour intersection turning movement volumes for analysis years 2016 and 2036, with and without the project

2. EXISTING TRAFFIC COUNT DATA

Four existing intersections have been identified for analysis. Three additional intersections, which will be created when Pepper Avenue is extended north to Highland Avenue and the SR-210 interchange is complete, will be analyzed in the With Project and future forecast scenarios. The seven project study intersections are:

1. SR-210 WB Ramps & Riverside Avenue
2. SR-210 EB Ramps & Riverside Avenue
3. Pepper Avenue & Highland Avenue *(Future and With Project Conditions Only)*
4. SR-210 WB Ramps & Pepper Avenue *(With Project Conditions Only)*
5. SR-210 EB Ramps & Pepper Avenue *(With Project Conditions Only)*
6. SR-210 WB Ramps & State Street/University Parkway
7. SR-210 EB Ramps & State Street/University Parkway

Turning movement counts were made at the four existing intersections on Tuesday, April 26th, 2011 from 6:00 AM to 9:00 AM and from 4:00 PM to 7:00 PM. Daily (24-hour) counts were also made on Riverside Avenue (just south of SR-210), Highland Avenue (at the approximate location of the future Pepper Avenue intersection) and on State Street (north of Highland Avenue). Ramp approach and departure volumes obtained from the counts were balanced according to methodology contained in Chapter 4 of the Federal Highway Administration's Traffic Monitoring Guide of 2001. The turning movement counts were adjusted to reflect the balanced ramp volumes and are passenger car equivalent (PCE) volumes. The count and ramp balancing sheets are included in the Appendix, and the AM and PM peak hour volumes are shown in Figure 1 and Figure 2. The

FIGURE 1 EXISTING YEAR (2011) INTERSECTION PCE VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages were obtained from the traffic counts.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Existing Unsignalized Study Intersection
- # Proposed Signalized Intersection
- Future Facilities
- ## Turning Movement Volume

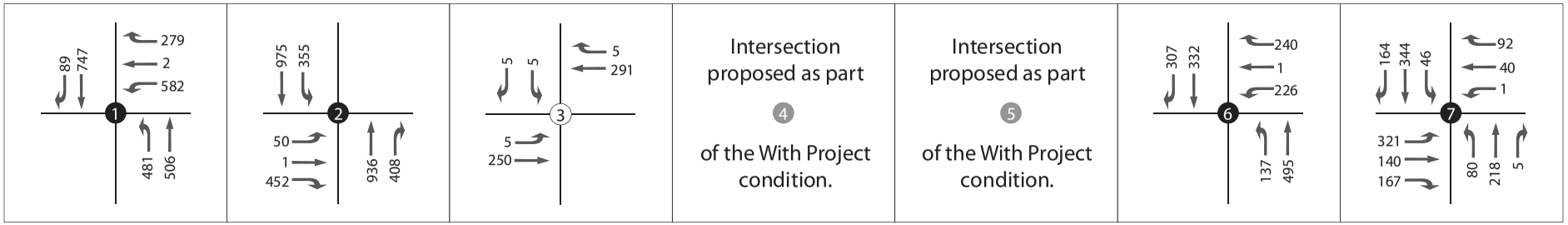
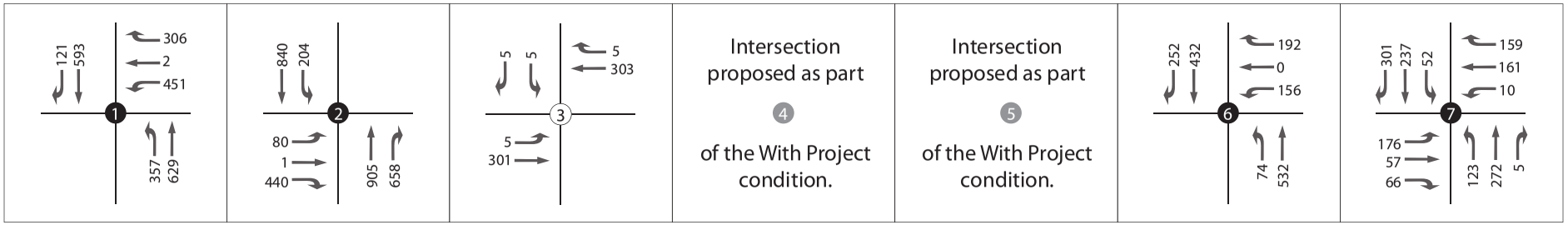


FIGURE 2 EXISTING YEAR (2011) INTERSECTION PCE VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages were obtained from the traffic counts.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Existing Unsignalized Study Intersection
- # Proposed Signalized Intersection
- Future Facilities
- ## Turning Movement Volume



3. FORECAST TRAFFIC VOLUMES

Future forecast traffic volumes with and without the project were previously derived from the San Bernardino Association of Governments (SANBAG) model developed for the analysis of the I-10 HOV lanes. Originally, the Southern California Association of Governments (SCAG) Regional Travel Demand Model was proposed for use in developing future traffic volume forecasts. However, in reviewing the SCAG model forecasts, it was determined that the SCAG model was forecasting unrealistic traffic volumes on Highland Avenue and Pepper Avenue, particularly for the northbound to eastbound flow and the westbound to southbound flow.

Given this condition, the consultant and SANBAG staff determined that the SANBAG I-10 HOV model could provide more appropriate forecasts of traffic volumes within the study area. These model forecasts were again used for this updated analysis. The SCAG model roadway network was likely not detailed enough within the study area, and recalibration of the model to address the observed unreasonable forecasts would require substantial time and effort by SCAG, making this approach infeasible for this analysis.

The SANBAG I-10 HOV model plots are available for a base year of 2003 and a horizon year of 2030. Model plots were obtained for the following scenarios:

- 2003 AM Peak Period Without Project
- 2003 PM Peak Period Without Project
- 2030 AM Peak Period With Project
- 2030 PM Peak Period With Project

Model volume plots for the model base year and horizon year for both the SANBAG I-10 HOV model and the SCAG regional model were provided in the appendix of the original traffic volume memorandum (dated November 2011) for reference.

The SANBAG model for the base year 2003 contains the current configuration of Pepper Avenue, and the With Project condition includes the extension of Pepper Avenue from Base Line Road to Highland Avenue and the SR-210 diamond interchange at Pepper Avenue.

3.1 Intersection Turning Movement Volumes

The following process was used to derive peak hour intersection turning movement volumes from the SANBAG model data:

- Data from the year 2003 and 2030 models were used to derive the associated incremental growth between 2003 (existing) and 2030 (with project) conditions. This step also included the manual adjustments to ensure compatibility of the two networks, and the removal of unlikely high volumes on Highland Avenue due to modeling limitations related to freeway frontage road conditions.
    - Approach and departure balancing at the eastbound ramps at State Street (included in post-processor spreadsheet)

- Reassignment of E-W volumes on Highland to the freeway (included in post-processor spreadsheet)

- 2003 model volumes were subtracted from the 2030 model volumes per leg and movement (approach and departure), resulting in the modeled growth for the period.

- The directional growth in approaches and departures between 2003 and 2030 was factored to represent the growth from 2011 to 2036 and was added to the 2011 approaches and departures, resulting in 2036 with project volumes to be post processed. The same step was followed to estimate the incremental growth for the 2016 With Project Condition

- Peak hour forecast ramp volumes were balanced to future main line volumes, resulting in new ramp volumes for all future years

- New approach and departure volumes for the intersections that contained freeway ramps were obtained, considering the balanced ramp volumes as input and obtaining northbound and southbound volumes for the interchange (eastbound and westbound ramps were processed at the same time to ensure compatibility among adjacent intersections) as well as the same number of cars approaching and departing the intersections

- Approaches and departures for 2016 and 2036 were post processed considering the turning movements for the existing conditions as a base. A standard split of (1-3-1) (L-T-R) was considered as the initial split for the intersections along Pepper Avenue (these intersections do not exist in 2011)

- Approaches and departures for the year 2030 and no interchange were obtained through a 4-step process:

  - The portion of the network containing the SR-210/Pepper interchange and Pepper/Highland intersection was isolated from the rest of the network

  - A matrix for this "network" was estimated considering the 2030 SANBAG I-10 HOV model results as counts for the AM and PM peak hours

  - The ramps were removed and the estimated matrix was reassigned to the network to obtain the approaching and departing volumes for the no project condition for Pepper/Highland for both peak hours

  - Approaches and departures for the other intersections of the 2030 No Project condition were obtained by assigning the post processed Pepper ramp turning movements of the With Project condition to the approaches and departures of the neighboring intersections of the With Project condition

- The incremental growth in approaches and departures for the No Project condition was calculated considering the model 2003 volumes and 2030 volumes estimated above, and was factored to represent the growth from 2011 to 2016 and 2036, being added to the approaches and departures obtained from the traffic counts

- Peak hour forecast ramp volumes were balanced to future main line volumes, resulting in new ramp volumes for all future years

- New approach and departure volumes for the intersections that contained freeway ramps were obtained, considering the balanced ramp volumes as input and obtaining northbound and southbound volumes for the interchange (eastbound and westbound ramps were processed at the same time to ensure compatibility among adjacent intersections) as well as the same number of cars approaching and departing the intersections

- The volumes for the No Project condition for years 2016 and 2036 were post processed considering the new approaches and departures calculated in the previous step and the turning movement counts for the existing conditions

The peak hour link volumes for each scenario were post processed to intersection turning movement volumes using an Excel-based spreadsheet that utilizes the methodology described in National Cooperative Highway Research Program (NCHRP) Report 255. The post-processing procedure uses an iterative process to balance the intersection throughput volumes, which provides the best combination of reasonable turning movement volumes and traceability of results. Post processed volumes were rounded to the closest 5 and volumes were added to the 2016 and 2036 scenarios to account for movements in and out of the mining facility located north of the intersection of Pepper Avenue and Highland Avenue.

Year 2016 Without Project AM and PM peak hour forecast intersection PCE volumes are shown in Figures 3 and 4. Year 2016 With Project AM and PM peak hour forecast intersection PCE volumes are shown in Figures 5 and 6.

Year 2036 Without Project AM and PM peak hour forecast intersection PCE volumes are shown in Figures 7 and 8. Year 2036 With Project AM and PM peak hour forecast intersection PCE volumes are shown in Figures 9 and 10.

FIGURE 3 OPENING YEAR (2016) WITHOUT PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

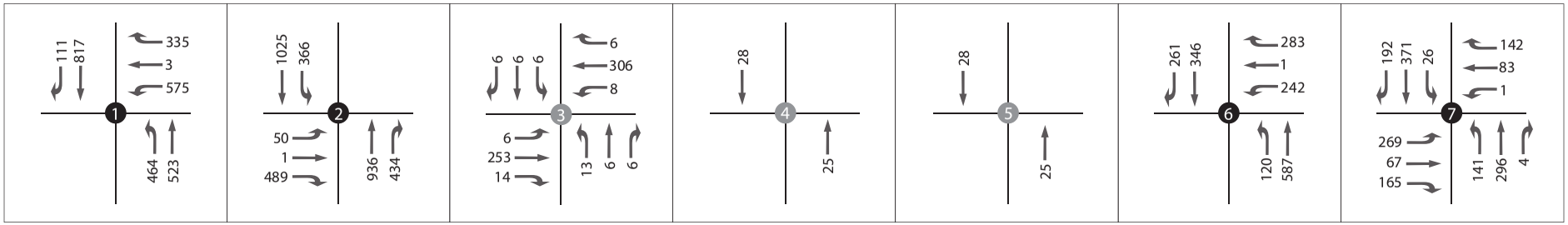


FIGURE 4 OPENING YEAR (2016) WITHOUT PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

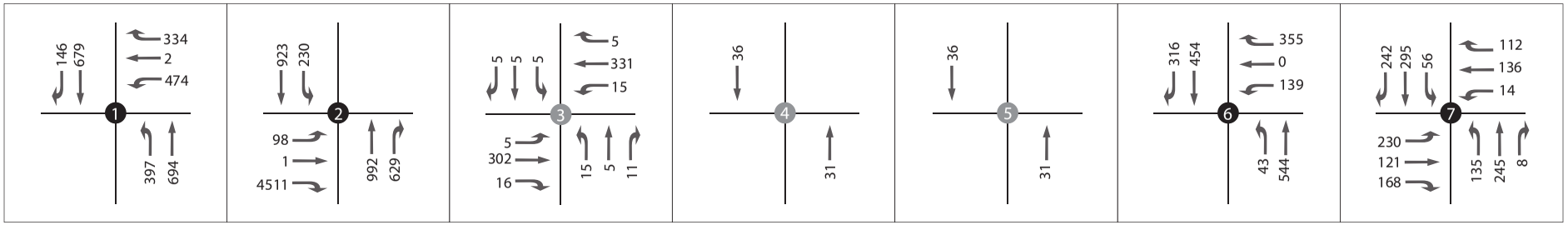


FIGURE 5 OPENING YEAR (2016) WITH PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

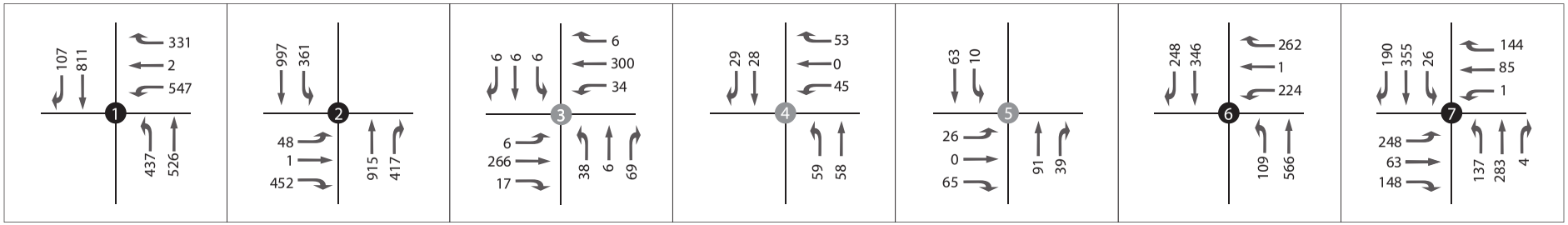


FIGURE 6 OPENING YEAR (2016) WITH PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

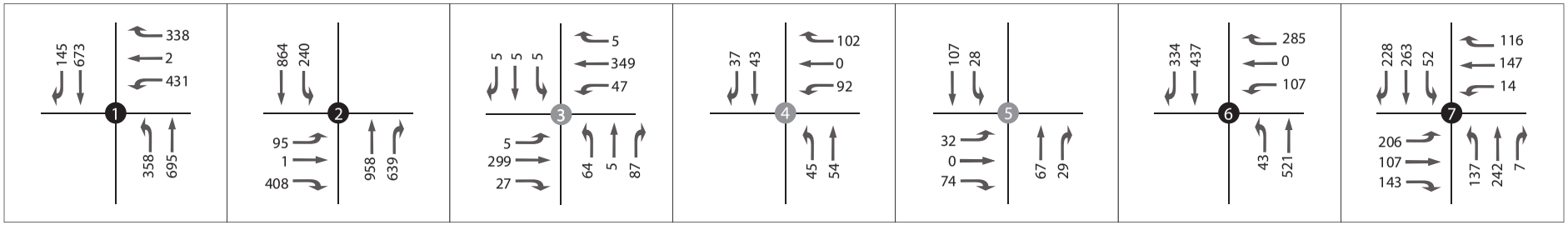


FIGURE 7 HORIZON YEAR (2036) WITHOUT PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

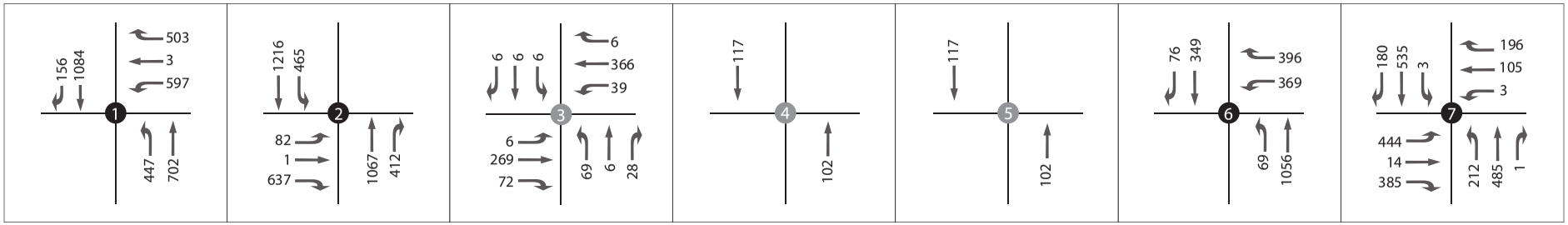


FIGURE 8 HORIZON YEAR (2036) WITHOUT PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

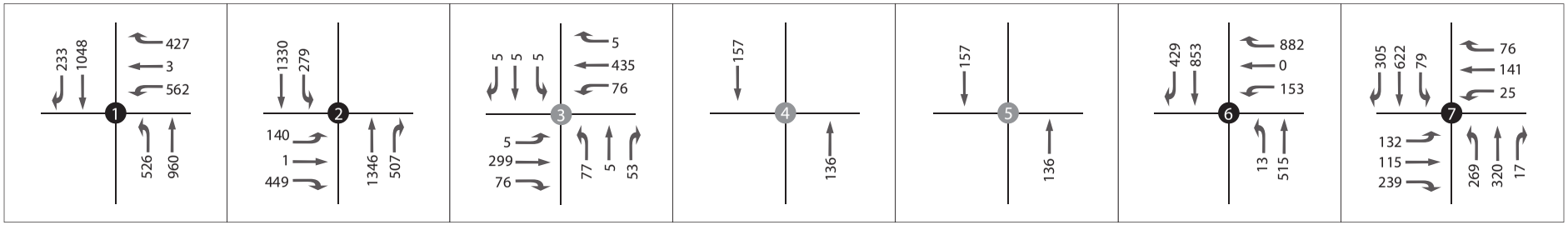


FIGURE 9 HORIZON YEAR (2036) WITH PROJECT VOLUMES – AM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume

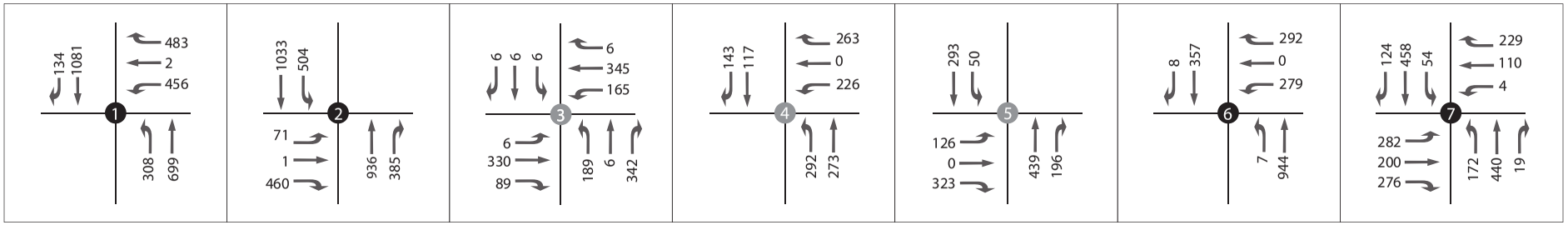
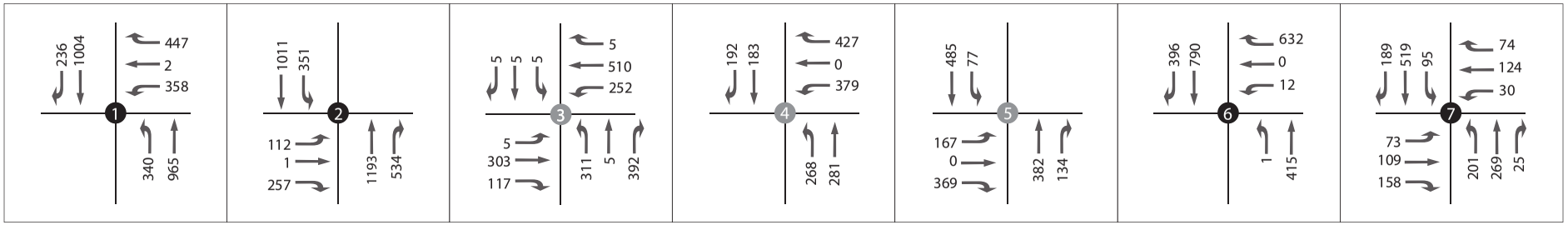


FIGURE 10 HORIZON YEAR (2036) WITH PROJECT VOLUMES – PM PEAK HOUR

Note: Volumes shown are PCE volumes. Truck percentages considered the same as existing conditions.
The following factors have been applied to each class of vehicle:
- Class 2 – 1.5
- Class 3 – 2.0
- Class 4+ – 3.0

LEGEND
- # Existing Signalized Study Intersection
- # Proposed Signalized Study Intersection
- Future Facilities
- ## Turning Movement Volume



3.2 Segment Volumes

The methodology to estimate the mainline mixed flow and HOV lane volumes is presented in this section. Detailed spreadsheets are included in the Appendix.

The existing conditions volumes for the mainline were extracted from the traffic sensor data provided by Caltrans District 8. The available data is for year 2011. The data is summarized in Table 1.

Table 1. Year 2011 Volumes on the SR-210

Dist.	Route	Co.	Postmile	Description	Back Peak Hour	Back AADT	Ahead Peak Hour	Ahead AADT
8	210 U	SBD	19.521	Rialto, Riverside Ave	6,715	102,000	7,275	110,500
8	210 U	SBD	20.02	Acacia Ave (Pepper proxy)	7,545	110,500	7,174	110,500
8	210 U	SBD	21.68	Cajon Blvd (proxy east of State)	7,275	111,000	7,275	111,000

Source: Caltrans District 8

Note: Back usually represents traffic south or west of the count location, and ahead represents traffic north or east of the count location. For the purpose of the study, it will be assumed that Ahead volumes for Acacia Avenue are the same as the Back volumes for Acacia Avenue. Original volumes were 2,700 for ahead peak hour, 28,500 for ahead peak month and 28,000 for ahead AADT.

Volumes related to the Acacia Avenue count are used as a proxy for the Pepper Avenue location, and back volumes related to Cajon Blvd are used as a proxy for volumes east of State Avenue.

Daily volumes for the ramps were estimated through the expansion of the balanced approach and departure volumes for each of the existing ramps. The expansion factor considered is 0.078[1], and the estimated daily ramp volumes are summarized in Table 2.

Table 2. Year 2011 Daily Volumes on Interchange Ramps

Interchange	Direction	Estimated Daily Volume
Riverside	WB off	9,400
Riverside	WB on	6,000
Riverside	EB off	6,600
Riverside	EB on	10,800
State	WB off	4,300
State	WB on	4,100
State	EB off	3,400
State	EB on	7,100

The procedure to obtain future volumes on the freeway mainline and the ramps is similar to the one utilized to forecast intersection turning movements. Forecast volumes on the mainline and ramps

[1] http://www.dot.ca.gov/hq/tpp/offices/ote/benefit_cost/models/calbc.html

were obtained by adding the estimated growth in vehicular traffic between base year and horizon year obtained from the SANBAG model to the existing traffic counts. Tables 3 and 4 summarize the forecast daily volumes for the mainline and the ramps for years 2016 and 2036 for the Without Project and With Project condition.

Table 3. Forecast Daily Volumes on SR-210

	2016 Without Project		2016 With Project		2036 Without Project		2036 With Project	
Segment	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**
Rialto, Riverside Ave	113,760	123,200	113,760	123,740	160,800	174,000	160,800	176,700
Acacia Ave (Pepper proxy)	123,200	123,200	123,740	123,660	174,000	174,000	176,700	176,300
Cajon Blvd (proxy east of State)	125,470	-	125,470	-	183,300	-	183,300	-

Note: volumes were rounded to the closest 10

Table 4. Forecast Daily Volumes on Interchange Ramps

Interchange	Direction	2016 Without Project Volume	2016 With Project Volume	2036 Without Project Volume	2036 With Project Volume
Riverside	WB off	10,090	9,620	12,350	10,050
Riverside	WB on	6,820	6,350	9,540	7,240
Riverside	EB off	6,640	6,360	7,420	4,640
Riverside	EB on	11,360	11,080	9,880	11,090
State	WB off	6,120	4,860	12,860	8,030
State	WB on	4,490	4,720	5,540	4,960
State	EB off	6,180	5,400	5,810	4,060
State	EB on	6,100	6,130	8,410	6,030
Pepper	WB off	-	2,380	-	9,910
Pepper	WB on	-	900	-	5,650
Pepper	EB off	-	1,320	-	6,580
Pepper	EB on	-	510	-	2,590

Note: volumes were rounded to the closest 10

Peak hour volume forecast considered as a base the peak hour volumes for the existing condition, and were split directionally utilizing D factors available for the closest segment to the study area. Volumes were split proportionally among mixed flow lanes and HOV lanes as the freeway does not operate under congested conditions in Year 2011, and the respective modeled growth was added to these volumes to obtain the forecast volumes. Table 5 contains the data related to Year 2011 and Tables 6 to 9 contain the summary for the directional volumes for the analyzed segments for each of the peak hours and scenarios.

Table 5. Directional Split AM and PM Peak Hour Volumes on SR-210 - Year 2011

201		1 AM Mixed Flow		2011 AM HOV		2011 PM Mixed Flow		2011 PM HOV	
Segment Dir		Back Volume	Ahead Volume	Back Volume	Ahead Volume	Back Volume	Ahead Volume	Back Volume	Ahead Volume
Rialto, Riverside Ave	WB	3,046	3,300	235	255	3,176	3,470	258	280
	EB	2,918	3,169	132	143	4,010	4,344	486	526
Acacia Ave (Pepper proxy)	WB	3,300	3,300	255	255	3,440	3,440	280	280
	EB	3,161	3,161	143	143	4,344	4,344	526	526
Cajon Blvd (proxy east of State)	WB	3,315	-	256	-	3,456	-	281	-
	EB	3,175	-	143	-	4,364	-	529	-

Table 6. Forecast AM Peak Hour Volumes on SR-210 – Mixed Flow Lanes

201		6 Without Project		2016 With Project		2036 Without Project		2036 With Project	
Segment Dir		Back Volume	Ahead Volume	Back Volume	Ahead Volume	Back Volume	Ahead Volume	Back Volume	Ahead Volume
Rialto, Riverside Ave	WB	3,223	3,511	3,223	3,511	3,932	4,354	3,932	4,354
	EB	3,245	3,467	3,245	3,504	4,552	4,692	4,552	4,874
Acacia Ave (Pepper proxy)	WB	3,511	3,511	3,511	3,523	4,354	4,354	4,354	4,413
	EB	3,467	3,467	3,504	3,467	4,692	4,692	4,874	4,692
Cajon Blvd (proxy east of State)	WB	3,638	-	3,638	-	4,928	-	4,928	
	EB	3,411	-	3,411	-	4,353	-	4,353	

Table 7. Forecast AM Peak Hour Volumes on SR-210 – HOV Lanes

201		6 Without Project		2016 With Project		2036 Without Project		2036 With Project	
Segment Dir		Back Volume	Ahead Volume	Back Volume	Ahead Volume	Back Volume	Ahead Volume	Back Volume	Ahead Volume
Rialto, Riverside Ave	WB	311	342	311	342	616	689	616	689
	EB	230	251	230	251	624	683	624	683
Acacia Ave (Pepper proxy)	WB	342	342	342	342	689	689	689	689
	EB	251	251	251	251	683	683	683	683
Cajon Blvd (proxy east of State)	WB	343	-	343	-	690	-	690	-
	EB	251	-	251	-	683	-	683	-

Table 8. Forecast PM Peak Hour Volumes on SR-210 – Mixed Flow Lanes

201		6 Without Project		2016 With Project		2036 Without Project		2036 With Project	
Segment Dir		**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**
Rialto, Riverside Ave	WB	3,623	3,878	3,623	3,878	5,410	5,629	5,410	5,629
	EB	4,229	4,534	4,229	4,597	5,104	5,296	5,104	5,607
Acacia Ave (Pepper proxy)	WB	3,878	3,878	3,878	3,944	5,629	5,629	5,629	5,961
	EB	4,534	4,534	4,597	4,537	5,296	5,296	5,607	5,296
Cajon Blvd (proxy east of State)	WB	4,005	-	4,005	-	6,200	-	6,200	-
	EB	4,591	-	4,591	-	5,499	-	5,499	-

Table 9. Forecast PM Peak Hour Volumes on SR-210 – HOV Lanes

201		6 Without Project		2016 With Project		2036 Without Project		2036 With Project	
Segment Dir		**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**	**Back Volume**	**Ahead Volume**
Rialto, Riverside Ave	WB	400	448	400	448	968	1120	968	1120
	EB	537	630	537	630	739	1046	739	1046
Acacia Ave (Pepper proxy)	WB	448	448	448	448	1120	1120	1120	1120
	EB	630	630	630	630	1046	1046	1046	1046
Cajon Blvd (proxy east of State)	WB	449	-	449	-	1121	-	1121	-
	EB	633	-	633	-	1049	-	1049	-

Peak hour ramp volumes were obtained by balancing the forecast peak hour ramp volumes with the mainline volumes presented in Tables 6 and 8. Balancing was done following the methodology included in FHWA's Traffic Monitoring Guide 2001 (Chapter 4). Tables 10 to 14 summarize the balanced ramp volumes for the AM and PM peak hours.

Table 10. Forecast Peak Hour Ramp Volumes on SR-210 – Year 2011

		AM Peak Hour Balanced Ramp Volume		PM Peak Hour Balanced Volume	
Segment Dir		**On**	**Off**	**On**	**Off**
Riverside Ave	WB	549	803	467	731
	EB	469	712	846	512
State Street	WB	417	431	317	333
	EB	354	368	557	267

Table 11. Forecast Peak Hour Ramp Volumes on SR-210 – Year 2016 Without Project

		AM Peak Hour Balanced Ramp Volume		PM Peak Hour Balanced Volume	
Segment Dir		**On**	**Off**	**On**	**Off**
Rialto, Riverside Ave	WB	554	842	532	787
	EB	724	502	846	541
Acacia Ave (Pepper proxy)	WB	-	-	-	-
	EB	-	-	-	-
Cajon Blvd (proxy east of State)	WB	359	486	350	477
	EB	401	457	508	451

Table 12. Forecast Peak Hour Ramp Volumes on SR-210 – Year 2016 With Project

		AM Peak Hour Balanced Ramp Volume		PM Peak Hour Balanced Volume	
Segment Dir		**On**	**Off**	**On**	**Off**
Rialto, Riverside Ave	WB	523	811	495	750
	EB	726	467	864	496
Acacia Ave (Pepper proxy)	WB	78	90	70	186
	EB	44	81	40	103
Cajon Blvd (proxy east of State)	WB	337	452	368	379
	EB	380	436	478	421

Table 13. Forecast Peak Hour Ramp Volumes on SR-210 – Year 2036 Without Project

		AM Peak Hour Balanced Ramp Volume		PM Peak Hour Balanced Volume	
Segment Dir		**On**	**Off**	**On**	**Off**
Rialto, Riverside Ave	WB	581	1003	744	963
	EB	813	673	771	579
Acacia Ave (Pepper proxy)	WB	-	-	-	-
	EB	-	-	-	-
Cajon Blvd (proxy east of State)	WB	136	710	432	1003
	EB	466	805	656	453

Table 14. Forecast Peak Hour Ramp Volumes on SR-210 – Year 2036 With Project

		AM Peak Hour Balanced Ramp Volume		PM Peak Hour Balanced Volume	
Segment Dir		**On**	**Off**	**On**	**Off**
Rialto, Riverside Ave	WB	425	847	565	784
	EB	820	498	815	362
Acacia Ave (Pepper proxy)	WB	389	448	441	773
	EB	221	403	202	513
Cajon Blvd (proxy east of State)	WB	15	530	387	626
	EB	380	719	470	317

4. CONCLUSIONS

According to the results obtained from the processing of the SANBAG I-10 HOV Model, the predominant flow at the intersection of Pepper Avenue and Highland Avenue is expected to remain in the east-west direction, for both 2016 and 2036. Volumes on Pepper Avenue are reasonably balanced in the northbound and southbound directions, and one-way peak hour volumes are expected to grow from about 25 vehicles in 2016 to about 100 vehicles in 2036.

Volumes on Pepper Avenue are expected increase significantly with the addition of the interchange, and are forecast to reach 485 vehicles in the northbound direction and about 235 vehicles in the southbound direction in the 2036 AM peak hour. The 2036 PM peak hour is forecast to operate with higher volumes, about 680 in the northbound direction and 360 in the southbound direction.