



CAMBRIDGE  
SYSTEMATICS

Think  Forward

# Synchro Training – Day 2

*Caltrans On-Call Traffic Simulation Training*

*presented to*

*Caltrans District 9*



*presented by*

*Cambridge Systematics, Inc.*

*John Duesing and Richard Ge*

June 6<sup>th</sup>, 2018

# Agenda

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## ➤ Day 2/ Part 3: Hands-on Exercise: Main Street Corridor Synchro Model (9am –Noon)

- Data Preparation
- Model Coding
- Extract and Report Existing Conditions



# Agenda

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- **Day 2/Part 4: Advanced Synchro Applications (1pm – 4pm)**
  - Signal Timing optimization
  - Incorporating Future Year Forecasts
  - Geometric changes in lanes, turning bays, lane diets
  - Roundabouts;
- **June 7 – Advanced applications, Review and Questions (9am-noon)**
- Richard will be available for the last day to review any procedures, software questions, or demonstrate analyzing other alternatives.

# *Training Session Overview*

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- Traffic Analysis Basics
- Synchro Introduction
- Data Preparation
- Synchro Operations
- **Hands-On Exercise**
- Advanced Applications



# Hands-On Exercise – Volume Data

## ➤ Sample Data Calculation Sheet

- » Identifying Peak Hour
- » Heavy Vehicle %
- » Peak Hour Factor (PHF): busies 15-min period

Study Name	Mannheim & IL 19 AM																
Start Date	05/02/2018																
Start Time	7:00 AM																
	Southbound St. Southbound			Westbound St. Westbound			Northbound St. Northbound			Eastbound St. Eastbound			All Mvnts	Hourly Volume	Heavy Veh %	PHF	
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right					
7:00 AM	32	261	131	129	187	33	20	265	132	135	190	14	1529	6637			
7:15 AM	22	272	113	143	163	16	16	365	188	161	160	14	1633	6646	0.09	0.94	
7:30 AM	28	253	121	120	235	29	22	350	153	191	193	21	1716	6523			
7:45 AM	37	312	123	131	190	21	14	429	145	180	158	19	1759	6391			
8:00 AM	21	220	96	127	193	36	14	351	131	201	133	15	1538	6060			
8:15 AM	26	230	115	104	173	30	18	370	143	170	118	13	1510				
8:30 AM	23	230	90	138	165	18	13	383	150	211	147	16	1584				
8:45 AM	16	226	96	104	166	34	21	344	132	143	128	18	1428				
Max Hourly														6646			
AM Peak Hour	108	1057	453	521	781	102	66	1495	617	733	644	69					

# Hands-On Exercise – Volume Balancing

## Sample Volume Balancing Sheet

1 Rock Island				2 Turtle Run Blvd																																																																																																											
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# Hands-On Exercise – Signal Data

## ➤ Signal Information

- » Timing
- » Phasing
- » Coordination

Page 1 of 6

**LACO - 3H**  
**TYPE 170 PROGRAM**

LOS ANGELES COUNTY  
DEPARTMENT OF PUBLIC WORKS  
TRAFFIC AND LIGHTING DIVISION  
TRAFFIC SIGNAL TIMING

Intersection: VALLEY BL @ ATHENS ACCESS  
T.S. No.: 5355

Date Requested: 1-27-13 HCH By: DJA  
Date Completed: 2/11/13 By: AV

PHASE TIMING		Keystrokes: F + Phase + Interval							
Phase #		1	2	3	4	5	6	7	8
Minimum Walk	0	0	0	0	0	7			
Flashing Don't Walk	1	0	0	0	0	14			
Minimum Green	2	10	7	8	10				
Queue Maximum	3	0	0	0	0				
Added Green/Actuation	4	2.2	0.0	0.0	2.2				
Vehicle Extension	5	4.5	3.5	2.5	4.5				
Maximum Gap	6	5.5	3.5	2.5	5.5				
Minimum Gap	7	3.0	3.5	2.5	3.0				
Max Extension 1 (Free)	8	50	35	20	50				
Max Extension 2 (Coord)	9	130	35	20	130				
		OVLPA	OVLPB	OVLPC	OVLPD	OVLPE	OVLPE	OVLPE	OVLPE
Ovip Green Extension	A *		3.0	0.0					
Ovip Yellow Clearance	b *		5.0	3.0					
Ovip Red Clearance	C *		1.0	1.0					
Reduce 0.1 Sec. Every...	d	1.5	0.0	0.0	1.5				
Yellow Clearance	E	5.0	3.0	3.0	5.0				
Red Clearance	F	1.0	1.0	1.0	1.0				
Red Rest Delay	F-0-7	0							
Green Rest Delay	F-0-8	0							
Max Added Green	F-0-E	25							
Red Revert	F-0-F	2.0							

Remarks:  
\*OLA - HARDWIRED CONTINUOUS GREEN ARROW.  
OLC = #6  
OLE = #4 + #5

PREEMPTION		Keystrokes: F + E + Function							
		0	1	2	3				
RxR Select (0, 1, 2, 3)		0							
RxR Track Clearance		1							
RxR1 All Red		2							
RxR2 Maximum (Minutes)		3							
Free Time After Preempt		4							
EV - A Delay		5							
EV - A Clearance		6							
EV - B Delay		7							
EV - B Clearance		8							
EV - C Delay		9							
EV - C Clearance		A							
EV - D Delay		b							
EV - D Clearance		C							
EV Maximum (Seconds)		d							
EV Delay/Clearance Timer		E							
RxR Delay/Clear/Mark Timer		F							

EV AFTER RxR PREEMPTION		Keystrokes: F + d + Function							
EV Type Select	F-C-0	1	2	3	4	5	6	7	8
Select: EV - A Enter 16									
EV - B Enter 32									
EV - C Enter 64									
EV - D Enter 128									
EV After RxR Delay		7							
EV After RxR Clearance		8							
EV After RxR Maximum		9							

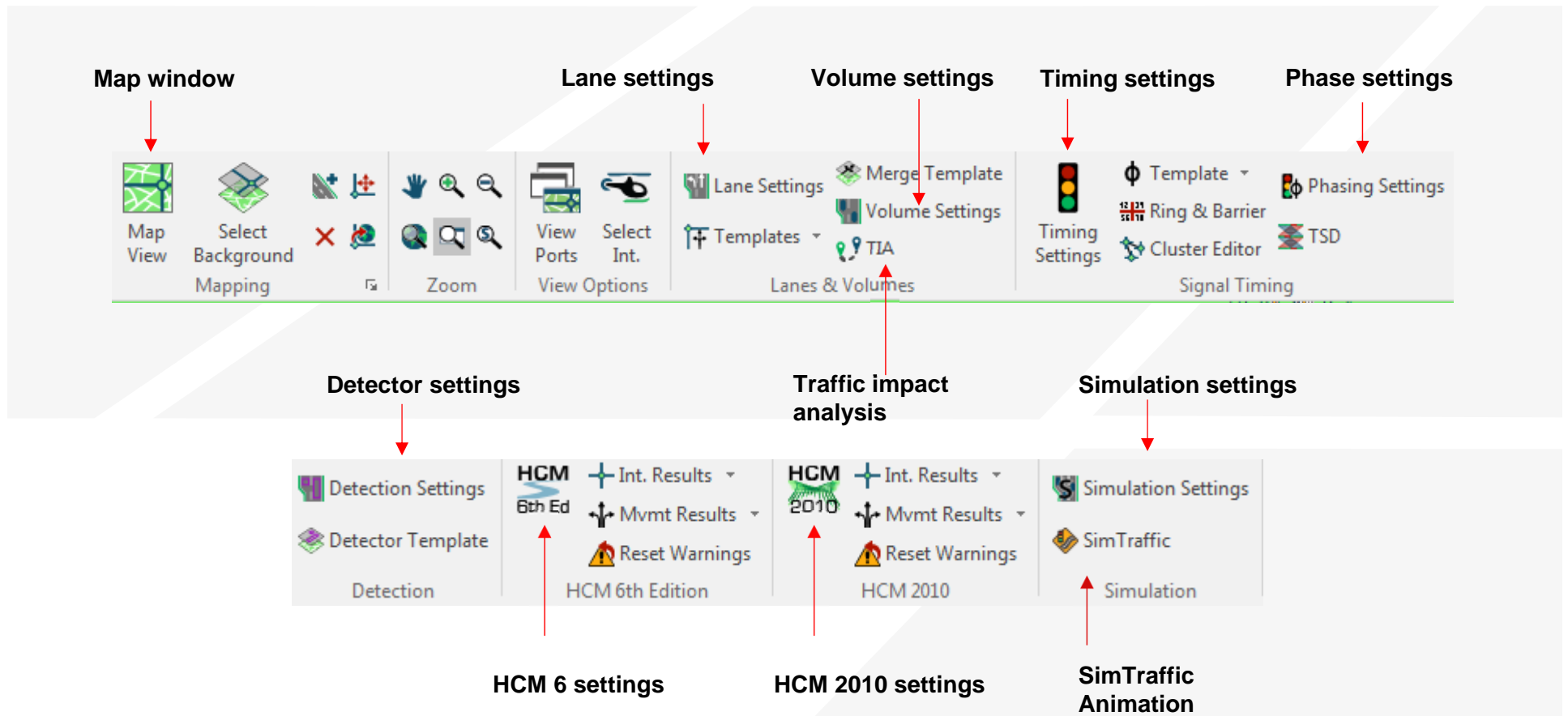
PREEMPTION PHASES		Keystrokes: F + d + Function							
		1	2	3	4	5	6	7	8
EV - A	0								
EV - B	1								
EV - C	2								
EV - D	3								
RR Track Clear	4								
RR2 Ltd Service	5								
RR1 Exit Phase	6								

PHASE FUNCTION FLAGS		Keystrokes: F + F + Function							
		1	2	3	4	5	6	7	8
Phases Permitted	0	X	X	X	X				
Red Lock	1		X						
Red & Yellow Lock	2	X							
Minimum Vehicle Recall	3	X			X				
Pedestrian Recall + Rest in Walk	4								
Green Rest (Set Delay F-0-8)	5								
Red Rest (Set Delay F-0-7)	6								
Semi Traffic Actuated Mode	7								
Double Entry	8								
Maximum Vehicle Recall	9								
Restricted Phases	A								
Protected/Permissive Left Turn	b								
Barrier Recall	C								
First Phases After Start Up	d								
Yellow Start Up	E	X					X		
Overlap Yellow Start Up:		A	b	c	d	e	f		
(Parents must be Yellow Start Up)	F	X	X	X	X	X	X	X	X

LAG PHASE FLAGS		Keystrokes: F + F + Function							
		1	2	3	4	5	6	7	8
Lag Free	d-F-0	X	X	X	X				
Lag Dial 1	d-F-1	X	X	X	X				
Lag Dial 2	d-F-2	X	X	X	X				
Lag Dial 3	d-F-3	X	X	X	X				

PEDESTRIAN PHASES		Keystrokes: F + F + Function							
		1	2	3	4	5	6	7	8
2 Ped Load Switch	d-F-4								
4 Ped Load Switch	d-F-5								
6 Ped Load Switch	d-F-6						X		
8 Ped Load Switch	d-F-7								

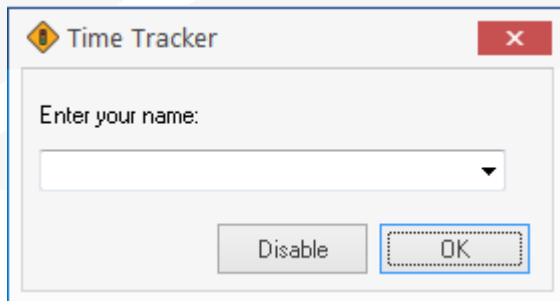
# Hands-On Exercise – Data Entry



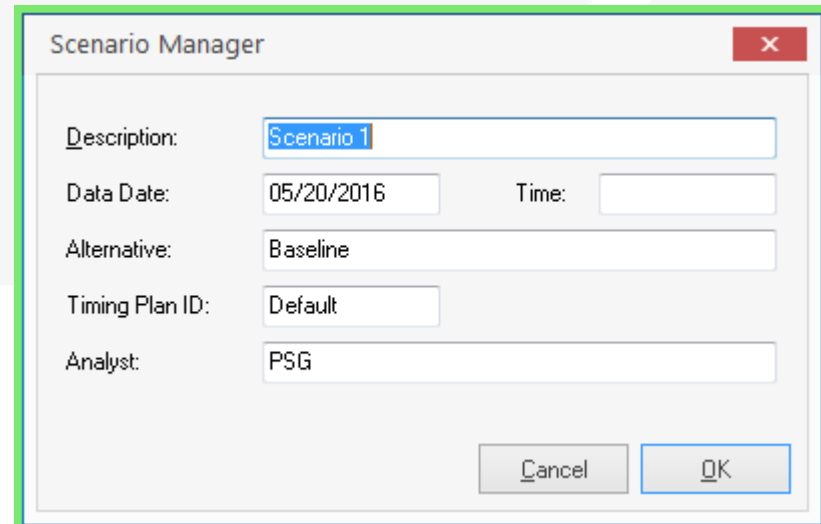


# Hands-On Exercise – Setup

- » Project Information
- » Time Tracking



The screenshot shows a dialog box titled "Time Tracker" with a red close button in the top right corner. Inside the dialog, there is a label "Enter your name:" followed by a text input field. Below the input field are two buttons: "Disable" and "OK".



The screenshot shows a dialog box titled "Scenario Manager" with a red close button in the top right corner. The dialog contains several input fields:

- Description: Scenario 1
- Data Date: 05/20/2016
- Time: (empty)
- Alternative: Baseline
- Timing Plan ID: Default
- Analyst: PSG

At the bottom right of the dialog are two buttons: "Cancel" and "OK".

# Hands-On Exercise

## Step 1. Background



Select Backgrounds

Background File List

Bing Region List

Region Name	Pt 1 Lat	Pt 1 Lon	Pt 2 Lat	Pt 2 Lon	Hide	Refresh	Remove
Region 1	37.3762	-118.3993	37.3607	-118.3908	<input type="checkbox"/>	Refresh	Remove

Create Bing Region

Bing Region Name: Region 1

Clear Cache

Remove All

Show All

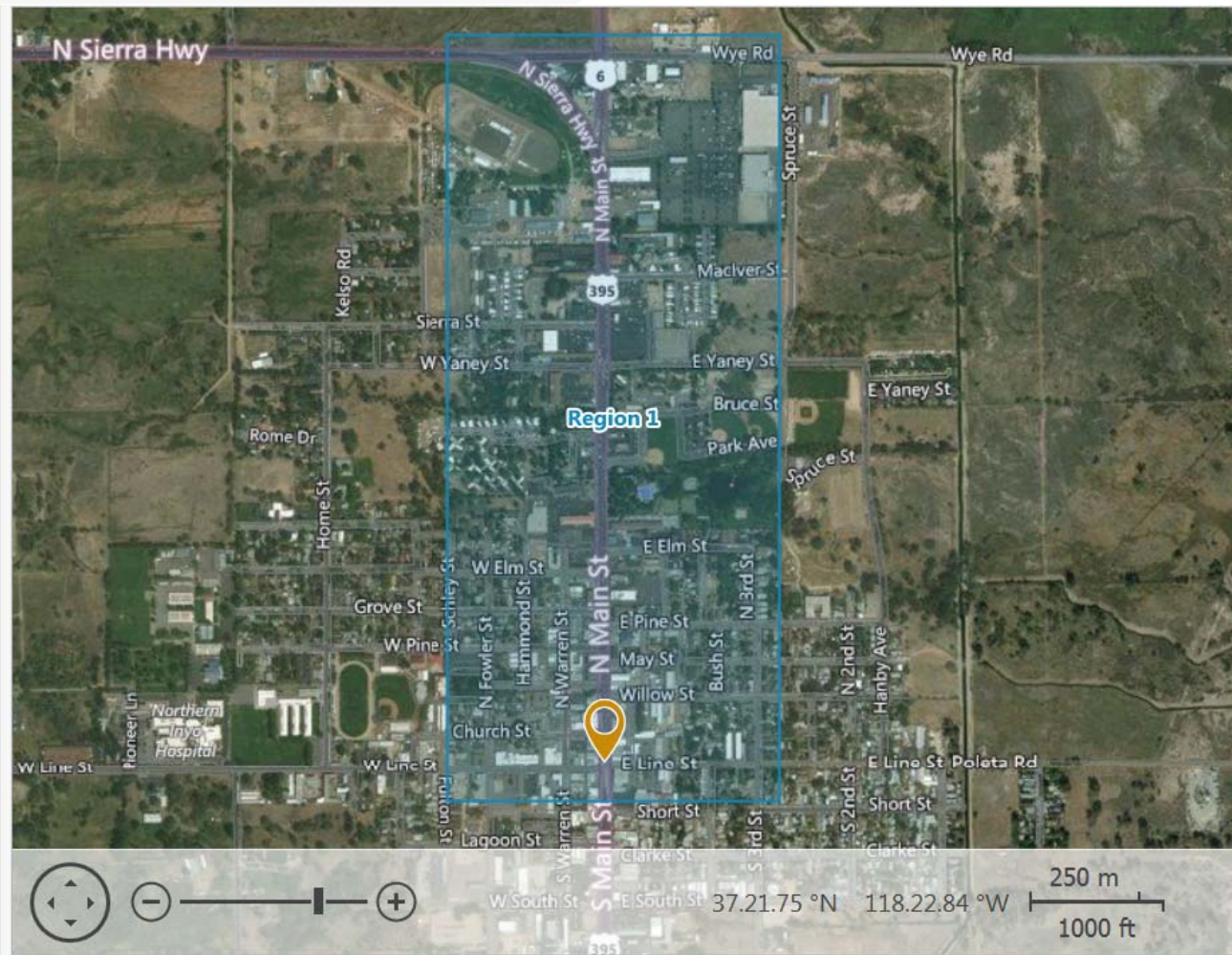
Hide All

Cancel

OK

# Hands-On Exercise

## Step 1. Background



# Hands-On Exercise

## Step 2. Build Links and Nodes



# Hands-On Exercise

## Step 3. Lane Setting

### » User Inputs

- Approach Name
- Lanes and Sharing
- Link Speed
- Storage Length
- Storage Lanes
- RTOR












LANE SETTINGS	EBL	EBT	EBR	WBL	WBT	WBR
Lanes and Sharing (#RL)	1	1	1	1	1	1
Traffic Volume (vph)	200	100	100	60	60	80
Future Volume (vph)	200	100	100	60	60	80
Street Name	Line St.			Line St.		
Link Distance (ft)	—	220	—	—	505	—
Link Speed (mph)	—	25	—	—	25	—
Set Arterial Name and Speed	—	EB	—	—	WB	—
Travel Time (s)	—	6.0	—	—	13.8	—
Ideal Satd. Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Grade (%)	—	0	—	—	0	—
Area Type CBD	—	<input checked="" type="checkbox"/>	—	—	<input checked="" type="checkbox"/>	—
Storage Length (ft)	145	—	80	0	—	65
Storage Lanes (#)	1	—	1	—	—	1
Right Turn Channelized	—	—	None	—	—	None
Curb Radius (ft)	—	—	—	—	—	—
Add Lanes (#)	—	—	—	—	—	—
Lane Utilization Factor	0.95	0.95	1.00	1.00	1.00	1.00
Right Turn Factor	1.000	1.000	0.850	—	1.000	0.850
Left Turn Factor (prot)	0.950	0.983	1.000	—	0.976	1.000
Saturated Flow Rate (prot)	1513	1566	1425	—	1391	1425
Left Turn Factor (perm)	0.950	0.983	1.000	—	0.976	1.000
Right Ped Bike Factor	1.000	1.000	1.000	—	1.000	1.000
Left Ped Factor	1.000	1.000	1.000	—	1.000	1.000
Saturated Flow Rate (perm)	1513	1566	1425	—	1391	1425
Right Turn on Red?	—	—	<input checked="" type="checkbox"/>	—	—	<input checked="" type="checkbox"/>
Saturated Flow Rate (RTOR)	0	0	100	—	0	80
Link Is Hidden	—	<input type="checkbox"/>	—	—	<input type="checkbox"/>	—
Hide Name in Node Title	—	<input type="checkbox"/>	—	—	<input type="checkbox"/>	—

# Hands-On Exercise

## Step 4. Volume Settings

### » User Inputs

- Traffic Volume
- Peak Hour Factor
- Heavy Vehicle %
- Adjacent Parking Lane
- Parking Maneuvers

VOLUME SETTINGS	 EBL	 EBT	 EBR	 WBL	 WBT	 WBR
Lanes and Sharing (#RL)						
Traffic Volume (vph)	200	100	100	60	60	80
Development Volume (vph)	0	0	0	0	0	0
Combined Volume (vph)	200	100	100	60	60	80
Future Volume (vph)	200	100	100	60	60	80
Conflicting Peds. (#/hr)	0	—	0	0	—	0
Conflicting Bicycles (#/hr)	—	—	0	—	—	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Growth Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adjusted Flow (vph)	200	100	100	60	60	80
Heavy Vehicles (%)	2	2	2	2	2	2
Bus Blockages (#/hr)	0	0	0	0	0	0
Adj. Parking Lane?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Parking Maneuvers (#/hr)	—	—	—	—	10	—
Traffic from mid-block (%)	—	5	—	—	100	—
Link OD Volumes	—	EB	—	—	—	—
Traffic in shared lane (%)	26	—	—	—	—	—
Lane Group Flow (vph)	148	152	100	0	120	80

# Hands-On Exercise

## Step 4. Volume Settings

### » Volume Transfer

- Import/Export
- Field data in Synchro format
- Still need to set up other parameters

The screenshot displays the 'UTDF Database Access' window with the 'Read Volume' tab selected. The interface includes a menu bar with 'Transfer', 'Optimize', 'Reports', and 'Help'. Below the menu are icons for 'Open Combined', 'Save Combined', 'Read/Write', 'Append', 'Merge File', and 'Save Part'. The main area shows 'Active File(s)' as 'VOLUME.CSV' with a 'File Style' dropdown set to 'Single File comma delim (Volume.CSV)'. A 'Read' button is highlighted. The 'Limit Records By' section contains dropdowns for 'Start Time From', 'Date From', 'Days Of Week', 'To', and 'To'. The 'Read Options' section has a 'Method for Averaging Volume Counts' dropdown set to 'Average All Times' and a checked 'Set PHF' checkbox. The 'Scope' section has radio buttons for 'Single Intersection', 'Zone', and 'Entire Network', with 'Entire Network' selected. A 'Close' button is at the bottom right.

# Hands-On Exercise

## Step 5. Intersection Control Settings

### » Node Inputs

- Node #
- Control Type
- Cycle Length
- Offset
- Reference to
- Reference Phase

NODE SETTINGS	
Node #	3
ATMS.now Controller ID	0
Import from ATMS.now:	Import
Export to ATMS.now:	Export
Zone:	0
X East (ft):	0
Y North (ft):	0
Z Elevation (ft):	0
Description	
Control Type	Actd-Coord
Cycle Length (s):	110.0
Lock Timings:	<input type="checkbox"/>
Optimize Cycle Length:	Optimize
Optimize Splits:	Optimize
Actuated Cycle(s):	110.0
Natural Cycle(s):	90.0
Max v/c Ratio:	0.63
Intersection Delay (s):	29.9
Intersection LOS:	C
ICU:	0.61
ICU LOS:	B
Offset (s) :	0.0
Referenced to:	Begin of Yellow
Reference Phase:	2+6 - NBT SBT
Coordination Mode:	Fixed
Master Intersection:	<input checked="" type="checkbox"/>
Yield Point:	Single
Mandatory Stop On Yellow:	<input type="checkbox"/>















# Hands-On Exercise

## Step 5. Intersection Control Settings

### » Timing Inputs

- Turn Type
- Protected/Permitted Phases
- Detector Phases
- Min Initial
- Yellow
- All-red
- Lost Time Adjust
- Lagging Phase
- Recall Mode







TIMING SETTINGS	 EBL	 EBT	 EBR	 WBL	 WBT	 WBR
Lanes and Sharing (#RL)	  	  				
Traffic Volume (vph)	200	100	100	60	60	80
Future Volume (vph)	200	100	100	60	60	80
Turn Type	Split	—	Perm	Split	—	Perm
Protected Phases	4	4		3	3	
Permitted Phases			4			3
Permitted Flashing Yellow	—	—	—	—	—	—
Detector Phases	4	4	None	3	3	None
Switch Phase	0	0	0	0	0	0
Leading Detector (ft)	110	110	25	—	110	25
Trailing Detector (ft)	0	0	0	—	0	0
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	6.0
Minimum Split (s)	25.7	25.7	25.7	21.7	21.7	21.7
Total Split (s)	26.0	26.0	26.0	22.0	22.0	22.0
Yellow Time (s)	3.2	3.2	3.2	3.2	3.2	3.2
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	-0.7	-0.7	-0.7	—	-0.7	-0.7
Lagging Phase?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allow Lead/Lag Optimize?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recall Mode	None	None	None	None	None	None
Speed limit (mph)	—	25	—	—	25	—

# Hands-On Exercise

## Step 5. Intersection Control Settings

### » Phasing Inputs

- Vehicle Extension
- Min Gap
- Time Before Reduce
- Time to Reduce
- Pedestrian Phase
- Walk Time
- Flash Don't Walk
- Pedestrian Calls
- Dual Entry













PHASING SETTINGS						
	1-SBL	2-NBT	3-WBTL	4-EBTL	5-NBL	6-SBT
Minimum Initial (s)	4.0	10.0	6.0	6.0	4.0	12.0
Minimum Split (s)	8.0	20.7	21.7	25.7	8.0	21.7
Maximum Split (s)	13.0	49.0	22.0	26.0	11.0	51.0
Yellow Time (s)	3.2	3.2	3.2	3.2	3.2	3.2
All-Red Time (s)	0.0	0.5	0.5	0.5	0.0	0.5
Lagging Phase?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Allow Lead/Lag Optimize?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Optimize Phs Weights - Delays	1.0	1.0	1.0	1.0	1.0	1.0
Vehicle Extension (s)	3.0	5.0	4.0	4.0	3.0	5.0
Minimum Gap (s)	2.0	2.5	2.5	2.5	2.0	3.0
Time Before Reduce (s)	0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	20.0	20.0	20.0	0.0	20.0
Recall Mode	None	C-Max	None	None	None	C-Max
Pedestrian Phase	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Walk Time (s)	—	7.0	7.0	7.0	—	7.0
Flash Dont Walk (s)	—	10.0	11.0	15.0	—	11.0
Pedestrian Calls (#/hr)	—	20	20	20	—	20
Dual Entry?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fixed Force Off?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
90th %ile Green Time (s)	10 mx	45 cd	18 mx	22 mx	8 mx	47 cd
70th %ile Green Time (s)	10 mx	45 cd	18 gp	22 pd	8 mx	47 cd
50th %ile Green Time (s)	9 gp	54 cd	16 gp	17 gp	10 gp	53 cd
30th %ile Green Time (s)	7 gp	61 cd	13 gp	14 gp	8 gp	60 cd
10th %ile Green Time (s)	0 sk	79 cd	10 gp	11 gp	0 sk	79 cd

# Hands-On Exercise

## Step . Simulation Settings

### » User Inputs

- Taper Length
- Two-Way Left Turn Lane (TWLTL)
  - Visual only

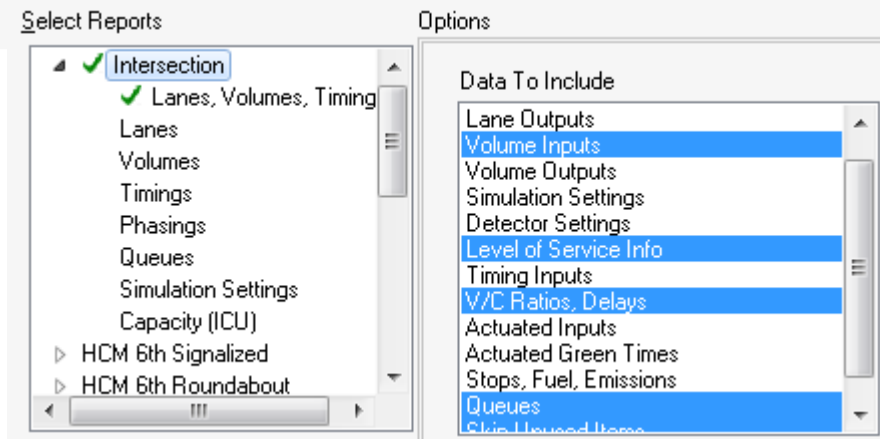
SIMULATION SETTINGS	  			  		
	EBL	EBT	EBR	WBL	WBT	WBR
Lanes and Sharing (#RL)						
Traffic Volume (vph)	200	100	100	60	60	80
Future Volume (vph)	200	100	100	60	60	80
Storage Length (ft)	145	—	80	0	—	65
Storage Lanes (#)	1	—	1	—	—	1
Taper Length (ft)	25	—	25	—	—	25
Lane Alignment	Left	Left	Right	Left	Left	Right
Lane Width (ft)	12	12	12	12	12	12
Enter Blocked Intersection	No	No	No	No	No	No
Median Width (ft)	—	12	—	—	12	—
Link Offset (ft)	—	0	—	—	0	—
Crosswalk Width (ft)	—	16	—	—	16	—
TWLTL Median	—	<input type="checkbox"/>	—	—	<input type="checkbox"/>	—
Headway Factor	1.14	1.14	1.14	1.14	1.40	1.14
Turning Speed (mph)	15	—	9	15	—	9
Mandatory Distance (ft)	—	458	—	—	458	—
Positioning Distance (ft)	—	1101	—	—	1101	—
Mandatory Distance 2 (ft)	—	734	—	—	734	—
Positioning Distance 2 (ft)	—	1468	—	—	1468	—

# Hands-On Exercise

## Step 6. Report

### » Measure of Effectiveness

- Volume-to-Capacity ratio (v/c)
- Delay
- LOS
- Queue Length
- ...



# Hands-On Exercise

## Step 6. Report

### » Customize Results

- Intersection level
- Scenario level

#### Huntington Area Transportation Study Preliminary Results

##### Future (2040) Base Conditions Synchro Intersection Delay and Level of Service

Synchro Node#	Intersection	Intersection Volume		Before Optimization			
		AM	PM	AM		PM	
				Int. Delay (sec/veh)	LOS	Int. Delay (sec/veh)	LOS
1	Route 1 & Fort Hunt Road	6150	6429	133.6	F*	177.4	F*
3	Route 1 & Shields Avenue	4692	6263	49.7	D*	259.6	F*
4	Route 1 at Walmart Entrance	4593	5092	71	E*	112.2	F*
5	Telegraph Road & Huntington Avenue	5219	6065	29.1	C	27.4	C
6	Telegraph Road & North Kings Highway	4785	5905	27.9	C	93.6	F*
7	North Kings Highway & School Street	2839	4242	30.1	C	160.9	F*
9	North Kings Highway/South Kings Highway & the Route 1 Connector	2171	2521	167.8	F*	123.7	F*
10	Route 1 & Beacon Hill Road	5234	6084	153.8	F*	162.1	F*
11	Route 1 & Sherwood Hall Lane	4894	5458	38.9	D*	66.4	E*
12	Telegraph Road & Franconia Road	3768	5025	40.3	D*	63.6	E*
13	Telegraph Road & South Kings Highway	3459	3533	57.8	E*	39.7	D*
14	Telegraph Road & South Van Dorn Street	3610	3862	82.9	F*	41.1	D*
15	Fort Hunt Road & Belle View Boulevard	2961	4045	117	F*	137.8	F*
16	Fort Hunt Road & Sherwood Hall Lane	2450	3052	92.5	F*	216.8	F*
17	Franconia Road & South Van Dorn Street	9857	11349	328	F*	315.6	F*
18	George Washington Memorial Parkway & Belle View Boulevard	3213	3372	30.3	C*	142.1	F*

\* These intersections have at least one movement operating at failing LOS F

#### 10. Route 1 & Beacon Hill Road 2013 Existing

Movement	Volume	Delay (seconds)	LOS	95th (ft)
NBL	74	114.2	F	m113
NBT	2070	9.7	A	372
NBR	669	7.1	A	174
SBL	79	104.2	F	#181
SBT	931	26.9	C	275
SBR	140	0.0	A	0
EBL	412	0.0	A	0
EBT	88	1030.2	F	#1333
EBR	345	454.4	F	#698
WBL	194	126.4	F	#423
WBT	118	165.3	F	#496
WBR	114	0.0	A	0
<b>Overall</b>		<b>153.8</b>	<b>F</b>	

#### 11. Route 1 & Sherwood Hall Lane 2013 Existing

Movement	Volume	Delay (seconds)	LOS	95th (ft)
NBL	63	94.1	F	m105
NBT	1942	17.8	B	401
NBR	786	16.0	B	250
SBL	164	147.2	F	#375
SBT	1251	24.0	C	337
SBR	11	15.1	B	m0
EBL	25	85.3	F	68
EBT	17	83.8	F	49
EBR	59	82.2	F	0
WBL	516	133.6	F	#584
WBT	16	136.6	F	#596
WBR	44	64.8	E	m7
<b>Overall</b>		<b>38.9</b>	<b>D</b>	

# Hands-On Exercise

## Step 6. Report

- » Customize Results
  - Comparing scenarios

ID	Intersection	2040 No Build AM									
		Existing AM		Un-mitigated		Mitigation C2		Mitigation C4 w/o GW Sig FAR 2.0		Mitigation C5 Hybrid Option FAR	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1	Route 1 & Fort Hunt Road	71.1	E (3)	134.6	F (5)	58.2	E (4)	60.0	E (4)	68.4	E (3)
2	Route 1 & Huntington Avenue	27.3	C (3)	56.2	E (3)	37.6	D (2)	36.2	D (2)	33.9	C (2)
3	Route 1 & Shields Avenue	16.3	B (5)	43.5	D (6)	26.3	C (3)	27.4	C (3)	26.7	C (3)
4	Route 1 & Walmart Entrance	35.5	D (2)	82.1	F (4)	36.2	D (2)	37.0	D (2)	36.9	D (2)
5	Telegraph Road & Huntington Avenue	15.1	B	29.0	C	28.5	C	29.8	C	29.0	C
6	Telegraph Road & North Kings Highway	28.0	C	37.4	D (1)	31.0	C	30.9	C	30.9	C
7	North Kings Highway & School Street	11.9	B	0.5	A	4.7	A	4.8	A	4.8	A
8	North Kings Highway (NB) & Shields Avenue	23.6	C	23.0	C	32.4	C	33.0	C	32.6	C
9	North Kings Highway/South Kings Highway & the Route 1 Connector	67.8	E (1)	125.1	F (2)	38.3	D	37.9	D	38.0	D
10	Route 1 & Beacon Hill Road	20.4	C (4)	42.3	D (5)	35.2	D (5)	37.6	D (5)	37.3	D (5)
11	Route 1 & Sherwood Hall Lane	31.1	C (7)	31.6	C (7)	32.1	C (5)	32.2	C (5)	32.2	C (5)
12	Telegraph Road & Franconia Road	31.8	C	45.5	D (1)	37.4	D	37.9	D	36.8	D
13	Telegraph Road & South Kings Highway	24.4	C	33.3	C	30.7	C	31.1	C	31.1	C
14	Telegraph Road & South Van Dorn Street	23.4	C (1)	35.5	D (1)	36.8	D (1)	36.8	D (1)	36.2	D (1)
15	Fort Hunt Road & Belle View Boulevard	34.2	C	71.5	E (2)	48.1	D	57.9	E (3)	60.4	E (3)
16	Fort Hunt Road & Sherwood Hall Lane	63.0	E (1)	89.1	F (1)	41.9	D	43.0	D	45.1	D
17	Franconia Road & South Van Dorn Street	121.9	F (4)	271.7	F (6)	178.2	F (7)	180.2	F (7)	179.8	F (7)
18	George Washington Memorial Parkway & Belle View Boulevard	617.9	F (1)	550.5	F (1)	45.1	D (1)	550.0	F (1)	548.2	F (1)
106	North Kings Highway & Poag Street	-	-	1.9	A	2.1	A	2.1	A	2.1	A
712	Route 1 & HOV Lanes	-	-	22.1	C (3)	23.9	C (3)	24.7	C (3)	27.3	C (3)

# *Training Session Overview*

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- Traffic Analysis Basics
- Synchro Introduction
- Data Preparation
- Synchro Operations
- Hands-On Exercise
- **Advanced Applications**



# Advanced Applications

## 1. Signal Optimization

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Step 1  
Individual Intersection Timing  
Optimize Splits and Cycle Lengths

Step 2  
Partition Network  
Divide Network into Multiple Systems

Step 3  
Optimize Cycle Lengths

Step 4  
Optimize Offsets and Phase Orders



# Advanced Applications

## 1. Signal Optimization – Step 1

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- Single Intersection Timing Plans
  - » Base data entry
  - » Optimize Cycle and Splits per individual intersections
  - » Error checking

# Advanced Applications

## 1. Signal Optimization – Step 2

---

### ➤ Partition Network

- » Divide network into subsystems
  - Based on Coordinatability Factor
- » Creates multiple zones for optimization
- » This part is optional

# Advanced Applications

## 1. Signal Optimization – Step 3

---

- Optimize Network Cycle Length
  - » Set cycle length ranges
  - » By zone or network
  - » Level of Optimization
  - » Manual selection or Automatic

# Advanced Applications

## 1. Signal Optimization – Step 4

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- Optimize Offsets, Lead-Lag Phasing
  - » After system cycle lengths have been set
  - » By zone or network
  - » Level of Optimization

# Advanced Applications

## 1. Signal Optimization – Performance Index

- Best cycle length found by calculating the Performance Index (PI)

$$PI = \frac{D*1 + ST*10 + QP*100}{3600}$$

PI = Performance Index

D = Percentile Signal Delay (s)

QP = Queue Penalty (vehicles affected)

ST = Vehicles Stops (vph)

Cycle Length	Perform Index	Queue Delay (hr)	Total Delay (hr)	Delay / Veh (s)	Total Stops
50	27	0	17	8	3553
60	25	0	17	8	3208
70	27	0	17	8	3370
80	27	0	18	9	3243
90	27	0	18	9	3023
100	27	0	19	9	2946
110	27	0	18	9	3237
120	25	0	17	8	3208
130	26	0	16	8	3287
140	27	0	17	8	3370
150	27	0	18	9	3298

# Advanced Applications

## 1. Signal Optimization – Coordinatability Factor

- CF is a measure of the desirability of coordinating intersections
- Components
  - » CF1 = Initial Coordinatability factor from Travel Time
  - » CF2 = Initial Coordinatability factor from Volume per Distance
  - » Ap = Platoon Adjustment
  - » Av = Volume Adjustment
  - » Ac = Cycle Length Adjustment
- CF scale from 0 to 100
  - » > 80 – Must be coordinated
  - » < 20 – Too far apart (coordination not desirable)

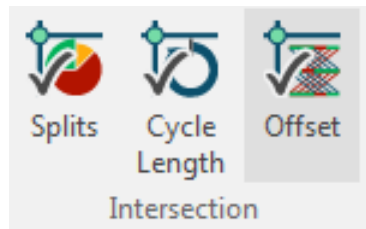
# Advanced Applications

## 1. Signal Optimization

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### ➤ Intersection Splits

- » Individual Intersection Optimizations
- » Select intersection in question and optimize the following:
  - Intersection Splits
  - Intersection Cycle Length
  - Intersection Offset



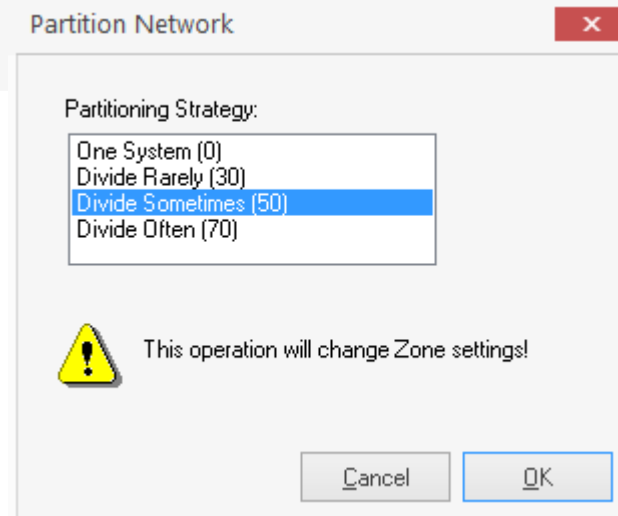
# Advanced Applications

## 1. Signal Optimization

### ➤ Partition Network

#### » Network Zones

- Manual Zones
- Automatic Zones
  - Set partition level to desired sensitivity





# Advanced Applications

## 1. Signal Optimization

### Optimize Network Cycle Lengths

Optimize Cycle Lengths

Min  Max  Increment  
 Cycle Length:

Allow Uncoordinated:

Allow Half Cycle Length  
 Preserve Files For Each Cycle Length  
 Optimize Phase Sequence

Offset Optimization:

**Weighting**  
 No Weighting  
 Optimize using Phs Weighting  
 Optimize using RefPhs Weighting of

**Scope**  
 Zone   
 Entire Network

Write Timing File  
 File Name    
 Timing Plan

#### Select Cycle Lengths

Cycle Length	Perform Index	Queue Delay (hr)	Total Delay (hr)	Delay / Veh (s)	Total Stops	Stops / Veh	Fuel (gal)	Unservd Vehicles	Dilemma Vehicles	% Dilem Vehicle
50	27	0	17	8	3553	0.48	46	0	53	1%
60	25	0	17	8	3206	0.43	44	0	44	1%
70	27	0	17	8	3370	0.45	45	0	38	1%
80	27	0	18	9	3243	0.44	45	0	56	1%
90	27	0	19	9	3155	0.43	45	0	57	1%
100	27	0	19	9	2946	0.40	45	0	53	1%
110	27	0	18	9	3236	0.44	45	0	48	1%
120	25	0	17	8	3208	0.43	44	0	44	1%
130	26	0	16	8	3287	0.44	44	0	40	1%
140	27	0	17	8	3370	0.45	45	0	38	1%
150	27	0	18	9	3298	0.44	45	0	35	0%

# Advanced Applications

## 1. Signal Optimization

### ➔ Optimize Offsets

Optimize Network Offsets

Use Existing  
 Optimize

Optimize Lead/Lag Phasing

Quicker  Best Timing Plans

Pass 1, offset and l/l optimization, step 4  
Pass 2, clustering offset optimization, step 4, CF 90  
Pass 3, offset, step 1

No Weight  
 Weight Ref Phase

Zone 1  
 Entire Network

OK  
Cancel

# Advanced Applications

## 2. Future Improvements & Mitigations

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- Volume Changes
- Geometric Changes
  - » Street widening
  - » Exclusive turn lanes
  - » Road diet
- Signal Optimization

# Advanced Applications

## 3. Roundabout

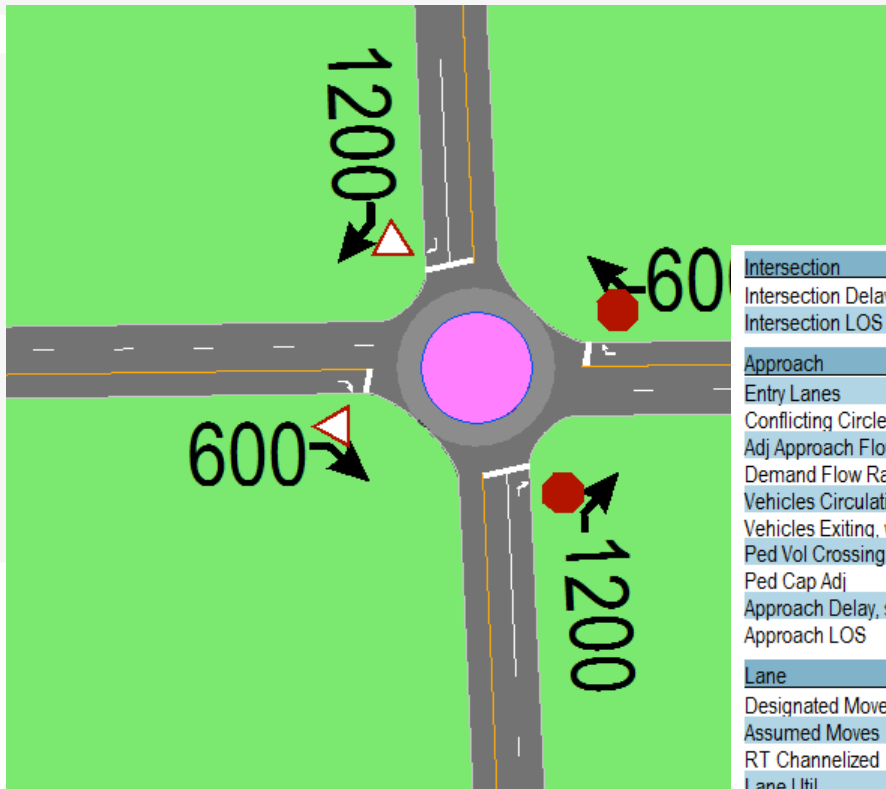
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### Synchro

- » HCM-based Method
- » “Trafficware states that SYNCHRO 10 implements the HCM 2010 and 6th Edition HCM roundabout methodologies. However, as is the case for any software described here, before using a new software version the analyst should verify the fidelity of the implementation by running some example problems where the results are known”
- *Multimodal Mobility Analysis Desk Reference from Caltrans Transportation Analysis Guide/Transportation Impact Studies Guide, June 2017*
- » Analyzing Roundabout in Synchro

# Advanced Applications

## 3. Roundabout



Intersection				
Intersection Delay, s/veh	21.8			
Intersection LOS	C			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	2	2
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	652	652	1304	1304
Demand Flow Rate, veh/h	665	665	1330	1330
Vehicles Circulating, veh/h	0	0	0	0
Vehicles Exiting, veh/h	1330	1330	665	665
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	7.5	7.5	29.0	29.0
Approach LOS	A	A	D	D
Lane	Left	Left	Right	Right
Designated Moves	R	R	R	R
Assumed Moves	R	R	R	R
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.535	2.535
Critical Headway, s	4.976	4.976	4.544	4.544
Entry Flow, veh/h	665	665	1330	1330
Cap Entry Lane, veh/h	1380	1380	1420	1420
Entry HV Adj Factor	0.980	0.980	0.980	0.980
Flow Entry, veh/h	652	652	1304	1304
Cap Entry, veh/h	1353	1353	1392	1392
V/C Ratio	0.482	0.482	0.937	0.937
Control Delay, s/veh	7.5	7.5	29.0	29.0
LOS	A	A	D	D
95th %tile Queue, veh	3	3	17	17

# Advanced Applications

## 3. Roundabout

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### ➤ Recommended Software

#### » SIDRA Intersection

- Deterministic tool
- Account for the effects of vehicle arrivals based on adjacent traffic controls, whereas HCM does not

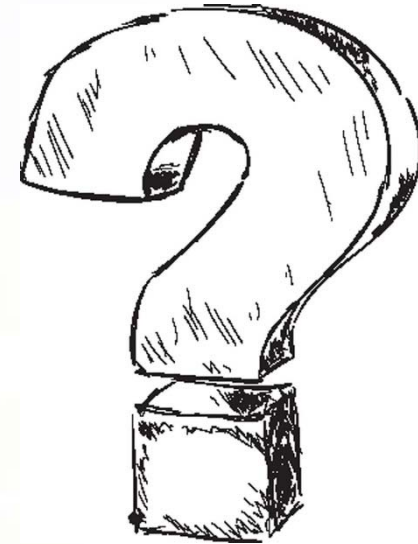
#### » VISSIM

- Microsimulation package
- Capable of analyzing full range of roadway

# *Training Summary*

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- Traffic Analysis Basics
- Synchro Introduction
- Hands-On Exercise
- Advanced Applications



# Resources

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- Richard Ge
  - » [rge@camsys.com](mailto:rge@camsys.com)
  - » (646) 364-5492
- Synchro User Manual/Online Help
- Trafficware User Groups

