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SECTION ACRONYMS/ABBREVIATIONS

ACRONYM/ ABBREVIATION	DEFINITION
CALTRANS	California Department of Transportation
CHP	California Highway Patrol
DPLU	Department of Planning and Land Use
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HDM	Highway Design Manual
I-15	Interstate 15
ILV/hr	Intersecting Lane Vehicles per hour
LORS	Laws, Ordinances, Regulations and Standards
LOS	Level of Service
MCAS	Marine Corps Air Station
MOE	Measures of Effectiveness
RTP	Regional Transportation Plan
SDG&E	San Diego Gas and Electric
SDNR	San Diego Northern Railway
SR	State Route

6.11 TRAFFIC AND TRANSPORTATION

This section presents an evaluation of the existing traffic and transportation systems in the Project region and the potential effects of the Project on these systems. The Site is located within the Pala-Pauma Community Plan area of San Diego County, approximately two miles west of the community of Pala. Access to the Site would be via Pala Del Norte Road, which is located west of the Site. The Site is located north of, and is adjacent to, State Route (SR) 76 approximately 4 (road) miles east of Interstate 15 (I-15). The nearby interstate provides convenient access to the Site for equipment and materials delivered from distant locations.

The primary affect to traffic and transportation systems will occur during Project construction. The analysis contained in this section demonstrates that construction traffic effects will be less than significant. The average construction traffic volume will consist of only approximately 71 vehicles per day over the 6-month construction period, including both construction worker traffic and deliveries. Further, the construction employees will arrive at the Site before 7:00 a.m. so the construction workforce will not to add to peak morning traffic at most of the study locations. As shown in the analysis, the construction trips do not significantly impact the study locations. Project operations traffic will typically consist of no more than four staff per shift with a maximum of five deliveries per day, and will have negligible traffic impact.

The traffic analysis for the Project was prepared by TPG Consulting, Inc. The analysis is summarized in this section. Additional details of the analysis are provided in Appendix 6.11-A through Appendix 6.11-D. Due to the volume of worksheet analyses that support the summary information, the worksheets are not provided herein. Instead, a compact disk, or printout of the worksheets that support this traffic analysis is available upon request. Two-lane roadway segment levels of service (LOS) were calculated using the *2000 Highway Capacity Manual (HCM 2000)* methodologies contained in the *Highway Capacity Software (HCS+)*. Unsignalized and signalized intersection levels of service were calculated using *Synchro 6.0* software which also incorporates *HCM 2000* methodologies. Ramp merge/diverge and freeway segment levels of service were analyzed using the *HCS+*. In addition to the above LOS requirements, Caltrans staff has also requested that ramp intersection capacity analysis be conducted for the SR 76 at I 15 ramp intersections. The ramp intersection capacity analyses were prepared according to the methodologies presented in the *Highway Design Manual*, Topic 406.

6.11.1 Existing Conditions

The following is a description of existing traffic and transportation facilities in the Project region including roads, highways, freeways, rail lines, bike trails, airports, bus routes, pipelines and canals. Regional traffic and transportation facilities are discussed in Section 6.11.1.1. Local traffic and transportation facilities are described in Section 6.11.1.2. New traffic and transportation facilities planned in the Project area by either San Diego County or Caltrans are discussed in Section 6.11.1.3.

6.11.1.1 Regional Setting

Figure 6.11-1 shows the regional traffic and transportation facilities. The Site is located in the northeast portion of San Diego County, approximately 4 miles east of Interstate 15 north of SR 76. The Project area is rural residential with some agriculture uses. The community of Pala, located on the Pala Reservation, is about 2 miles east of the Site. Figures 6.11-1 and 6.11.2 detail the existing road system, canals and major pipelines near the Project. There are no existing public transit or bicycle routes in the area.

6.11.1.1.1 Roads and Highways

The major highways and roads in the Project vicinity are shown in Figure 6.11-1. State Route 76 is located just south of the Site, and runs east-west between Interstate 15 and SR 79. I-15 runs north and south between the City of San Diego and the U.S./Canada International Border. Characteristics of these and other relevant roads and highways in the area are presented in the local traffic and transportation facilities discussion in Section 6.11.1.2.

6.11.1.1.2 Rail Service

There are no rail lines in the vicinity of the Site. The nearest rail line is owned and operated by the San Diego Northern Railway (SDNR) and runs from Oceanside to Escondido, through Vista and San Marcos. The nearest junction on this line is approximately 15 miles from the Site.

6.11.1.1.3 Air Service

Public and private airports located within approximately 30 miles of the Site include: McClellan-Palomar Airport, located approximately 20 miles to the southwest, Ramona Airport, located approximately 24 miles to the southeast, Oceanside Municipal Airport, located approximately 18 miles to the southwest, Marine Corps Air Station (MCAS) Camp Pendleton, located approximately 17 miles to the west, French Valley Airport, located approximately 15 miles to the north, and Fallbrook Community Airpark, located approximately 8 miles to the west. There are no airports closer than the Fallbrook Community Airpark.

6.11.1.1.4 Public Transit

There are no public transit facilities in the vicinity of the Site.

6.11.1.1.5 Waterways

There are no vehicle-use waterways in the Project area.

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Figure 6.11-1 – Regional Transportation Infrastructure

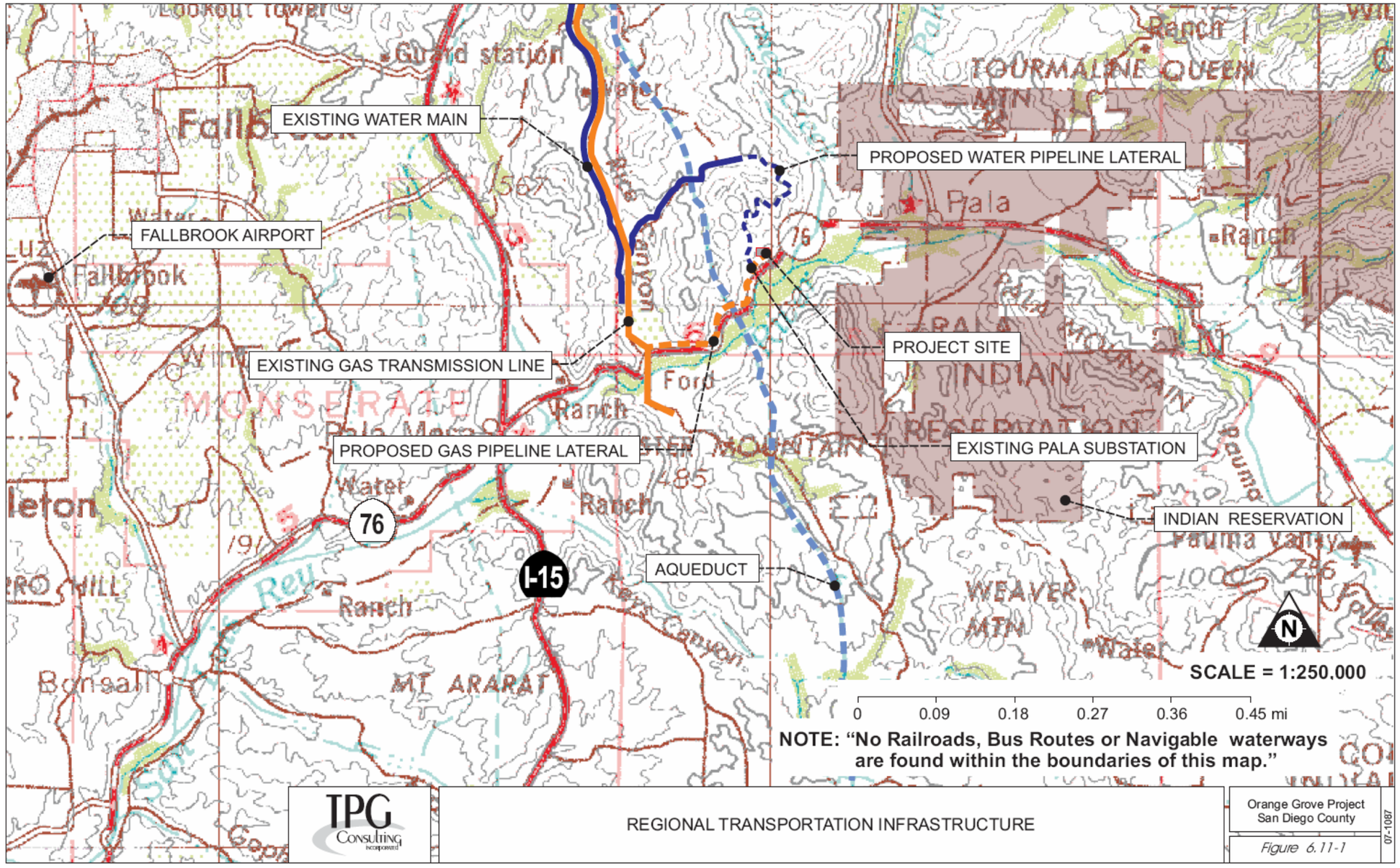
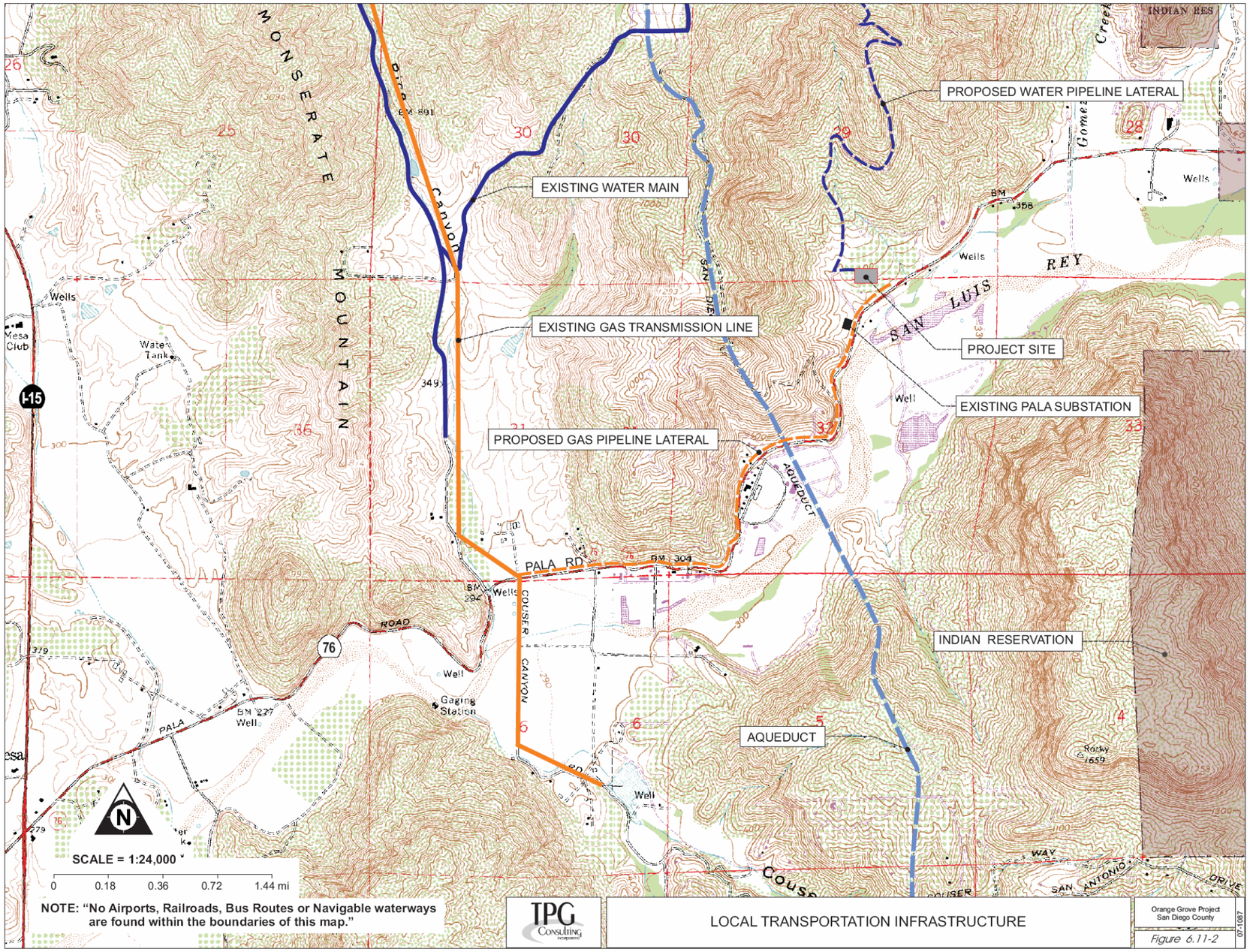


Figure 6.11-2 – Local Transportation Infrastructure



6.11.1.1.6 Other Transportation Facilities

A number of pipeline systems occur in the region. The San Diego Aqueduct runs in a north-south direction between the Site and Interstate 15. San Diego Gas & Electric (SDG&E) operates a natural gas pipeline that parallels Rice Canyon Road. The Project will connect to the SDG&E pipeline near its intersection with SR 76. The Rainbow Municipal Water District operates a water pipeline system in areas to the north and west of the Site, to which the Project will connect to for its water supply.

6.11.1.2 Local Setting

The roads and highways in the Project area are shown in Figure 6.11-2. As shown, the roadway system includes I-15 and SR 76. Pala del Norte Road is a private road that intersects SR 76 just south of the Site. The classification and design capacities for these roads and highways are listed in Table 6.11-1.

Table 6.11-1 – Roads & Highways in the Vicinity of the Project

STREET	CLASSIFICATION	NO. OF LANES	DAILY DESIGN CAPACITY (1)	POSTED SPEED LIMIT (MPH)	WEIGHT & LOAD LIMITATIONS
Interstate 15	Interstate/Freeway	8	115,000(2)	70	Legal load
SR 76	Freeway/Expressway(1) Major Road	2	15,400(2)	55	Legal load
Pala del Norte Road	Not Classified(3)	2	---(3)	NPS(3)	Not Classified(3)

NPS = No Posted Speed
(1) SR 76 is a part of the Freeway & Expressway (F&E) system west of Interstate 15.
(2) Capacity shown was taken from the County of San Diego General Plan 2020 Circulation Element Framework using closest applicable roadway classification. Caltrans has jurisdiction over the roadway.
(3) Pala del Norte Road of a local/private road not included in the list of County maintained roads.

Table 6.11-2 shows average daily and peak hour traffic counts, and percentages of passenger vehicles, buses and heavy vehicles (trucks) for key road segments in the vicinity of the Site.

Trucks are allowed on all State Routes and San Diego County highways and roads in the vicinity of the Project.

Traffic counts on key road segments, intersections and on- and off-ramps in the Site area were performed in March 2007. Due to projected Project work hours, peak hour periods studied were from 6:00 a.m. to 8:00 a.m. and 4:00 p.m. to 6:00 p.m. The existing weekday LOS and ramp intersections capacity analysis for the study locations during the peak hours are shown in Table 6.11-3 (LOS) and Table 6.11-4 (ramp intersection capacity analysis).

Table 6.11-2 – Average Daily Traffic (ADT) Volumes on the Existing Road System

STREET/SEGMENT	AVERAGE DAILY TRAFFIC	PEAK HOUR TRAFFIC	PERCENT OF DAILY TRAFFIC		
			Passenger Vehicles (Percent)	Buses (Percent)	Heavy Vehicles (Percent)
Interstate 15					
South of SR 76	128,000	8,839	90	--- (1)	10
North of SR 76	121,000	7,764	92	--- (1)	8
SR 76					
West of Old Highway 395	19,145	1,390 / 1,962(2)	90	0.5	9.5
East of Interstate 15	9,439	524 / 986(2)	94	0.5	5.5
East of Rice Canyon Road	8,987	494 / 701(2)	94	0.5	5.5

Source: Annual average daily traffic volumes, peak hour and percentages are shown for Interstate 15 and were taken from the Caltrans *2005 Peak Hour Volumes Data Report* and the Caltrans *2005 Annual Average Daily Truck Traffic on the California State Highway System.* Average daily traffic volumes, peak hour and percentages for the remaining segments are based on field data.

(1) Bus percentages are not available for Interstate 15
(2) AM/PM peak hour volumes

Table 6.11-3 and 6.11-4 also show the projections for LOS and ramp intersection capacity analysis for the road segments, intersections and ramps in the Project area for 2008 without construction or operation workers and deliveries. The projections at these locations are provided to characterize the period when peak Project construction is scheduled (early 2008) and also the period when the Project is scheduled to begin commercial operation (late 2008). To be conservative, the traffic analysis assumes a 5 percent yearly growth rate for traffic volumes on all road segments, ramps and intersections shown in Table 6.11-3 and Table 6.11-4. These growth factors are derived from 5 years of Caltrans count data on Interstate 15 and SR 76 in the study area.

6.11.1.3 Planned Transportation Facilities

The planned improvements for SR 76 vary depending on different agency concepts. According to the Caltrans *SR 76 Transportation Concept Report*, SR 76 is planned as a 4-lane conventional highway. According to the County of San Diego *General Plan 2020*, SR 76 between Interstate 15 and Pala-Pauma Road, located east of the Site, should be downgraded from a Major Road to a 2-lane Community Collector with intermittent turn lanes. A corridor study is currently being developed for SR 76 from I-15 to SR 79 by the Reservation Transportation Authority (RTA), in conjunction with Caltrans. The findings of the SR 76 corridor study are not currently available. According to the *I-15 Transportation Concept Report*, no changes are planned for I-15. There are no other known major new transportation facilities planned in the area of the Site.

6.11.2 Impacts

This section presents the results of the analysis of potential Project impacts to traffic and transportation systems during both construction and operations. The Project's affects on traffic and transportation systems will not be significant, largely due to the low Project-related traffic volumes, and the short-term nature of construction impacts when the most vehicle trips will occur.

Table 6.11-3 – Existing and Projected Levels of Service Without Project Workers/ Deliveries

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)
Hwy 76 at I-15 SB Ramps	B/E	B/E
Hwy 76 at I-15 NB Ramps	C/D	C/E
Hwy 76 at Rice Canyon Road		
EB Approach	A/A	A/A
WB Approach	A/A	A/A
SB Approach	B/B	B/B
Hwy 76 at Pala del Norte Road		
EB Approach	A/A	A/A
WB Approach	A/A	A/A
SB Approach	A/B	A/B
Freeway Segments		
I-15 south of Hwy 76		
NB	A/D	A/D
SB	D/A	D/A
I-15 north of Hwy 76		
NB	A/D	A/D
SB	D/A	D/A
Highway Segments		
Hwy 76 – west of Old Highway 395	E/E	E/E
Hwy 76 – I-15 NB Ramps to Rice Canyon Road	C/D	C/D
Hwy 76 – Rice Canyon Road to Project	C/C	C/D
Ramps		
I-15 NB Off-Ramp	A/D	A/E
I-15 NB On-Ramp	A/D	A/D
I-15 SB Off-Ramp	D/B	E/B
I-15 SB On-Ramp	C/B	C/B

Table 6.11-4 – Existing and Projected Ramp Intersection Capacity without Project Workers/Deliveries

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)
Hwy 76 at I-15 SB Ramps	1,207/1,619	1,268/1,700
Hwy 76 at I-15 NB Ramps	821/1,528	862/1,604

6.11.2.1 Significance Criteria

Significance criteria were determined based on CEQA Guidelines, Appendix G, Environmental Checklist Form, and on performance standards or thresholds adopted by responsible agencies. An impact may be considered significant if the Project results in:

- An increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads or congestion at intersections).
- Exceeding a level of service standard established by the County for designated roads.
- A substantial increase in hazards to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses.
- Inadequate emergency access.
- Inadequate parking capacity.
- A conflict with adopted policies, plans or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).
- A change in air traffic patterns.

The following LOS requirements are recommended by the County of San Diego and Caltrans for roads under their jurisdiction.

Table 6.11-5 – Local Recommended LOS Requirements

AGENCY	RECOMMENDATION
SANDAG 2006 Congestion Management Program Update	Minimum of LOS D for county roadways but if Existing LOS is worse than D, then the Existing LOS must be maintained.
Caltrans	Caltrans endeavors to maintain a target LOS at the transition between LOS C and LOS D on State highway facilities. If an existing State highway facility is operating at less than the appropriate target LOS, the existing measures of effectiveness (MOE) should be maintained.

In addition to the LOS analysis, at Caltrans' request the I-15 ramps at SR 76 were analyzed using the ramp intersection capacity analysis method. The ramp intersection capacity analysis method measures the capacity of ramp intersections based on intersecting lane vehicles per hour (ILV/hr), as shown in the *Highway Design Manual* (HDM). This analysis is a planning level

analysis which generally coincides with the LOS analysis. Based on HDM methodologies, the following thresholds are defined for ramp intersection capacity analysis:

- < 1,200 ILV/hr – Stable flow with slight, but acceptable delay. Occasional signal loading may develop. Free midblock operations.
- 1,200 – 1,500 ILV/hr – Unstable flow with considerable delays possible. Some vehicles occasionally wait two or more cycles to pass through the intersection. Continuous backup occurs on some approaches.
- > 1,500 ILV/hr – Stop-and-go operation with severe delay and heavy congestion. Traffic volume is limited by maximum discharge rates of each phase. Continuous backup in varying degrees occurs on all approaches. Where downstream capacity is restrictive, mainline congestion can impede orderly discharge through the intersection.

6.11.2.2 Construction Impacts

Tables 6.11-6 and 6.11-7 show "2008 with Project Construction Trips" a.m. and p.m. peak hour LOS for the study locations in the Project area, and “2008 with Project Construction Trips” a.m. and p.m. peak hour ramp intersection capacity analysis for the I 15 ramps at SR 76 intersections. The Construction Trips includes both construction worker trips and construction material and equipment delivery trips. Construction worker trips and construction material and equipment delivery trips are described below.

6.11.2.2.1 Construction Worker Traffic

Project construction worker traffic peaks will occur twice each day: once in the morning as construction workers travel to the Site; and once again in the late afternoon as the construction workers depart the Site at the end of the construction shift. This cycle would be repeated Monday through Friday during the 6-month Project construction period, and potentially on some Saturdays.

Table 2.13-1 in Section 2.0 shows monthly manpower loading for the 6-month construction phase of the Project. As shown, Project manpower rises to a peak of 105 construction workers during month 5. The average monthly manpower level over the 6-month construction period is 70 construction workers. To analyze maximum potential impacts for the Project, the maximum construction manpower month, with 105 workers, was used. Peak hour background traffic loading that occurred between 6:00 a.m. to 8:00 a.m. and 4:00 p.m. to 6:00 p.m. was used on the road segments, intersection and on- and off-ramps based on the planned peak staffing period shift schedule.

No special designated employee access routes have been identified for this Project. Instead, the commute routes and quantities of workers using these routes were estimated taking into account the location of population centers where workers would most likely reside and the distances to those population centers. The routes that the construction workers are expected to use commuting to and from the Site, and the percentages of workers using each route, are shown in Figure 6.11-3. The actual construction worker trip assignments are shown on Figure 6.11-4.

Other key assumptions that form the basis for the Project's construction work traffic analysis are as follows:

- Twenty percent of the workers will carpool. The rest will drive a separate vehicle to and from the construction site.
- Except for special circumstances, minimal offsite travel will occur during the work day.
- Each day, the construction shift will typically commence at 7:00 a.m. and end between 4:30 and 5:30 p.m.

Table 6.11-6 – Projected Levels of Service Construction

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)	2008 WITH PROJECT CONSTRUCTION WORKERS LOS (AM/PM)
Hwy 76 at I-15 SB Ramps	B/**E**	B/**E**	B/**E**
Hwy 76 at I-15 NB Ramps	C/**D**	C/**E**	B/**E**
Hwy 76 at Rice Canyon Road			
• EB Approach	A/A	A/A	A/A
• WB Approach	A/A	A/A	A/A
• SB Approach	B/B	B/B	B/B
Hwy 76 at Pala del Norte Road			
• EB Approach	A/A	A/A	A/A
• WB Approach	A/A	A/A	A/A
• SB Approach	A/B	A/B	A/B
Freeway Segments			
I-15 south of Hwy 76			
• **NB**	A/**D**	A/**D**	A/**D**
• **SB**	**D**/A	**D**/A	**D**/A
I-15 north of Hwy 76			
• **NB**	A/**D**	A/**D**	A/**D**
• **SB**	**D**/A	**D**/A	**D**/A
Highway Segments			
Hwy 76 – west of Old Highway 395	**E/E**	**E/E**	**E/E**
Hwy 76 – I-15 NB Ramps to Rice Canyon Road	C/**D**	C/**D**	C/**D**
Hwy 76 – Rice Canyon Road to Project	C/C	C/**D**	C/**D**

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)	2008 WITH PROJECT CONSTRUCTION WORKERS LOS (AM/PM)
Ramps			
I-15 NB Off-Ramp	A/**D**	A/**E**	A/**E**
I-15 NB On-Ramp	A/**D**	A/**D**	A/**D**
I-15 SB Off-Ramp	**D**/B	**E**/B	**E**/B
I-15 SB On-Ramp	C/B	C/B	C/B

Table 6.11-7 – Projected Ramp Intersection Capacity Analysis Construction

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)	2008 WITH PROJECT CONSTRUCTION WORKERS LOS (AM/PM)
Hwy 76 at I-15 SB Ramps	1,207/**1,619**	1,268/**1,700**	1,282/**1,739**
Hwy 76 at I-15 NB Ramps	821/**1,528**	862/**1,604**	877/**1,614**

As shown in Table 6.11-6, even at the peak of construction activities, Project construction inbound traffic and outbound traffic is not projected to reduce any local road or highway LOS beyond the forecasted "without Project" LOS. As shown in Table 6.11-7, the ramp intersection capacity analysis corresponds with the LOS analysis for the I 15 ramps at SR 76. Furthermore, the construction worker traffic will be short-term. The peak construction activities evaluated in this analysis will occur for a term of only about one month. The average construction worker traffic over the 6-month construction period will be about 30 percent less. Due to the relatively low number of construction worker trips resulting in no change to LOS on roadways, and considering the short term of construction worker traffic impact, Project impacts for construction worker traffic congestion will be less than significant.

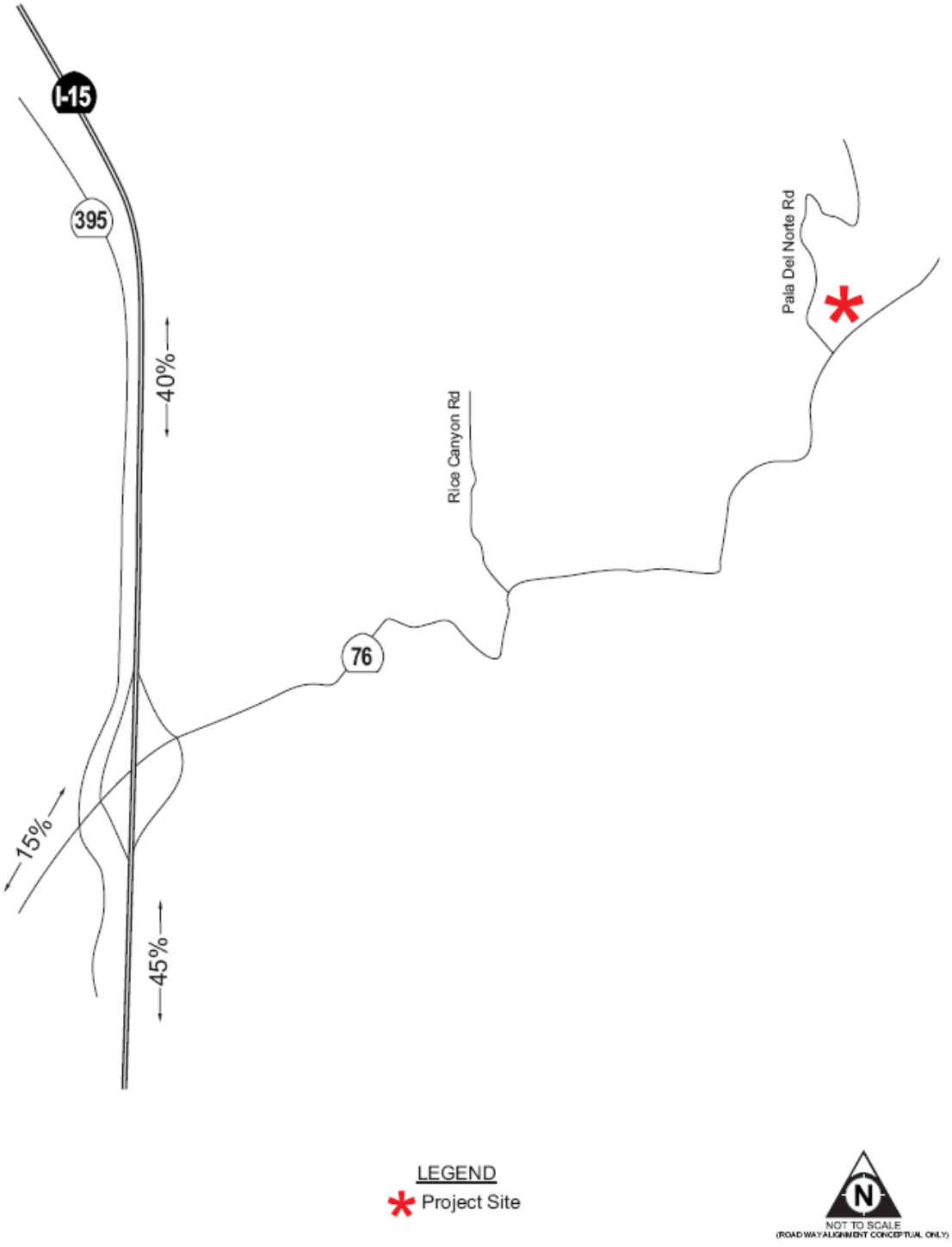
6.11.2.2.2 Construction Equipment and Material Deliveries

Equipment and materials for construction of the Project will be delivered by truck from various locations. The majority of truck deliveries are expected to arrive primarily along either of the following routes: via Interstate 15, exiting onto SR 76 and then to the Site, or along SR 76 from west of Interstate 15 to the Site.

Daily and monthly truck traffic will vary. Over the 6-month period, the estimated number of deliveries is 7 per day on average, with up to 15 per day maximum. This traffic evaluation included a peak typical traffic assessment that had 15 inbound and 15 outbound trucks traveling along SR 76 from/to the Project site.

As shown in Tables 6.11-6 and 6.11-7, the traffic analysis determined that the addition of this number of delivery trucks to local roads and highways throughout the Project construction period will not reduce LOS on local roads and highways. As a result, congestion impacts to traffic and transportation systems for construction equipment and deliveries will be less than significant.

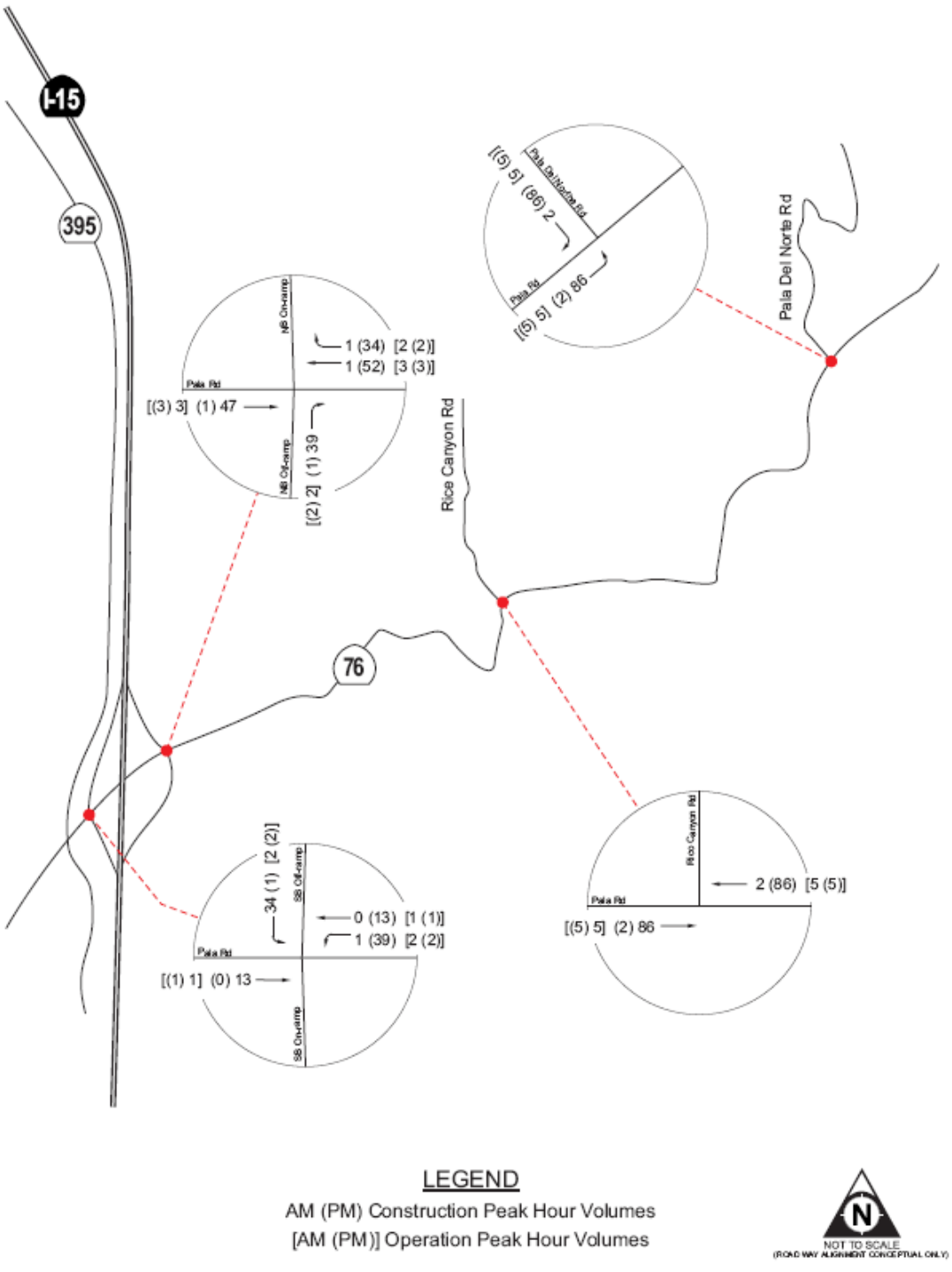
Figure 6.11-3 – Construction & Operation Trip Distribution Percentages



Orange Grove Project - SPPE Application

Source: TPG Consulting Inc.

Figure 6.11-4 – Project Trips Intersection Volumes



Orange Grove Project - SPPE Application

Source: TPG Consulting Inc.

6.11.2.2.3 Pipeline Construction Traffic Controls

The Project includes construction of an underground gas pipeline lateral west along SR 76 as shown in Figure 2.2-2. SDG&E will construct, own and operate the pipeline. The construction activities along SR 76 will take approximately one month and will involve the opening of a narrow trench, hauling and stringing and assembling, inspecting and laying pipe, backfilling the trench, and surfacing in accordance with Caltrans requirements. SDG&E will obtain an encroachment permit from Caltrans for the gas pipeline installation. It is expected that Caltrans will require the pipeline to be installed in the road shoulder, as far outside of traffic lanes as practical. Construction equipment and work may encroach within traffic lanes. Typical localized traffic management procedures (cones and flagmen) will be used to minimize traffic impacts, and one-lane traffic may be required during gas pipeline construction. All work within the SR 76 ROW will occur in accordance with the Caltrans encroachment permit and a Caltrans/California Highway Patrol (CHP) approved traffic management plan designed to minimize impacts on traffic and provide for traffic safety. Considering the performance of work in accordance with a Caltrans encroachment permit and Caltrans/CHP approved traffic control plan, and due to the short term nature of pipeline construction, the impact of the gas pipeline lateral on traffic and transportation will be less than significant.

The Project also includes construction of an underground water pipeline lateral north along the private Pala Del Norte Road as shown in Figure 2.2-2. The construction activities along Pala Del Norte Road will take approximately one month and involve the opening of a narrow trench, hauling and stringing and assembling, inspecting and laying pipe, backfilling the trench, and road surfacing. Construction of the water pipeline along Pala Del Norte Road will be done in accordance with an agreement with the private road owners that will include measures for traffic safety and to maintain through access during the construction period. Considering this, and due to the short term nature of pipeline construction, the impact of the water pipeline lateral on traffic and transportation will be less than significant.

6.11.2.2.4 Oversize Loads

Large equipment deliveries (i.e., oversize or heavy loads) will be required during construction. These loads will arrive at the site using I-15 and SR 76. If such loads exceed weight or size limits, these movements will be performed under appropriate permits from Caltrans. Given that the impacts from these deliveries are temporary, and are managed by special local and/or state permits, effects to roads and highways from movement of heavy/oversize loads are not projected to be significant.

6.11.2.2.5 Construction Hazardous Materials Transportation

Only a small percentage of the deliveries during construction will be consumable materials, including small amounts of hazardous materials. Hazardous materials will include fuels, lubricants, paints, sealers, adhesives, solvents, batteries, compressed gasses, solvents, and other materials used for construction. Most of these materials will be consumed. Small amounts will

be used and then transported off-site as hazardous waste. Hazardous materials will be transported to and from the site via I-15 and SR 76.

These types of materials are routinely transported over California highways throughout the state each day in accordance with applicable federal, state and local safety requirements. In fact, for the Project, the largest quantities of hazardous materials are represented by commonly transported diesel fuel for the construction equipment. Project deliveries for hazardous materials will be required to comply with all applicable federal and state safety requirements for transport of hazardous materials. As a result, impacts from hazardous material transportation will not be significant.

6.11.2.2.6 Hazards Due to Existing Transportation Design Features

SR 76, from I-15 to Pala Del Norte Road, is a two-lane undivided expressway in rolling terrain. Portions of the road are bordered by a rock slope on the north side and portions of the south side have heavy vegetation. The typical section of SR 76 has one 12-foot lane in each direction, separated by a double yellow stripe, and a 2-foot non standard outside shoulder width. The expressway has several sight deficiencies caused by either short vertical crest curves or sharp horizontal curves around the rock wall. These sight deficiencies prohibit vehicle passing; however, intermittent vehicle pullouts are provided along the route. Sight deficiencies will be more prominent at night due to absence of roadway lighting. The asphalt pavement structure of SR 76 is in good condition and does not appear to require roadway rehabilitation. There are no visible posted speed limit signs for the expressway, but advisory warning signs and associated speed reduction signs are present to warn motorist of upcoming sharp curves. The sharpest horizontal curve in the Project vicinity is signed for 20 mph.

From SR 76, the Site is accessed from Pala Del Norte Road. Pala Del Norte Road is an asphalt road in visually good condition and does not appear to require rehabilitation. The intersection of Pala Del Norte Road and SR 76 is an non-signalized tee-intersection. The Project also will involve constructing a secondary Project driveway off of SR 76 as shown in Figure 2.2-4 in Section 2.0 – Project and Facilities Description. A sight distance survey will be performed for the Pala Del Norte Road and secondary Project access intersections on SR 76 to document that the locations meet Caltrans sight distance requirements.

6.11.2.2.7 Hazards to Pedestrians or Bicyclists

Pedestrian and bicycle facilities and traffic are limited in the study area. Pedestrians are permitted on the north side of SR 76 at the I 15 interchange, but limited or no sidewalks are available. Pedestrian signals are provided at both ramp intersections, but pedestrians are not permitted to cross SR 76 at the I 15 ramps. I 15 north and south of SR 76 and SR 76 west of I 15 are designated as regional bikeway corridors according to the San Diego County Regional Transportation Plan (RTP), *Mobility 2030*. There are no pedestrian or bike facilities at the remaining study locations east of I 15. Since there are no or limited pedestrian or bike facilities located in the study area, impacts/hazards due to construction trips to pedestrians or bicyclists will not be significant. No significance criteria for pedestrian or bicycle facilities are identified in

either the current *San Diego County General Plan* or *General Plan 2020*. Therefore, the Project does not create significant conflicts with current policies regarding pedestrian and bicycle travel.

6.11.2.2.8 Parking Capacity

All vehicle parking for construction will be off-road in a construction lay down area. Project construction will have no impact on traffic related to Project parking.

6.11.2.2.9 School Traffic

The Bonsall Union School District provides bus service to and from Pala on SR 76. Project construction workers will arrive at the Site early (before 7 a.m.) and will leave the Site late (after 4:30 p.m.) compared to normal school arrival and departure times, so the construction traffic impact on school traffic will be less than significant.

6.11.2.3 Operations and Maintenance Impacts

Table 6.11-8 shows the "2008 with Project Operations and Maintenance Trips" a.m. and p.m. peak hour LOS for the study locations in the Project area. Table 6.11-9 shows the "2008 with Project Operations and Maintenance Trips" a.m. and p.m. peak hour ramp intersection capacity analysis for the I 15 ramps at SR 76. The 2008 with Project analysis includes Site personnel and deliveries.

6.11.2.3.1 Operations Personnel and Deliveries

The Project will be operated and maintained by approximately 6 full-time employees. There typically will be no more than four employees on the same shift. For purposes of this analysis, these employees are conservatively assumed to commute daily to work at the Site, each in their own vehicle.

This analysis considered the impacts of 4 workers arriving to work each morning between 6:00 a.m. and 8:00 a.m. An analysis is also provided for the day shift employees who leave at 5:00 p.m. The operational workers are assumed to use I 15 and SR 76 for trips to and from the Site. The routes that the operation workers are expected to use commuting to and from the Site, and the percentages of workers using each route, are shown in Figure 6.11-3. The actual operation worker trip assignments are shown on Figure 6.11-4. The impact of these workers on the LOS of the studied roadways is shown in Table 6.11-8. Due to this very small number of employees, the LOS on all roadways remains the same on all study locations as projected for the period without operation workers. As shown in Table 6.11-9, the ramp intersection capacity analysis corresponds with the LOS analysis for the I 15 ramps at SR 76. Further, daily delivery traffic will be small, with less than 5 trucks arriving and departing the Site each day. This small amount of delivery traffic will also not cause a noticeable change in LOS conditions for any of the study locations. The Project operations and maintenance traffic will be far below thresholds that DPLU has determined to cause noticeable change on roads that are congested (DPLU, 2006). As a result, traffic congestion impacts from operations will be less than significant.

6.11.2.3.2 Operations Hazardous Materials Transportation

A minimal number of hazardous materials deliveries will occur to support Project operations and maintenance. Section 6.15 – Hazardous Materials identifies the quantities of various hazardous materials that will be transported to the Site. Hazardous materials that will be routinely delivered to the Site include aqueous ammonia, petroleum productsand flammable and compressed gases. Occasional transport of hazardous waste from the Site also will occur, typically twice per year. Hazardous material and hazardous waste transport will use SR 76 and I 15. Hazardous materials and hazardous waste transportation will occur in accordance with applicable Federal and State requirements.

Table 6.11-8 – Projected Levels of Service – Operation

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)	2008 WITH PROJECT CONSTRUCTION WORKERS LOS (AM/PM)
Hwy 76 at I-15 SB Ramps	B/E	B/E	B/E
Hwy 76 at I-15 NB Ramps	C/D	C/E	C/E
Hwy 76 at Rice Canyon Road			
EB Approach	A/A	A/A	A/A
WB Approach	A/A	A/A	A/A
SB Approach	B/B	B/B	B/B
Hwy 76 at Pala del Norte Road			
EB Approach	A/A	A/A	A/A
WB Approach	A/A	A/A	A/A
SB Approach	A/B	A/B	A/B
Freeway Segments			
I-15 south of Hwy 76			
NB	A/D	A/D	A/D
SB	D/A	D/A	D/A
I-15 north of Hwy 76			
NB	A/D	A/D	A/D
SB	D/A	D/A	D/A
Highway Segments			
Hwy 76 – west of Old Highway 395	E/E	E/E	E/E
Hwy 76 – I-15 NB Ramps to Rice Canyon Road	C/D	C/D	C/D
Hwy 76 – Rice Canyon Road to Project	C/C	C/D	C/D
Ramps			
I-15 NB Off-Ramp	A/D	A/E	A/E

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)	2008 WITH PROJECT CONSTRUCTION WORKERS LOS (AM/PM)
I-15 NB On-Ramp	A/D	A/D	A/D
I-15 SB Off-Ramp	D/B	E/B	E/B
I-15 SB On-Ramp	C/B	C/B	C/B

Table 6.11-9 – Projected Ramp Intersection Capacity Analysis – Operation

INTERSECTION	EXISTING (2007) LOS (AM/PM)	2008 WITHOUT PROJECT WORKERS LOS (AM/PM)	2008 WITH PROJECT CONSTRUCTION WORKERS LOS (AM/PM)
Hwy 76 at I-15 SB Ramps	1,207/1,619	1,268/1,700	1,271/1,703
Hwy 76 at I-15 NB Ramps	821/1,528	862/1,604	865/1,607

All of the hazardous materials that will be use for operations are commonly transported on roads and highways throughout the United States each day in accordance with applicable federal, state and local requirements. Because Project hazardous material deliveries will be subject to the same federal and state requirements as materials that are currently transported on local roads and highways each day, impacts will not be significant.

Aqueous ammonia will be transported in a 19.0 percent by weight solution of ammonia in water. At this concentration, it is not designated as an inhalation hazard under Section 32101 of the California Vehicle Code. Instead, aqueous ammonia is classified as corrosive. Trucks used to transport aqueous ammonia are subject to design requirements that assure their integrity to hold the material without leaking. These requirements are specified in 49 CFR 171-180. The trucks are subject to regular safety and integrity inspection according to the requirements of the California Department of Transportation (Caltrans) (Foose, 1999). The Enforcement Services Division of the California Highway Patrol (CHP) is responsible for enforcing the hazardous materials regulations.

6.11.2.3.3 Other Impacts

Due to the small number of trips generated by Project operations and maintenance, there will be no substantial increase in traffic. Project operations will not increase the hazard of existing road design feature. No vapor plumes are expected that could affect driver visibility on roads. The Project will provide emergency access with a primary driveway and a secondary driveway both designed to accommodate emergency response vehicles. The project will provide parking onsite and will not impact offsite parking. The project will be designed with adequate vehicle parking onsite for operations and maintenance in accordance with DPLU requirements. Project operations and maintenance will not conflict with transportation policies, plans or programs for alternative transportation. The closest airport is approximately 8 miles west and no air traffic will be impacted by the Project. The number of trips generated by Project operations and

maintenance will be too low to result in a noticeable difference in congestion during school traffic hours. Considering these factors, Project operation and maintenance impacts related to transportation will be less than significant.

6.11.2.4 Cumulative Impacts

Projects with potential for cumulative impacts are identified in Section 6.1.2. Only two of the projects identified in Section 6.1.2 have the potential to be constructed before or concurrent with the Orange Grove Project, thereby having potential for cumulative impacts with Project construction traffic. The two projects that may be constructed prior to or concurrent with the Orange Grove Project area the cell tower generator installation (see Section 6.1.2.5) and Rosemary's Mountain Quarry (see Section 6.1.2.3). The installation of the cell tower generator, due to the limited scope of this work, would have few vehicle trips and a brief construction period (e.g., days). The construction of Rosemary's Mountain Quarry will be a bigger project and will include widening and straightening of the segment of SR-76 between I 15 and Rice Canyon Road. The road improvement will be completed as an initial phase of quarry construction. There is potential for a cumulative impact if the road work associated with Rosemary's Mountain Quarry coincides with Orange Grove Project construction. The SR 76 construction improvements will occur under a traffic management plan developed pursuant to Caltrans requirements. The Orange Grove Project natural gas line construction does not affect the segment of SR 76 that will be upgraded in conjunction with the Rosemary's Mountain Quarry Project. Overall, considering that construction impacts for both projects are short term, and traffic management plans will be implemented for work within the SR 76 right-of-way, the cumulative impact will be less than significant.

Except for the planned cell tower generator installation, each of the projects identified in Section 6.1.2 have the potential for cumulative traffic impacts with Project operations. However, the extent of impact will be dependent on the timing for construction of these projects and potential regional infrastructure improvements that may occur before these projects are completed. There is a reasonable likelihood that some of the projects identified in Section 6.1.2 may not be build for a period of years decades, if at all. Nonetheless, project operations and maintenance will have cumulative impacts with those other projects that are constructed and add vehicle trips on regional and vicinity roads. The Project will pay traffic impact fees assessed by jurisdictional agencies to mitigate cumulative impacts to a level that is less than significant.

6.11.2.5 Project Design Features to Avoid or Minimize Impacts

The following Site characteristics and Project design features avoid or minimize Project impacts to traffic and transportation facilities:

- Parking for construction workers and operations and maintenance staff will be provided onsite.
- Construction traffic control procedures will be implemented for construction of the gas pipeline lateral and water line lateral.

6.11.3 Mitigation Measures

Since there are no significant impacts on traffic and transportation from construction and operation of the Project, no mitigation measures are required.

6.11.4 Significant Unavoidable Adverse Impacts

There are no significant unavoidable adverse impacts on traffic and transportation from either construction or operation of the Project.

6.11.5 Laws, Ordinances, Regulations and Standards (LORS)

Laws, ordinances, regulations and standards related to traffic and transportation are summarized in Table 6.11-10. Table 6.11-11 identifies agency contacts related to transportation, and permits that will be required. The timing for obtaining these permits is shown in Figure 2.15-1.

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Table 6.11-10 – Traffic and Transportation LORS Compliance

JURIS-DICTION	AUTHORITY	AGENCY	REQUIREMENTS	COMPLIANCE	SPPE SECTION
Federal	49 CFR, Chapter II, Subchapter C; and Chapter III, Subchapter B.	Under jurisdiction of states	Regulations for the safe transport of hazardous materials; requires that transport of hazardous materials be by appropriate class of vehicle.	By meeting standards for the transport of hazardous materials.	6.11.2.2 6.11.2.3
State	California Vehicle Code §35780; California Streets & Highways Code §117, 660-711; 21 CCR §1411.1-1411.6	California Department of Transportation	Transport oversized loads over state highways; requires permit to transport over-size loads over State highways. Enforced by the California Highway Patrol.	By obtaining necessary permits from Caltrans.	6.11.2.4
	California Vehicle Code §31303-31309, 31600-31620, 32000-32004, 32050-32053, 32100-32109, & 34000-34100	California Department of Transportation	Regulations for the safe transport of hazardous materials; requires that transport of hazardous material follow certain regulations.	By meeting standards for the transport of hazardous materials.	6.11.2.2 6.11.2.3
	California Vehicle Code §35550	California Department of Transportation	Regulations for maximum weight of vehicles on highways; requires that vehicles on highways meet certain weight restrictions.	By meeting the necessary weight requirements for all Project related vehicles.	6.11.2.2 6.11.2.3
	California MUTCD, Chapter 6C	California Department of Transportation	Traffic control plans for construction near roadways; the needs and control of all road users through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.	By preparing the necessary temporary traffic control plans.	6.11.2.5
	California Department of Transportation	California Department of Transportation	Level of service standards for state facilities; Caltrans endeavors to maintain a target LOS at the transition between LOS C and LOS D on State Highway facilities. If an existing State highway facility is operating at less than the appropriate target LOS, the existing MOE should be maintained.	By not impacting Caltrans roadways such that LOS is decreased below C or Existing LOS.	6.11.2
Local	County of San Diego Congestion Management Program	County of San Diego/SANDAG	Level of service for local facilities; minimum of LOS D for county roadways but if existing LOS is worse than D, then the existing LOS must be maintained.	By not impacting County of San Diego roadways such that LOS is decreased below D or Existing LOS.	6.11.2

Table 6.11-11 –Agency Contacts

AGENCY AND CONTACT	AUTHORITY
Caltrans - Permit Office John Markey 2050 Taylor Street San Diego. CA 92110 (619) 688-6158	Heavy/Oversize Load Permit. Encroachment Permit.
SD County Department of Public Works Nael Areigat, P.E. DPW Project Manager Land Development Division 5201 Ruffin Road, Suite D San Diego, CA 92123-4310 (858) 495-5747	Advisory.

6.11.6 References

2006 Congestion Management Program Update, SANDAG, July 2006.

Al Cox, California Department of Transportation, District 11, Personal communication. April 2007.

California Vehicle Code. Section 32101.

Cindee Feaver, California Department of Transportation, District 11, Personal communication. April 2007.

General Plan 2020, County of San Diego, ongoing.

Highway Design Manual, California Department of Transportation, September 2006.

I-15 Transportation Concept Report, California Department of Transportation, September 2000.

Mobility 2030 – The Transportation Plan for the San Diego Region Final Amendment – Number 1, San Diego County Regional Transportation Plan, SANDAG, 2005.

San Diego County General Plan, County of San Diego Department of Planning and Land Use, Amended July 1994.

County of San Diego Guidelines for Determining Significance, Transportation and Traffic. Department of Planning and Land Use and Department of Public Works, September 26, 2006.

SR-76 Transportation Concept Report, California Department of Transportation, March 2002.

Traffic Evaluation Research and Analysis, TPG Consulting, Inc., April 2007.

6.11-A. A

APPENDIX 6.11-A – EXISTING LOS ANALYSIS

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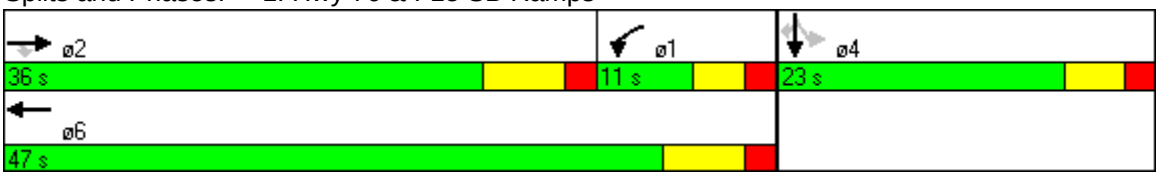
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.956	
Satd. Flow (prot)	0	1827	1553	1719	1810	0	0	0	0	0	1730	1538
Flt Permitted				0.950							0.956	
Satd. Flow (perm)	0	1827	1553	1719	1810	0	0	0	0	0	1730	1538
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			341									562
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		16.4			18.2			13.7			30.8	
Volume (vph)	0	558	300	90	280	0	0	0	0	66	5	559
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	5%	5%	5%
Adj. Flow (vph)	0	634	341	102	318	0	0	0	0	75	6	635
Lane Group Flow (vph)	0	634	341	102	318	0	0	0	0	0	81	635
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases			2							4		4
Detector Phases		2	2	1	6					4	4	4
Minimum Initial (s)		5.0	5.0	5.0	5.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.2	24.0					22.0	22.0	22.0
Total Split (s)	0.0	36.0	36.0	11.0	47.0	0.0	0.0	0.0	0.0	23.0	23.0	23.0
Total Split (%)	0.0%	51.4%	51.4%	15.7%	67.1%	0.0%	0.0%	0.0%	0.0%	32.9%	32.9%	32.9%
Maximum Green (s)		29.0	29.0	5.8	40.0					17.4	17.4	17.4
Yellow Time (s)		5.0	5.0	3.2	5.0					3.6	3.6	3.6
All-Red Time (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Minimum Gap (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Time Before Reduce (s)		0.0	0.0	0.5	0.0					0.0	0.0	0.0
Time To Reduce (s)		0.0	0.0	0.1	0.0					0.0	0.0	0.0
Recall Mode		C-Min	C-Min	Min	C-Max					Min	Min	Min
Walk Time (s)					7.0							
Flash Dont Walk (s)					10.0							
Pedestrian Calls (#/hr)					10							
Act Effct Green (s)		34.8	34.8	9.6	48.4						13.6	13.6
Actuated g/C Ratio		0.50	0.50	0.14	0.69						0.19	0.19
v/c Ratio		0.70	0.36	0.43	0.25						0.24	0.85
Control Delay		19.5	2.7	27.1	0.5						23.5	15.9
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		19.5	2.7	27.1	0.5						23.5	15.9
LOS		B	A	C	A						C	B
Approach Delay		13.6			7.0						16.8	
Approach LOS		B			A						B	
Queue Length 50th (ft)		179	0	48	0						30	27
Queue Length 95th (ft)		330	37	m#98	2						57	123
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		908	943	237	1252						470	827
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		0.70	0.36	0.43	0.25						0.17	0.77

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 30 (43%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 60
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 13.4 Intersection LOS: B
Intersection Capacity Utilization 56.0% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.953	
Satd. Flow (prot)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Flt Permitted				0.950							0.953	
Satd. Flow (perm)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			172									154
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		30.0			33.5			13.7			30.8	
Volume (vph)	0	880	233	137	797	0	0	0	0	141	2	602
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	1000	265	156	906	0	0	0	0	160	2	684
Lane Group Flow (vph)	0	1000	265	156	906	0	0	0	0	0	162	684
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		4		3	8						6	
Permitted Phases			4							6		6
Detector Phases		4	4	3	8					6	6	6
Minimum Initial (s)		5.0	5.0	4.0	4.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.0	22.0					24.0	24.0	24.0
Total Split (s)	0.0	63.0	63.0	14.0	77.0	0.0	0.0	0.0	0.0	43.0	43.0	43.0
Total Split (%)	0.0%	52.5%	52.5%	11.7%	64.2%	0.0%	0.0%	0.0%	0.0%	35.8%	35.8%	35.8%
Maximum Green (s)		57.4	57.4	8.0	71.0					36.0	36.0	36.0
Yellow Time (s)		3.6	3.6	5.0	5.0					5.0	5.0	5.0
All-Red Time (s)		2.0	2.0	1.0	1.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Recall Mode		C-Min	C-Min	None	C-Max					None	None	None
Walk Time (s)										7.0	7.0	7.0
Flash Dont Walk (s)										10.0	10.0	10.0
Pedestrian Calls (#/hr)										10	10	10
Act Effct Green (s)		59.0	59.0	10.0	73.0						39.0	39.0
Actuated g/C Ratio		0.49	0.49	0.08	0.61						0.32	0.32
v/c Ratio		1.09	0.31	1.05	0.80						0.28	1.11
Control Delay		88.3	7.3	73.0	1.2						31.8	99.3
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0
Total Delay		88.3	7.3	73.0	1.2						31.8	99.3
LOS		F	A	E	A						C	F
Approach Delay		71.4			11.7						86.4	
Approach LOS		E			B						F	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		~874	38	~130	0						93	~519
Queue Length 95th (ft)		#1085	85	m#117	m0						148	#726
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		916	866	148	1133						577	618
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		1.09	0.31	1.05	0.80						0.28	1.11

Intersection Summary

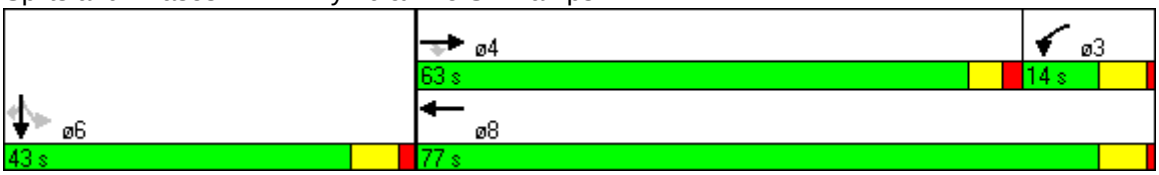
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 61 (51%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.11
Intersection Signal Delay: 55.4 Intersection LOS: E
Intersection Capacity Utilization 91.2% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



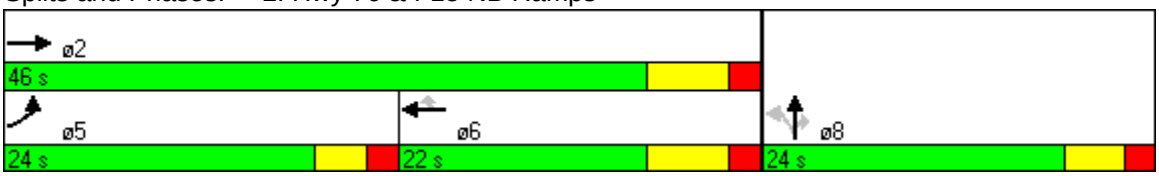
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						56			130			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		18.2			13.0			23.4			11.2	
Volume (vph)	451	173	0	0	204	49	165	1	114	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	512	197	0	0	232	56	188	1	130	0	0	0
Lane Group Flow (vph)	512	197	0	0	232	56	0	189	130	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	5	2			6			8				
Permitted Phases						6	8		8			
Detector Phases	5	2			6	6	8	8	8			
Minimum Initial (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	12.0	22.0			22.0	22.0	24.0	24.0	24.0			
Total Split (s)	24.0	46.0	0.0	0.0	22.0	22.0	24.0	24.0	24.0	0.0	0.0	0.0
Total Split (%)	34.3%	65.7%	0.0%	0.0%	31.4%	31.4%	34.3%	34.3%	34.3%	0.0%	0.0%	0.0%
Maximum Green (s)	18.8	39.0			15.0	15.0	18.4	18.4	18.4			
Yellow Time (s)	3.2	5.0			5.0	5.0	3.6	3.6	3.6			
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Minimum Gap (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Time Before Reduce (s)	0.5	0.0			0.0	0.0	0.0	0.0	0.0			
Time To Reduce (s)	0.1	0.0			0.0	0.0	0.0	0.0	0.0			
Recall Mode	None	C-Max			C-Max	C-Max	Min	Min	Min			
Walk Time (s)							7.0	7.0	7.0			
Flash Dont Walk (s)							10.0	10.0	10.0			
Pedestrian Calls (#/hr)							10	10	10			
Act Effct Green (s)	25.5	47.5			18.0	18.0		14.5	14.5			
Actuated g/C Ratio	0.36	0.68			0.26	0.26		0.21	0.21			
v/c Ratio	0.81	0.16			0.48	0.12		0.56	0.32			
Control Delay	23.2	3.8			26.1	7.2		30.5	6.6			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	23.2	3.8			26.1	7.2		30.5	6.6			
LOS	C	A			C	A		C	A			
Approach Delay		17.8			22.4			20.7				
Approach LOS		B			C			C				
Queue Length 50th (ft)	202	30			85	0		73	0			
Queue Length 95th (ft)	#388	m36			144	24		116	34			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	633	1240			479	449		470	512			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	0.81	0.16			0.48	0.12		0.40	0.25			

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 19.5 Intersection LOS: B
Intersection Capacity Utilization 56.0% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						127			213			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		33.5			23.9			23.4			11.2	
Volume (vph)	549	472	0	0	432	123	502	5	226	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	624	536	0	0	491	140	570	6	257	0	0	0
Lane Group Flow (vph)	624	536	0	0	491	140	0	576	257	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases						8	2		2			
Detector Phases	7	4			8	8	2	2	2			
Minimum Initial (s)	4.0	4.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	10.0	22.0			24.0	24.0	22.0	22.0	22.0			
Total Split (s)	44.0	79.0	0.0	0.0	35.0	35.0	41.0	41.0	41.0	0.0	0.0	0.0
Total Split (%)	36.7%	65.8%	0.0%	0.0%	29.2%	29.2%	34.2%	34.2%	34.2%	0.0%	0.0%	0.0%
Maximum Green (s)	38.0	73.0			29.4	29.4	34.0	34.0	34.0			
Yellow Time (s)	5.0	5.0			3.6	3.6	5.0	5.0	5.0			
All-Red Time (s)	1.0	1.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Recall Mode	None	C-Max			C-Min	C-Min	None	None	None			
Walk Time (s)					7.0	7.0						
Flash Dont Walk (s)					10.0	10.0						
Pedestrian Calls (#/hr)					10	10						
Act Effct Green (s)	40.0	75.0			31.0	31.0		37.0	37.0			
Actuated g/C Ratio	0.33	0.62			0.26	0.26		0.31	0.31			
v/c Ratio	1.06	0.46			1.02	0.28		1.05	0.40			
Control Delay	62.4	4.5			90.7	9.1		93.8	9.0			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			
Total Delay	62.4	4.5			90.7	9.1		93.8	9.0			
LOS	E	A			F	A		F	A			
Approach Delay		35.6			72.6			67.6				
Approach LOS		D			E			E				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~518	87			~404	8		~487	24			
Queue Length 95th (ft)	m#412	m109			#592	55		#682	85			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	590	1164			481	503		547	635			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	1.06	0.46			1.02	0.28		1.05	0.40			

Intersection Summary

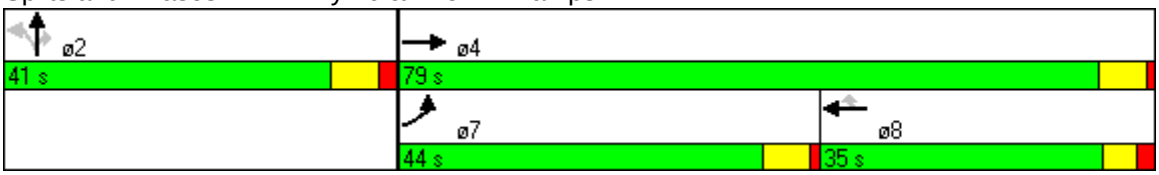
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 120
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.06
Intersection Signal Delay: 54.7 Intersection LOS: D
Intersection Capacity Utilization 91.2% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	12	277	200	4	13	19
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	13	301	217	4	14	21
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	222				547	220
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	222				547	220
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	97
cM capacity (veh/h)	1341				493	820

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	314	222	35
Volume Left	13	0	14
Volume Right	0	4	21
cSH	1341	1700	646
Volume to Capacity	0.01	0.13	0.05
Queue Length 95th (ft)	1	0	4
Control Delay (s)	0.4	0.0	10.9
Lane LOS	A		B
Approach Delay (s)	0.4	0.0	10.9
Approach LOS			B

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	34.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	20	307	379	9	6	12
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	22	334	412	10	7	13
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	422				794	417
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	422				794	417
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	98
cM capacity (veh/h)	1137				350	636

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	355	422	20
Volume Left	22	0	7
Volume Right	0	10	13
cSH	1137	1700	500
Volume to Capacity	0.02	0.25	0.04
Queue Length 95th (ft)	1	0	3
Control Delay (s)	0.7	0.0	12.5
Lane LOS	A		B
Approach Delay (s)	0.7	0.0	12.5
Approach LOS			B

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	42.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	1	263	183	1	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	286	199	1	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	200				488	199
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	200				488	199
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1372				539	842

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	287	200	1
Volume Left	1	0	0
Volume Right	0	1	1
cSH	1372	1700	842
Volume to Capacity	0.00	0.12	0.00
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	0.0	0.0	9.3
Approach LOS			A

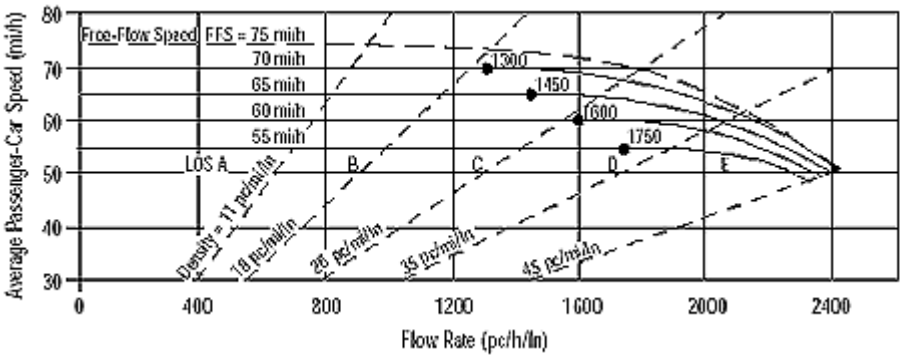
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	24.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	1	290	389	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	315	423	1	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	424				741	423
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	424				741	423
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1135				383	631

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	316	424	1
Volume Left	1	0	1
Volume Right	0	1	0
cSH	1135	1700	383
Volume to Capacity	0.00	0.25	0.00
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.0	14.4
Lane LOS	A		B
Approach Delay (s)	0.0	0.0	14.4
Approach LOS			B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	30.5%	ICU Level of Service	A
Analysis Period (min)	15		

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*NB I-15*
Agency or Company	*TPG Consulting*	From/To	*south of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs				
Volume, V	*1203*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}	*0.0*	mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}	*0.0*	mi/h
Interchange Density	*0.50*	I/mi	f_{ID}	*0.0*	mi/h
Number of Lanes, N	*4*		f_N	*0.0*	mi/h
FFS (measured)		mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*359*	pc/h/ln	Design LOS	
S	*70.0*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	*5.1*	pc/mi/ln	S	mi/h
LOS	*A*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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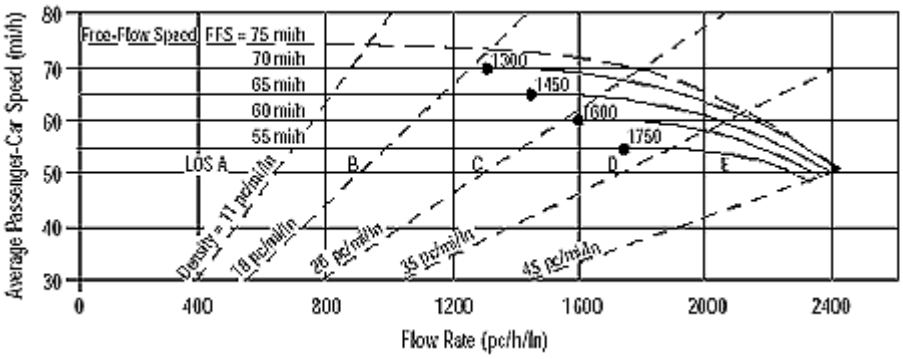
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*NB I-15*
Agency or Company	*TPG Consulting*	From/To	*south of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6431*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*4*		f_N		mi/h
FFS (measured)	*70.0*	mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1918*	pc/h/ln	Design LOS	
S	*66.3*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	*28.9*	pc/mi/ln	S	mi/h
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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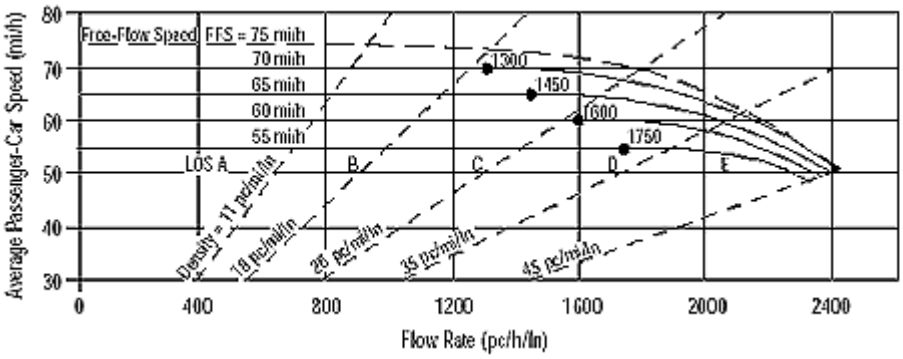
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		***Site Information***	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*SB I-15*
Agency or Company	*TPG Consulting*	From/To	*south of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs				
Volume, V	*6047*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments			
f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs			**Calc Speed Adj and FFS**		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*4*		f_N		mi/h
FFS (measured)	*70.0*	mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures			**Design (N)**	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1804*	pc/h/ln	Design LOS	
S	*67.8*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	*26.6*	pc/mi/ln	S	mi/h
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		**Factor Location**	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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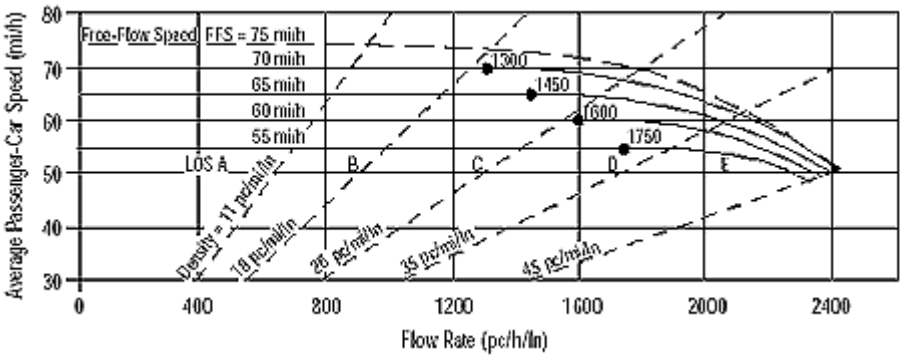

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1958*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*584*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*8.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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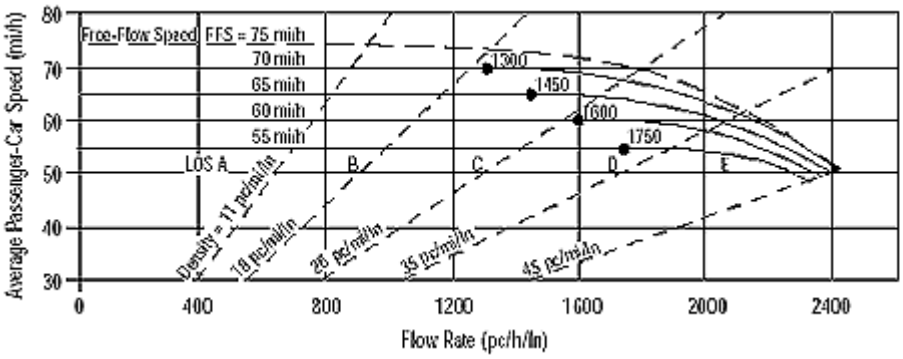

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*	Highway/Direction of Travel	*NB I-15*
Agency or Company	*TPG Consulting*	From/To	*north of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1424*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*421*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*6.0*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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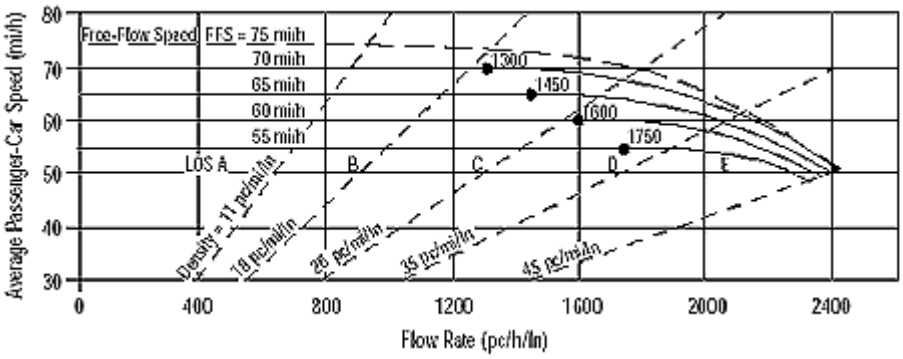

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*NB I-15*
Agency or Company	*TPG Consulting*	From/To	*north of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6375*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*4*		f_N		mi/h
FFS (measured)	*70.0*	mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1884*	pc/h/ln	Design LOS	
S	*66.8*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	*28.2*	pc/mi/ln	S	mi/h
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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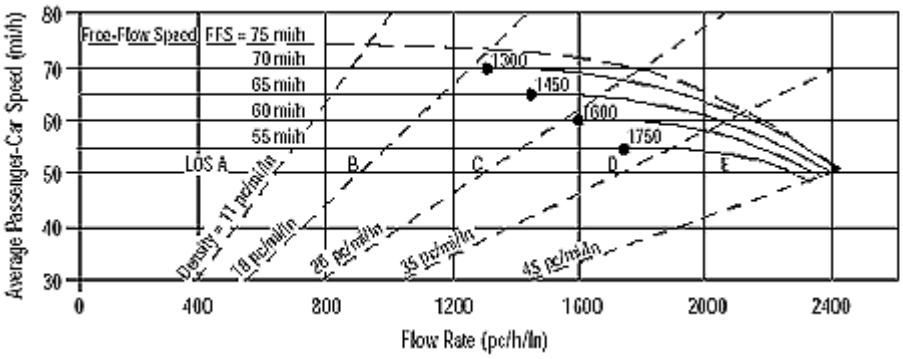

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*SB I-15*
Agency or Company	*TPG Consulting*	From/To	*north of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6282*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*4*		f_N		mi/h
FFS (measured)	*70.0*	mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1856*	pc/h/ln	Design LOS	
S	*67.2*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
D = v_p / S	*27.6*	pc/mi/ln	S	mi/h
LOS	*D*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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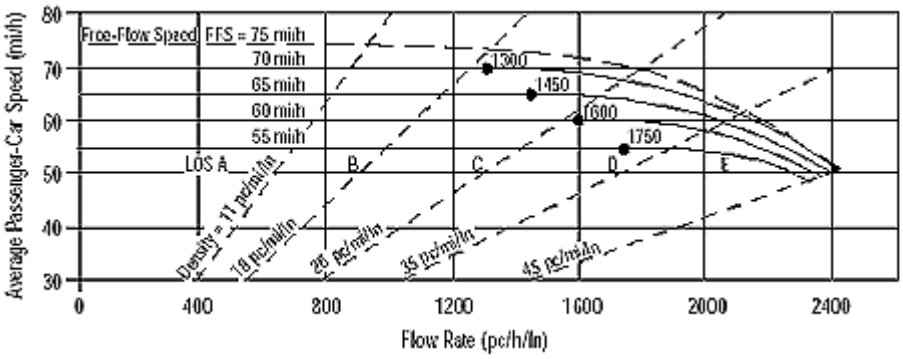

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2007*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2331*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*689*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*9.8*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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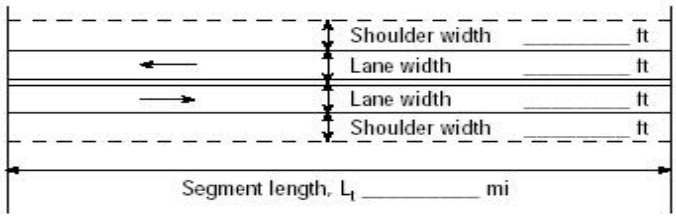
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1390* veh/h
Directional split	*53 / 47*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1598*
v_p * highest directional split proportion[2] (pc/h)	*847*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.5*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*41.1*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1580*
v_p * highest directional split proportion[2] (pc/h)	*837*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*75.1*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*6.9*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*81.9*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.50*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*395*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1390*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*9.6*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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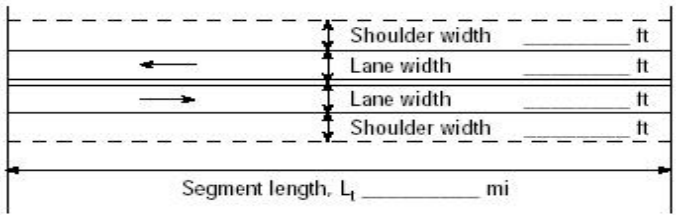
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2007*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1962* veh/h
Directional split	*54 / 46*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*10* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.990*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2252*
v_p * highest directional split proportion[2] (pc/h)	*1216*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.1*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*36.4*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2230*
v_p * highest directional split proportion[2] (pc/h)	*1204*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*85.9*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*3.6*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*89.5*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.70*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*111*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*392*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.0*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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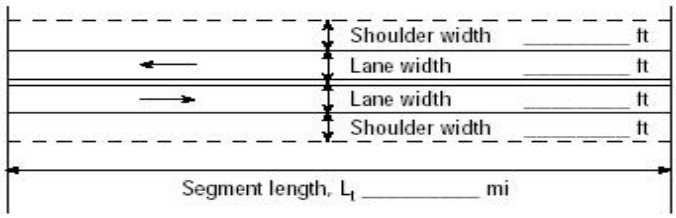
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain	☑ Level ☐ Rolling
Two-way hourly volume	*524* veh/h
Directional split	*55 / 45*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*9* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*601*
v_p * highest directional split proportion[2] (pc/h)	*331*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.3*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*47.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*601*
v_p * highest directional split proportion[2] (pc/h)	*331*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*41.0*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*19.5*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*60.5*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.19*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*298*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1048*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*6.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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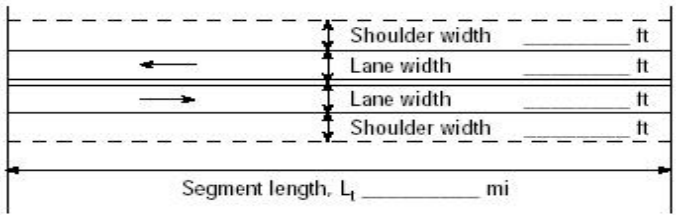
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2007*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*986* veh/h
Directional split	*52 / 48*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*6* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1127*
v_p * highest directional split proportion[2] (pc/h)	*586*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.9*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*44.3*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1127*
v_p * highest directional split proportion[2] (pc/h)	*586*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*62.9*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*10.4*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*73.3*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.35*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*560*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1972*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*12.6*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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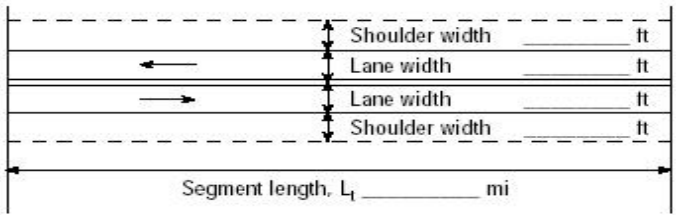
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2007*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*494* veh/h
Directional split	*59 / 41*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*8* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*566*
v_p * highest directional split proportion[2] (pc/h)	*334*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.4*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*47.2*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*566*
v_p * highest directional split proportion[2] (pc/h)	*334*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*39.2*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*19.9*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*59.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.18*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*281*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*988*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*6.0*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2007*

Project Description: *07-1087 Pala Power Plant*

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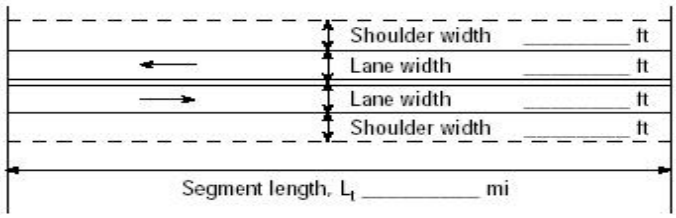

☑ Class I highway ☐ Class II highway

Terrain	☑ Level ☐ Rolling
Two-way hourly volume	*701* veh/h
Directional split	*55 / 45*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*5* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*801*
v_p * highest directional split proportion[2] (pc/h)	*441*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.6*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*46.2*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*801*
v_p * highest directional split proportion[2] (pc/h)	*441*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*50.5*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*14.0*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*64.5*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.25*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*398*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1402*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*8.6*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 501 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1203	0.88	Level	8	0	0.962	1.00	1422
Ramp	280	0.88	Level	8	0	0.962	1.00	331
UpStream								
DownStream	501	0.88	Level	10	0	0.952	1.00	598

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 807 pc/h

V_3 or V_{av34} 307 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1422	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1091	Exhibit 25-14	9600	No
V_R	331	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	807	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 8.9 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.458 (Exhibit 25-19)

S_R= 57.2 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 677 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6431	0.88	Level	8	0	0.962	1.00	7600
Ramp	733	0.88	Level	8	0	0.962	1.00	866
UpStream								
DownStream	677	0.88	Level	10	0	0.952	1.00	808

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3802 pc/h

V_3 or V_{av34} 1899 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7600	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	6734	Exhibit 25-14	9600	No
V_R	866	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3802	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 34.7 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.506 (Exhibit 25-19)

S_R= 55.8 mph (Exhibit 25-19)

S_0= 73.3 mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 280 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	923	0.88	Level	10	0	0.952	1.00	1101
Ramp	501	0.88	Level	10	0	0.952	1.00	598
UpStream	280	0.88	Level	8	0	0.962	1.00	331
DownStream								

Merge Areas | Diverge Areas

Estimation of v_{12} (Merge Areas)

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.366 using Equation (Exhibit 25-5)

V_{12} = 403 pc/h

V_3 or V_{av34} 349 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 440 pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1699	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1038	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 8.9 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.283 (Exibit 25-19)

S_R= 62.1 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 677 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5698	0.88	Level	10	0	0.952	1.00	6799
Ramp	677	0.88	Level	10	0	0.952	1.00	808
UpStream	677	0.88	Level	8	0	0.962	1.00	800
DownStream								

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.340 using Equation (Exhibit 25-5)

V_{12} = 2310 pc/h

V_3 or V_{av34} 2244 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2719 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7607	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3527	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 28.2 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.405 (Exibit 25-19)

S_R= 58.7 mph (Exhibit 25-19)

64.5 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 395 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	6282	0.88	Level	10	0	0.952	1.00	7496
Ramp	630	0.88	Level	10	0	0.952	1.00	752
UpStream								
DownStream	395	0.88	Level	8	0	0.962	1.00	467

Estimation of v_{12} — Merge Areas

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3692 pc/h

V_3 or V_{av34} 1902 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7496	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	6744	Exhibit 25-14	9600	No
V_R	752	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3692	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = 34.9 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.496 (Exhibit 25-19)

S_R= 56.1 mph (Exhibit 25-19)

S_0= 73.3 mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 372 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2331	0.88	Level	10	0	0.952	1.00	2781
Ramp	745	0.88	Level	10	0	0.952	1.00	889
UpStream								
DownStream	372	0.88	Level	8	0	0.962	1.00	440

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 1714 pc/h

V_3 or V_{av34} 533 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2781	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1892	Exhibit 25-14	9600	No
V_R	889	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1714	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 17.9 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

D_s = 0.508 (Exhibit 25-19)

S_R= 55.8 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 630 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	5652	0.88	Level	8	0	0.962	1.00	6680
Ramp	395	0.88	Level	8	0	0.962	1.00	467
UpStream	630	0.88	Level	10	0	0.952	1.00	752
DownStream								

Merge Areas | Diverge Areas

Estimation of v_{12} (Merge Areas)

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.359 using Equation (Exhibit 25-5)

V_{12} = 2395 pc/h

V_3 or V_{av34} 2142 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2672 pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	7147	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area (Merge Areas)

	Actual	Max Desirable		Violation?
V_{R12}	3139	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area (Diverge Areas)

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F) (Merge Areas)

$D_R = 5.475 + 0.00734 v_R + 0.0078 V_{12} - 0.00627 L_A$

D_R = 25.8 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

$D_R = 4.252 + 0.0086 V_{12} - 0.0009 L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.367 (Exibit 25-19)

S_R= 59.7 mph (Exhibit 25-19)

64.6 mph (Exhibit 25-19)

Speed Determination (Diverge Areas)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2007

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 745 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1586	0.88	Level	8	0	0.962	1.00	1874
Ramp	372	0.88	Level	8	0	0.962	1.00	440
UpStream	745	0.88	Level	10	0	0.952	1.00	889
DownStream								

Merge Areas | Diverge Areas

Estimation of v_{12} (Merge Areas)

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.362 using Equation (Exhibit 25-5)

V_{12} = 678 pc/h

V_3 or V_{av34} 598 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 749 pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	2314	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area (Merge Areas)

	Actual	Max Desirable		Violation?
V_{R12}	1189	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area (Diverge Areas)

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F) (Merge Areas)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 10.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.290 (Exibit 25-19)

S_R= 61.9 mph (Exhibit 25-19)

S_0= 69.8 mph (Exhibit 25-19)

Speed Determination (Diverge Areas)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

6.11-B. A

APPENDIX 6.11-B – 2008 NO PROJECT LOS ANALYSIS

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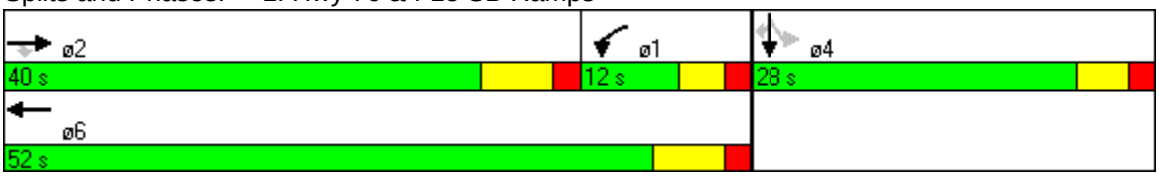
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.956	
Satd. Flow (prot)	0	1827	1553	1719	1810	0	0	0	0	0	1730	1538
Flt Permitted				0.950							0.956	
Satd. Flow (perm)	0	1827	1553	1719	1810	0	0	0	0	0	1730	1538
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			358									534
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		16.4			18.2			13.7			30.8	
Volume (vph)	0	586	315	95	294	0	0	0	0	69	5	587
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	5%	5%	5%
Adj. Flow (vph)	0	666	358	108	334	0	0	0	0	78	6	667
Lane Group Flow (vph)	0	666	358	108	334	0	0	0	0	0	84	667
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases			2							4		4
Detector Phases		2	2	1	6					4	4	4
Minimum Initial (s)		5.0	5.0	5.0	5.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.2	24.0					22.0	22.0	22.0
Total Split (s)	0.0	40.0	40.0	12.0	52.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0
Total Split (%)	0.0%	50.0%	50.0%	15.0%	65.0%	0.0%	0.0%	0.0%	0.0%	35.0%	35.0%	35.0%
Maximum Green (s)		33.0	33.0	6.8	45.0					22.4	22.4	22.4
Yellow Time (s)		5.0	5.0	3.2	5.0					3.6	3.6	3.6
All-Red Time (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Minimum Gap (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Time Before Reduce (s)		0.0	0.0	0.5	0.0					0.0	0.0	0.0
Time To Reduce (s)		0.0	0.0	0.1	0.0					0.0	0.0	0.0
Recall Mode		C-Min	C-Min	Min	C-Max					Min	Min	Min
Walk Time (s)					7.0							
Flash Dont Walk (s)					10.0							
Pedestrian Calls (#/hr)					10							
Act Effct Green (s)		40.4	40.4	10.4	54.8						17.2	17.2
Actuated g/C Ratio		0.50	0.50	0.13	0.68						0.22	0.22
v/c Ratio		0.72	0.37	0.48	0.27						0.23	0.89
Control Delay		22.4	2.9	35.6	0.8						24.7	21.6
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		22.4	2.9	35.6	0.8						24.7	21.6
LOS		C	A	D	A						C	C
Approach Delay		15.6			9.3						21.9	
Approach LOS		B			A						C	
Queue Length 50th (ft)		240	0	60	0						34	56
Queue Length 95th (ft)		#422	41	m#114	0						63	#187
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		924	962	223	1240						519	835
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		0.72	0.37	0.48	0.27						0.16	0.80

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 40 (50%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 16.5 Intersection LOS: B
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.953	
Satd. Flow (prot)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Flt Permitted				0.950							0.953	
Satd. Flow (perm)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			169									135
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		30.0			33.5			13.7			30.8	
Volume (vph)	0	924	245	144	837	0	0	0	0	148	2	632
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	1050	278	164	951	0	0	0	0	168	2	718
Lane Group Flow (vph)	0	1050	278	164	951	0	0	0	0	0	170	718
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		4		3	8						6	
Permitted Phases			4							6		6
Detector Phases		4	4	3	8					6	6	6
Minimum Initial (s)		5.0	5.0	4.0	4.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.0	22.0					24.0	24.0	24.0
Total Split (s)	0.0	62.0	62.0	14.0	76.0	0.0	0.0	0.0	0.0	44.0	44.0	44.0
Total Split (%)	0.0%	51.7%	51.7%	11.7%	63.3%	0.0%	0.0%	0.0%	0.0%	36.7%	36.7%	36.7%
Maximum Green (s)		56.4	56.4	8.0	70.0					37.0	37.0	37.0
Yellow Time (s)		3.6	3.6	5.0	5.0					5.0	5.0	5.0
All-Red Time (s)		2.0	2.0	1.0	1.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Recall Mode		C-Min	C-Min	None	C-Max					None	None	None
Walk Time (s)										7.0	7.0	7.0
Flash Dont Walk (s)										10.0	10.0	10.0
Pedestrian Calls (#/hr)										10	10	10
Act Effct Green (s)		58.0	58.0	10.0	72.0						40.0	40.0
Actuated g/C Ratio		0.48	0.48	0.08	0.60						0.33	0.33
v/c Ratio		1.17	0.33	1.11	0.85						0.29	1.16
Control Delay		117.2	8.2	91.6	2.1						31.2	120.2
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0
Total Delay		117.2	8.2	91.6	2.1						31.2	120.2
LOS		F	A	F	A						C	F
Approach Delay		94.4			15.3						103.2	
Approach LOS		F			B						F	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		~967	46	~143	0						97	~587
Queue Length 95th (ft)		#1178	97	m#114	m0						152	#794
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		900	852	148	1118						592	618
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		1.17	0.33	1.11	0.85						0.29	1.16

Intersection Summary

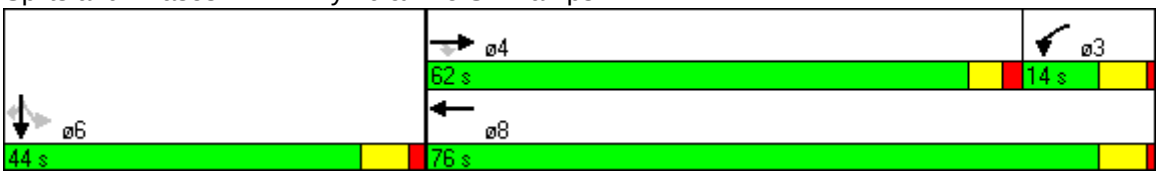
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 61 (51%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 150
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.17
Intersection Signal Delay: 70.3 Intersection LOS: E
Intersection Capacity Utilization 95.3% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



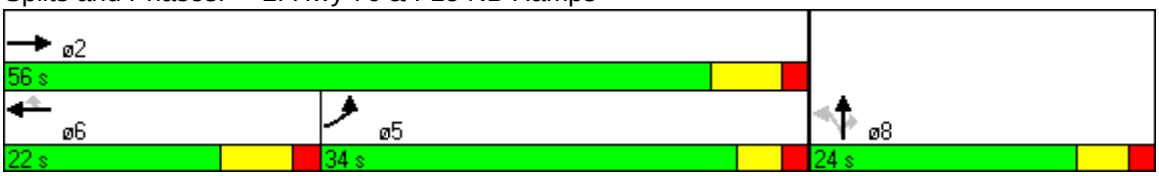
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						58			136			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		18.2			13.0			23.4			11.2	
Volume (vph)	474	182	0	0	214	51	173	1	120	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	539	207	0	0	243	58	197	1	136	0	0	0
Lane Group Flow (vph)	539	207	0	0	243	58	0	198	136	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	5	2			6			8				
Permitted Phases						6	8		8			
Detector Phases	5	2			6	6	8	8	8			
Minimum Initial (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	12.0	22.0			22.0	22.0	24.0	24.0	24.0			
Total Split (s)	34.0	56.0	0.0	0.0	22.0	22.0	24.0	24.0	24.0	0.0	0.0	0.0
Total Split (%)	42.5%	70.0%	0.0%	0.0%	27.5%	27.5%	30.0%	30.0%	30.0%	0.0%	0.0%	0.0%
Maximum Green (s)	28.8	49.0			15.0	15.0	18.4	18.4	18.4			
Yellow Time (s)	3.2	5.0			5.0	5.0	3.6	3.6	3.6			
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lag				Lead	Lead						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Minimum Gap (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Time Before Reduce (s)	0.5	0.0			0.0	0.0	0.0	0.0	0.0			
Time To Reduce (s)	0.1	0.0			0.0	0.0	0.0	0.0	0.0			
Recall Mode	None	C-Max			C-Max	C-Max	Min	Min	Min			
Walk Time (s)							7.0	7.0	7.0			
Flash Dont Walk (s)							10.0	10.0	10.0			
Pedestrian Calls (#/hr)							10	10	10			
Act Effct Green (s)	30.0	56.3			22.3	22.3		15.7	15.7			
Actuated g/C Ratio	0.38	0.70			0.28	0.28		0.20	0.20			
v/c Ratio	0.83	0.16			0.47	0.12		0.61	0.34			
Control Delay	21.6	0.9			28.8	8.1		37.1	7.4			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	21.6	0.9			28.8	8.1		37.1	7.4			
LOS	C	A			C	A		D	A			
Approach Delay		15.9			24.8			25.0				
Approach LOS		B			C			C				
Queue Length 50th (ft)	247	8			101	0		91	0			
Queue Length 95th (ft)	#378	m14			177	27		144	39			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	651	1285			519	483		412	469			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	0.83	0.16			0.47	0.12		0.48	0.29			

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 24 (30%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 20.0 Intersection LOS: C
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						125			212			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		33.5			23.9			23.4			11.2	
Volume (vph)	576	496	0	0	454	129	527	5	237	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	655	564	0	0	516	147	599	6	269	0	0	0
Lane Group Flow (vph)	655	564	0	0	516	147	0	605	269	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases						8	2		2			
Detector Phases	7	4			8	8	2	2	2			
Minimum Initial (s)	4.0	4.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	10.0	22.0			24.0	24.0	22.0	22.0	22.0			
Total Split (s)	45.0	79.0	0.0	0.0	34.0	34.0	41.0	41.0	41.0	0.0	0.0	0.0
Total Split (%)	37.5%	65.8%	0.0%	0.0%	28.3%	28.3%	34.2%	34.2%	34.2%	0.0%	0.0%	0.0%
Maximum Green (s)	39.0	73.0			28.4	28.4	34.0	34.0	34.0			
Yellow Time (s)	5.0	5.0			3.6	3.6	5.0	5.0	5.0			
All-Red Time (s)	1.0	1.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Recall Mode	None	C-Max			C-Min	C-Min	None	None	None			
Walk Time (s)					7.0	7.0						
Flash Dont Walk (s)					10.0	10.0						
Pedestrian Calls (#/hr)					10	10						
Act Effct Green (s)	41.0	75.0			30.0	30.0		37.0	37.0			
Actuated g/C Ratio	0.34	0.62			0.25	0.25		0.31	0.31			
v/c Ratio	1.08	0.48			1.11	0.30		1.11	0.42			
Control Delay	65.1	4.3			116.3	10.6		110.1	10.1			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			
Total Delay	65.1	4.3			116.3	10.6		110.1	10.1			
LOS	E	A			F	B		F	B			
Approach Delay		37.0			92.9			79.3				
Approach LOS		D			F			E				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~556	87			~456	13		~534	32			
Queue Length 95th (ft)	m369	m100			#647	62		#732	96			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	605	1164			466	490		547	635			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	1.08	0.48			1.11	0.30		1.11	0.42			

Intersection Summary

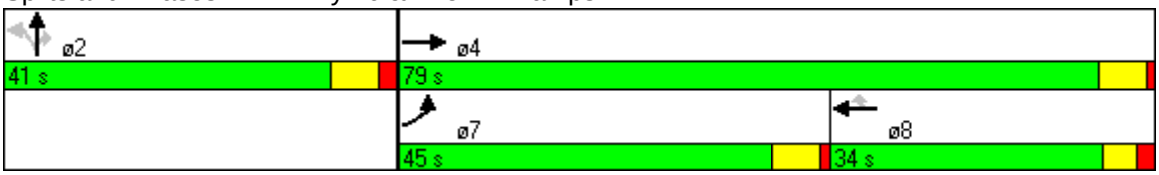
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 120
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.11
Intersection Signal Delay: 63.9 Intersection LOS: E
Intersection Capacity Utilization 95.3% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	13	291	210	4	14	20
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	316	228	4	15	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	233				575	230
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	233				575	230
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	97
cM capacity (veh/h)	1329				475	809

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	330	233	37
Volume Left	14	0	15
Volume Right	0	4	22
cSH	1329	1700	627
Volume to Capacity	0.01	0.14	0.06
Queue Length 95th (ft)	1	0	5
Control Delay (s)	0.4	0.0	11.1
Lane LOS	A		B
Approach Delay (s)	0.4	0.0	11.1
Approach LOS			B

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	35.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	21	322	398	9	6	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	350	433	10	7	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	442				833	438
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	442				833	438
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	98
cM capacity (veh/h)	1118				332	619

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	373	442	21
Volume Left	23	0	7
Volume Right	0	10	14
cSH	1118	1700	486
Volume to Capacity	0.02	0.26	0.04
Queue Length 95th (ft)	2	0	3
Control Delay (s)	0.7	0.0	12.7
Lane LOS	A		B
Approach Delay (s)	0.7	0.0	12.7
Approach LOS			B

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	44.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	1	276	192	1	0	1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	300	209	1	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	210				511	209
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	210				511	209
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1361				522	831

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	301	210	1
Volume Left	1	0	0
Volume Right	0	1	1
cSH	1361	1700	831
Volume to Capacity	0.00	0.12	0.00
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	0.0	0.0	9.3
Approach LOS			A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	25.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	1	305	408	1	1	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	332	443	1	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	445				778	444
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	445				778	444
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1116				365	614

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	333	445	1
Volume Left	1	0	1
Volume Right	0	1	0
cSH	1116	1700	365
Volume to Capacity	0.00	0.26	0.00
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.0	14.9
Lane LOS	A		B
Approach Delay (s)	0.0	0.0	14.9
Approach LOS			B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	31.5%	ICU Level of Service	A
Analysis Period (min)	15		

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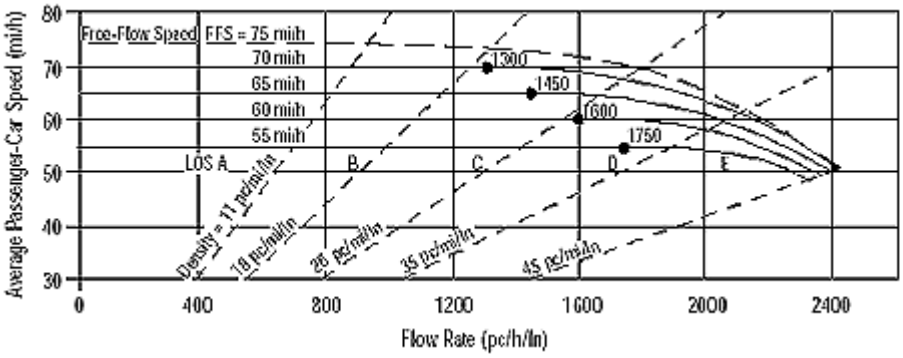

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1263*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h

Calc Speed Adj and FFS

f_{LW}	*0.0*	mi/h
f_{LC}	*0.0*	mi/h
f_{ID}	*0.0*	mi/h
f_N	*0.0*	mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*377*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*5.4*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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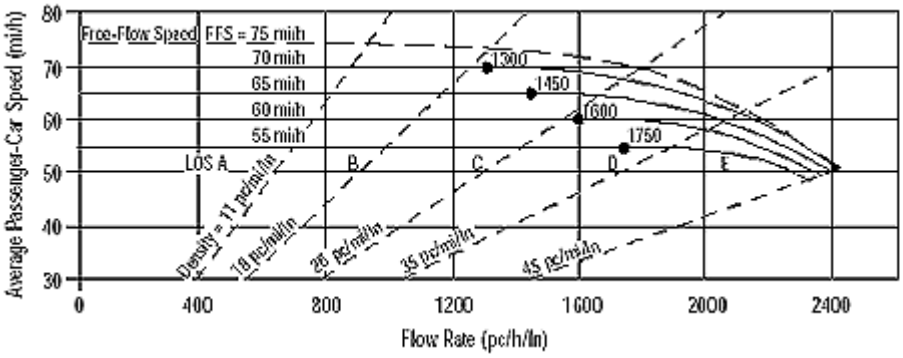
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6753*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2014*	pc/h/ln
S	*64.6*	mi/h
D = v_p / S	*31.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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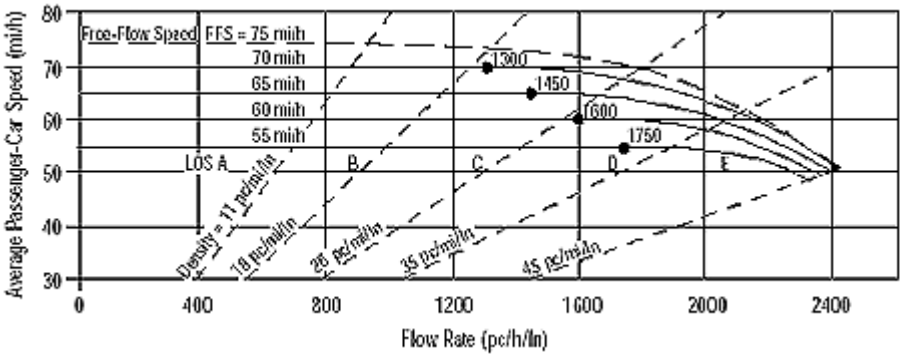

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6349*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1894*	pc/h/ln
S	*66.6*	mi/h
D = v_p / S	*28.4*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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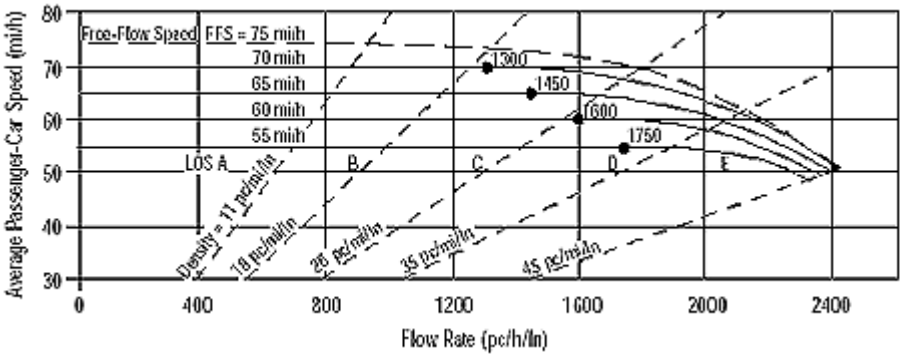
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2056*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*613*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*8.8*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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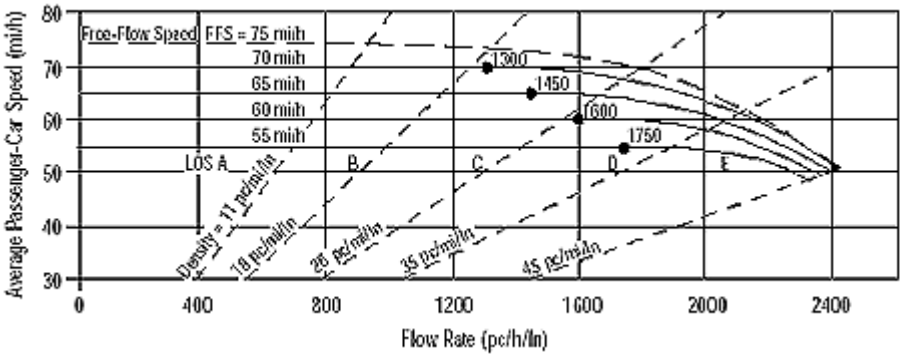
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1495*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*442*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*6.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

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f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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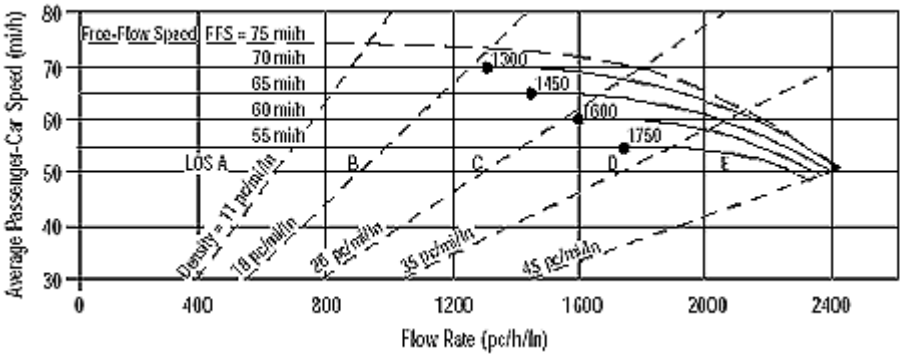

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6694*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1978*	pc/h/ln
S	*65.3*	mi/h
D = v_p / S	*30.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
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f_{LC} - Exhibit 23-5
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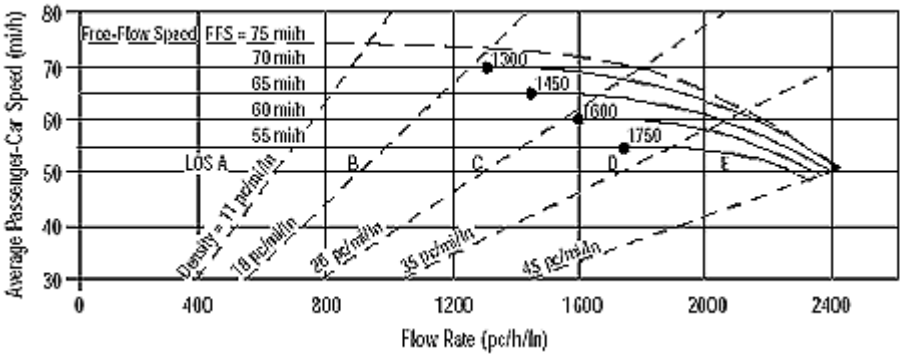
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6596*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1949*	pc/h/ln
S	*65.8*	mi/h
D = v_p / S	*29.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

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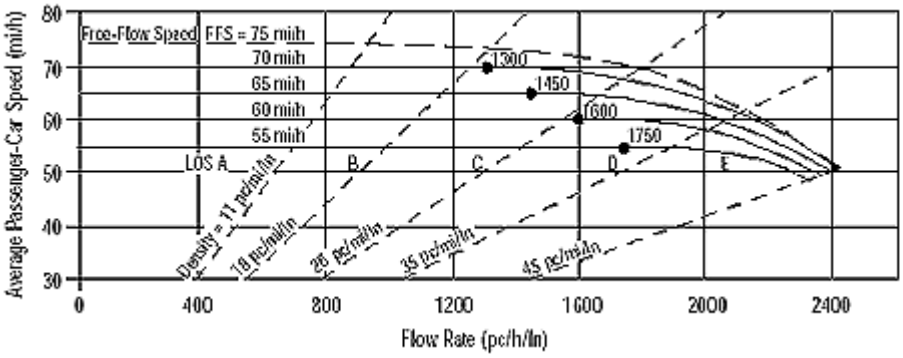

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 No Project*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2448*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*723*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*10.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

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f_p - Page 23-12
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f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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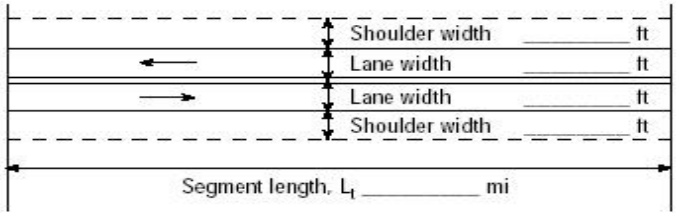
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 No Project*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1460* veh/h
Directional split	*53 / 47*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1679*
v_p * highest directional split proportion[2] (pc/h)	*890*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.4*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*40.5*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1659*
v_p * highest directional split proportion[2] (pc/h)	*879*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*76.7*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*6.4*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*83.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.52*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*415*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1460*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*10.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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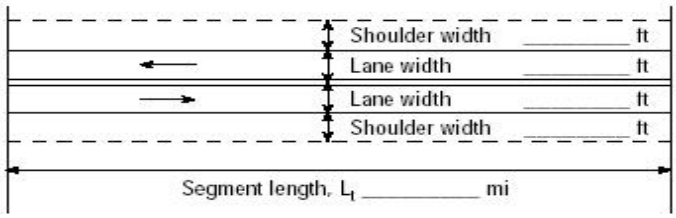
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 No Project*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*2060* veh/h
Directional split	*54 / 46*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*10* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.990*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2364*
v_p * highest directional split proportion[2] (pc/h)	*1277*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.1*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*35.6*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2341*
v_p * highest directional split proportion[2] (pc/h)	*1264*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*87.2*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*3.2*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*90.4*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.74*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*117*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*412*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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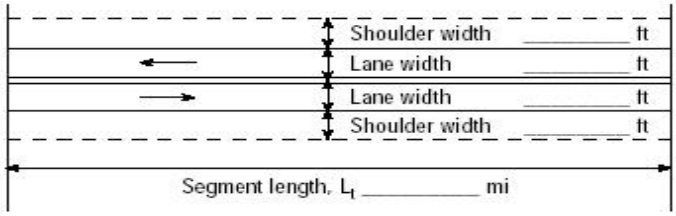
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 No Project*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*551* veh/h
Directional split	*55 / 45*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*9 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*632*
v_p * highest directional split proportion[2] (pc/h)	*348*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.2*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*46.9*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*632*
v_p * highest directional split proportion[2] (pc/h)	*348*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*42.6*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*18.6*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*61.2*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.20*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*313*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1102*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*6.7*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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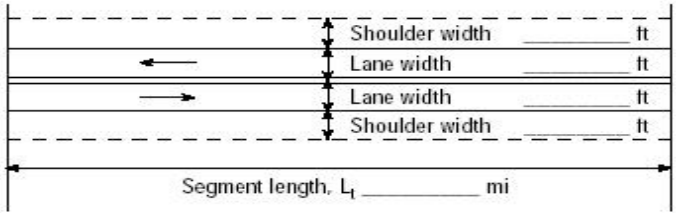
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 No Project*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1035* veh/h
Directional split	*52 / 48*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*6 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1183*
v_p * highest directional split proportion[2] (pc/h)	*615*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.9*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*44.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1183*
v_p * highest directional split proportion[2] (pc/h)	*615*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*64.6*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*9.8*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*74.4*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.37*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*588*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*2070*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*13.4*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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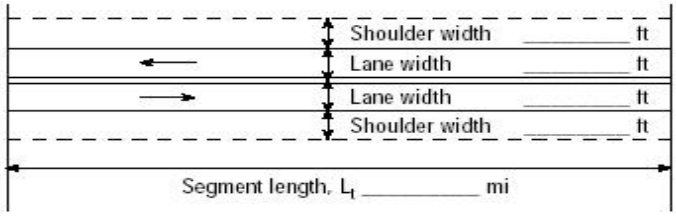
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 No Project*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*519* veh/h
Directional split	*59 / 41*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*8* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*594*
v_p * highest directional split proportion[2] (pc/h)	*350*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.3*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*47.1*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*594*
v_p * highest directional split proportion[2] (pc/h)	*350*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*40.7*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*19.6*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*60.3*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.19*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*295*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1038*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*6.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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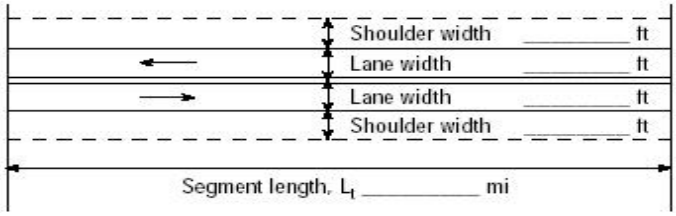
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 No Project*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*735* veh/h
Directional split	*55 / 45*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*5* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*839*
v_p * highest directional split proportion[2] (pc/h)	*461*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.5*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*46.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*839*
v_p * highest directional split proportion[2] (pc/h)	*461*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*52.2*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*13.5*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*65.7*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.26*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*418*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1470*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*9.1*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 526 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1263	0.88	Level	8	0	0.962	1.00	1493
Ramp	294	0.88	Level	8	0	0.962	1.00	347
UpStream								
DownStream	526	0.88	Level	10	0	0.952	1.00	628

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 847 pc/h

V_3 or V_{av34} 323 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1493	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1146	Exhibit 25-14	9600	No
V_R	347	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	847	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 9.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.459 (Exhibit 25-19)

S_R= 57.1 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 710 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6753	0.88	Level	8	0	0.962	1.00	7981
Ramp	769	0.88	Level	8	0	0.962	1.00	909
UpStream								
DownStream	710	0.88	Level	10	0	0.952	1.00	847

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3992 pc/h

V_3 or V_{av34} 1994 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7981	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	7072	Exhibit 25-14	9600	No
V_R	909	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3992	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 36.3 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.510 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 72.9 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 294 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	969	0.88	Level	10	0	0.952	1.00	1156
Ramp	526	0.88	Level	10	0	0.952	1.00	628
UpStream	294	0.88	Level	8	0	0.962	1.00	347
DownStream								

Estimation of v_{12} — Merge Areas

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.362 using Equation (Exhibit 25-5)

V_{12} = 419 pc/h

V_3 or V_{av34} 368 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 462 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1784	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1090	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 9.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.284 (Exibit 25-19)

S_R= 62.1 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 769 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5984	0.88	Level	10	0	0.952	1.00	7140
Ramp	710	0.88	Level	10	0	0.952	1.00	847
UpStream	769	0.88	Level	8	0	0.962	1.00	909
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.335 using Equation (Exhibit 25-5)

V_{12} = 2391 pc/h

V_3 or V_{av34} 2374 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2856 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7987	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3703	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.430 (Exibit 25-19)

S_R= 58.0 mph (Exhibit 25-19)

S_0= 64.1 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 415 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6596	0.88	Level	10	0	0.952	1.00	7870
Ramp	661	0.88	Level	10	0	0.952	1.00	789
UpStream								
DownStream	415	0.88	Level	8	0	0.962	1.00	490

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3876 pc/h

V_3 or V_{av34} 1997 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7870	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	7081	Exhibit 25-14	9600	No
V_R	789	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3876	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 36.5 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.499 (Exhibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

S_0= 72.9 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 391 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2448	0.88	Level	10	0	0.952	1.00	2921
Ramp	782	0.88	Level	10	0	0.952	1.00	933
UpStream								
DownStream	391	0.88	Level	8	0	0.962	1.00	462

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 1800 pc/h

V_3 or V_{av34} 560 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2921	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1988	Exhibit 25-14	9600	No
V_R	933	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1800	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 18.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.512 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 661 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5934	0.88	Level	8	0	0.962	1.00	7013
Ramp	415	0.88	Level	8	0	0.962	1.00	490
UpStream	661	0.88	Level	10	0	0.952	1.00	789
DownStream								

Merge Areas | Diverge Areas

Estimation of v_{12} (Merge Areas)

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.356 using Equation (Exhibit 25-5)

V_{12} = 2494 pc/h

V_3 or V_{av34} 2259 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2805 pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}	7503	Exhibit 25-7		No

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area (Merge Areas)

	Actual	Max Desirable		Violation?
V_{R12}	3295	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area (Diverge Areas)

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F) (Merge Areas)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.0 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = 0.382 (Exibit 25-19)

S_R= 59.3 mph (Exhibit 25-19)

S_0= 64.2 mph (Exhibit 25-19)

Speed Determination (Diverge Areas)

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 No Project

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 782 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1665	0.88	Level	8	0	0.962	1.00	1968
Ramp	391	0.88	Level	8	0	0.962	1.00	462
UpStream	782	0.88	Level	10	0	0.952	1.00	933
DownStream								

Estimation of v_{12} — Merge Areas

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.359 using Equation (Exhibit 25-5)

V_{12} = 707 pc/h

V_3 or V_{av34} 630 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 787 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2430	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1249	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 11.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.291 (Exibit 25-19)

S_R= 61.9 mph (Exhibit 25-19)

S_0= 69.7 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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6.11-C. A

APPENDIX 6.11-C – 2008 CONSTRUCTION LOS ANALYSIS

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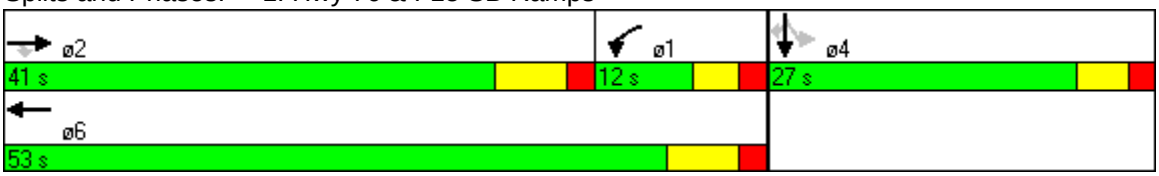
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.955	
Satd. Flow (prot)	0	1827	1553	1719	1810	0	0	0	0	0	1728	1538
Flt Permitted				0.950							0.955	
Satd. Flow (perm)	0	1827	1553	1719	1810	0	0	0	0	0	1728	1538
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			358									542
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		16.4			18.2			13.7			30.8	
Volume (vph)	0	599	315	96	294	0	0	0	0	103	5	587
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	5%	5%	5%
Adj. Flow (vph)	0	681	358	109	334	0	0	0	0	117	6	667
Lane Group Flow (vph)	0	681	358	109	334	0	0	0	0	0	123	667
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases			2							4		4
Detector Phases		2	2	1	6					4	4	4
Minimum Initial (s)		5.0	5.0	5.0	5.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.2	24.0					22.0	22.0	22.0
Total Split (s)	0.0	41.0	41.0	12.0	53.0	0.0	0.0	0.0	0.0	27.0	27.0	27.0
Total Split (%)	0.0%	51.3%	51.3%	15.0%	66.3%	0.0%	0.0%	0.0%	0.0%	33.8%	33.8%	33.8%
Maximum Green (s)		34.0	34.0	6.8	46.0					21.4	21.4	21.4
Yellow Time (s)		5.0	5.0	3.2	5.0					3.6	3.6	3.6
All-Red Time (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Minimum Gap (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Time Before Reduce (s)		0.0	0.0	0.5	0.0					0.0	0.0	0.0
Time To Reduce (s)		0.0	0.0	0.1	0.0					0.0	0.0	0.0
Recall Mode		C-Min	C-Min	Min	C-Max					Min	Min	Min
Walk Time (s)					7.0							
Flash Dont Walk (s)					10.0							
Pedestrian Calls (#/hr)					10							
Act Effct Green (s)		40.7	40.7	10.6	55.3						16.7	16.7
Actuated g/C Ratio		0.51	0.51	0.13	0.69						0.21	0.21
v/c Ratio		0.73	0.37	0.48	0.27						0.34	0.89
Control Delay		22.5	2.8	35.2	0.7						27.6	21.4
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		22.5	2.8	35.2	0.7						27.6	21.4
LOS		C	A	D	A						C	C
Approach Delay		15.7			9.2						22.4	
Approach LOS		B			A						C	
Queue Length 50th (ft)		246	0	60	0						51	52
Queue Length 95th (ft)		#419	40	m#115	0						88	#193
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		929	966	228	1251						497	828
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		0.73	0.37	0.48	0.27						0.25	0.81

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 40 (50%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 70
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 16.7 Intersection LOS: B
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.953	
Satd. Flow (prot)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Flt Permitted				0.950							0.953	
Satd. Flow (perm)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			166									134
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		30.0			33.5			13.7			30.8	
Volume (vph)	0	924	245	183	850	0	0	0	0	149	2	632
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	1050	278	208	966	0	0	0	0	169	2	718
Lane Group Flow (vph)	0	1050	278	208	966	0	0	0	0	0	171	718
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		4		3	8						6	
Permitted Phases			4							6		6
Detector Phases		4	4	3	8					6	6	6
Minimum Initial (s)		5.0	5.0	4.0	4.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.0	22.0					24.0	24.0	24.0
Total Split (s)	0.0	61.0	61.0	16.0	77.0	0.0	0.0	0.0	0.0	43.0	43.0	43.0
Total Split (%)	0.0%	50.8%	50.8%	13.3%	64.2%	0.0%	0.0%	0.0%	0.0%	35.8%	35.8%	35.8%
Maximum Green (s)		55.4	55.4	10.0	71.0					36.0	36.0	36.0
Yellow Time (s)		3.6	3.6	5.0	5.0					5.0	5.0	5.0
All-Red Time (s)		2.0	2.0	1.0	1.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Recall Mode		C-Min	C-Min	None	C-Max					None	None	None
Walk Time (s)										7.0	7.0	7.0
Flash Dont Walk (s)										10.0	10.0	10.0
Pedestrian Calls (#/hr)										10	10	10
Act Effct Green (s)		57.0	57.0	12.0	73.0						39.0	39.0
Actuated g/C Ratio		0.48	0.48	0.10	0.61						0.32	0.32
v/c Ratio		1.19	0.33	1.18	0.85						0.30	1.19
Control Delay		125.7	8.7	116.4	2.4						32.0	130.4
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0
Total Delay		125.7	8.7	116.4	2.4						32.0	130.4
LOS		F	A	F	A						C	F
Approach Delay		101.2			22.6						111.4	
Approach LOS		F			C						F	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		~979	48	~190	0						99	~598
Queue Length 95th (ft)		#1190	101	m#156	m0						154	#804
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		885	839	177	1133						577	605
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		1.19	0.33	1.18	0.85						0.30	1.19

Intersection Summary

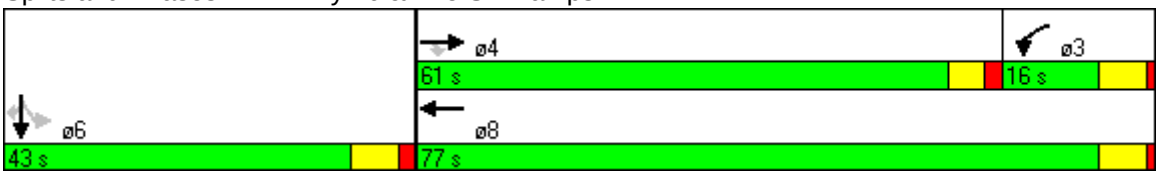
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 57 (48%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 150
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.19
Intersection Signal Delay: 76.7 Intersection LOS: E
Intersection Capacity Utilization 98.0% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



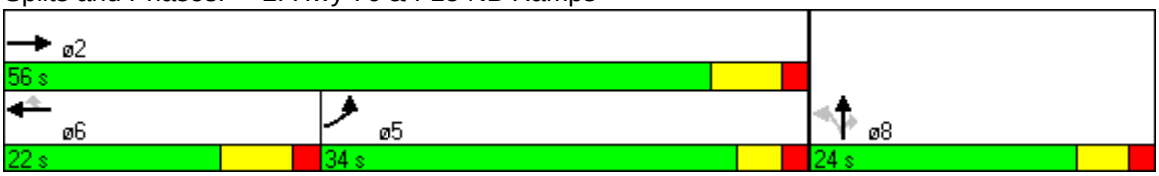
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						59			181			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		18.2			13.0			23.4			11.2	
Volume (vph)	474	229	0	0	215	52	173	1	159	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	539	260	0	0	244	59	197	1	181	0	0	0
Lane Group Flow (vph)	539	260	0	0	244	59	0	198	181	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	5	2			6			8				
Permitted Phases						6	8		8			
Detector Phases	5	2			6	6	8	8	8			
Minimum Initial (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	12.0	22.0			22.0	22.0	24.0	24.0	24.0			
Total Split (s)	34.0	56.0	0.0	0.0	22.0	22.0	24.0	24.0	24.0	0.0	0.0	0.0
Total Split (%)	42.5%	70.0%	0.0%	0.0%	27.5%	27.5%	30.0%	30.0%	30.0%	0.0%	0.0%	0.0%
Maximum Green (s)	28.8	49.0			15.0	15.0	18.4	18.4	18.4			
Yellow Time (s)	3.2	5.0			5.0	5.0	3.6	3.6	3.6			
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lag				Lead	Lead						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Minimum Gap (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Time Before Reduce (s)	0.5	0.0			0.0	0.0	0.0	0.0	0.0			
Time To Reduce (s)	0.1	0.0			0.0	0.0	0.0	0.0	0.0			
Recall Mode	None	C-Max			C-Max	C-Max	Min	Min	Min			
Walk Time (s)							7.0	7.0	7.0			
Flash Dont Walk (s)							10.0	10.0	10.0			
Pedestrian Calls (#/hr)							10	10	10			
Act Effct Green (s)	30.0	56.3			22.3	22.3		15.7	15.7			
Actuated g/C Ratio	0.38	0.70			0.28	0.28		0.20	0.20			
v/c Ratio	0.83	0.20			0.47	0.12		0.61	0.42			
Control Delay	23.2	1.2			28.9	8.1		37.1	7.4			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	23.2	1.2			28.9	8.1		37.1	7.4			
LOS	C	A			C	A		D	A			
Approach Delay		16.1			24.8			22.9				
Approach LOS		B			C			C				
Queue Length 50th (ft)	251	11			102	0		91	0			
Queue Length 95th (ft)	#381	m23			177	28		144	44			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	651	1285			519	483		412	503			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	0.83	0.20			0.47	0.12		0.48	0.36			

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 24 (30%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 19.6 Intersection LOS: B
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						150			208			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		33.5			23.9			23.4			11.2	
Volume (vph)	576	497	0	0	506	163	527	5	238	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	655	565	0	0	575	185	599	6	270	0	0	0
Lane Group Flow (vph)	655	565	0	0	575	185	0	605	270	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases						8	2		2			
Detector Phases	7	4			8	8	2	2	2			
Minimum Initial (s)	4.0	4.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	10.0	22.0			24.0	24.0	22.0	22.0	22.0			
Total Split (s)	42.0	81.0	0.0	0.0	39.0	39.0	39.0	39.0	39.0	0.0	0.0	0.0
Total Split (%)	35.0%	67.5%	0.0%	0.0%	32.5%	32.5%	32.5%	32.5%	32.5%	0.0%	0.0%	0.0%
Maximum Green (s)	36.0	75.0			33.4	33.4	32.0	32.0	32.0			
Yellow Time (s)	5.0	5.0			3.6	3.6	5.0	5.0	5.0			
All-Red Time (s)	1.0	1.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Recall Mode	None	C-Max			C-Min	C-Min	None	None	None			
Walk Time (s)					7.0	7.0						
Flash Dont Walk (s)					10.0	10.0						
Pedestrian Calls (#/hr)					10	10						
Act Effct Green (s)	38.0	77.0			35.0	35.0		35.0	35.0			
Actuated g/C Ratio	0.32	0.64			0.29	0.29		0.29	0.29			
v/c Ratio	1.17	0.47			1.06	0.33		1.17	0.44			
Control Delay	103.3	4.1			96.5	9.9		133.5	11.3			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			
Total Delay	103.3	4.1			96.5	9.9		133.5	11.3			
LOS	F	A			F	A		F	B			
Approach Delay		57.4			75.4			95.8				
Approach LOS		E			E			F				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~593	97			~489	20		~558	35			
Queue Length 95th (ft)	m#476	m101			#684	73		#756	103			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	561	1195			543	568		518	609			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	1.17	0.47			1.06	0.33		1.17	0.44			

Intersection Summary

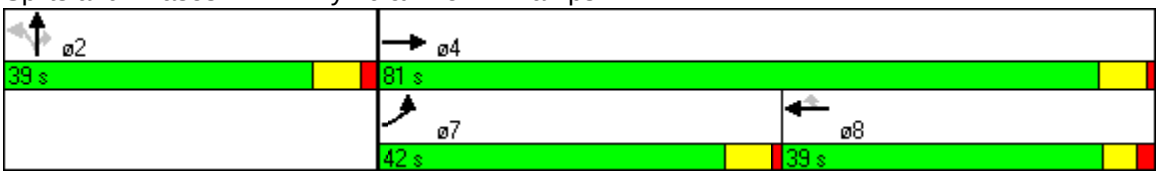
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.17
Intersection Signal Delay: 74.0 Intersection LOS: E
Intersection Capacity Utilization 98.0% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	13	377	212	4	14	20
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	410	230	4	15	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	235				671	233
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	235				671	233
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				96	97
cM capacity (veh/h)	1327				417	807

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	424	235	37
Volume Left	14	0	15
Volume Right	0	4	22
cSH	1327	1700	583
Volume to Capacity	0.01	0.14	0.06
Queue Length 95th (ft)	1	0	5
Control Delay (s)	0.4	0.0	11.6
Lane LOS	A		B
Approach Delay (s)	0.4	0.0	11.6
Approach LOS			B

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	21	324	484	9	6	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	352	526	10	7	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	536				929	531
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	536				929	531
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	97
cM capacity (veh/h)	1032				291	548

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	375	536	21
Volume Left	23	0	7
Volume Right	0	10	14
cSH	1032	1700	428
Volume to Capacity	0.02	0.32	0.05
Queue Length 95th (ft)	2	0	4
Control Delay (s)	0.7	0.0	13.8
Lane LOS	A		B
Approach Delay (s)	0.7	0.0	13.8
Approach LOS			B

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	87	276	192	1	0	3
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	95	300	209	1	0	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	210				698	209
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	210				698	209
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				100	100
cM capacity (veh/h)	1361				378	831

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	395	210	3
Volume Left	95	0	0
Volume Right	0	1	3
cSH	1361	1700	831
Volume to Capacity	0.07	0.12	0.00
Queue Length 95th (ft)	6	0	0
Control Delay (s)	2.4	0.0	9.3
Lane LOS	A		A
Approach Delay (s)	2.4	0.0	9.3
Approach LOS			A

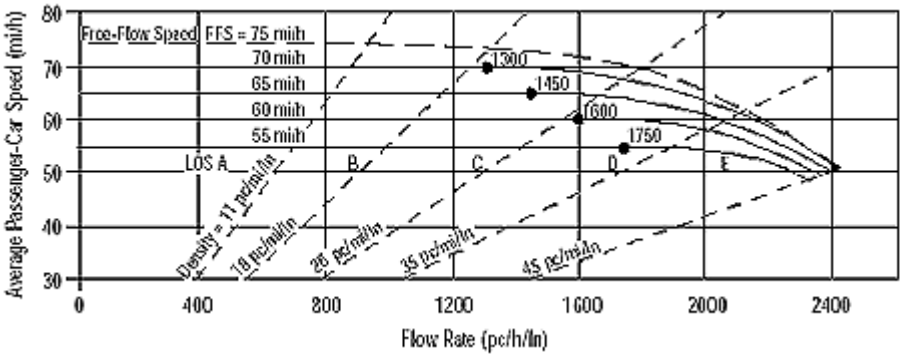
Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	42.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	3	305	408	1	1	86
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	3	332	443	1	1	93
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	445				782	444
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	445				782	444
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	85
cM capacity (veh/h)	1116				362	614

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	335	445	95
Volume Left	3	0	1
Volume Right	0	1	93
cSH	1116	1700	609
Volume to Capacity	0.00	0.26	0.16
Queue Length 95th (ft)	0	0	14
Control Delay (s)	0.1	0.0	12.0
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	12.0
Approach LOS			B

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	33.6%	ICU Level of Service	A
Analysis Period (min)	15		

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1302*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h

Calc Speed Adj and FFS

f_{LW}	*0.0*	mi/h
f_{LC}	*0.0*	mi/h
f_{ID}	*0.0*	mi/h
f_N	*0.0*	mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*388*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*5.5*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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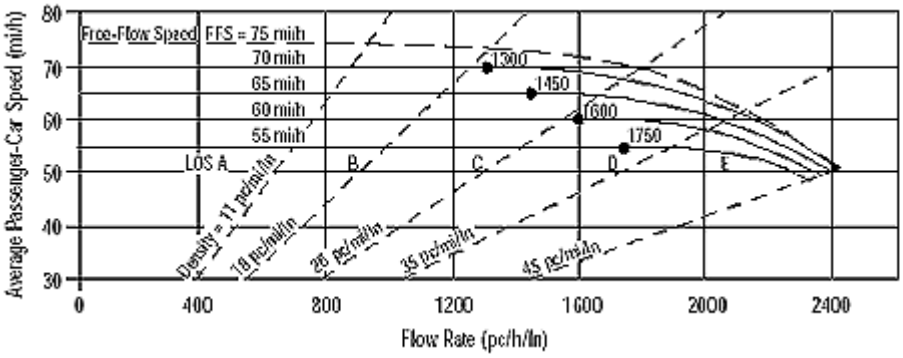
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6754*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2015*	pc/h/ln
S	*64.6*	mi/h
D = v_p / S	*31.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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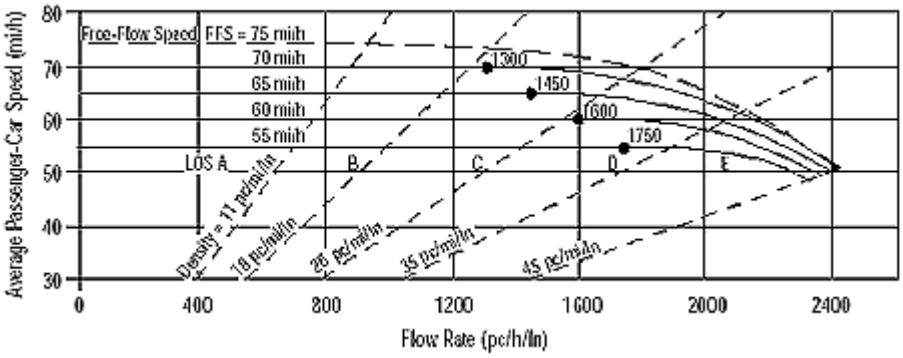

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6350*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1894*	pc/h/ln
S	*66.6*	mi/h
D = v_p / S	*28.4*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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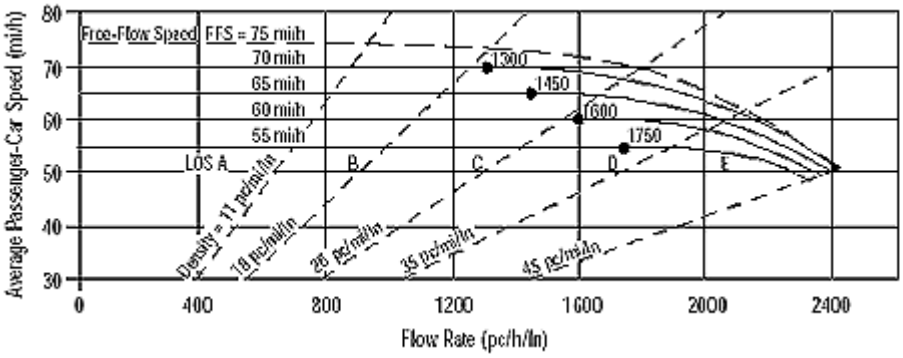

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2095*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*625*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*8.9*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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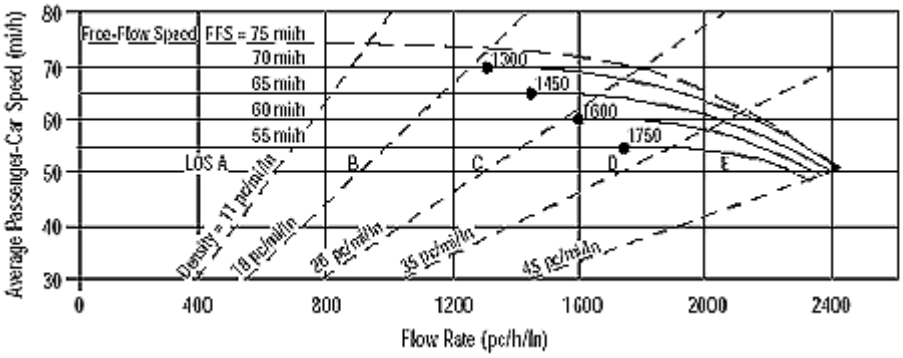
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1496*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*442*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*6.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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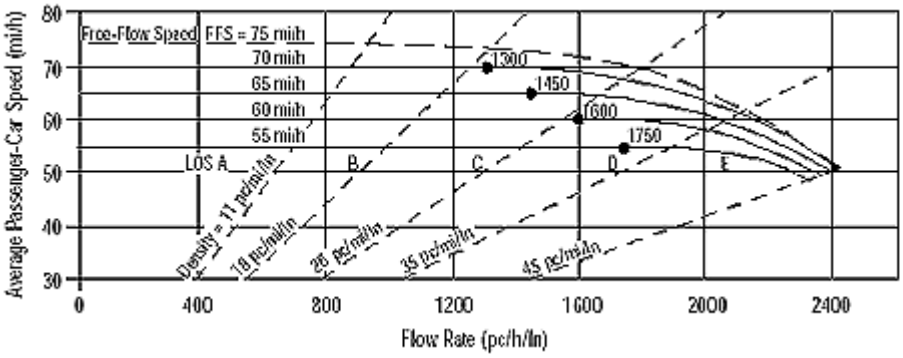
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6728*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1988*	pc/h/ln
S	*65.1*	mi/h
D = v_p / S	*30.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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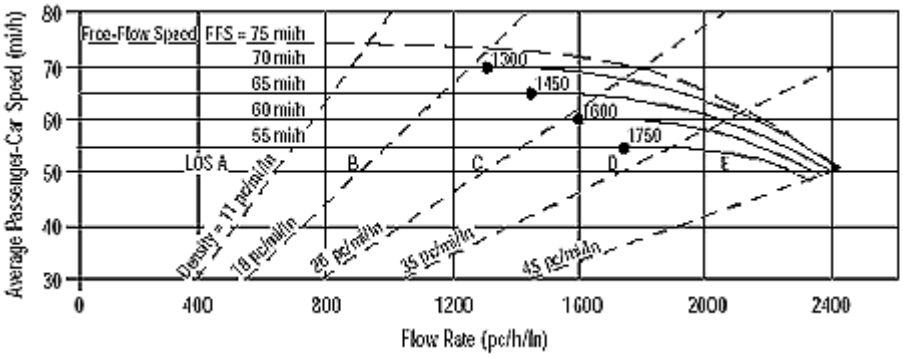
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6630*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1959*	pc/h/ln
S	*65.6*	mi/h
D = v_p / S	*29.9*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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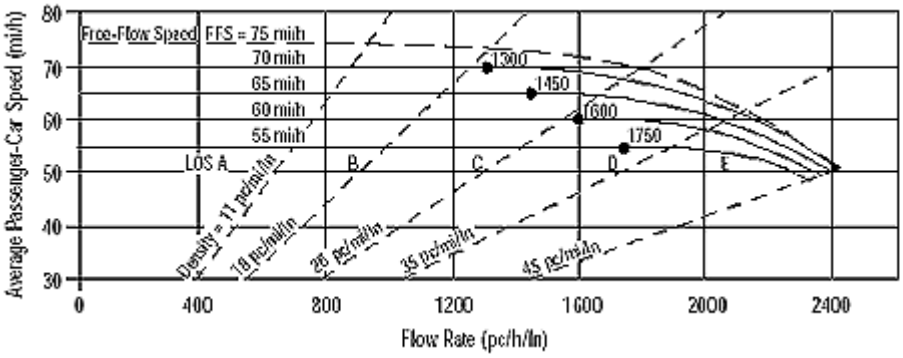
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Construction*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2449*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*724*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*10.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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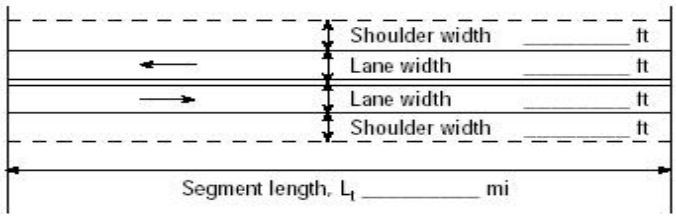
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Construction*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1473* veh/h
Directional split	*53 / 47*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1694*
v_p * highest directional split proportion[2] (pc/h)	*898*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.4*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*40.4*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1674*
v_p * highest directional split proportion[2] (pc/h)	*887*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*77.0*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*6.3*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*83.4*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.53*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*418*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1473*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*10.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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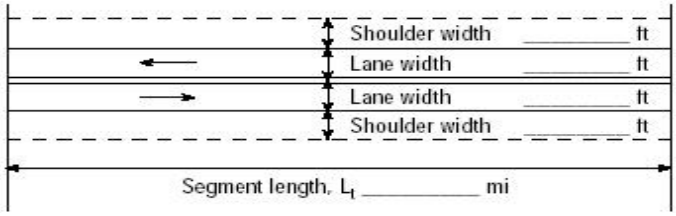
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Construction*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*2073* veh/h
Directional split	*54 / 46*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*10* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.990*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2379*
v_p * highest directional split proportion[2] (pc/h)	*1285*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.1*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*35.4*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2356*
v_p * highest directional split proportion[2] (pc/h)	*1272*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*87.4*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*3.1*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*90.5*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.74*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*118*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*415*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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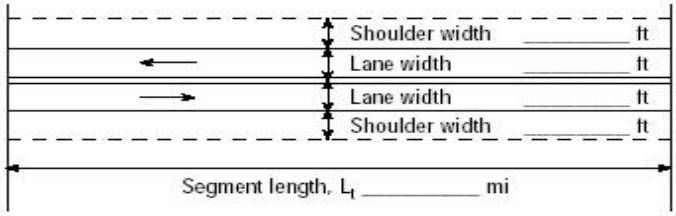
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Construction*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*639* veh/h
Directional split	*61 / 39*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*9 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*733*
v_p * highest directional split proportion[2] (pc/h)	*447*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.9*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*46.5*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*733*
v_p * highest directional split proportion[2] (pc/h)	*447*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*47.5*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*15.6*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*63.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.23*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*363*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1278*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*7.8*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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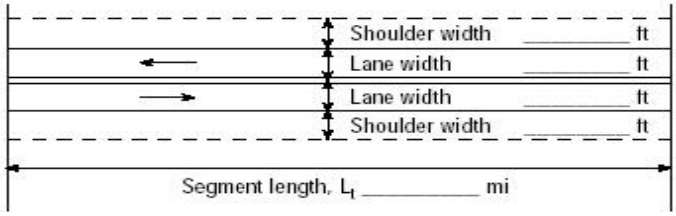
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Construction*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1123* veh/h
Directional split	*52 / 48*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*6 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1284*
v_p * highest directional split proportion[2] (pc/h)	*668*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.6*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*43.4*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1276*
v_p * highest directional split proportion[2] (pc/h)	*664*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*67.4*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*8.7*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*76.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.40*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*638*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*2246*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*14.7*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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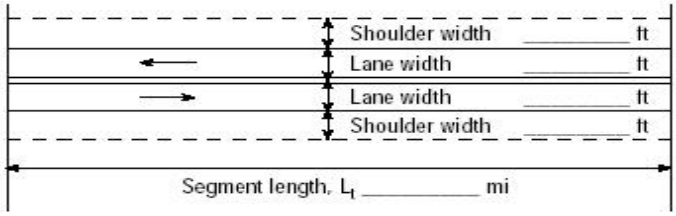
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Construction*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*607* veh/h
Directional split	*64 / 36*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*8* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*695*
v_p * highest directional split proportion[2] (pc/h)	*445*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.0*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*46.6*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*695*
v_p * highest directional split proportion[2] (pc/h)	*445*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*45.7*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*16.8*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*62.5*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.22*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*345*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1214*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*7.4*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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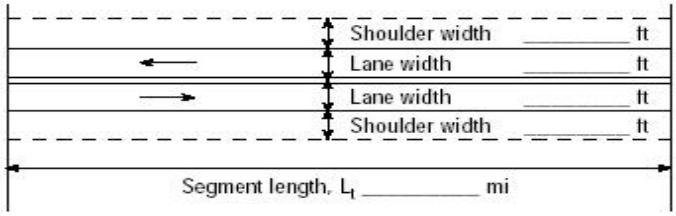
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Construction*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*823* veh/h
Directional split	*60 / 40*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*5* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*940*
v_p * highest directional split proportion[2] (pc/h)	*564*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.3*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*45.4*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*940*
v_p * highest directional split proportion[2] (pc/h)	*564*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*56.2*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*12.1*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*68.3*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.29*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*468*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1646*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*10.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 527 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1302	0.88	Level	8	0	0.962	1.00	1539
Ramp	333	0.88	Level	8	0	0.962	1.00	394
UpStream								
DownStream	527	0.88	Level	10	0	0.952	1.00	629

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 893 pc/h

V_3 or V_{av34} 323 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	1539	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1145	Exhibit 25-14	9600	No
V_R	394	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	893	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 9.7 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.463 (Exhibit 25-19)

S_R= 57.0 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 744 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6754	0.88	Level	8	0	0.962	1.00	7982
Ramp	770	0.88	Level	8	0	0.962	1.00	910
UpStream								
DownStream	744	0.88	Level	10	0	0.952	1.00	888

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3993 pc/h

V_3 or V_{av34} 1994 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7982	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	7072	Exhibit 25-14	9600	No
V_R	910	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3993	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 36.3 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.510 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 72.9 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 333 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	969	0.88	Level	10	0	0.952	1.00	1156
Ramp	527	0.88	Level	10	0	0.952	1.00	629
UpStream	333	0.88	Level	8	0	0.962	1.00	394
DownStream								

Estimation of v_{12} — Merge Areas

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.362 using Equation (Exhibit 25-5)

V_{12} = 419 pc/h

V_3 or V_{av34} 368 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 462 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1785	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1091	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 9.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.284 (Exibit 25-19)

S_R= 62.1 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 770 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5984	0.88	Level	10	0	0.952	1.00	7140
Ramp	744	0.88	Level	10	0	0.952	1.00	888
UpStream	770	0.88	Level	8	0	0.962	1.00	910
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.330 using Equation (Exhibit 25-5)

V_{12} = 2355 pc/h

V_3 or V_{av34} 2392 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2856 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	8028	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3744	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.9 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.437 (Exibit 25-19)

S_R= 57.8 mph (Exhibit 25-19)

S_0= 64.1 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 416 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6630	0.88	Level	10	0	0.952	1.00	7911
Ramp	695	0.88	Level	10	0	0.952	1.00	829
UpStream								
DownStream	416	0.88	Level	8	0	0.962	1.00	492

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3917 pc/h

V_3 or V_{av34} 1997 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7911	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	7082	Exhibit 25-14	9600	No
V_R	829	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3917	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 36.8 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.503 (Exhibit 25-19)

S_R= 55.9 mph (Exhibit 25-19)

S_0= 72.9 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 430 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2449	0.88	Level	10	0	0.952	1.00	2922
Ramp	783	0.88	Level	10	0	0.952	1.00	934
UpStream								
DownStream	430	0.88	Level	8	0	0.962	1.00	508

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 1801 pc/h

V_3 or V_{av34} 560 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2922	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1988	Exhibit 25-14	9600	No
V_R	934	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1801	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 18.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.512 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 695 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5934	0.88	Level	8	0	0.962	1.00	7013
Ramp	416	0.88	Level	8	0	0.962	1.00	492
UpStream	695	0.88	Level	10	0	0.952	1.00	829
DownStream								

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.355 using Equation (Exhibit 25-5)

V_{12} = 2492 pc/h

V_3 or V_{av34} 2260 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2805 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7505	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3297	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.0 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.383 (Exibit 25-19)

S_R= 59.3 mph (Exhibit 25-19)

S_0= 64.2 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 Construction

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 783 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1665	0.88	Level	8	0	0.962	1.00	1968
Ramp	430	0.88	Level	8	0	0.962	1.00	508
UpStream	783	0.88	Level	10	0	0.952	1.00	934
DownStream								

Estimation of v_{12} — Merge Areas

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.353 using Equation (Exhibit 25-5)

V_{12} = 696 pc/h

V_3 or V_{av34} 636 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 787 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2476	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1295	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 11.4 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.291 (Exibit 25-19)

S_R= 61.8 mph (Exhibit 25-19)

S_0= 69.7 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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6.11-D. A

APPENDIX 6.11-D – 2008 OPERATIONS LOS ANALYSIS

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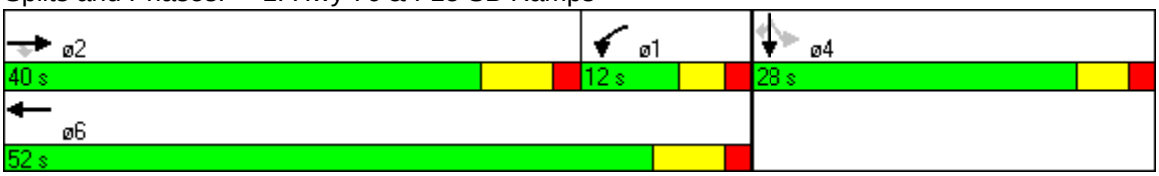
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.956	
Satd. Flow (prot)	0	1827	1553	1719	1810	0	0	0	0	0	1730	1538
Flt Permitted				0.950							0.956	
Satd. Flow (perm)	0	1827	1553	1719	1810	0	0	0	0	0	1730	1538
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			358									533
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		16.4			18.2			13.7			30.8	
Volume (vph)	0	587	315	97	295	0	0	0	0	71	5	587
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	5%	5%	5%	2%	2%	2%	5%	5%	5%
Adj. Flow (vph)	0	667	358	110	335	0	0	0	0	81	6	667
Lane Group Flow (vph)	0	667	358	110	335	0	0	0	0	0	87	667
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases			2							4		4
Detector Phases		2	2	1	6					4	4	4
Minimum Initial (s)		5.0	5.0	5.0	5.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.2	24.0					22.0	22.0	22.0
Total Split (s)	0.0	40.0	40.0	12.0	52.0	0.0	0.0	0.0	0.0	28.0	28.0	28.0
Total Split (%)	0.0%	50.0%	50.0%	15.0%	65.0%	0.0%	0.0%	0.0%	0.0%	35.0%	35.0%	35.0%
Maximum Green (s)		33.0	33.0	6.8	45.0					22.4	22.4	22.4
Yellow Time (s)		5.0	5.0	3.2	5.0					3.6	3.6	3.6
All-Red Time (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Minimum Gap (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Time Before Reduce (s)		0.0	0.0	0.5	0.0					0.0	0.0	0.0
Time To Reduce (s)		0.0	0.0	0.1	0.0					0.0	0.0	0.0
Recall Mode		C-Min	C-Min	Min	C-Max					Min	Min	Min
Walk Time (s)					7.0							
Flash Dont Walk (s)					10.0							
Pedestrian Calls (#/hr)					10							
Act Effct Green (s)		40.4	40.4	10.3	54.8						17.2	17.2
Actuated g/C Ratio		0.50	0.50	0.13	0.68						0.22	0.22
v/c Ratio		0.72	0.37	0.50	0.27						0.23	0.89
Control Delay		22.5	2.9	35.8	0.8						24.8	21.5
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		22.5	2.9	35.8	0.8						24.8	21.5
LOS		C	A	D	A						C	C
Approach Delay		15.6			9.5						21.9	
Approach LOS		B			A						C	
Queue Length 50th (ft)		241	0	61	0						35	56
Queue Length 95th (ft)		#424	41	m#115	0						64	#189
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		923	962	222	1239						519	835
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		0.72	0.37	0.50	0.27						0.17	0.80

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 40 (50%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 16.5 Intersection LOS: B
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850									0.850
Flt Protected				0.950							0.953	
Satd. Flow (prot)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Flt Permitted				0.950							0.953	
Satd. Flow (perm)	0	1863	1583	1770	1863	0	0	0	0	0	1775	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			169									135
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1319			1472			1103			2482	
Travel Time (s)		30.0			33.5			13.7			30.8	
Volume (vph)	0	925	245	146	838	0	0	0	0	150	2	632
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	1051	278	166	952	0	0	0	0	170	2	718
Lane Group Flow (vph)	0	1051	278	166	952	0	0	0	0	0	172	718
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		4		3	8						6	
Permitted Phases			4							6		6
Detector Phases		4	4	3	8					6	6	6
Minimum Initial (s)		5.0	5.0	4.0	4.0					5.0	5.0	5.0
Minimum Split (s)		22.0	22.0	10.0	22.0					24.0	24.0	24.0
Total Split (s)	0.0	62.0	62.0	14.0	76.0	0.0	0.0	0.0	0.0	44.0	44.0	44.0
Total Split (%)	0.0%	51.7%	51.7%	11.7%	63.3%	0.0%	0.0%	0.0%	0.0%	36.7%	36.7%	36.7%
Maximum Green (s)		56.4	56.4	8.0	70.0					37.0	37.0	37.0
Yellow Time (s)		3.6	3.6	5.0	5.0					5.0	5.0	5.0
All-Red Time (s)		2.0	2.0	1.0	1.0					2.0	2.0	2.0
Lead/Lag		Lead	Lead	Lag								
Lead-Lag Optimize?		Yes	Yes	Yes								
Vehicle Extension (s)		3.0	3.0	3.0	3.0					3.0	3.0	3.0
Recall Mode		C-Min	C-Min	None	C-Max					None	None	None
Walk Time (s)										7.0	7.0	7.0
Flash Dont Walk (s)										10.0	10.0	10.0
Pedestrian Calls (#/hr)										10	10	10
Act Effct Green (s)		58.0	58.0	10.0	72.0						40.0	40.0
Actuated g/C Ratio		0.48	0.48	0.08	0.60						0.33	0.33
v/c Ratio		1.17	0.33	1.12	0.85						0.29	1.16
Control Delay		117.7	8.2	96.6	2.4						31.2	120.2
Queue Delay		0.0	0.0	0.0	0.0						0.0	0.0
Total Delay		117.7	8.2	96.6	2.4						31.2	120.2
LOS		F	A	F	A						C	F
Approach Delay		94.8			16.4						103.0	
Approach LOS		F			B						F	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)		~968	46	~146	0						98	~587
Queue Length 95th (ft)		#1179	97	m#118	m0						153	#794
Internal Link Dist (ft)		1239			1392			1023			2402	
Turn Bay Length (ft)												
Base Capacity (vph)		900	852	148	1118						592	618
Starvation Cap Reductn		0	0	0	0						0	0
Spillback Cap Reductn		0	0	0	0						0	0
Storage Cap Reductn		0	0	0	0						0	0
Reduced v/c Ratio		1.17	0.33	1.12	0.85						0.29	1.16

Intersection Summary

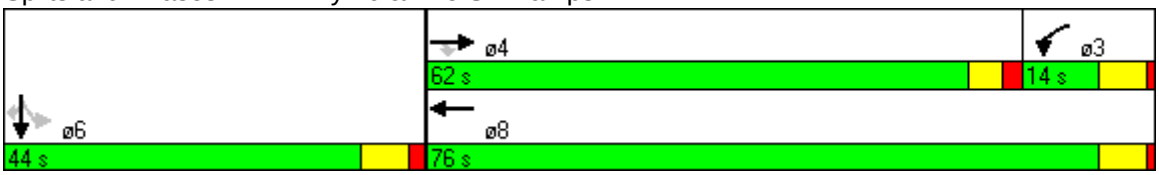
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 60 (50%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 150
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.17
Intersection Signal Delay: 70.7 Intersection LOS: E
Intersection Capacity Utilization 95.4% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 1: Hwy 76 & I-15 SB Ramps



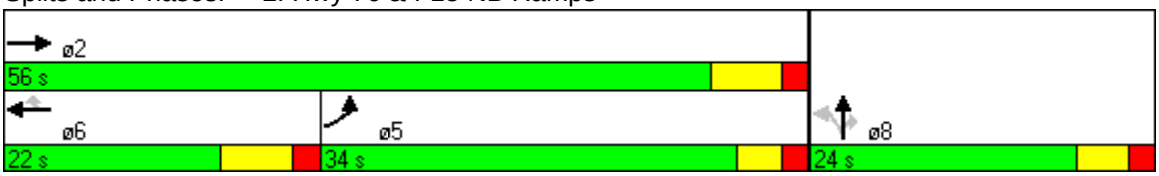
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1736	1827	0	0	1863	1583	0	1646	1468	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						60			139			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		55			55			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		18.2			13.0			23.4			11.2	
Volume (vph)	474	185	0	0	217	53	173	1	122	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	539	210	0	0	247	60	197	1	139	0	0	0
Lane Group Flow (vph)	539	210	0	0	247	60	0	198	139	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	5	2			6			8				
Permitted Phases						6	8		8			
Detector Phases	5	2			6	6	8	8	8			
Minimum Initial (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	12.0	22.0			22.0	22.0	24.0	24.0	24.0			
Total Split (s)	34.0	56.0	0.0	0.0	22.0	22.0	24.0	24.0	24.0	0.0	0.0	0.0
Total Split (%)	42.5%	70.0%	0.0%	0.0%	27.5%	27.5%	30.0%	30.0%	30.0%	0.0%	0.0%	0.0%
Maximum Green (s)	28.8	49.0			15.0	15.0	18.4	18.4	18.4			
Yellow Time (s)	3.2	5.0			5.0	5.0	3.6	3.6	3.6			
All-Red Time (s)	2.0	2.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lag				Lead	Lead						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Minimum Gap (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Time Before Reduce (s)	0.5	0.0			0.0	0.0	0.0	0.0	0.0			
Time To Reduce (s)	0.1	0.0			0.0	0.0	0.0	0.0	0.0			
Recall Mode	None	C-Max			C-Max	C-Max	Min	Min	Min			
Walk Time (s)							7.0	7.0	7.0			
Flash Dont Walk (s)							10.0	10.0	10.0			
Pedestrian Calls (#/hr)							10	10	10			
Act Effct Green (s)	30.0	56.3			22.3	22.3		15.7	15.7			
Actuated g/C Ratio	0.38	0.70			0.28	0.28		0.20	0.20			
v/c Ratio	0.83	0.16			0.48	0.12		0.61	0.35			
Control Delay	21.7	0.9			29.0	8.0		37.1	7.4			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay	21.7	0.9			29.0	8.0		37.1	7.4			
LOS	C	A			C	A		D	A			
Approach Delay		15.9			24.9			24.9				
Approach LOS		B			C			C				
Queue Length 50th (ft)	248	8			103	0		91	0			
Queue Length 95th (ft)	#378	m14			180	28		144	39			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	651	1285			519	484		412	471			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	0.83	0.16			0.48	0.12		0.48	0.30			

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 80
Offset: 24 (30%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.83
Intersection Signal Delay: 20.0 Intersection LOS: C
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15
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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
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	4.0	4.0
Leading Detector (ft)	50	50			50	50	50	50	50			
Trailing Detector (ft)	0	0			0	0	0	0	0			
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected	0.950							0.953				
Satd. Flow (prot)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Flt Permitted	0.950							0.953				
Satd. Flow (perm)	1770	1863	0	0	1863	1583	0	1775	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						129			212			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			55			55	
Link Distance (ft)		1472			1051			1885			903	
Travel Time (s)		33.5			23.9			23.4			11.2	
Volume (vph)	576	499	0	0	457	131	527	5	239	0	0	0
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	655	567	0	0	519	149	599	6	272	0	0	0
Lane Group Flow (vph)	655	567	0	0	519	149	0	605	272	0	0	0
Turn Type	Prot					Perm	Perm		Perm			
Protected Phases	7	4			8			2				
Permitted Phases						8	2		2			
Detector Phases	7	4			8	8	2	2	2			
Minimum Initial (s)	4.0	4.0			5.0	5.0	5.0	5.0	5.0			
Minimum Split (s)	10.0	22.0			24.0	24.0	22.0	22.0	22.0			
Total Split (s)	44.0	80.0	0.0	0.0	36.0	36.0	40.0	40.0	40.0	0.0	0.0	0.0
Total Split (%)	36.7%	66.7%	0.0%	0.0%	30.0%	30.0%	33.3%	33.3%	33.3%	0.0%	0.0%	0.0%
Maximum Green (s)	38.0	74.0			30.4	30.4	33.0	33.0	33.0			
Yellow Time (s)	5.0	5.0			3.6	3.6	5.0	5.0	5.0			
All-Red Time (s)	1.0	1.0			2.0	2.0	2.0	2.0	2.0			
Lead/Lag	Lead				Lag	Lag						
Lead-Lag Optimize?	Yes				Yes	Yes						
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0			
Recall Mode	None	C-Max			C-Min	C-Min	None	None	None			
Walk Time (s)					7.0	7.0						
Flash Dont Walk (s)					10.0	10.0						
Pedestrian Calls (#/hr)					10	10						
Act Effct Green (s)	40.0	76.0			32.0	32.0		36.0	36.0			
Actuated g/C Ratio	0.33	0.63			0.27	0.27		0.30	0.30			
v/c Ratio	1.11	0.48			1.04	0.29		1.14	0.44			
Control Delay	77.7	4.0			95.5	9.7		120.9	10.7			
Queue Delay	0.0	0.0			0.0	0.0		0.0	0.0			
Total Delay	77.7	4.0			95.5	9.7		120.9	10.7			
LOS	E	A			F	A		F	B			
Approach Delay		43.5			76.4			86.7				
Approach LOS		D			E			F				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 50th (ft)	~568	82			~436	12		~546	34			
Queue Length 95th (ft)	m#385	m96			#626	60		#744	100			
Internal Link Dist (ft)		1392			971			1805			823	
Turn Bay Length (ft)												
Base Capacity (vph)	590	1180			497	517		533	623			
Starvation Cap Reductn	0	0			0	0		0	0			
Spillback Cap Reductn	0	0			0	0		0	0			
Storage Cap Reductn	0	0			0	0		0	0			
Reduced v/c Ratio	1.11	0.48			1.04	0.29		1.14	0.44			

Intersection Summary

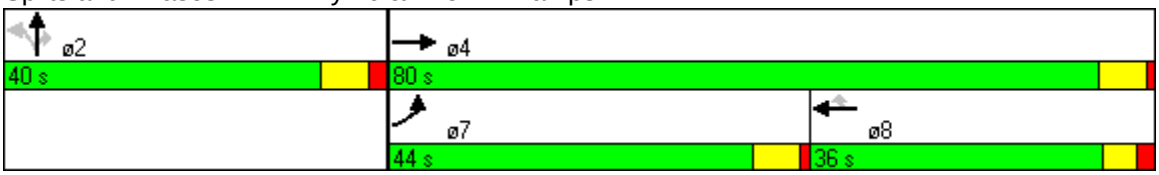
Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 120
Offset: 0 (0%), Referenced to phase 4:EBT and 8:WBT, Start of Yellow
Natural Cycle: 130
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.14
Intersection Signal Delay: 65.1 Intersection LOS: E
Intersection Capacity Utilization 95.4% ICU Level of Service F
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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.

Splits and Phases: 2: Hwy 76 & I-15 NB Ramps



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	13	296	215	4	14	20
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	14	322	234	4	15	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	238				586	236
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	238				586	236
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				97	97
cM capacity (veh/h)	1323				468	803

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	336	238	37
Volume Left	14	0	15
Volume Right	0	4	22
cSH	1323	1700	620
Volume to Capacity	0.01	0.14	0.06
Queue Length 95th (ft)	1	0	5
Control Delay (s)	0.4	0.0	11.2
Lane LOS	A		B
Approach Delay (s)	0.4	0.0	11.2
Approach LOS			B

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	36.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	21	327	403	9	6	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	355	438	10	7	14
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	448				844	443
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	448				844	443
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				98	98
cM capacity (veh/h)	1112				327	615

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	378	448	21
Volume Left	23	0	7
Volume Right	0	10	14
cSH	1112	1700	481
Volume to Capacity	0.02	0.26	0.04
Queue Length 95th (ft)	2	0	3
Control Delay (s)	0.7	0.0	12.8
Lane LOS	A		B
Approach Delay (s)	0.7	0.0	12.8
Approach LOS			B

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	6	276	192	1	0	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	300	209	1	0	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	210				522	209
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	210				522	209
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	99
cM capacity (veh/h)	1361				512	831

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	307	210	7
Volume Left	7	0	0
Volume Right	0	1	7
cSH	1361	1700	831
Volume to Capacity	0.00	0.12	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.2	0.0	9.4
Lane LOS	A		A
Approach Delay (s)	0.2	0.0	9.4
Approach LOS			A

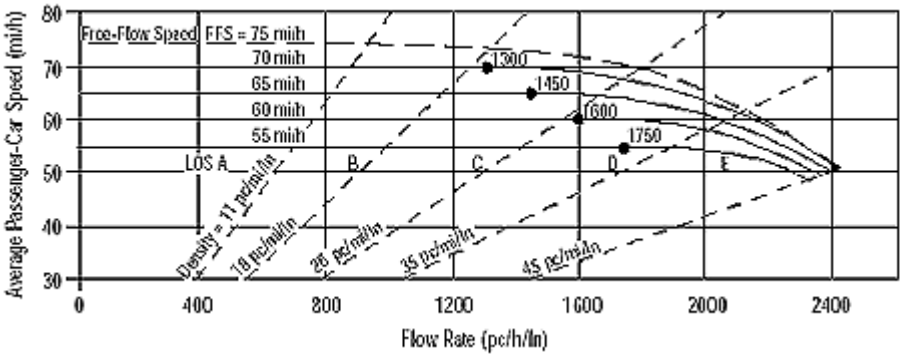
Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	29.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	6	305	408	1	1	5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	332	443	1	1	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	445				789	444
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	445				789	444
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				100	99
cM capacity (veh/h)	1116				358	614

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	338	445	7
Volume Left	7	0	1
Volume Right	0	1	5
cSH	1116	1700	548
Volume to Capacity	0.01	0.26	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.2	0.0	11.6
Lane LOS	A		B
Approach Delay (s)	0.2	0.0	11.6
Approach LOS			B

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	31.5%	ICU Level of Service	A
Analysis Period (min)	15		

BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1265*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)		mi/h
Base free-flow Speed, BFFS	*70.0*	mi/h

Calc Speed Adj and FFS

f_{LW}	*0.0*	mi/h
f_{LC}	*0.0*	mi/h
f_{ID}	*0.0*	mi/h
f_N	*0.0*	mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*377*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*5.4*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h
S	mi/h
D = v_p / S	pc/mi/ln
Required Number of Lanes, N	

Glossary

N - Number of lanes	S - Speed
V - Hourly volume	D - Density
v_p - Flow rate	FFS - Free-flow speed
LOS - Level of service	BFFS - Base free-flow speed
DDHV - Directional design hour volume	

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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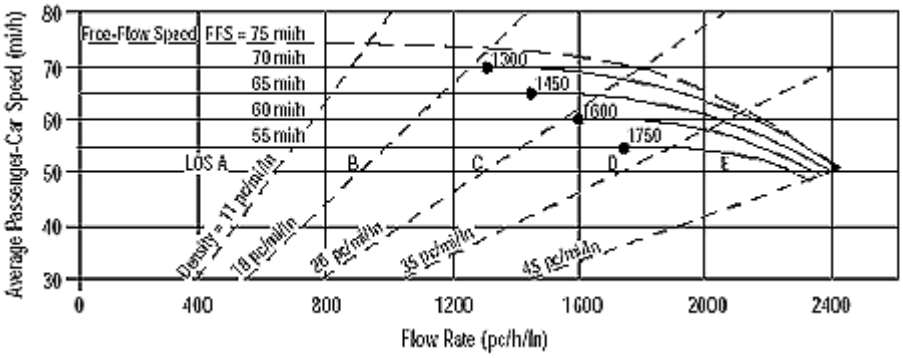

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*NB I-15*
Agency or Company	*TPG Consulting*	From/To	*south of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6755*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*4*		f_N		mi/h
FFS (measured)	*70.0*	mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2015*	pc/h/ln	Design LOS		
S	*64.6*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	*31.2*	pc/mi/ln	S		mi/h
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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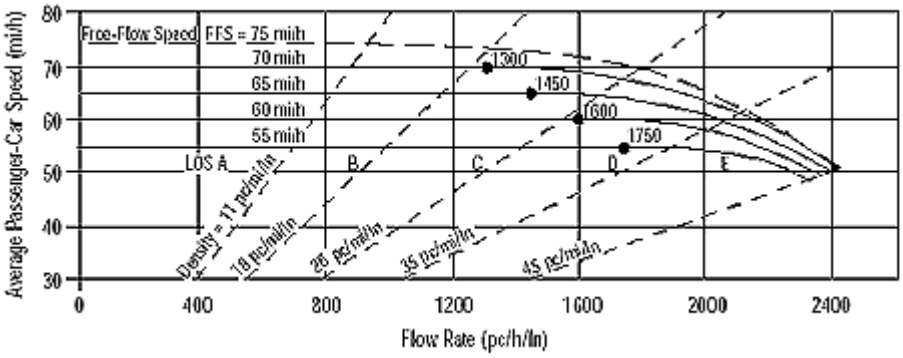

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information / Site Information

General Information		Site Information	
Analyst	*W Hutcheson*	Highway/Direction of Travel	*SB I-15*
Agency or Company	*TPG Consulting*	From/To	*south of Hwy 76*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6351*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs / Calc Speed Adj and FFS

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*4*		f_N		mi/h
FFS (measured)	*70.0*	mi/h	FFS	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures / Design (N)

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1894*	pc/h/ln	Design LOS		
S	*66.6*	mi/h	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
D = v_p / S	*28.4*	pc/mi/ln	S		mi/h
LOS	*D*		D = v_p / S		pc/mi/ln
			Required Number of Lanes, N		

Glossary / Factor Location

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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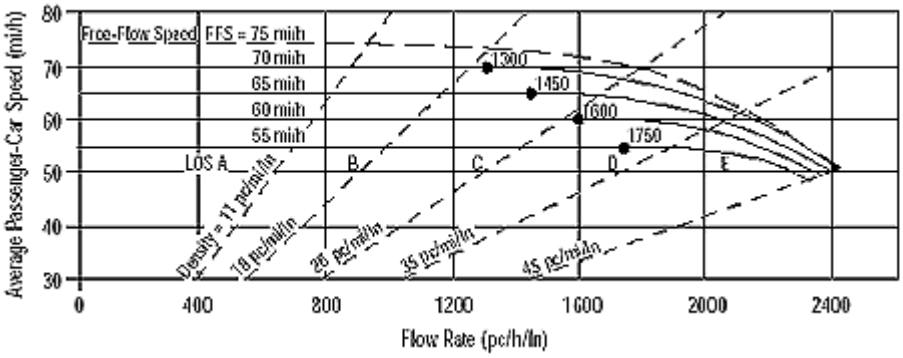

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*south of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2058*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*10*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.952*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*614*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*8.8*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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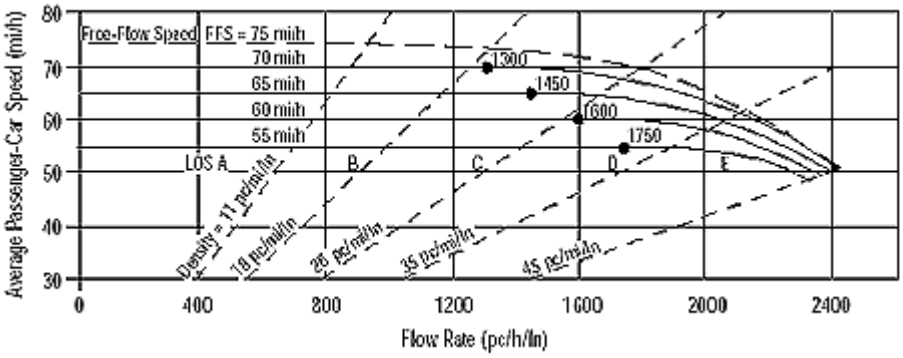

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1497*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*442*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*6.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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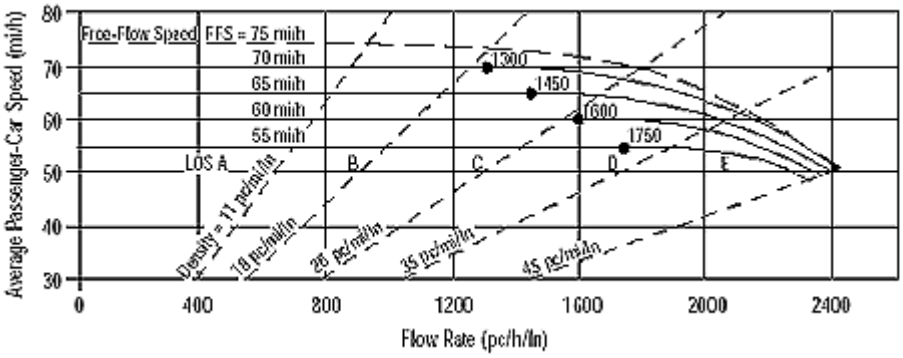

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*NB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/Sand Diego Co*
Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6696*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1978*	pc/h/ln
S	*65.3*	mi/h
D = v_p / S	*30.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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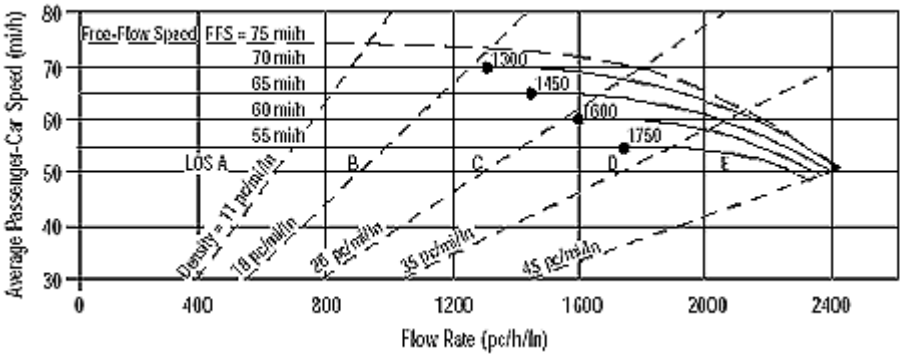

Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*AM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6598*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1949*	pc/h/ln
S	*65.8*	mi/h
D = v_p / S	*29.6*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
DDHV - Directional design hour volume
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed

Factor Location

E_R - Exhibits23-8, 23-10
E_T - Exhibits 23-8, 23-10, 23-11
f_p - Page 23-12
LOS, S, FFS, v_p - Exhibits 23-2, 23-3
f_{LW} - Exhibit 23-4
f_{LC} - Exhibit 23-5
f_N - Exhibit 23-6
f_{ID} - Exhibit 23-7

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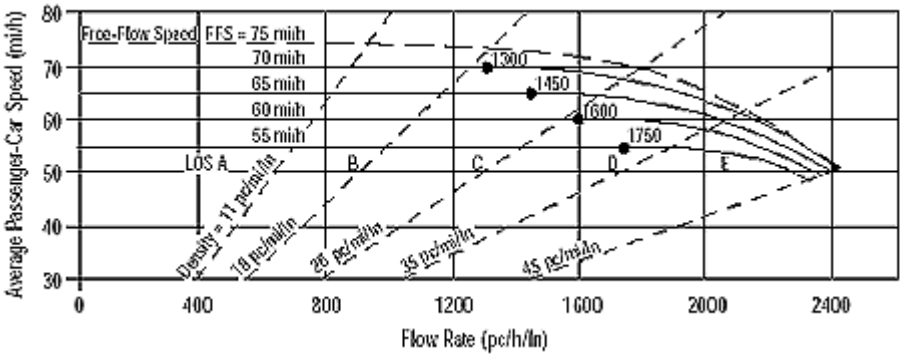
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information

Analyst	*W Hutcheson*
Agency or Company	*TPG Consulting*
Date Performed	*4/4/2007*
Analysis Time Period	*PM*

Site Information

Highway/Direction of Travel	*SB I-15*
From/To	*north of Hwy 76*
Jurisdiction	*Caltrans/San Diego Co*
Analysis Year	*2008 Operation*

Project Description 07-1087 Pala Power Plant

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2450*	veh/h	Peak-Hour Factor, PHF	*0.88*
AADT		veh/day	%Trucks and Buses, P_T	*8*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.962*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Shoulder Lat. Clearance	*6.0*	ft
Interchange Density	*0.50*	I/mi
Number of Lanes, N	*4*	
FFS (measured)	*70.0*	mi/h
Base free-flow Speed, BFFS		mi/h

Calc Speed Adj and FFS

f_{LW}		mi/h
f_{LC}		mi/h
f_{ID}		mi/h
f_N		mi/h
FFS	*70.0*	mi/h

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*724*	pc/h/ln
S	*70.0*	mi/h
D = v_p / S	*10.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S		mi/h
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
S - Speed
V - Hourly volume
D - Density
v_p - Flow rate
FFS - Free-flow speed
LOS - Level of service
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
f_p - Page 23-12	f_N - Exhibit 23-6
LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7

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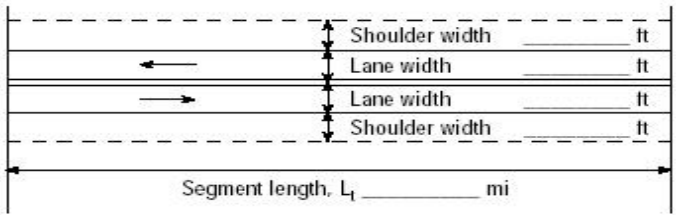
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Operation*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1462* veh/h
Directional split	*53 / 47*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*12* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.988*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1681*
v_p * highest directional split proportion[2] (pc/h)	*891*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.4*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*40.5*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1661*
v_p * highest directional split proportion[2] (pc/h)	*880*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*76.8*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*6.4*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*83.2*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.53*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*415*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1462*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*10.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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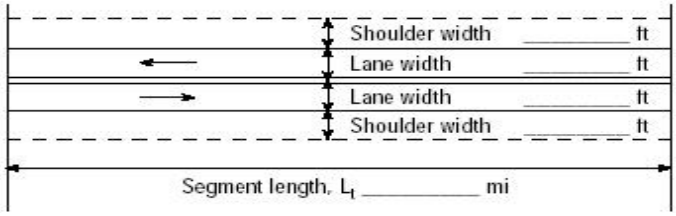
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*west of Old Highway 395*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Operation*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*2062* veh/h
Directional split	*54 / 46*
Peak-hour factor, PHF	*0.88*
No-passing zone	*100*
% Trucks and Buses , P_T	*10* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*8*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.990*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2367*
v_p * highest directional split proportion[2] (pc/h)	*1278*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.1*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*35.5*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*2343*
v_p * highest directional split proportion[2] (pc/h)	*1265*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*87.2*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*3.2*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*90.4*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*E*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.74*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*117*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*412*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*3.3*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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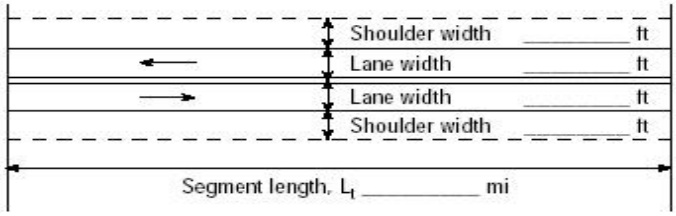
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Operation*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*561* veh/h
Directional split	*55 / 45*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*9 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*643*
v_p * highest directional split proportion[2] (pc/h)	*354*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.2*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*46.9*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.991*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*643*
v_p * highest directional split proportion[2] (pc/h)	*354*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*43.2*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*18.3*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*61.5*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.20*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*319*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1122*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*6.8*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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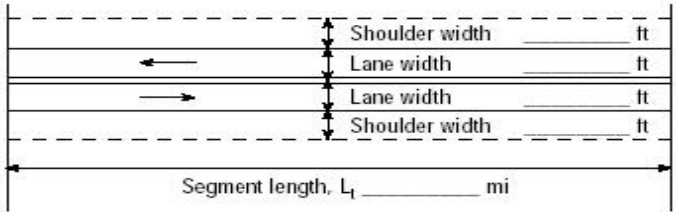
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*I-15 NB Ramps to Rice Canyon*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Operation*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*1045* veh/h
Directional split	*52 / 48*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*6 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1195*
v_p * highest directional split proportion[2] (pc/h)	*621*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.8*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*43.9*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*0.994*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*1195*
v_p * highest directional split proportion[2] (pc/h)	*621*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*65.0*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*9.6*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*74.6*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.37*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*594*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*2090*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*13.5*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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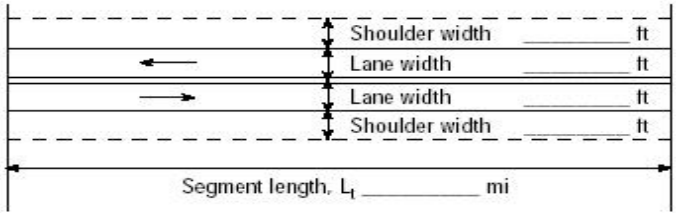
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*AM*	Analysis Year	*2008 Operation*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*529* veh/h
Directional split	*59 / 41*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*8* %
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*606*
v_p * highest directional split proportion[2] (pc/h)	*358*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*3.3*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*47.0*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*606*
v_p * highest directional split proportion[2] (pc/h)	*358*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*41.3*
Adj. for directional distribution and no-passing zone, $f_{d/hp}$(%)(Exh. 20-12)	*19.4*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*60.7*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*C*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.19*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*301*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1058*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*6.4*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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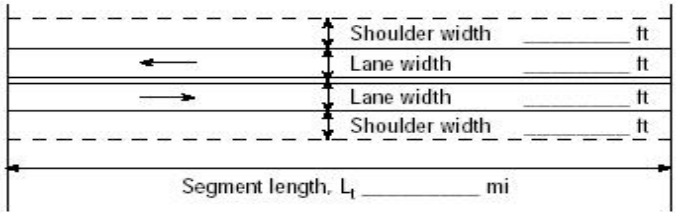
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*W Hutcheson*	Highway	*Highway 76*
Agency or Company	*TPG Consulting*	From/To	*Rice Canyon to Project*
Date Performed	*4/4/2007*	Jurisdiction	*Caltrans/San Diego Co*
Analysis Time Period	*PM*	Analysis Year	*2008 Operation*

Project Description: *07-1087 Pala Power Plant*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☑ Level ☐ Rolling

Two-way hourly volume	*745* veh/h
Directional split	*55 / 45*
Peak-hour factor, PHF	*0.88*
No-passing zone	*75*
% Trucks and Buses , P_T	*5 %*
% Recreational vehicles, P_R	*0%*
Access points/ *mi*	*2*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*851*
v_p * highest directional split proportion[2] (pc/h)	*468*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*55 mi/h*	Base free-flow speed, $BFFS_{FM}$	*mi/h*
Observed volume, V_f	*0 veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/ f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*55.0 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*2.5*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*45.9*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.995*
Two-way flow rate[1], v_p (pc/h)=V/ (PHF * f_G * f_{HV})	*851*
v_p * highest directional split proportion[2] (pc/h)	*468*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*52.7*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*13.4*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*66.1*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/ 3,200	*0.27*
Peak 15-min veh-miles of travel, VMT_{15} (veh- *mi*)= 0.25L_t(V/PHF)	*423*
Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1490*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*9.2*

Notes

1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F.
2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 528 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1265	0.88	Level	8	0	0.962	1.00	1495
Ramp	296	0.88	Level	8	0	0.962	1.00	350
UpStream								
DownStream	528	0.88	Level	10	0	0.952	1.00	630

Merge Areas | Diverge Areas

Estimation of v_{12} (Merge Areas)

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} (Diverge Areas)

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 849 pc/h

V_3 or V_{av34} 323 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks (Merge Areas)

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks (Diverge Areas)

	Actual	Capacity		LOS F?
V_F	1495	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1145	Exhibit 25-14	9600	No
V_R	350	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area (Merge Areas)

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area (Diverge Areas)

	Actual	Max Desirable		Violation?
V_{12}	849	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F) (Merge Areas)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F) (Diverge Areas)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 9.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Speed Determination (Merge Areas)

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination (Diverge Areas)

D_s = 0.460 (Exhibit 25-19)

S_R= 57.1 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	PM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3300 ft

V_D = 712 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6755	0.88	Level	8	0	0.962	1.00	7983
Ramp	771	0.88	Level	8	0	0.962	1.00	911
UpStream								
DownStream	712	0.88	Level	10	0	0.952	1.00	850

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3994 pc/h

V_3 or V_{av34} 1994 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7983	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	7072	Exhibit 25-14	9600	No
V_R	911	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3994	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 36.4 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.510 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 72.9 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 296 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	969	0.88	Level	10	0	0.952	1.00	1156
Ramp	528	0.88	Level	10	0	0.952	1.00	630
UpStream	296	0.88	Level	8	0	0.962	1.00	350
DownStream								

Estimation of v_{12} — Merge Areas

$$V_{12} = V_F (P_{FM})$$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.362 using Equation (Exhibit 25-5)

V_{12} = 419 pc/h

V_3 or V_{av34} 368 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 462 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$$V_{12} = V_R + (V_F - V_R)P_{FD}$$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1786	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1092	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$$

D_R = 9.3 (pc/mi/ln)

LOS = A (Exhibit 25-4)

Level of Service Determination (if not F)

$$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.284 (Exibit 25-19)

S_R= 62.1 mph (Exhibit 25-19)

S_0= 70.0 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	NB I-15
Agency or Company	TPG Consulting	Junction	NB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3300 ft

V_u = 771 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5984	0.88	Level	10	0	0.952	1.00	7140
Ramp	712	0.88	Level	10	0	0.952	1.00	850
UpStream	771	0.88	Level	8	0	0.962	1.00	911
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.335 using Equation (Exhibit 25-5)

V_{12} = 2389 pc/h

V_3 or V_{av34} 2375 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2856 pc/h (Equation 25-8)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7990	Exhibit 25-7		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3706	Exhibit 25-7	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 29.6 (pc/mi/ln)

LOS = D (Exhibit 25-4)

Speed Determination

M_S = 0.431 (Exibit 25-19)

S_R= 57.9 mph (Exhibit 25-19)

S_0= 64.1 mph (Exhibit 25-19)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans/San Diego Co
Analysis Time Period	AM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 417 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	6598	0.88	Level	10	0	0.952	1.00	7873
Ramp	663	0.88	Level	10	0	0.952	1.00	791
UpStream								
DownStream	417	0.88	Level	8	0	0.962	1.00	493

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 3879 pc/h

V_3 or V_{av34} 1997 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	7873	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	7082	Exhibit 25-14	9600	No
V_R	791	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	3879	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 36.5 (pc/mi/ln)

LOS = E (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.499 (Exhibit 25-19)

S_R= 56.0 mph (Exhibit 25-19)

S_0= 72.9 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB Off-Ramp
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{up} = ft

V_u = veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{down} = 3500 ft

V_D = 393 veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2450	0.88	Level	10	0	0.952	1.00	2923
Ramp	784	0.88	Level	10	0	0.952	1.00	935
UpStream								
DownStream	393	0.88	Level	8	0	0.962	1.00	464

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = using Equation (Exhibit 25-5)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 using Equation (Exhibit 25-12)

V_{12} = 1802 pc/h

V_3 or V_{av34} 560 pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}		Exhibit 25-7		

Capacity Checks

	Actual	Capacity		LOS F?
V_F	2923	Exhibit 25-14	9600	No
$V_{FO} = V_F - V_R$	1988	Exhibit 25-14	9600	No
V_R	935	Exhibit 25-3	2000	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}		Exhibit 25-7		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}	1802	Exhibit 25-14	4400:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = 18.6 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Speed Determination

M_S = (Exibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

Speed Determination

D_s = 0.512 (Exhibit 25-19)

S_R= 55.7 mph (Exhibit 25-19)

S_0= 76.8 mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	AM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 663 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	5934	0.88	Level	8	0	0.962	1.00	7013
Ramp	417	0.88	Level	8	0	0.962	1.00	493
UpStream	663	0.88	Level	10	0	0.952	1.00	791
DownStream								

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.355 using Equation (Exhibit 25-5)

V_{12} = 2492 pc/h

V_3 or V_{av34} 2260 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2805 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	7506	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3298	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 27.1 (pc/mi/ln)

LOS = C (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.383 (Exibit 25-19)

S_R= 59.3 mph (Exhibit 25-19)

S_0= 64.2 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

General Information		Site Information	
Analyst	W Hutcheson	Freeway/Dir of Travel	SB I-15
Agency or Company	TPG Consulting	Junction	SB on-ramp from Hwy 76
Date Performed	4/4/2007	Jurisdiction	Caltrans
Analysis Time Period	PM	Analysis Year	2008 Operation

Project Description 07-1087 Pala Power Plant

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 3500 ft

V_u = 784 veh/h

Terrain: Level

S_{FF} = 70.0 mph S_{FR} = 35.0 mph

Sketch (show lanes, L_A, L_D, V_R, V_f)

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1665	0.88	Level	8	0	0.962	1.00	1968
Ramp	393	0.88	Level	8	0	0.962	1.00	464
UpStream	784	0.88	Level	10	0	0.952	1.00	935
DownStream								

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.359 using Equation (Exhibit 25-5)

V_{12} = 706 pc/h

V_3 or V_{av34} 631 pc/h (Equation 25-4 or 25-5)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 787 pc/h (Equation 25-8)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = using Equation (Exhibit 25-12)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 25-15 or 25-16)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 25-18)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	2432	Exhibit 25-7		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 25-14		
$V_{FO} = V_F - V_R$		Exhibit 25-14		
V_R		Exhibit 25-3		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1251	Exhibit 25-7	4600:All	No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 25-14		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 11.1 (pc/mi/ln)

LOS = B (Exhibit 25-4)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.0009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 25-4)

Speed Determination

M_S = 0.291 (Exibit 25-19)

S_R= 61.9 mph (Exhibit 25-19)

S_0= 69.7 mph (Exhibit 25-19)

Speed Determination

D_s = (Exhibit 25-19)

S_R= mph (Exhibit 25-19)

S_0= mph (Exhibit 25-19)

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