

# SYSTEM PLANNING TRAINING

# TCR CORRIDOR PERFORMANCE DATA & ANALYSIS

PROVIDED BY:  
THE DIVISION OF TRANSPORTATION PLANNING,  
OFFICE OF SYSTEM & FREIGHT PLANNING

Module 5

May 21, 2013



# Corridor Performance Training Plan

2

- Module 5: Finding TCR Corridor Performance data for uncongested freeways and rural two-lane conventional highway.
- PeMS: In-District training using PeMS to find TCR Corridor Performance datasets. Held throughout Summer 2013.
- Module 6: Finding TCR Corridor Performance data for severely congested freeways. Likely to be held in Fall 2013.

# Module 5 Scope

3

- Urban Route
  - Uncongested Freeway Methodology
- Rural Route
  - Two-lane Highway Methodology
- Cover all required datasets and some important optional datasets.
- Using a simple, baseline methodology, that is available statewide.
  - PeMS will be covered as a separate training through Traffic Operations

# Urban Route Datasets

4

- AADT
- LOS
- VMT
- DVHD (35 mph)
- Peak Hour
  - ▣ Directional Split
  - ▣ VMT
  - ▣ V/C
  - ▣ Avg. Speed
  - ▣ VHD (35 mph)

Segment #		1
Basic System Operations		
AADT (BY)		9200
AADT (HY)		13340
AADT: Growth Rate/Year		1.55%
LOS Method		HCM
LOS (BY)		E
LOS (HY)		E
LOS Concept		E
VMT (BY)		21022
VMT (HY)		30482
Daily Vehicle Hours of Delay (35 MPH)(BY)		50
Daily Vehicle Hours of Delay (35 MPH)(HY)		70
Daily VHD (35 MPH) Method		PeMS

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		N/A
Peak Hour Time of Day		am
Peak Hour Directional Split (BY)		70/30
Peak Hour Directional Split (HY)		80/20
Peak Hour VMT (BY)		10000
Peak Hour VMT (HY)		20000
Peak Hour V/C (BY)		1
Peak Hour V/C (HY)		1
Peak Hour Avg. Speed (mph)(BY)		30
Peak Hour Avg. Speed (mph)(HY)		25
Peak Hour Vehicle Hours of Delay (35 mph) (BY)		100
Peak Hour Vehicle Hours of Delay (35 mph) (HY)		140
Peak Hour VHD (35 MPH) Method		PeMS

\*Managed Lane Performance and Bottleneck datasets are covered in the PeMS training

\* Truck AADT covered in Rural

# Rural Route Datasets

5

- AADT
- LOS
- VMT
- Truck Traffic
- Peak Hour
  - ▣ Directional Split
  - ▣ VMT
  - ▣ V/C
  - ▣ Avg. Speed
  - ▣ VHD (35 mph)

Segment #		1
<b>Basic System Operations</b>		
AADT (BY)		9200
AADT (HY)		13340
AADT: Growth Rate/Year		1.55%
LOS Method		HCM
LOS (BY)		E
LOS (HY)		E
LOS Concept		E
VMT (BY)		21022
VMT (HY)		30482
<b>Truck Traffic</b>		
Total Average Annual Daily Truck Traffic (AADTT) (BY)		322
Total Average Annual Daily Truck Traffic (AADTT) (HY)		700
Total Trucks (% of AADT) (BY)		3.5%
Total Trucks (% of AADT)(HY)		5.2%
5+ Axle Average Annual Daily Truck Traffic (AADTT)(BY)		129
5+ Axle Average Annual Daily Truck Traffic (AADTT)(HY)		300
5+ Axle Trucks (as % of AADT)(BY)		1.40%
5+ Axle Trucks (as % of AADT)(HY)		2.2%

<b>Peak Hour Traffic Data</b>		
Peak Period Length		1
Peak Hour Direction		N/A
Peak Hour Time of Day		am
Peak Hour Directional Split (BY)		70/30
Peak Hour Directional Split (HY)		80/20
Peak Hour VMT (BY)		10000
Peak Hour VMT (HY)		20000
Peak Hour V/C (BY)		1
Peak Hour V/C (HY)		1
Peak Hour Avg. Speed (mph)(BY)		30
Peak Hour Avg. Speed (mph)(HY)		25
Peak Hour Vehicle Hours of Delay (35 mph) (BY)		100
Peak Hour Vehicle Hours of Delay (35 mph) (HY)		140
Peak Hour VHD (35 MPH) Method		PeMS

# SR-99 Segment Analysis

6

## Urban Uncongested Freeway

# Urban Route: Uncongested Freeway

7

- A freeway is a separated highway with full control of access and two or more lanes in each direction dedicated to the exclusive use of traffic. (HCM Ch. 10)
- Uncongested: This methodology applies to freeway routes that are not experiencing severe congestion. For the purposes of this methodology, severe congestion occurs when travel demand exceeds freeway capacity, vehicular speeds are 35 miles per hour (mph) or less, and conditions lasts for 15 minutes or longer during peak commute periods on a typical incident-free weekday.

# Urban Route Sample: SR 99

8

- Segment: PM 29.364 - PM T37.451 (north of Southgate Ave. to north of W. Eaton Rd.)
- 4F facility within the City of Chico in Butte County
- Important north-south corridor that provides access for commuting and recreational traffic
- Urban development along the corridor



*SR 99 from the Skyway overcrossing*



**PM T37.451**  
**North of W. Eaton Rd.**

**PM 29.364**  
**North of Southgate Ave.**

# Urban Data Tools and Sources

10

- Google Measuring Tool
- Highway Capacity Software 2010
  - LOSPLAN - FREEPLAN module
- Traffic Volumes Book
- Traffic Volumes Book – Peak Hour Volume Data Table (back of book)
- Ramp Volumes Book
- Truck Volumes Book
  
- Traffic, Ramp, and Truck Volumes Books can be found here:  
<http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm>

# Google Measuring Tool

11

The image is a screenshot of the Google Maps website. The browser address bar shows the URL `maps.google.com/maps?hl=en&tab=wl`. The search bar contains the text "chico, ca". The main map area displays a satellite view of Chico, California, with various streets and landmarks labeled. On the left side, there is a sidebar with information for "Chico, CA", including "Directions", "Search nearby", "Photos", and "Places". A red callout bubble is overlaid on the bottom left of the map, containing the text "Maps Labs - ©2013 Google".

← → ↻ 🏠 `maps.google.com/maps?hl=en&tab=wl` ☆ ☰

+You Search Images **Maps** Play YouTube News Gmail Drive Calendar More -

Google  🔍 SIGN IN

Get directions My places 🖨️ 🗲️

**Chico, CA**  
Directions Search nearby more ▾

Explore this area ▸

**Photos**  
[Photo thumbnails]

**Places**  
Sierra Nevada Brewing Company  
Cal Northern School of Law  
California State University

Maps Labs - Help  
Google Maps - ©2013 Google - Terms of Use - Privacy

**Maps Labs - ©2013 Google**

# Google Measuring Tool

12

The screenshot shows the Google Maps Labs interface. At the top, there's a navigation bar with links for +You, Search, Images, Maps, Play, YouTube, News, Gmail, Drive, Calendar, and More. Below this is the Google search bar with 'chico, ca' entered. The main map area shows a satellite view of Chico, CA. On the left sidebar, there's information about Chico, CA, including directions, nearby photos, and places like Sierra Nevada Brewing Company, Cal Northern School of Law, and California State University.

The 'Google Maps Labs' panel is open, displaying a list of experimental features. A red callout bubble with the text 'Click Enable & Save Changes' points to the 'Enable' radio button for the 'Distance Measurement Tool'.

Feature Name	Author	Enable	Disable
Distance Measurement Tool	Adam S, Andrey S, James M, Seth L	<input checked="" type="radio"/>	<input type="radio"/>
Show Me Here!	Cornelius Q	<input type="radio"/>	<input checked="" type="radio"/>
Drag 'n' Zoom	Dave D	<input type="radio"/>	<input checked="" type="radio"/>
Back to Beta	David S	<input type="radio"/>	<input checked="" type="radio"/>

At the bottom of the panel, there are 'Save changes' and 'Cancel' buttons, and an important note: 'Important: To save your enabled Labs for next time, you must sign in to your Google account.'

# Google Maps & Measuring Tool

13

Get directions My places

### Distance Measurement Tool

Click on the map to trace a path you want to measure.

Units:  
 Metric  English [I'm feeling geeky](#)

**Total distance:**  
**8.00691 mi**

Delete last point Reset



Click  
Measurement  
Icon and Begin

# HCS 2010

14



# Urban: AADT BY and HY

15

- Required
- Average Annual Daily Traffic

Basic System Operations		
AADT (BY)		
AADT (HY)		
AADT: Growth Rate/Year		
LOS Method		
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		
Daily VHD (35 MPH) Method		

# Traffic Volumes Book

2011 Traffic Volumes Book

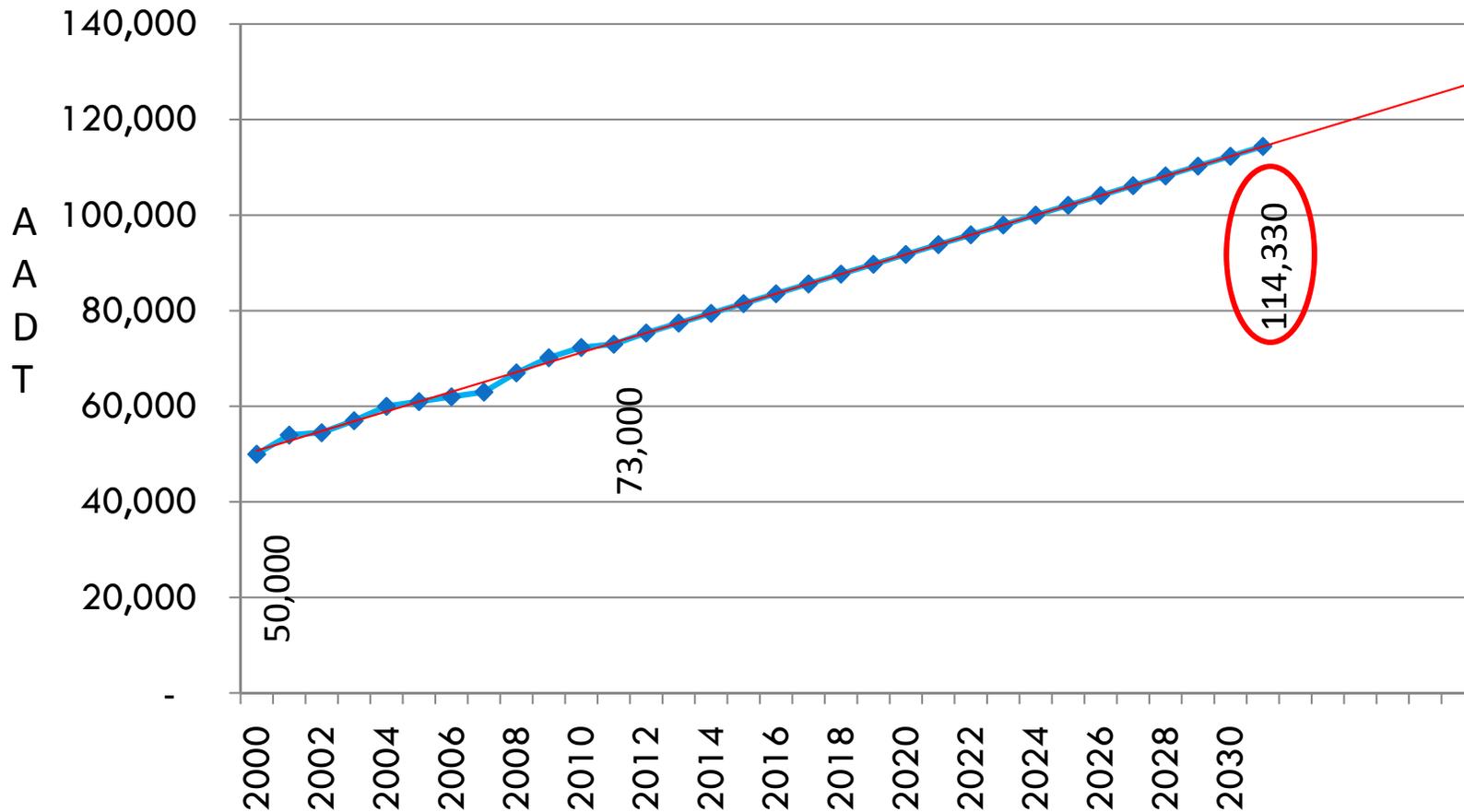
	Dist	Rout	CO	Postmil	Description	Back	Back	Back	Ahead	Ahead	Ahead
		e		e		Peak	Peak	Back	Peak	Peak	Ahead
						Hour	Month	AAADT	Hour	Month	AAADT
3	99	BUT		26.04	NEAL HIGHWAY	2600	28500	26000	2350	26000	24000
3	99	BUT	R	30.603	CHICO, SKYWAY OC	3150	33500	32500	4500	53000	49500
3	99	BUT	R	31.498	EAST 20TH ST	4500	53000	49500	6200	72000	70000
3	99	BUT	R	32.445	CHICO, JCT. RTE. 32 E	6200	72000	70000	7200	75000	73000
3	99	BUT	R	33.282	CHICO, EAST FIRST AVE	7200	75000	73000	5800	61000	59000
3	99	BUT	R	34.245	CHICO, COHASSET HIGHWAY	5800	61000	59000	3700	45000	41500
3	99	BUT	R	34.927	EAST AVE	3750	45000	41500	2600	31000	28000
3	99	BUT	R	36.305	EATON AVE	2600	31000	28000	1800	19400	18800
3	99	BUT		38.79	WILSON LANDING RD	1800	19400	18800	1400	15000	14700

Basic System Operations		
AAADT (BY)		73,000
AAADT (HY)		114,330
AAADT: Growth Rate/Year		

- Present AAADT acquired from the Traffic Volumes (Pick the Highest)
- AAADT 20 Years Horizon produced by MPO model forecast: 114,330

# Develop Traffic Projection

Establish Traffic Growth Trend  
Based on Existing Data



# Urban: AADT Growth Rate/Year

18

- Percent of growth of AADT per year

$$g = (x/y)^{1/Z} - 1$$

$g$  = average annual growth rate

$x$  = future (base) year volume

$y$  = earlier year volume

$Z$  = number of years

$$g = ((114,330/73,000)^{1/20}) - 1$$

$$g = 2.2\%$$

**Source:** NCHRP 255 Highway Traffic Data for Urbanized area Planning and Design

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		
Daily VHD (35 MPH) Method		

# Urban: LOS Method, BY, HY, Concept

19

- Optional
- Use FREEPLAN to find LOS BY and HY
- This method only applies if LOS does not reach LOS F. If it does reach LOS F use the congested method that will be covered in Module 6.

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		

# FREEPLAN: TCR Inputs and Outputs

20

## □ Inputs

- ▣ Peak Hour Directional Split
- ▣ Peak Direction Volume
- ▣ % Heavy Vehicles (All Trucks)

## □ Outputs

- ▣ LOS
- ▣ Avg. Speed

# HCS 2010

21



# FREEPLAN LOS

22



# FREEPLAN Project Properties

23

File View Help

Roadway Information

Freeway Name

From  To

Area Type

Peak Direction

Off Peak Direction

Study Period

File Information

File Name

Analyst

Analysis Date

Agency

Notes

The area type sets the default values that will initially appear in the data input fields.  
Note that changing the area type at any time during an analysis will reset all data input fields to the default values corresponding to the selected area type.

For the variables highlighted in blue on the following screen, local values must be used.

<<-- **Project Properties** | Segment Data | LOS Results | Service Volumes | -->>

## INPUTS:

- County & Route
- Post Mile Range
- Area Type
- Peak & Off-Peak Direction
- Study Period: Directional Hour Demand Volumes

# FREEPLAN: Peak Direction

- Chose NB direction because collected on a Thursday, which is more representative of an average day than a Monday
- Resource: Traffic Volumes Book – Peak Hour Volume Data Table (back of book)

OTM32420  
06/29/2012  
08:07:16

CALTRANS TRAFFIC VOLUMES  
LATEST TRAFFIC YEAR SELECTED  
PEAK HOUR VOLUME DATA

DI	RTE	CO	PRE	PM	CS	LEG	YR	Dir	1 WAY PHV	AM PEAK			Dir	1 WAY PHV	PM PEAK								
										% K	% D	% KD			HR	DAY	MNTH	% K	% D	% KD	HR	DAY	MNTH
03	099	BUT	R	30.60	585	B	11	S	1985	9.65	63.22	6.1	7	MON	SEP	N	1808	10.03	55.38	5.55	16	THU	SEP

# FREEPLAN Study Period

25

The screenshot shows the 'Project Properties' dialog box in FREEPLAN 2009. The window title is 'FREEPLAN 2009: Transitioning/Urban Area - [Project Properties]'. The interface is divided into two main sections: 'Roadway Information' and 'File Information'.  
**Roadway Information:**  
- Freeway Name: BUT- 99  
- From: PM 29.4 To: PM T37.5  
- Area Type: Transitioning/Urban (dropdown menu)  
- Peak Direction: Northbound (dropdown menu)  
- Off Peak Direction: Southbound  
- Study Period: Dir Hr Demand Vol (dropdown menu, with K100, Kother, and Dir Hr Demand Vol visible in the list)  
**File Information:**  
- File Name: 4SR-99 NorthBound.xfp  
- Analyst: Al Arana  
- Analysis Date: 5/ 7/2013  
- Agency: Caltrans  
- Notes: (empty text area)  
At the bottom of the dialog, a red note states: 'The area type sets the default values that will initially appear in the data input fields. Note that changing the area type at any time during an analysis will reset all data input.'

- **Dir. Hr Demand Vol**
- **K100th** The ratio of the 100th highest traffic volume hour of the year to the annual average daily traffic.
- **Kother** User enters a K factor for a time period other than the K100, such as, K30, K5/6.

# FREEPLAN Segment Data

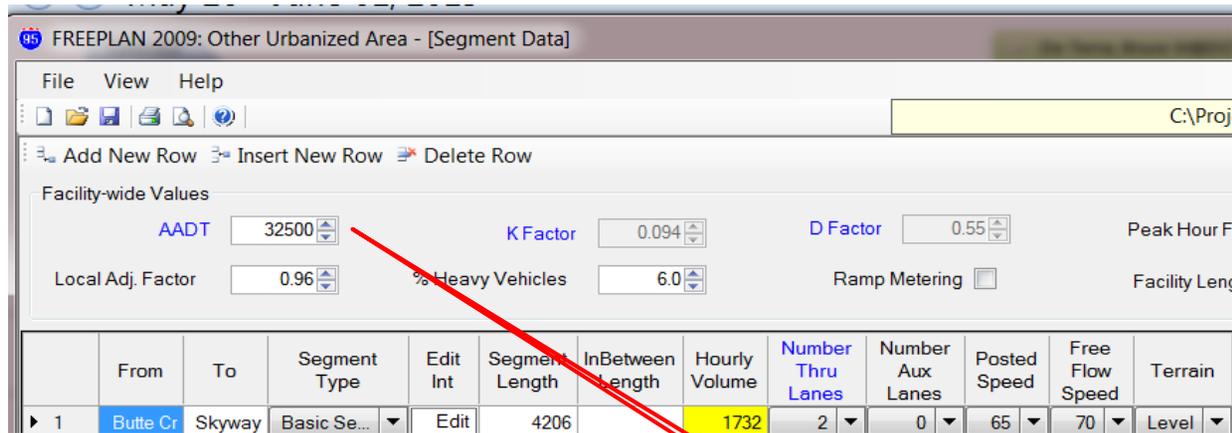
26

- Data Inputs: AADT, % Heavy Vehicles, Peak Hour Factor, and Hourly Volumes
- Characteristic Inputs: From/To, Segment Type, Segment Length, Number of Thru lanes, Number of Aux Lanes, Posted Speed, Free Flow Speed, and Terrain
- Must start with a Segment Type of Basic Segment as Segment 1
- Local Adj. Factor automatically set when Area type is selected under Project Properties

The screenshot shows the 'FREEPLAN 2009: Other Urbanized Area - [Segment Data]' window. The 'Facility-wide Values' section contains several input fields: AADT (32500), K Factor (0.094), D Factor (0.55), Peak Hour Factor (0.950), Local Adj. Factor (0.96), % Heavy Vehicles (6.0), Ramp Metering (unchecked), and Facility Length (mi) (8.505). The 'Characteristic Inputs' table below has columns for From, To, Segment Type, Edit Int, Segment Length, InBetween Length, Hourly Volume, Number Thru Lanes, Number Aux Lanes, Posted Speed, Free Flow Speed, and Terrain. The first row shows 'Butte Cr' to 'Skyway' with a Segment Type of 'Basic Se...', Segment Length of 4206, Hourly Volume of 1732, 2 Thru Lanes, 0 Aux Lanes, Posted Speed of 65, Free Flow Speed of 70, and Level Terrain.

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Butte Cr	Skyway	Basic Se...	Edit	4206		1732	2	0	65	70	Level

# FREEPLAN: AADT



- Pick an AADT that is representative of the beginning of the segment

2011 Traffic Volumes Book

Dist	Rout e	CO	Postmil e	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour
3	99	BUT	26.04	NEAL HIGHWAY	2600	28500	26000	2350
3	99	BUT	R 30.603	CHICO, SKYWAY OC	3150	33500	32500	4500
3	99	BUT	R 31.498	EAST 20TH ST	4500	53000	49500	6200
3	99	BUT	R 32.445	CHICO, JCT. RTE. 32 E	6200	72000	70000	7200
3	99	BUT	R 33.282	CHICO, EAST FIRST AVE	7200	75000	73000	5800
3	99	BUT	R 34.245	CHICO, COHASSET HIGHWAY	5800	61000	59000	3700
3	99	BUT	R 34.927	EAST AVE	3750	45000	41500	2600

- Likely different than the AADT Reported in the TCR

# FREEPLAN: % Heavy Vehicles

28

Resource:

- Truck Volumes Book 2011
- TRUCK % TOT VEH

FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Proj

Add New Row Insert New Row Delete Row

Facility-wide Values

AADT: 32500 K Factor: 0.094 D Factor: 0.55 Peak Hour F

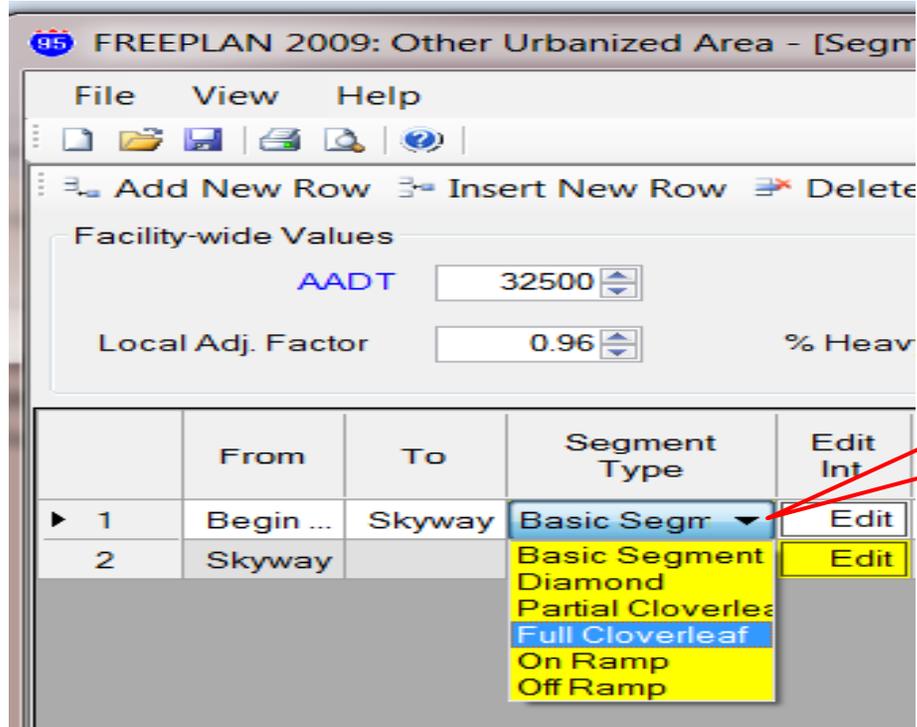
Local Adj. Factor: 0.96 % Heavy Vehicles: 6.0 Ramp Metering:  Facility Leng

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volum	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Butte Cr	Skyway	Basic Se...	Edit	4206		1732	2	0	65	70	Level

RTE	DIST	CNTY	POST MILE	LEG	DESCRIPTION	VEHICLE AADT TOTAL	TRUCK AADT TOTAL	TRUCK % TOT VEH	2	TRUCK By 3	AADT Axle 4	TOTAL 5+
99	3	BUT	4.38	A	GRIDLEY, SPRUCE STREET	14500	1305	9	301	194	124	685
99	3	BUT	11.159	B	JCT. RTE. 162 WEST	10500	1050	10	231	140	106	573
99	3	BUT	11.159	A	JCT. RTE. 162 WEST	10700	1070	10	235	143	108	583
99	3	BUT	13.161	B	JCT. RTE. 162 EAST	12500	1250	10	275	166	126	683
99	3	BUT	13.161	A	JCT. RTE. 162 EAST	9100	910	10	200	122	92	496
99	3	BUT	R30.603	B	CHICO, SKYWAY OVERCROSSING	32500	3380	10.4	1437	439	226	1278
99	3	BUT	R30.603	A	CHICO, SKYWAY OVERCROSSING	49500	3277	6.62	2177	193	73	834
99	3	BUT	R32.445	A	CHICO, JCT. RTE. 32 EAST	73000	4833	6.62	3211	284	107	1230
99	3	BUT	R34.245	B	CHICO, COHASSET	59000	3475	5.89	2346	178	70	881

# FREEPLAN: Segment Type

29



- Segment Type
  - ▣ Basic Segment
  - ▣ Diamond
  - ▣ Partial Cloverleaf
  - ▣ Full Cloverleaf
  - ▣ On Ramp
  - ▣ Off Ramp

- Although we are finding data for one TCR segment, for analysis purposes in FREEPLAN, the segment needs to be broken into smaller sub-segments to capture interchanges separately from basic segments.

**Slide 29**

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**KLier20**

AADT in this image does not match the AADT chosen earlier, which was 32500

s138232, 5/30/2013

# FREEPLAN: Sub-segment Length

30

Tool:

- Google Measuring Tool

FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Projects\Training\But-99-R

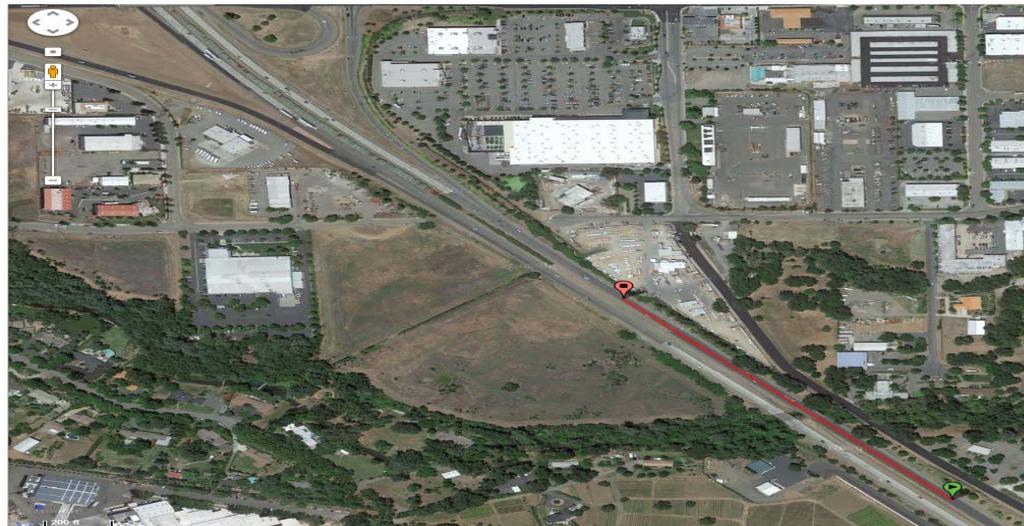
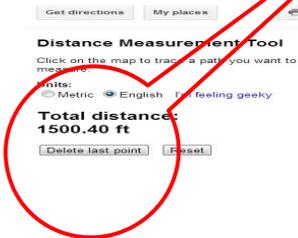
Add New Row Insert New Row Delete Row

Facility-wide Values

AAADT: 32500 K Factor: 0.094 D Factor: 0.55 Peak Hour Factor: 0.950

Local Adj. Factor: 0.96 % Heavy Vehicles: 6.0 Ramp Metering:  Facility Length (mi): 8.082

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Begin...	Skyway	Basic Se...	Edit	1500		1732	2	0	65	70	Level



# FREEPLAN: Hourly Volume

31

- Use Peak Hour Volume for the direction chosen for analysis
- Peak Hour Vol x Directional Split Factor = Hourly Vol

The screenshot shows the FREEPLAN 2009 software interface for 'Other Urbanized Area - [Segment Data]'. The 'Facility-wide Values' section includes the following parameters:

- AADT: 32500
- K Factor: 0.094
- D Factor: 0.55
- Local Adj. Factor: 0.96
- % Heavy Vehicles: 6.0
- Ramp Metering:
- Peak Hour F: (partially visible)
- Facility Leng: (partially visible)

The data table below has the following columns: From, To, Segment Type, Edit Int, Segment Length, InBetween Length, Hourly Volume, Number Thru Lanes, Number Aux Lanes, Posted Speed, Free Flow Speed, and Terrain. The 'Hourly Volume' column for the first row is circled in red.

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
▶ 1	Butte Cr	Skyway	Basic Se...	Edit	4206		1732	2	0	65	70	Level

# Urban : Peak Hour Directional Split Factor

- ❑ Assume Peak Hour Directional Split Remains Unchanged for HY
- ❑ Directional Split Factor = 0.55
- ❑ Resource: Traffic Volumes Book – Peak Hour Volume Data Table (back of book)

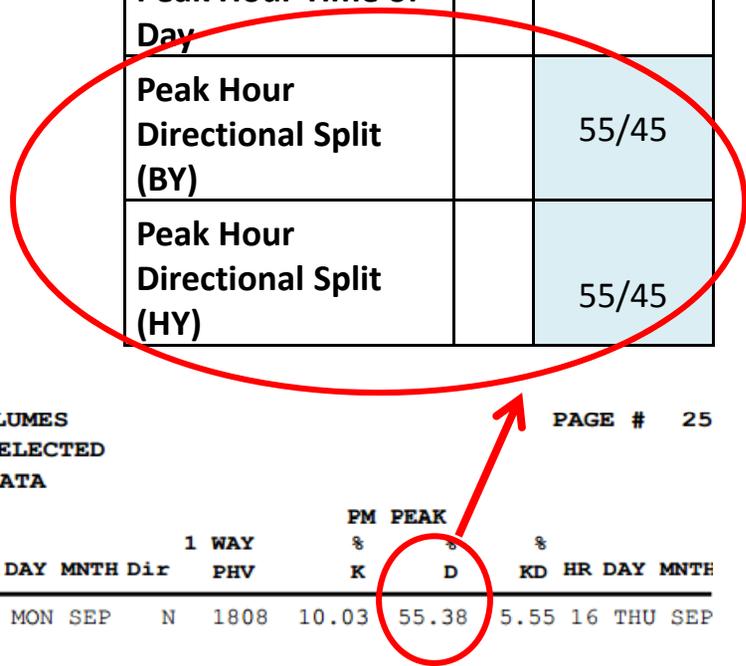
Peak Hour Traffic Data		
Peak Period Length		
Peak Hour Direction		
Peak Hour Time of Day		
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45

OTM32420  
06/29/2012  
08:07:16

CALTRANS TRAFFIC VOLUMES  
LATEST TRAFFIC YEAR SELECTED  
PEAK HOUR VOLUME DATA

PAGE # 25

DI	RTE	CO	PRE	PM	CS	LEG	YR	Dir	AM PEAK				Dir	PM PEAK					
									1 WAY PHV	% K	% D	% KD		1 WAY PHV	% K	% D	% KD		
03	099	BUT	R	30.60	585	B	11	S	1985	9.65	63.22	6.1	7 MON SEP	N	1808	10.03	55.38	5.55	16 THU SEP



# FREEPLAN: Hourly Volume

95 FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Proj

Add New Row Insert New Row Delete Row

Facility-wide Values

AAADT 32500 K Factor 0.094 D Factor 0.55 Peak Hour F

Local Adj. Factor 0.96 % Heavy Vehicles 6.0 Ramp Metering Facility Leng

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Butte Cr	Skyway	Basic Se...	Edit	4206		1732	2	0	65	70	Level

- Peak Hour Volume = 6200
- Directional Split Factor = .55

2011 Traffic Volumes Book

- Hourly Vol =  $3150 \times 0.55 = 1732$

Dist	Rout e	CO	Postmil e	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour
3	99	BUT	26.04	NEAL HIGHWAY	2600	28500	26000	2350
3	99	BUT	R 30.603	CHICO, SKYWAY OC	3150	33500	32500	4500
3	99	BUT	R 31.498	EAST 20TH ST	4500	53000	49500	6200
3	99	BUT	R 32.445	CHICO, JCT. RTE. 32 E	6200	72000	70000	7200
3	99	BUT	R 33.282	CHICO, EAST FIRST AVE	7200	75000	73000	5800
3	99	RIJT	R 34.745	CHICO. COHASSFT HIGHWAY	5800	61000	59000	3700

# FREEPLAN: Sub-segment 2

34

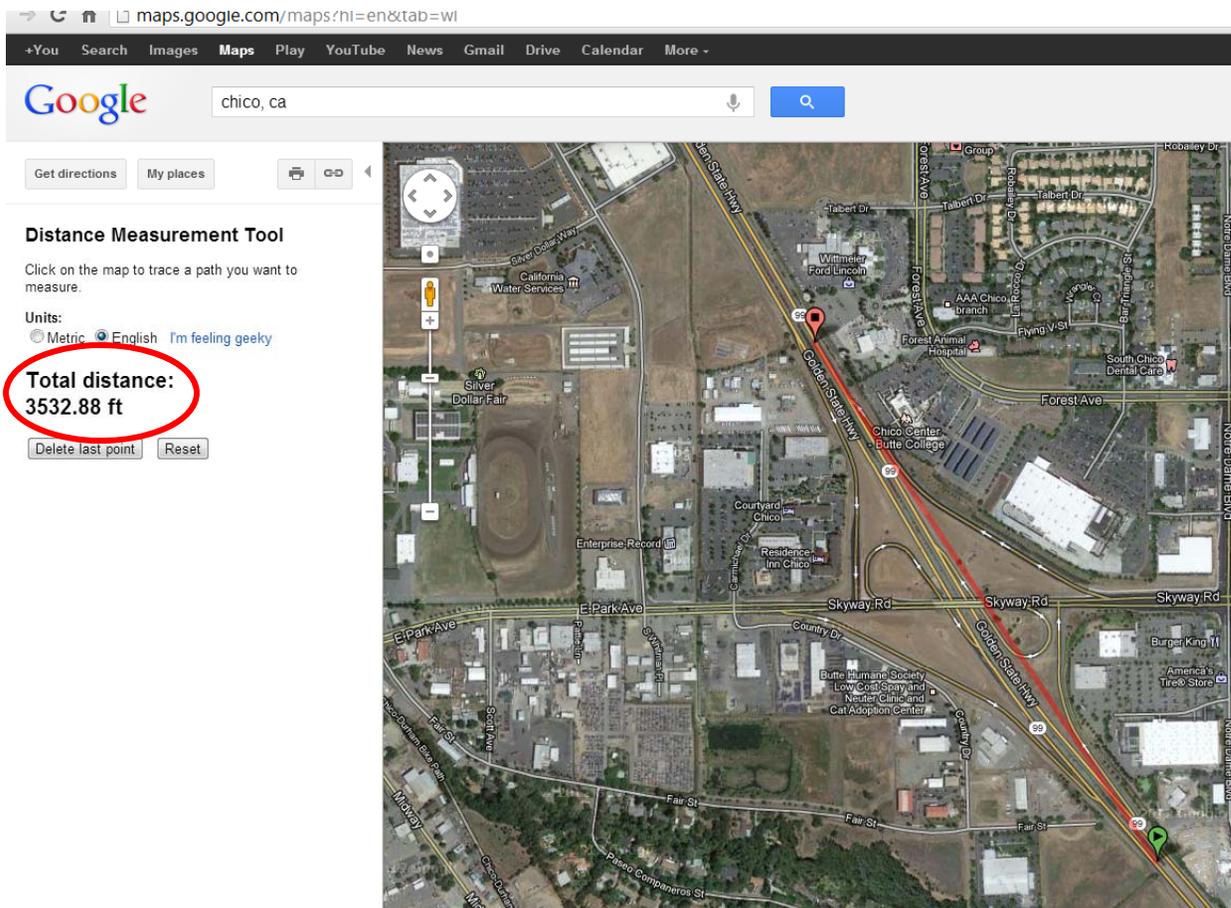
- Once the inputs for the Basic Segment have been entered, need to add a new row for analysis of the interchange

The screenshot shows the FREEPLAN 2009 software interface for segment data. The title bar reads "FREEPLAN 2009: Other Urbanized Area - [Segment Data]". The menu bar includes "File", "View", and "Help". The toolbar contains icons for file operations and a red circle highlights the "Add New Row" button. Below the toolbar, there are input fields for "Facility-wide Values": AADT (32500), K Factor (0.094), D Factor (0.55), Local Adj. Factor (0.96), % Heavy Vehicles (6.0), Ramp Metering (checkbox), and Peak Hour Factor. Below these are two rows of segment data:

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	State St	Skyway	Basic Se...	Edit	2688		1732	2	0	65	70	Level
2	Skyway		Full Clove...	Edit	3530		1732	2	0	65	70	Level

# FREEPLAN: Segment Data

35



- Measure the Segment Length
- Segment is a Full Cloverleaf

# FREEPLAN: Segment Data

36

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes
▶ 1	Butte Cr	Skyway	Basic Se...	Edit	2000		1732	2	0
2	Skyway		Full Clove...	Edit	3530		1732	2	0

## INPUTS:

- Pick Full Cloverleaf
- Input Segment Length
- Ramp data

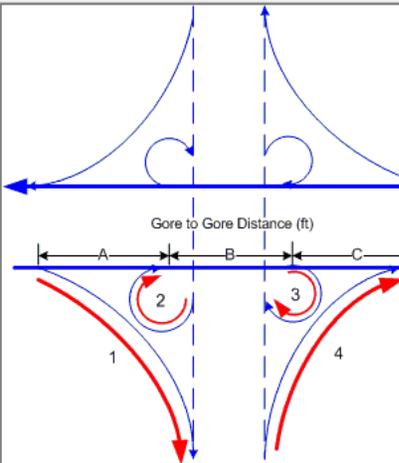
Click on Edit to input ramp data

# FREEPLAN: Editing Ramp Data

37

Interchange Data

Segment #2: From Skyway to



06/21/2012  
06:38:19

CALTRANS TRAFFIC VOLUMES  
PRINT FILE FOR RAMP AADT

03-BUT-099

P	POST P	S	DESCRIPTION	2002 ADT	2003 ADT	2004 ADT	2005 ADT
	023.613	P	NB OFF TO PENTZ/DURHAM	700			
	023.692	P	SB ON FR PENTZ/DURHAM	710			
	024.127	P	SBOFF TO PENTZ/DURHAM	2060			
	024.145	P	NB ON FR PENTZ/DURHAM	2030			
R	030.355	P	NB OFF TO SKYWAY	3610			4590
R	030.448	P	SB ON FR SKYWAY	4480			5250
R	030.693	P	NB ON FR EB SKYWAY	2950			3740

Gore to Gore Distance (ft)

A B C

1 2 3 4

Gore to Gore Distance

A 334 B 0 C 666 Total 1000  Auxiliary lane between ramps 2 and 3

Ramp Number	Ramp Type	Demand (veh/h)	% Heavy Vehicles	Number of Lanes	Accel/Decel Length	Free Flow Speed	Off-Ramp Analysis	Edit
1	Off Ra...	523	5	1	426	45	<input type="checkbox"/>	Edit
2	On Ra...	422	5	1	668	45	<input type="checkbox"/>	Edit
3	Off Ra...	0	0	1	450	40	<input type="checkbox"/>	Edit
4	On Ra...	1181	5	1	1000	40	<input type="checkbox"/>	Edit

$(4,590 * 0.1) * 1.14 = 523$

- Resource: Ramp Volumes Book
- Assume 10% of RAMP ADT for Ramp Peak Hourly Volume
- For Ramp Volumes extrapolate base year (2005) using Extrapolation Factor (Fe) from NCHRP formula:

$$Fe = (g + 1)^n$$

$$g = \text{AADT growth rate} / \text{year} = 2.2\% \text{ or } 0.022$$

n = Number of Years  
in this case is 2011-2005 = 6 Years

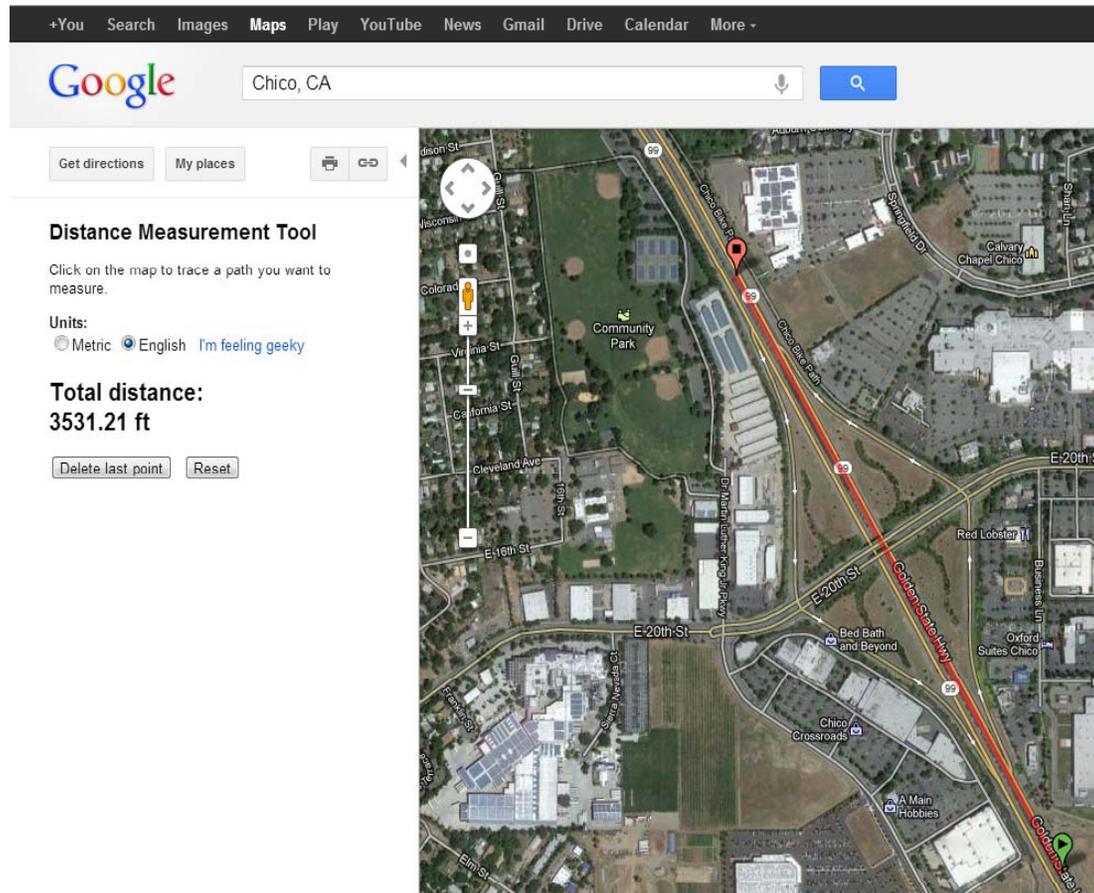
$$Fe = (0.022 + 1)^6$$

$$Fe = 1.14$$

- Free Flow Speed is a default set by the program
- Accel/Decel Length: measured using the Google measurement tool

# FREEPLAN: Sub-segment 4

38



## INPUTS:

- Measure the Next Segment
- Segment is a Diamond I/C

# Diamond I/C

39

FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Projects\Training\But-99-Revision Base Year...

Add New Row Insert New Row Delete Row

Facility-wide Values

AADT 32500 K Factor 0.094 D Factor 0.55 Peak Hour Factor 0.950

Local Adj. Factor 0.96 % Heavy Vehicles 6.0 Ramp Metering  Facility Length (mi) 8.082

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Begin ...	Skyway	Basic Se...	Edit	1500		1732	2	0	65	70	Level
2	Skyway		Full Clove...	Edit	4000		1732	2	0	65	70	Level
3			Basic Se...	Edit	1500		2812	2	0	65	70	Level
▶ 4	E. 20th		Diamond I/C	Edit	3530		2812	2	0	65	70	Level
5			Basic S...	Edit	1657		3847	2	0	65	70	Level

Click on Edit to input ramp data

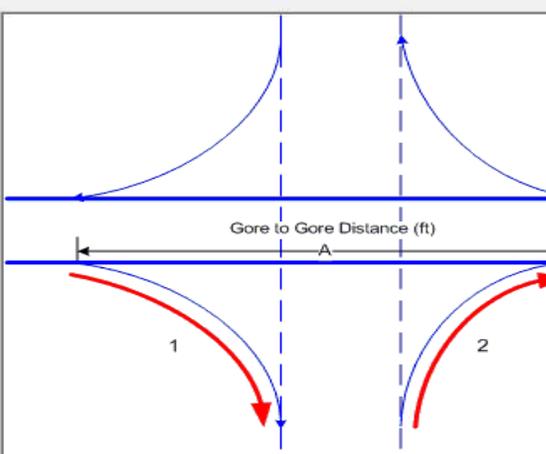
- Pick Diamond I/C
- Input Segment Length
- Ramp data

# Diamond I/C Ramp Volumes

40

Interchange Data

Segment # 4: From E. 20th to



				Year 2005
R 030.355	NB OFF TO SKYWAY	3610		4590
R 030.448	SB ON FR SKYWAY	4480		5250
R 030.693	NB ON FR EB SKYWAY	2950		3740
R 030.748	SB OFF TO EB SKYWAY			8990
R 030.749	SB OFF TO WB SKYWAY			4400
R 030.820	NB ON FR SKYWAY	9360		
R 030.821	NB ON FR WB SKYWAY			10460
R 030.887	SB OFF TO SKYWAY	23960		13390
R 031.298	NB OFF TO 20TH ST	2730		3550
R 031.319	SB ON FROM 20TH ST	2750		2950
R 031.677	NB ON FROM 20TH ST	12540		12710

Gore to Gore Distance (ft)

A 530

Ramp Number	Ramp Type	Demand (veh/h)	% Heavy Vehicles	Number of Lanes	Accel/Decel Length	Free Flow Speed	Off-Ramp Analysis	Edit
1	Off Ra...	401	5	1	450	40	<input checked="" type="checkbox"/>	Edit
2	On Ra...	1436	5	1	820	45	<input type="checkbox"/>	Edit

(3,555\*0.1)\*1.14=401

## INPUTS:

- Assume 10% of the ADT for Ramps
- For Ramp Volumes extrapolate base year (2005) using factor based on NCHRP formula:

$$Fe=(GF+1)^n,$$

$$GF =0.022 \text{ or } 2.2\%$$

n= Number of Years

in this case is 2011-2005 = 6 Years

$$Fe=(0.022+1)^6$$

$$Fe= 1.14$$

# FREEPLAN: Completed Segment

41

95 FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Projects\Training\But-99-

Add New Row Insert New Row Delete Row

Facility-wide Values

AADT 32500 K Factor 0.094 D Factor 0.55 Peak Hour Factor 0.950

Local Adj. Factor 0.96 % Heavy Vehicles 6.0 Ramp Metering Facility Length (mi) 8.082

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Begin ...	Skyway	Basic Se...	Edit	1500		1732	2	0	65	70	Level
2	Skyway		Full Clove...	Edit	4000		1732	2	0	65	70	Level
3			Basic Se...	Edit	1500		2812	2	0	65	70	Level
▶ 4	E. 20th		Diamond	Edit	3530		2812	2	0	65	70	Level
5			Basic Se...	Edit	1657		3847	2	0	65	70	Level
6	SR-32		Diamond	Edit	3530		3847	2	0	65	70	Level
7			Basic Se...	Edit	2500		3899	2	0	65	70	Level
8	E. 1st ...	Ave	Diamond	Edit	3530		3899	2	0	65	70	Level
9			Basic Se...	Edit	2365		3059	2	0	65	70	Level
10	Cohas...		Partial Cl...	Edit	3530		3059	2	0	65	70	Level
11			Basic Se...	Edit	1850		1999	2	0	65	70	Level
12	East A...		Diamond	Edit	3530		1999	2	0	65	70	Level
13			Basic Se...	Edit	3300		1353	2	0	65	70	Level
14	W. Eat...		Diamond	Edit	3530		1353	2	0	65	70	Level
15			Basic Se...	Edit	2820		887	2	0	65	70	Level

<<-- | Project Properties Segment Data LOS Results Service Volumes | -->>

- Continue Downstream
- Measure and Indicate Type of I/C
- Last segment is recommended to be a Basic Segment
- Click LOS Results to get the outputs

# Results

42

FREEPLAN 2009: Other Urbanized Area - [LOS Results]

File View Help

C:\Projects\Training\But-99-Revision B

	Segment	Segment Type	Dir. Hourly Volume	Adj. Dir. Capacity	Average Speed	Density	Segment LOS	Hot Spots
1	Begin Proje...	Basic	1732	4250	70.0	14.0	B	View
2	Skyway-	FullClover	1732	4249	61.6	18.4	C	View
3	-	Basic	2812	4258	68.3	23.2	C	View
4	E. 20th-	Diamond	2812	3903	58.1	28.8	D	View
5	-	Basic	3847	4261	59.2	36.6	E	View
6	SR-32-	Diamond	3847	3906	58.2	33.7	D	View
7	-	Basic	3899	4262	58.5	37.5	E	View
8	E. 1st. Ave-...	Diamond	3899	3906	62.8	28.3	D	View
9	-	Basic	3059	4259	66.8	25.8	C	View
10	Cohasset-	ParClo	3059	3904	60.2	22.1	C	View
11	-	Basic	1999	4253	69.5	16.2	B	View
12	East Ave.-	Diamond	1999	3898	61.8	14.3	B	View
13	-	Basic	1353	4244	69.9	11.0	A	View
14	W. Eaton-	Diamond	1353	3891	61.4	9.6	A	View
15	-	Basic	887	4231	69.8	7.2	A	View

Length (mi) 8.082 Free Flow Delay (sec/veh) 47.7 LOS Threshold Delay (sec/veh) 0.0 Avg. Speed (mi/h) 62.8 Density (pc/mi/ln) 21.4 LOS C

Outputs:

- LOS: C
- Average Speed: 62.8

# Urban: LOS BY

43

- Optional
- Level of Service (BY)

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		

Length (mi) 8.082 Free Flow Delay (sec/veh) 47.7 LOS Threshold Delay (sec/veh) 0.0 Avg. Speed (mi/h) 62.8 Density (pc/mi/ln) 21.4 LOS C

# Urban: LOS HY

44

- Level of Service (HY)
- Optional

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		

# Urban LOS HY

FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Projects\T

Add New Row Insert New Row Delete Row

Facility-wide Values

AAADT: 50700 K Factor: 0.094 D Factor: 0.55 Peak Hour Factor: [ ]

Local Adj. Factor: 0.96 % Heavy Vehicles: 6.0 Ramp Metering: [ ] Facility Length (m): [ ]

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Begin ...	Skyway	Basic Se...	Edit	1500		2700	2	0	65	70	Level
2	Skyway		Full Clove...	Edit	4000		2700	2	0	65	70	Level
3			Basic Se...	Edit	1500		4384	2	0	65	70	Level
4	E. 20th		Diamond	Edit	3530		4384	2	0	65	70	Level
5			Basic Se...	Edit	1657		5958	2	0	65	70	Level
6	SR-32		Diamond	Edit	3530		5958	2	0	65	70	Level
7			Basic Se...	Edit	2500		6039	2	0	65	70	Level
8	E. 1st ...	Ave	Diamond	Edit	3530		6039	2	0	65	70	Level
9			Basic Se...	Edit	2365		4729	2	0	65	70	Level
10	Cohas...		Partial Cl...	Edit	3530		4729	2	0	65	70	Level
11			Basic Se...	Edit	1850		3075	2	0	65	70	Level
12	East A...		Diamond	Edit	3530		3075	2	0	65	70	Level
13			Basic Se...	Edit	3300		2067	2	0	65	70	Level
14	W. Eat...		Diamond	Edit	3530		2067	2	0	65	70	Level
15			Basic Se...	Edit	2820		1340	2	0	65	70	Level

<<-- Project Properties Segment Data LOS Results Service Volumes >>

- When future Peak Hour Volumes are entered in FREEPLAN, future LOS is displayed in the LOS results screen
- Capture fiscally constrained projects in the STIP by setting the facility characteristics (Number Thru Lanes, Number AUX lanes, etc.) in the HY FREEPLAN Segment Data sheet
- Hourly Vol (HY) = Hourly Vol BY x 20 Yr GF
- 20 Yr GF =  $AAADT (HY) / AAADT (BY) = 114,300 / 73,000 = 1.56$
- Hourly Vol HY =  $1,732 \times 1.56 = 2,700$
- Apply the same GF to BY OFF and ON Ramps volumes previously estimated
- Click LOS Results to get LOS HY

# Urban LOS HY

46

Segment	Segment Type	Dir. Hourly Volume	Adj. Dir. Capacity	Average Speed	Density	Segment LOS	Hot Spots
1 Begin Proje...	Basic	2700	4250	68.8	22.2	C	View
2 Skyway-	FullClover	2700	4249	N/A	N/A	F	View
3 -	Basic	4384	4258	N/A	N/A	F	View
4 E. 20th-	Diamond	4384	3903	N/A	N/A	F	View
5 -	Basic	5958	4261	N/A	N/A	F	View
6 SR-32-	Diamond	5958	3906	N/A	N/A	F	View
7 -	Basic	6039	4262	N/A	N/A	F	View
8 E. 1st. Ave-...	Diamond	6039	3906	N/A	N/A	F	View
9 -	Basic	4729	4259	N/A	N/A	F	View
10 Cohasset-	ParClo	4729	3904	N/A	N/A	F	View
11 -	Basic	3075	4253	66.7	26.0	D	View
12 East Ave.-	Diamond	3075	3898	60.8	22.0	C	View
13 -	Basic	2067	4244	69.8	16.7	B	View
14 W. Eaton-	Diamond	2067	3890	60.8	14.7	B	View
15 -	Basic	1340	4229	69.8	10.9	A	View

Length (mi) 8.082 Free Flow Delay (sec/veh) N/A LOS Threshold Delay (sec/veh) N/A Avg. Speed (mi/h) N/A Density (pc/mi/ln) N/A LOS F

- Starting at the initial segment the Freeway immediately goes over capacity, resulting in LOS F for the entire facility
- Note that none of the other outputs can be calculated

# Urban: LOS HY

47

- Level of Service (HY)
- Optional

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		F
LOS Concept		
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		

# Urban: LOS CONCEPT

48

- Optional
- Based on District policy

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		F
LOS Concept		E
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		

# Urban: VMT BY

49

- Required
- Vehicle Miles Traveled
- Resource: Traffic Volumes Book
- $VMT = AADT \times Length$

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		F
LOS Concept		E
VMT (BY)		
VMT (HY)		
Daily Vehicle Hours of Delay (35 MPH)(BY)		
Daily Vehicle Hours of Delay (35 MPH)(HY)		

# Urban: VMT BY (Daily, Bi-Directional)

Dist	Rout	CO	Postmil	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour	Ahead Peak Month	Ahead AADT
3	99	BUT	26.04	NEAL HIGHWAY	2600	28500	26000	2350	26000	24000
3	99	BUT	R 30.603	CHICO, SKYWAY OC	3150	33500	32500	4500	53000	49500
3	99	BUT	R 31.498	EAST 20TH ST	4500	53000	49500	6200	72000	70000
3	99	BUT	R 32.445	CHICO, JCT. RTE. 32 E	6200	72000	70000	7200	75000	73000
3	99	BUT	R 33.282	CHICO, EAST FIRST AVE	7200	75000	73000	5800	61000	59000
3	99	BUT	R 34.245	CHICO, COHASSET HIGHWAY	5800	61000	59000	3700	45000	41500
3	99	BUT	R 34.927	EAST AVE	3750	45000	41500	2600	31000	28000
3	99	BUT	R 36.305	EATON AVE	2600	31000	28000	1800	19400	18800
3	99	BUT	38.79	WILSON LANDING RD	1800	19400	18800	1400	15000	14700

PM	Distance	Back AADT	Daily VMT
29.364	(Begin Segment)		
30.603	1.239	32,500	40,268
31.498	0.895	49,500	44,303
32.445	0.947	70,000	66,290
33.282	0.837	73,000	61,101
34.245	0.963	59,000	56,817
34.927	0.682	41,500	28,303
36.305	1.378	28,000	38,584
37.451	1.146	18,800	21,545
TOTAL VMT			357,210

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		F
LOS Concept		E
VMT (BY)		357,210
VMT (HY)		

# Urban: VMT HY(Daily, Bi-Directional)

51

- Present AADT acquired from the Traffic Volumes
- AADT 20 Years Horizon produced by MPO model forecast: 114,330
- To obtain your 20 Year Growth Factor Divide Future Year AADT Over Present Year AADT and apply resulting factor to your present year VMT

$$\text{VMT HY} = \text{VMT (BY)} \times \text{20 YR GF}$$

$$\text{20 YR GF} = \text{AADT (HY)} / \text{AADT (BY)} = 1.56$$

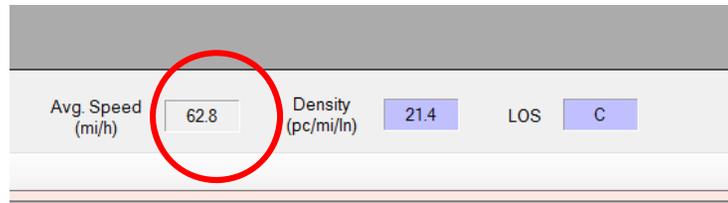
$$\text{VMT (HY)} = 357,210 \times 1.56 = 557,000$$

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		C
LOS (HY)		F
LOS Concept		E
VMT (BY)		357,210
VMT (HY)		557,000
Daily Vehicle Hours of Delay (35 MPH)(BY)		

# Urban : Daily VHD (35 mph) BY

52

- Required
- Daily Vehicle Hours of Delay using a threshold of 35 mph



- Based on FREEPLAN, average Speed throughout the segment is 62.8 MPH therefore there is no delay under 35 MPH

Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		D
LOS (HY)		F
LOS Concept		E
VMT (BY)		357,210
VMT (HY)		557,000
Daily Vehicle Hours of Delay (<35 MPH)(BY)		0

# Urban: DVHD (35 mph) HY

53

- Optional
- Daily Vehicle Hours of Delay using a threshold of 35 mph
- Suggested for Freeways and Expressways in Urban areas.
- Cannot calculate using this method because the segment reaches LOS F in the HY

Segment #		1
Basic System Operations		
AADT (BY)		73,000
AADT (HY)		114,330
AADT: Growth Rate/Year		2.2%
LOS Method		HCM 2010
LOS (BY)		D
LOS (HY)		F
LOS Concept		E
VMT (BY)		357,210
VMT (HY)		557,000
Daily Vehicle Hours of Delay (35 MPH)(BY)		0
Daily Vehicle Hours of Delay (35 MPH)(HY)		*

# Urban: Peak Hour

54

- **Peak Period Length:** The length of time during which the peak traffic occurs. Must use a minimum length of 1 hour. Only required if Peak Period is being reported instead of Peak Hour.
- **Peak Hour Direction:** Indicate direction of peak traffic. Indicate Northbound (NB), Southbound (SB), Eastbound (EB), Westbound (WB), or both. Only required if repeating the datasets by direction.
- **Peak Hour Time of Day:** Indicate am, pm, am and pm, or the actual time. Only required if Peak Hour/Period data will be provided.

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		
Peak Hour Directional Split (HY)		
Peak Hour VMT (BY)		
Peak Hour VMT (HY)		
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

# Urban : Peak Hour Directional Split BY and HY

- Optional
- Suggested to include if not repeating peak hour measures for each direction.
- Assume Peak Hour Directional Split Remains Unchanged for HY

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45

OTM32420  
06/29/2012  
08:07:16

CALTRANS TRAFFIC VOLUMES  
LATEST TRAFFIC YEAR SELECTED  
PEAK HOUR VOLUME DATA

PAGE # 25

DI	RTE	CO	PRE	PM	CS	LEG	YR	Dir	1 WAY PHV	AM PEAK			HR	DAY	MNTH	Dir	1 WAY PHV	PM PEAK		KD	HR	DAY	MNTH
										% K	% D	% KD						% K	% D				
03	099	BUT	R	30.60	585	B	11	S	1985	9.65	63.22	6.1	7	MON	SEP	N	1808	10.03	55.38	5.55	16	THU	SEP

# Urban : Peak Hour VMT BY

56

- This measure is encouraged but if data is completely unavailable it is not required
- Resource: FREEPLAN Segment Length and Hourly Volume

FREEPLAN 2009: Other Urbanized Area - [Segment Data]

File View Help

C:\Projects\Training\But-99-

Add New Row Insert New Row Delete Row

Facility-wide Values

AADT 32500 K Factor 0.094 D Factor 0.55 Peak Hour Factor 0.950

Local Adj. Factor 0.96 % Heavy Vehicles 6.0 Ramp Metering Facility Length (mi) 8.082

	From	To	Segment Type	Edit Int	Segment Length	InBetween Length	Hourly Volume	Number Thru Lanes	Number Aux Lanes	Posted Speed	Free Flow Speed	Terrain
1	Begin ...	Skyway	Basic Se...	Edit	1500		1732	2	0	65	70	Level
2	Skyway		Full Clove...	Edit	4000		1732	2	0	65	70	Level
3			Basic Se...	Edit	1500		2812	2	0	65	70	Level
4	E. 20th		Diamond	Edit	3530		2812	2	0	65	70	Level
5			Basic Se...	Edit	1657		3847	2	0	65	70	Level
6	SR-32		Diamond	Edit	3530		3847	2	0	65	70	Level
7			Basic Se...	Edit	2500		3899	2	0	65	70	Level
8	E. 1st ...	Ave	Diamond	Edit	3530		3899	2	0	65	70	Level
9			Basic Se...	Edit	2365		3059	2	0	65	70	Level
10	Cohas...		Partial Cl...	Edit	3530		3059	2	0	65	70	Level
11			Basic Se...	Edit	1850		1999	2	0	65	70	Level
12	East A...		Diamond	Edit	3530		1999	2	0	65	70	Level
13			Basic Se...	Edit	3300		1353	2	0	65	70	Level
14	W. Eat...		Diamond	Edit	3530		1353	2	0	65	70	Level
15			Basic Se...	Edit	2820		887	2	0	65	70	Level

<<- Project Properties Segment Data LOS Results Service Volumes ->>

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		
Peak Hour VMT (HY)		
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

# Peak Hr. VMT BY

57

- Peak Hour Volume is copied from Hourly Volume column in FREEPLAN
- Convert FREEPLAN Segment Length from feet to miles
- Peak Hour VMT = Segment Length x Peak Hour Volume
- Calculate SB Peak Hr. VMT using 55/45 split

Segment Length (ft)	Segment Length (mi)	Peak Hour Volume	Daily VMT
1500	0.28	1732	492
4000	0.76	1732	1312
1500	0.28	2812	799
3530	0.67	2812	1880
1657	0.31	3847	1207
3530	0.67	3847	2572
2500	0.47	3899	1846
3530	0.67	3899	2607
2365	0.45	3059	1370
3530	0.67	3059	2045
1850	0.35	1999	700
3530	0.67	1999	1336
3300	0.63	1363	852
3530	0.67	1363	911
2820	0.53	887	474
Peak Hr. VMT NB			20,404
Peak Hr. VMT SB (based on 55/45 split)			16,694
TOTAL Peak Hr. VMT			37,098

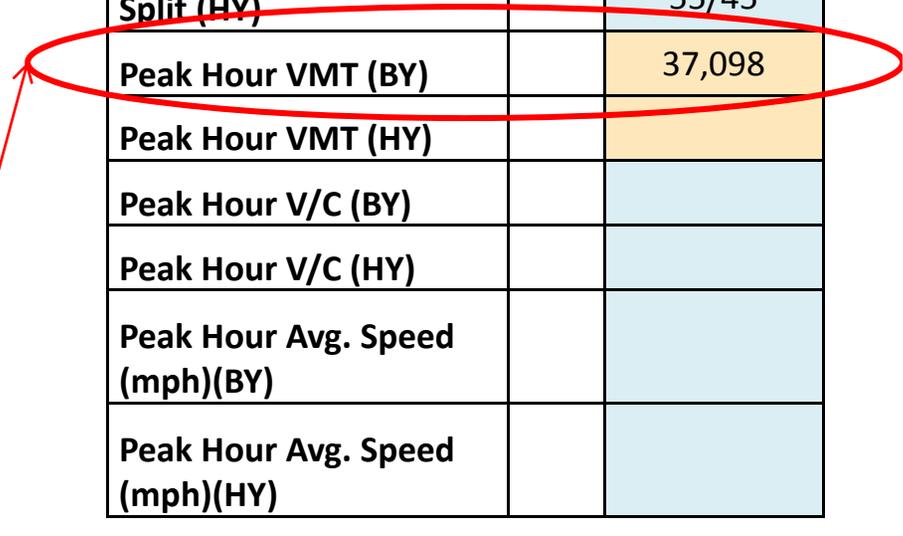
# Urban : Peak Hour VMT BY

58

- This measure is encouraged but if data is completely unavailable it is not required

Peak Hr. VMT NB	20,404
Peak Hr. VMT SB (based on 55/45 split)	16,694
<b>TOTAL Peak Hr. VMT</b>	<b>37,098</b>

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		37,098
Peak Hour VMT (HY)		
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		



# Peak Hr. VMT HY

- Peak Hour Volume is copied from the HY Hourly Volume column in FREEPLAN
- Convert FREEPLAN Segment Length from feet to miles
- Peak Hour VMT = Segment Length x Peak Hour Volume
- Calculate SB Peak Hr. VMT using 55/45 split

Segment Length (ft)	Segment Length (mi)	Peak Hour Volume	Peak Hr. VMT
1500	0.28	2700	767
4000	0.76	2700	2045
1500	0.28	4384	1245
3530	0.67	4384	2931
1657	0.31	5958	1870
3530	0.67	5958	3983
2500	0.47	6039	2859
3530	0.67	6039	4037
2365	0.45	4729	2118
3530	0.67	4729	3162
1850	0.35	3075	1077
3530	0.67	3075	2056
3300	0.63	2067	1292
3530	0.67	2067	1382
2820	0.53	1340	716
Peak Hr. VMT NB			31,541
Peak Hr. VMT SB (based on 55/45 split)			25,813
TOTAL Peak Hr. VMT			57,354

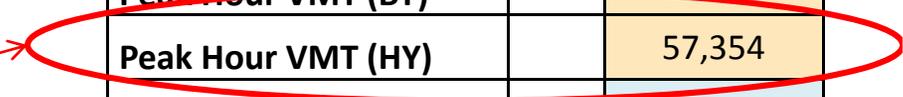
# Urban : Peak Hour VMT HY

60

- This measure is encouraged but if data is completely unavailable it is not required

Peak Hr. VMT NB	31,541
Peak Hr. VMT SB (based on 55/45 split)	25,813
TOTAL Peak Hr. VMT	57,354

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		37,098
Peak Hour VMT (HY)		57,354
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		



# Urban : Peak Hour V/C BY

61

- Optional
- If  $V/C > 1$  report D/C.
- D/C is the ratio of demand to capacity which measures the extent to which capacity is exceeded during the analysis period.
- Report the highest V/C in the segment
- Resource: FREEPLAN LOS results

	Segment	Segment Type	Dir. Hourly Volume	Adj. Dir. Capacity	Average Speed	Density	Segment LOS	Hot Spots
1	Begin Proje...	Basic	1732	4250	70.0	14.0	B	View
2	Skyway-	FullClover	1732	4249	61.6	18.4	C	View
3	-	Basic	2812	4258	68.3	23.2	C	View
4	E. 20th-	Diamond	2812	3903	58.1	28.8	D	View
5	-	Basic	3917	4261	59.2	36.6	E	View
6	SR-32-	Diamond	3847	3906	58.2	33.7	D	View
7	-	Basic	3638	4262	58.5	37.5	E	View
8	E. 1st. Ave-...	Diamond	3899	3906	62.8	28.3	D	View

$$V/C = 3,847 / 3,906 = 0.98$$

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		37,098
Peak Hour VMT (HY)		57,354
Peak Hour V/C (BY)		0.98
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

# Urban : Peak Hour V/C HY

62

- Optional
- Because V/C is  $> 1$ , report as D/C
- Resource: HY FREEPLAN LOS results

	Segment	Segment Type	Dir. Hourly Volume	Adj. Dir. Capacity	Average Speed	Density	Segment LOS	Hot Spots
1	Begin Proje...	Basic	2700	4250	68.8	22.2	C	View
2	Skyway-	FullClover	2700	4249	N/A	N/A	F	View
3	-	Basic	4384	4258	N/A	N/A	F	View
4	E. 20th-	Diamond	4384	3903	N/A	N/A	F	View
5	-	Basic	5958	4261	N/A	N/A	F	View
6	SR-32-	Diamond	5958	3906	N/A	N/A	F	View
7	-	Basic	6039	4262	N/A	N/A	F	View
8	E. 1st. Ave-...	Diamond	6039	3906	N/A	N/A	F	View

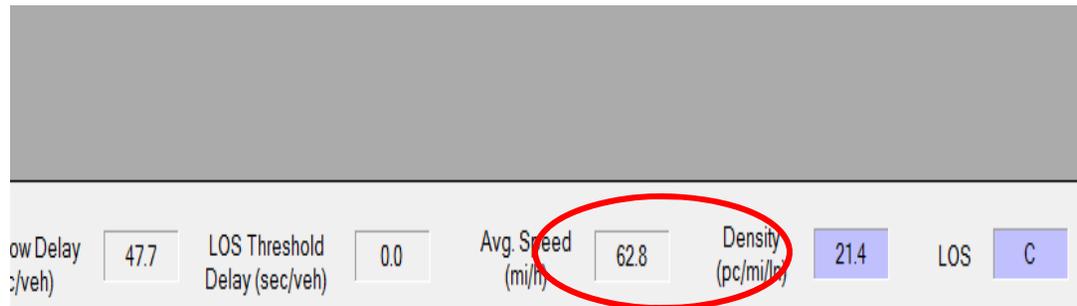
$$V/C = 5,958 / 3,906 = 1.52 = D/C (HY)$$

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		37,098
Peak Hour VMT (HY)		57,354
Peak Hour V/C (BY)		0.98
Peak Hour D/C (HY)		1.52
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

# Urban : Peak Hour Avg. Speed BY

63

- Required
- Avg. Speed in MPH is provided in the FREEPLAN results table



Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		37,098
Peak Hour VMT (HY)		57,354
Peak Hour V/C (BY)		0.98
Peak Hour V/C (HY)		1.52
Peak Hour Avg. Speed (mph)(BY)		62.8
Peak Hour Avg. Speed (mph)(HY)		N/A

# Urban : Peak Hour VHD (35 mph) BY and HY

64

- When delay occurs at 35 MPH or less the segment is congested, therefore this method is not applicable
- The method to find delay will be covered in module 6

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		16:00
Peak Hour Directional Split (BY)		55/45
Peak Hour Directional Split (HY)		55/45
Peak Hour VMT (BY)		37,098
Peak Hour VMT (HY)		57,354
Peak Hour V/C (BY)		0.98
Peak Hour V/C (HY)		1.52
Peak Hour Avg. Speed (mph)(BY)		62.8
Peak Hour Avg. Speed (mph)(HY)		N/A
Peak Hour Vehicle Hours of Delay (35 mph) (BY)		0
Peak Hour Vehicle Hours of Delay (35 mph) (HY)		N/A
Peak Hour VHD (35 mph) Method (HY)		N/A

# Rural Two-Lane Highway

# Rural Route: SR 99 Sutter Co.

66

- ❑ Segment: PM T34.97 to PM 39.045 (end of freeway near Lomo Crossing to Bishop Ave.)
- ❑ 2C, Class I facility
- ❑ North-south corridor that serves commuter traffic



*SR 99 south of Live Oak*

# Rural: Class I Two-Lane Hwy

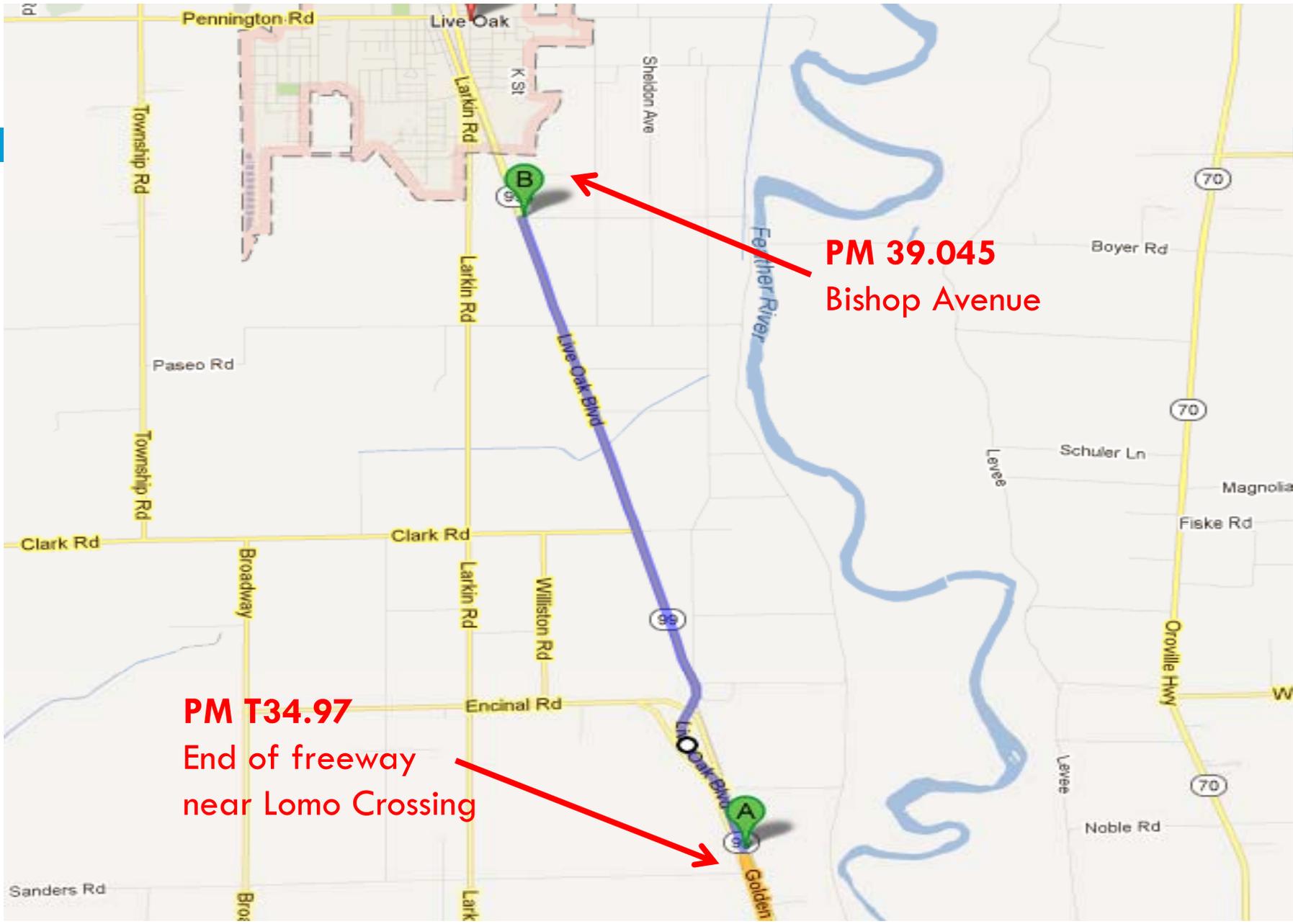
- Highways where motorists expect to travel at relatively high speeds. Two-lane highways that are major intercity routes, primary connectors of major traffic generators, daily commuter routes, or major links in state or national highway networks are generally assigned to Class I. These facilities serve mostly long-distance trips or provide the connections between facilities that serve long-distance trips.  
(HCM Ch.15)

# Rural: Class II Two-lane Hwy

- Highways where motorists do not necessarily expect to travel at high speeds. Two-lane highways functioning as access routes to Class I facilities, serving as scenic or recreational routes (and not as primary arterials), or passing through rugged terrain (where high-speed operation would be impossible) are assigned to Class II. Class II facilities most often serve relatively short trips, the beginning or ending portions of longer trips, or trips for which sightseeing plays a significant role. (HCM Ch.15)

# Rural: Class III Two-lane Hwy

- Highways serving moderately developed areas. They may be portions of a Class I or Class II highway that pass through small towns or developed recreational areas. On such segments, local traffic often mixes with through traffic, and the density of unsignalized roadside access points is noticeably higher than in a purely rural area. Class III highways may also be longer segments passing through more spread-out recreational areas, also with increased roadside densities. Such segments are often accompanied by reduced speed limits that reflect the higher activity level. (HCM Ch. 15)



**PM T34.97**  
End of freeway  
near Lomo Crossing

**PM 39.045**  
Bishop Avenue

# Rural Data Tools

71

- Google Measuring Tool
- Highway Capacity Software 2010
  - TwoLane module
- Traffic Volumes Book
- Truck Volumes Book
  
- Traffic and Truck Volumes Books can be found here:  
[http://www.dot.ca.gov/hq/traffops/saferesr/trafd  
ata/index.htm](http://www.dot.ca.gov/hq/traffops/saferesr/trafd<br/>ata/index.htm)

# Rural: AADT BY

72

- Average Annual Daily Traffic
- Required

Basic System Operations		
AADT (BY)		
AADT (HY)		
AADT: Growth Rate/Year		
LOS Method		
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		

# Rural: AADT BY

2011 Traffic Volumes Book

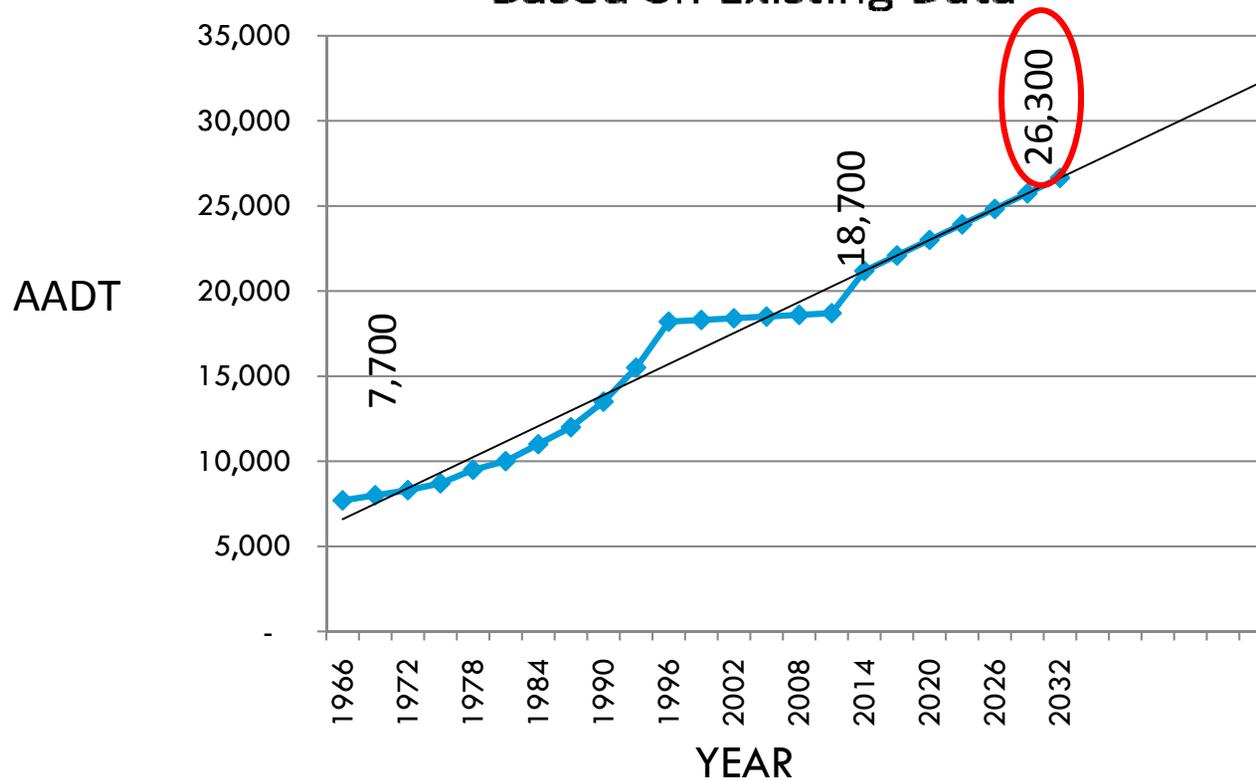
Dist	Route	CO	Postmile	Description	Back	Back	Ahead	Ahead	Ahead	
					Peak Hour	Peak Month	Back AADT	Peak Hour		Peak Month
3	99	SUT	35.96	ENCINAL/LIVE OAK	1650	21100	18700	1600	18600	18000
3	99	SUT	40.25	LIVE OAK, PENNINGTON	1600	18600	18000	1800	22000	18000
3	99	SUT	42.389	SUTTER/BUTTE CO LINE	1450	15300	14600			

- Present AADT acquired from the Traffic Volumes (Pick the Highest)

Basic System Operations		
AADT (BY)		18,700
AADT (HY)		
AADT: Growth Rate/Year		
LOS Method		
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		

# Rural: AADT (HY)

Establish Traffic Growth Trend  
Based on Existing Data



# Rural: AADT Growth Rate/Year

75

- Percent of growth of AADT per year

$$g = (x/y)^{1/Z} - 1$$

$g$  = average annual growth rate

$x$  = future (base) year volume

$y$  = earlier year volume

$Z$  = number of years

$$g = ((26,300/18,000)^{1/20}) - 1$$

$$g = 1.9\%$$

Source: NCHRP 255 Highway Traffic Data for Urbanized area Planning and Design

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		

# Rural: LOS Method, BY, HY, Concept

76

- Optional
- Use HCS 2010 TwoLane module to find LOS BY and HY

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		

# HCS 2010: TwoLane

77



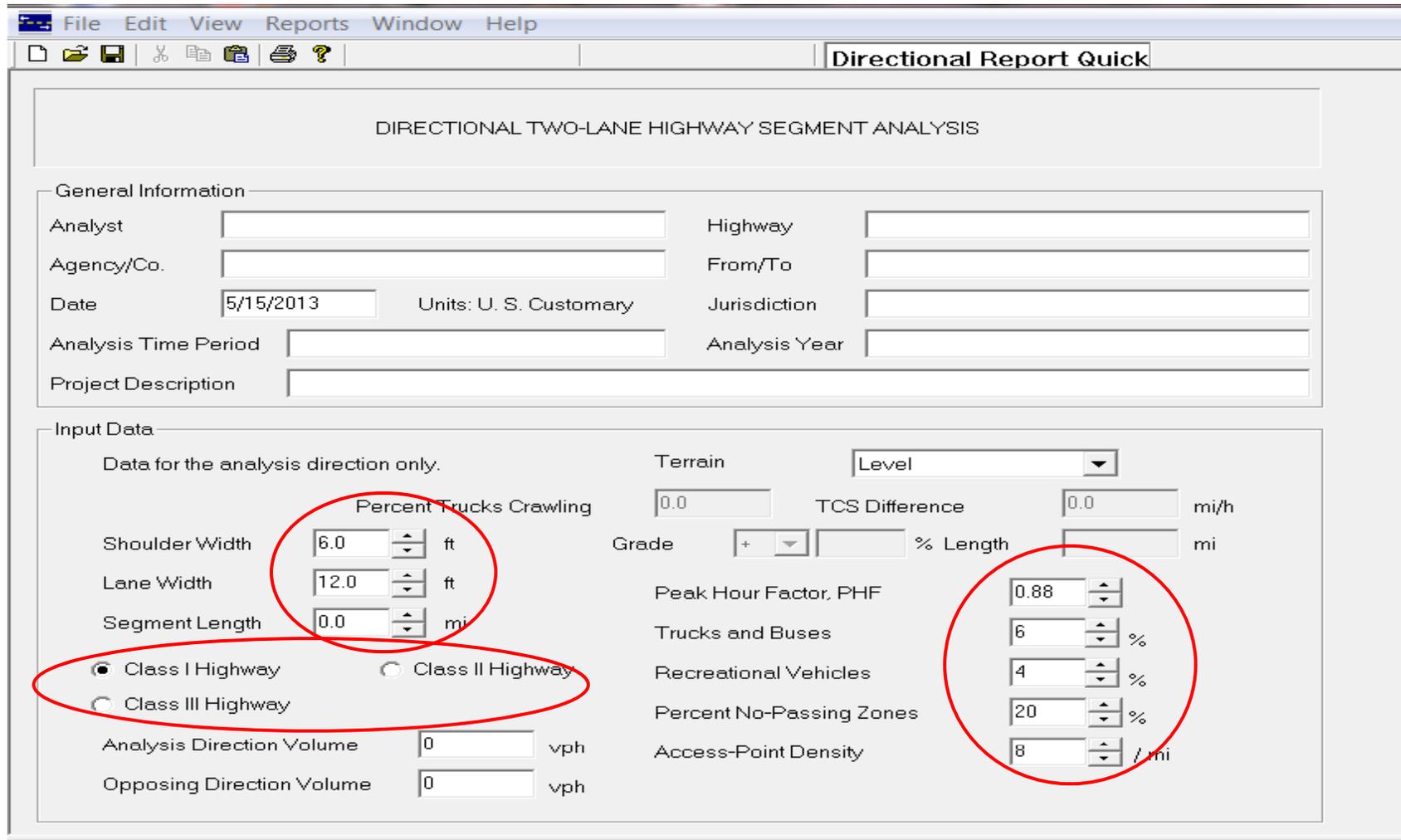
# HCS 2010

78



# TwoLane: Default Data

79



File Edit View Reports Window Help

Directional Report Quick

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT ANALYSIS

General Information

Analyst:  Highway:

Agency/Co.:  From/To:

Date: 5/15/2013 Units: U. S. Customary Jurisdiction:

Analysis Time Period:  Analysis Year:

Project Description:

Input Data

Data for the analysis direction only.

Terrain: Level

Percent Trucks Crawling: 0.0 TCS Difference: 0.0 mi/h

Shoulder Width: 6.0 ft

Lane Width: 12.0 ft

Segment Length: 0.0 mi

Class I Highway  Class II Highway

Class III Highway

Analysis Direction Volume: 0 vph

Opposing Direction Volume: 0 vph

Grade: + % Length:  mi

Peak Hour Factor, PHF: 0.88

Trucks and Buses: 6 %

Recreational Vehicles: 4 %

Percent No-Passing Zones: 20 %

Access-Point Density: 8 /mi

# TwoLane: General Information

The screenshot shows a software application window with a menu bar (File, Edit, View, Reports, Window, Help) and a toolbar with icons for file operations. The window title is "Directional Report Quick". The main content area is titled "DIRECTIONAL TWO-LANE HIGHWAY SEGMENT ANALYSIS". Below this is a "General Information" section with the following fields:

Analyst	Kelly Lier	Highway	SR-99	
Agency/Co.	Caltrans OFSP	From/To	PM T34.97 to PM 39.045	
Date	5/15/2013	Units: U. S. Customary	Jurisdiction	Dist-3
Analysis Time Period	PM Peak Hour	Analysis Year	2011	
Project Description	Perf. Measures for SR-99 TCR			

# TwoLane: Classification, Segment Length, Shoulder Width

File Edit View Reports Window Help

Directional Report Quick

Date: 5/15/2013 Units: U. S. Customary Jurisdiction: Dist-3

Analysis Time Period: PM Peak Hour Analysis Year: 2011

Project Description: Perf. Measures for SR-99 TCR

Input Data

Data for the analysis direction only.

Shoulder Width: 9.9 ft

Lane Width: 12.0 ft

Segment Length: 4.1 mi

Class I Highway  Class II Highway  Class III Highway

Analysis Direction Volume: 0 vph

Opposing Direction Volume: 0 vph

Terrain: Level

Percent Trucks Crawling: 0.0 TCS Difference: 0.0 mi/h

Grade: + % Length: mi

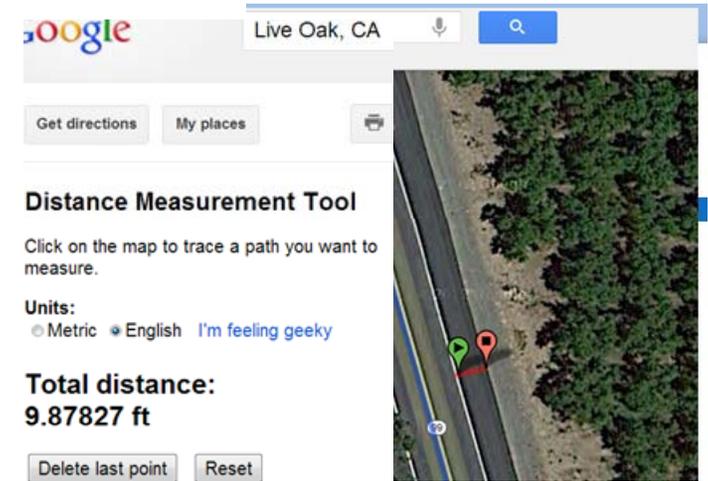
Peak Hour Factor, PHF: 0.88

Trucks and Buses: 6 %

Recreational Vehicles: 4 %

Percent No-Passing Zones: 20 %

Access-Point Density: 8 / mi



- Estimate Shoulder Width using Google Measurement Tool
- Segment Length: From PM T34.97 to PM 39.045 = 4.07 Miles

# TwoLane: Directional Volume

82

File Edit View Reports Window Help

Directional Report Quick

Date: 5/15/2013 Units: U. S. Customary Jurisdiction: Dist-3

Analysis Time Period: PM Peak Hour Analysis Year: 2011

Project Description: Perf. Measures for SR-99 TCR

Input Data

Data for the analysis direction only:

Terrain: Level

Percent Trucks Crawling: 0.0 TCS Difference: 0.0 mi/h

Shoulder Width: 9.9 ft Grade: + % Length: mi

Lane Width: 12.0 ft

Segment Length: 4.1 mi

Peak Hour Factor, PHF: 0.88

Trucks and Buses: 9 %

Recreational Vehicles: 4 %

Percent No-Passing Zones: 100 %

Access-Point Density: 8 / mi

Class I Highway  Class II Highway  Class III Highway

Analysis Direction Volume: 940 vph

Opposing Direction Volume: 684 vph

## INPUTS

- Peak Hourly Volumes Based on 58/42 Split
- Peak Hour Factor (Default)

OTM32420  
06/29/2012  
08:07:16

CALTRANS TRAFFIC VOLUMES  
LATEST TRAFFIC YEAR SELECTED  
PEAK HOUR VOLUME DATA

PAGE # 25

DI	RTE	CO	PRE	PM CS	LEG	YR	Dir	AM PEAK				PM PEAK										
								1 WAY PHV	% K	% D	% KD	1 WAY PHV	% K	% D	% KD							
03	099	SUT	T	35.96	563	B 11	S	638	5.73	59.63	3.42	7	TUE	MAR	N	940	8.7	57.85	5.03	16	THU	DEC

# TwoLane: Truck Volumes

83

File Edit View Reports Window Help

Directional Report Quick

Date: 5/15/2013 Units: U. S. Customary Jurisdiction: Dist-3

Analysis Time Period: PM Peak Hour Analysis Year: 2011

Project Description: Perf. Measures for SR-99 TCR

Input Data

Data for the analysis direction only.

Terrain: Level

Percent Trucks Crawling: 0.0 TCS Difference: 0.0 mi/h

Shoulder Width: 9.9 ft

Lane Width: 12.0 ft

Segment Length: 4.1 mi

Grade: + % Length: mi

Peak Hour Factor, PHF: 0.88

Trucks and Buses: 9 %

Recreational Vehicles: 4 %

Percent No-Passing Zones: 20 %

Access-Point Density: 8 / mi

Class I Highway  Class II Highway  Class III Highway

Analysis Direction Volume: 940 vph

Opposing Direction Volume: 684 vph

## INPUTS

- Truck and Buses From Truck Volumes Book
- TRUCK % TOT VEH

RTE	DIST	CNTY	POST MILE	L E G	DESCRIPTION	VEHICLE	TRUCK	TRUCK	TRUCK AADT TOTAL					% TRUCK AADT					EAL	YEAR
						AADT TOTAL	AADT TOTAL	% TOT VEH	By Axle					By Axle						
									2	3	4	5+	2	3	4	5+	(1000)	VER/EST		
099	03	SUT	T35.96	B	ENCINAL ROAD/LIVE OAK BOULEVARD	18700	1720	9.2	628	273	230	588	36.5	15.9	13.4	34.2	284	97E		
099	03	SUT	T35.96	A	ENCINAL ROAD/LIVE OAK BOULEVARD	18000	1656	9.2	604	263	224	565	36.5	15.9	13.5	34.1	273	97E		

# TwoLane: Percent No-Passing Zone & Access Point Density

84

- Find Percent No-Passing Zone and Access-Point Density using Photolog, Google Maps, or a field check

File Edit View Reports Window Help

Directional Report Quick

Date 5/15/2013 Units: U. S. Customary Jurisdiction Dist-3

Analysis Time Period PM Peak Hour Analysis Year 2011

Project Description Perf. Measures for SR-99 TCR

Input Data

Data for the analysis direction only.

Terrain Level

Percent Trucks Crawling 0.0 TCS Difference 0.0 mi/h

Shoulder Width 9.9 ft

Lane Width 12.0 ft

Segment Length 4.1 mi

Class I Highway  Class II Highway

Class III Highway

Analysis Direction Volume 940 vph

Opposing Direction Volume 684 vph

Grade + % Length mi

Peak Hour Factor, PHF 0.88

Trucks and Buses 9 %

Recreational Vehicles 4 %

Percent No-Passing Zones 100 %

Access-Point Density 8 / mi

# TwoLane: Terrain

85

- Find Terrain using TSN or historical data

The screenshot shows the 'Directional Report Quick' software interface. The menu bar includes File, Edit, View, Reports, Window, and Help. The toolbar contains icons for file operations and help. The main window is titled 'Directional Report Quick' and contains the following fields:

- Date: 5/15/2013
- Units: U. S. Customary
- Jurisdiction: Dist-3
- Analysis Time Period: PM Peak Hour
- Analysis Year: 2011
- Project Description: Perf. Measures for SR-99 TCR

The 'Input Data' section is divided into two columns of controls:

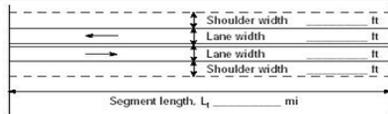
- Left Column:**
  - Data for the analysis direction only.
  - Shoulder Width: 9.9 ft
  - Lane Width: 12.0 ft
  - Segment Length: 4.1 mi
  - Class I Highway (selected), Class II Highway, Class III Highway
  - Analysis Direction Volume: 940 vph
  - Opposing Direction Volume: 684 vph
- Right Column:**
  - Terrain: Level (highlighted with a red circle)
  - Percent Trucks Crawling: 0.0
  - TCS Difference: 0.0 mi/h
  - Grade: +
  - % Length: (empty)
  - Peak Hour Factor, PHF: 0.88
  - Trucks and Buses: 9 %
  - Recreational Vehicles: 4 %
  - Percent No-Passing Zones: 100 %
  - Access-Point Density: 8 / mi

# TwoLane: Report

86

HCS 2010 TwoLane - [TwoLane1.k] File Edit View **Reports** Window Help

### DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	Kelly Lier	Highway / Direction of Travel	SR-99
Agency or Company	Caltrans OFSP	From/To	PM T34.97 to PM 39.045
Date Performed	5/15/2013	Jurisdiction	Dist-3
Analysis Time Period	PM Peak Hour	Analysis Year	2011
Project Description: Perf. Measures for SR-99 TCR			
Input Data			
		<input checked="" type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway <input type="checkbox"/> Class III highway <input checked="" type="checkbox"/> Terrain Level <input type="checkbox"/> Rolling Grade Length mi    Up/down Peak-hour factor, PHF    0.88 No-passing zone    100% % Trucks and Buses, P <sub>T</sub> 9% % Recreational vehicles, P <sub>R</sub> 4% Access points mi    8/mi	
Analysis direction vol., V <sub>d</sub>	940veh/h		
Opposing direction vol., V <sub>o</sub>	684veh/h		
Shoulder width ft	9.9		
Lane Width ft	12.0		
Segment Length mi	4.1		
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E <sub>T</sub> (Exhibit 15-11 or 15-12)		1.0	1.1
Passenger-car equivalents for RVs, E <sub>R</sub> (Exhibit 15-11 or 15-13)		1.0	1.0
Heavy-vehicle adjustment factor, f <sub>HV,ATS</sub> = 1 / (1 + P <sub>T</sub> (E <sub>T</sub> - 1) + P <sub>R</sub> (E <sub>R</sub> - 1))		1.000	0.991
Grade adjustment factor <sup>1</sup> , f <sub>g,ATS</sub> (Exhibit 15-9)		1.00	1.00
Demand flow rate <sup>2</sup> , v <sub>i</sub> (pc/h) v <sub>i</sub> = V <sub>i</sub> / (PHF * f <sub>g,ATS</sub> * f <sub>HV,ATS</sub> )		1068	784
		Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Mean speed of sample <sup>3</sup> , S <sub>FM</sub>			60.0 mi/h
Total demand flow rate, both directions, v			0.0 mi/h
Free-flow speed, FFS = S <sub>FM</sub> + 0.00776(v f <sub>HV,ATS</sub> )			2.0 mi/h
Adj. for no-passing zones, f <sub>np,ATS</sub> (Exhibit 15-15) 1.4 mi/h			58.0 mi/h
			42.2 mi/h
			72.7 %

# Rural: LOS BY

- Optional
- Use TwoLane results

<i>Level of Service and Other Performance Measures</i>	
Level of service, LOS (Exhibit 15-3)	<b>E</b>
Volume to capacity ratio, $v/c$	0.63
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	1685
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	1700
Percent Free-Flow Speed $PFFS_d$ (Equation 15-11 - Class III only)	72.7

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		E
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		



# Rural: LOS HY

88

- Optional
- Need to use projected Peak Hourly Volumes in TwoLane to find LOS (HY)
- $PHV(HY) = PHV(BY) \times 20$   
Yr GF
- 20 YR GF =  
 $AADT(HY) / AADT(BY)$   
= 1.46

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		E
LOS (HY)		
LOS Concept		
VMT (BY)		
VMT (HY)		

# TwoLane: LOS HY

89

File Edit View Reports Window Help

Directional Report Quick

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT ANALYSIS

General Information

Analyst	Kelly Lier	Highway	SR-99	
Agency/Co.	Caltrans OFSP	From/To	PM T34 97 to PM 39 045	
Date	5/15/2013	Units: U. S. Customary	Jurisdiction	Dist-3
Analysis Time Period	PM Peak Hour	Analysis Year	2011	
Project Description	Perf. Measures for SR-99 TCR			

Input Data

Data for the analysis direction only.

Terrain: Level

Percent Trucks Crawling: 0.0 TCS Difference: 0.0 mi/h

Shoulder Width: 9.9 ft

Lane Width: 12.0 ft

Segment Length: 4.1 mi

Grade: + % Length: mi

Class I Highway  Class II Highway  Class III Highway

Analysis Direction Volume: 1372 vph

Opposing Direction Volume: 998 vph

Peak Hour Factor, PHF: 0.88

Trucks and Buses: 9 %

Recreational Vehicles: 4 %

Percent No-Passing Zones: 100 %

Access-Point Density: 8 / mi

## INPUTS

- Peak Hourly Volumes Based on 58/42 Split Remain the same
- Peak Hour Factor (Default)
- Percent No-Passing Zones and other factors remain constant

$$\begin{aligned} \text{PHV (HY)} &= 940 \times 1.46 = 1372 \\ &= 684 \times 1.46 = 998 \end{aligned}$$

# Rural: LOS HY

- Optional
- From HY TwoLane Results

<i>Level of Service and Other Performance Measures</i>	
Level of service, LOS (Exhibit 15-3)	E
Volume to capacity ratio, $v/c$	0.93
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	1700
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	1700
Percent Free-Flow Speed $PFFS_d$ (Equation 15-11 - Class III only)	61.8

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		E
LOS (HY)		E
LOS Concept		
VMT (BY)		
VMT (HY)		



# Rural: LOS Concept

91

- Optional
- Based on District Policy

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		E
LOS (HY)		E
LOS Concept		D
VMT (BY)		
VMT (HY)		

# Rural: VMT BY(Daily, Bi-Directional)

Dist	Rout e	CO	Postmil e	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour	Ahead Peak Month	Ahead AADT
3	99	SUT	T 35.96	ENCINAL/LIVE OAK	1650	21100	18700	1600	18600	18000
3	99	SUT	40.25	LIVE OAK, PENNINGTON	1600	18600	18000	1800	22000	18000
3	99	SUT	42.389	SUTTER/BUTTE CO LINE	1450	15300	14600			

Resource: Traffic Volumes Book

Daily VMT=AADT x Length

PM	Distance	AADT	Daily VMT
	(Begin Segment)		
34.97			
39.045	4.075	18,000	73,350

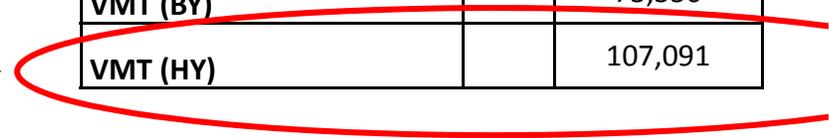
Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		E
LOS (HY)		E
LOS Concept		D
VMT (BY)		73,350
VMT (HY)		



# Rural: VMT HY(Daily, Bi-Directional)

- VMT Horizon Year is derived by Dividing Future AADT over Present AADT
- $26,300/18,000 = 1.46$
- This factor is applied to Present VMT
- $73,350 \times 1.46 = 107,091$

Basic System Operations		
AADT (BY)		18,000
AADT (HY)		26,300
AADT: Growth Rate/Year		1.9%
LOS Method		HCM 2010
LOS (BY)		E
LOS (HY)		E
LOS Concept		D
VMT (BY)		73,350
VMT (HY)		107,091



# Truck Volumes BY

- ❑ Required
- ❑ Total and 5+ Axle Average Annual Daily Truck Traffic
- ❑ Total and 5+ Axle Trucks (% of AADT)
- ❑ Resource: Truck Volumes Book

Truck Traffic		
Total Average Annual Daily Truck Traffic (AADTT) (BY)		1720
Total Average Annual Daily Truck Traffic (AADTT) (HY)		
Total Trucks (% of AADT) (BY)		9.2%
Total Trucks (% of AADT)(HY)		
5+ Axle Average Annual Daily Truck Traffic (AADTT)(BY)		588
5+ Axle Average Annual Daily Truck Traffic (AADTT)(HY)		
5+ Axle Trucks (as % of AADT)(BY)		3.1%
5+ Axle Trucks (as % of AADT)(HY)		

RTE	DIST	CNTY	MILE	L POST E G	DESCRIPTION	VEHICLE	TRUCK	TRUCK	TRUCK AADT TOTAL				% TRUCK AADT				EAL	YEAR
						AADT	AADT	& TOT	----- By Axle -----				----- By Axle -----					
TOTAL	TOTAL	VEH	2	3	4	5+	2	3	4	5+	(1000)	EST						
099	03	SUT	T35.96	B	ENCINAL ROAD/LIVE OAK BOULEVARD	18700	1720	9.2	628	273	230	588	36.5	15.9	13.4	34.2	84	97E
099	03	SUT	T35.96	A	ENCINAL ROAD/LIVE OAK BOULEVARD	18000	1656	9.2	604	263	224	565	36.5	15.9	13.5	34.1	273	97E

# Truck Volumes HY

- ❑ Optional
- ❑ Total and 5+ Axle Average Annual Daily Truck Traffic
- ❑ Total and 5+ Axle Trucks (% of AADT)
- ❑ Use AADT reported in the Truck Volumes Book
- ❑ 1.46 GF is Applied to Existing Truck Volumes Data
- ❑ Resource: Truck Volumes Book

Truck Traffic		
Total Average Annual Daily Truck Traffic (AADTT) (BY)		1720
Total Average Annual Daily Truck Traffic (AADTT) (HY)		2511
Total Trucks (% of AADT) (BY)		9.2%
Total Trucks (% of AADT)(HY)		9.2%
5+ Axle Average Annual Daily Truck Traffic (AADTT)(BY)		588
5+ Axle Average Annual Daily Truck Traffic (AADTT)(HY)		858
5+ Axle Trucks (as % of AADT)(BY)		3.1%
5+ Axle Trucks (as % of AADT)(HY)		3.1%

RTE	DIST	CNTY	MILE	L POST E G	DESCRIPTION	VEHICLE	TRUCK	TRUCK	TRUCK AADT TOTAL				% TRUCK AADT				EAL	YEAR
						AADT	AADT	& TOT	----- By Axle -----				----- By Axle -----					
						TOTAL	TOTAL	VEH	2	3	4	5+	2	3	4	5+	(1000)	EST
099	03	SUT	T35.96	B	ENCINAL ROAD/LIVE OAK BOULEVARD	18700	1720	9.2	628	273	230	588	36.5	15.9	13.4	34.2	84	97E
099	03	SUT	T35.96	A	ENCINAL ROAD/LIVE OAK BOULEVARD	18000	1656	9.2	604	263	224	565	36.5	15.9	13.5	34.1	273	97E

# Rural: Peak Hour

- **Peak Period Length:** The length of time during which the peak traffic occurs. Must use a minimum length of 1 hour. Only required if Peak Period is being reported instead of Peak Hour.
- **Peak Hour Direction:** Indicate direction of peak traffic. Indicate Northbound (NB), Southbound (SB), Eastbound (EB), Westbound (WB), or both. Only required if repeating the datasets by direction.
- **Peak Hour Time of Day:** Indicate am, pm, am and pm, or the actual time. Only required if Peak Hour/Period data will be provided.

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		
Peak Hour Directional Split (HY)		
Peak Hour VMT (BY)		
Peak Hour VMT (HY)		
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

# Rural: Peak Hour Directional Split BY and HY

- Optional
- Suggested to include if not repeating peak hour measures for each direction.
- Assume same split in HY

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (BY)		58/42

OTM32420  
06/29/2012  
08:07:16

CALTRANS TRAFFIC VOLUMES  
LATEST TRAFFIC YEAR SELECTED  
PEAK HOUR VOLUME DATA

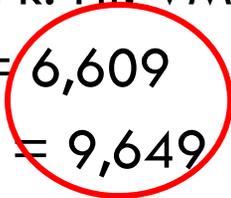
PAGE # 25

DI	RTE	CO	PRE	PM CS	LEG	YR	Dir	1 WAY PHV	AM PEAK			HR	DAY	MNT	Dir	PM PEAK			HR	DAY	MNT		
									% K	% D	% KD					% K	% D	% KD					
03	099	SUT	T	35.96	563	B	11	S	638	5.73	59.63	3.42	7	TUE	MAR	N	940	8.7	57.85	5.03	16	TUE	DEC

# Rural: Peak Hour VMT BY

- This measure is encouraged but if data is completely unavailable it is not required
- Analysis direction vol.,  $V_d$  940veh/h  
Opposing direction vol.,  $V_o$  684veh/h
- $(V_d + V_o) \times \text{Length} = \text{Pk. Hr. VMT}$
- $(940 + 684) \times 4.07 = 6,609$
- $\text{HY} = \text{BY} \times 1.46 \text{ GF} = 9,649$

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (HY)		58/42
Peak Hour VMT (BY)		6609
Peak Hour VMT (HY)		9649
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		



# Rural: Peak Hour V/C BY

99

- Optional
- If  $V/C > 1$  report D/C. D/C is the ratio of demand to capacity which measures the extent to which capacity is exceeded during the analysis period.
- Use BY TwoLane Report to find V/C

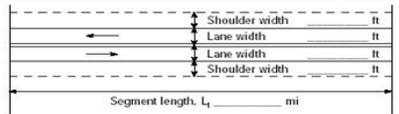
Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (HY)		58/42
Peak Hour VMT (BY)		6609
Peak Hour VMT (HY)		9649
Peak Hour V/C (BY)		
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

# HCM 2010 TwoLane Report

100

HCS 2010 TwoLane - [TwoLane1]  
 File Edit View Reports Window Help

**DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET**

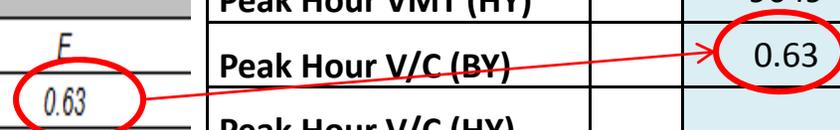
General Information		Site Information	
Analyst	Kelly Lier	Highway / Direction of Travel	SR-99
Agency or Company	Caltrans OFSP	From/To	PM T34.97 to PM 39.045
Date Performed	5/15/2013	Jurisdiction	Dist-3
Analysis Time Period	PM Peak Hour	Analysis Year	2011
Project Description: Perf. Measures for SR-99 TCR			
Input Data			
		<input checked="" type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway <input type="checkbox"/> Class III highway <input checked="" type="checkbox"/> Terrain Level <input type="checkbox"/> Rolling Grade Length mi    Up/down Peak-hour factor, PHF    0.88 No-passing zone    100% % Trucks and Buses, P <sub>T</sub> 9% % Recreational vehicles, P <sub>R</sub> 4% Access points mi    8/mi	
Analysis direction vol., V <sub>d</sub>	940veh/h		
Opposing direction vol., V <sub>o</sub>	684veh/h		
Shoulder width ft	9.9		
Lane Width ft	12.0		
Segment Length mi	4.1		
Average Travel Speed			
		Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E <sub>T</sub> (Exhibit 15-11 or 15-12)		1.0	1.1
Passenger-car equivalents for RVs, E <sub>R</sub> (Exhibit 15-11 or 15-13)		1.0	1.0
Heavy-vehicle adjustment factor, f <sub>HV,ATS</sub> = 1 / (1 + P <sub>T</sub> (E <sub>T</sub> -1) + P <sub>R</sub> (E <sub>R</sub> -1))		1.000	0.991
Grade adjustment factor <sup>1</sup> , f <sub>g,ATS</sub> (Exhibit 15-9)		1.00	1.00
Demand flow rate <sup>2</sup> , v <sub>i</sub> (pc/h) v <sub>i</sub> = V <sub>i</sub> / (PHF * f <sub>g,ATS</sub> * f <sub>HV,ATS</sub> )		1068	784
	<b>Free-Flow Speed from Field Measurement</b>	<b>Estimated Free-Flow Speed</b>	
Mean speed of sample <sup>3</sup> , S <sub>FM</sub>		Base free-flow speed <sup>4</sup> , BFFS    60.0 mi/h	
Total demand flow rate, both directions, v		Adj. for lane and shoulder width <sup>4</sup> , f <sub>LS</sub> (Exhibit 15-7)    0.0 mi/h	
Free-flow speed, FFS = S <sub>FM</sub> + 0.00776(v f <sub>HV,ATS</sub> )		Adj. for access points <sup>4</sup> , f <sub>A</sub> (Exhibit 15-8)    2.0 mi/h	
Adj. for no-passing zones, f <sub>np,ATS</sub> (Exhibit 15-15)    1.4 mi/h		Free-flow speed, FFS (FSS=BFFS-f <sub>LS</sub> -f <sub>A</sub> )    58.0 mi/h	
		Average travel speed, ATS <sub>d</sub> = FFS - 0.00776(v <sub>d,ATS</sub> + v <sub>o,ATS</sub> ) - f <sub>np,ATS</sub> 42.2 mi/h	
		Percent free flow speed, PFFS    72.7 %	

# Rural: Peak Hour V/C BY

- If  $V/C > 1$  report  $D/C$ .  
 $D/C$  is the ratio of demand to capacity which measures the extent to which capacity is exceeded during the analysis period.
- Optional

Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 15-3)	F
Volume to capacity ratio, $v/c$	0.63
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	1685
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	1700
Percent Free-Flow Speed $PFFS_d$ (Equation 15-11 - Class III only)	72.7

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (HY)		58/42
Peak Hour VMT (BY)		6609
Peak Hour VMT (HY)		9649
Peak Hour V/C (BY)		0.63
Peak Hour V/C (HY)		
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		

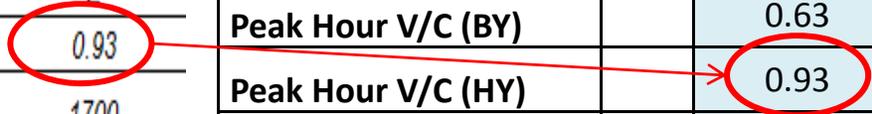


# Rural: Peak Hour V/C HY

- Optional
- Use HY TwoLane Report to find V/C

Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 15-3)	F
Volume to capacity ratio, v/c	0.93
Capacity, $C_{d,ATS}$ (Equation 15-12) pc/h	1700
Capacity, $C_{d,PTSF}$ (Equation 15-13) pc/h	1700
Percent Free-Flow Speed $PF_{FS,d}$ (Equation 15-11 - Class III only)	61.8

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (HY)		58/42
Peak Hour VMT (BY)		6609
Peak Hour VMT (HY)		9649
Peak Hour V/C (BY)		0.63
Peak Hour V/C (HY)		0.93
Peak Hour Avg. Speed (mph)(BY)		
Peak Hour Avg. Speed (mph)(HY)		



# Rural: Peak Hour Avg. Speed BY

103

- Optional
- Use BY TwoLane Report to find Peak Hour Average Speed BY

Base free-flow speed <sup>4</sup> , BFFS	60.0 mi/h
Adj. for lane and shoulder width, <sup>4</sup> $f_{LS}$ (Exhibit 15-	0.0 mi/h
Adj. for access points <sup>4</sup> , $f_A$ (Exhibit 15-8)	2.0 mi/h
Free-flow speed, FFS ( $FSS = BFFS \cdot f_{LS} \cdot f_A$ )	58.0 mi/h
Average travel speed, $ATS_d = FFS \cdot 0.00776(v_{d,ATS}$	42.2 mi/h
$v_{o,ATS}) \cdot f_{np,ATS}$	
Percent free flow speed, PFFS	72.7 %

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (HY)		58/42
Peak Hour VMT (BY)		6609
Peak Hour VMT (HY)		9649
Peak Hour V/C (BY)		0.63
Peak Hour V/C (HY)		0.93
Peak Hour Avg. Speed (mph)(BY)		42.2
Peak Hour Avg. Speed (mph)(HY)		

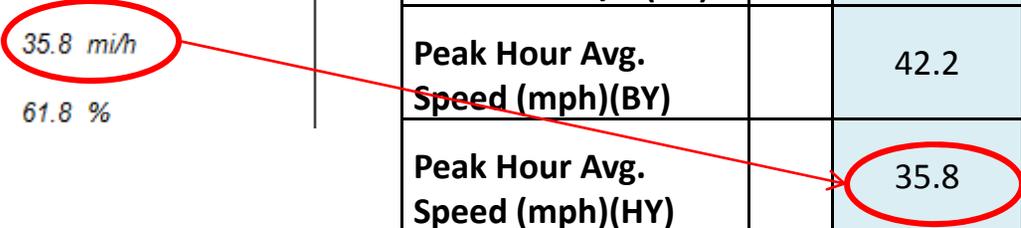
# Rural: Peak Hour Avg. Speed HY

104

- Optional
- Use HY TwoLane Report to find Peak Hour Average Speed HY

Base free-flow speed <sup>4</sup> , BFFS	60.0 mi/h
Adj. for lane and shoulder width, <sup>4</sup> $f_{LS}$ (Exhibit 15-7)	0.0 mi/h
Adj. for access points <sup>4</sup> , $f_A$ (Exhibit 15-8)	2.0 mi/h
Free-flow speed, FFS ( $FSS=BFFS-f_{LS}-f_A$ )	58.0 mi/h
Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}$	35.8 mi/h
$v_{o,ATS} - f_{np,ATS}$	
Percent free flow speed, PFFS	61.8 %

Peak Hour Traffic Data		
Peak Period Length		1
Peak Hour Direction		NB
Peak Hour Time of Day		PM
Peak Hour Directional Split (BY)		58/42
Peak Hour Directional Split (HY)		58/42
Peak Hour VMT (BY)		6609
Peak Hour VMT (HY)		9649
Peak Hour V/C (BY)		0.63
Peak Hour V/C (HY)		0.93
Peak Hour Avg. Speed (mph)(BY)		42.2
Peak Hour Avg. Speed (mph)(HY)		35.8



# Rural Class I: Peak Hour VHD (35 mph) BY and HY

105

- Peak Hour Vehicle Hours of Delay using a threshold of 35 mph
- Based on speed results previously posted, there is no delay under 35 MPH in BY or HY

Peak Hour Traffic Data		
Peak Hour V/C (BY)		0.63
Peak Hour V/C (HY)		0.93
Peak Hour Avg. Speed (mph)(BY)		42.2
Peak Hour Avg. Speed (mph)(HY)		35.8
Peak Hour Vehicle Hours of Delay (35 mph) (BY)		0
Peak Hour Vehicle Hours of Delay (35 mph) (HY)		0
Peak Hour VHD (35 MPH) Method		HCM 2010

# Formatting Tables

- To the extent possible format the tables as shown in the TCR template
- Once that format becomes too cumbersome use District discretion when formatting.
- If the tables are so large that they need to be moved to an appendix please reference the tables and their location in the corresponding narrative in the body of the TCR.
  - Feel free to include data tables in the appendix either within segment factsheets or as standalone tables

# Contact Us

107

- As you develop your TCRs feel free to direct questions to The Office of System & Freight Planning
- To find your current District Liaison please go to :  
<http://www.dot.ca.gov/hq/tpp/offices/oasp/>
  - ▣ Juven Alvarez: Districts 1, 2, and 9
  - ▣ Kelly Lier: Districts 5, 7, and 12
  - ▣ Paul Moore: Districts 6, 8, and 11
  - ▣ Robert J Peters: Districts 3, 4, and 10



# QUESTIONS?