

San Bernardino Valley Coordinated Traffic Signal Timing System Program Tier 3 and 4

Final Report



PREPARED FOR:



PREPARED BY:

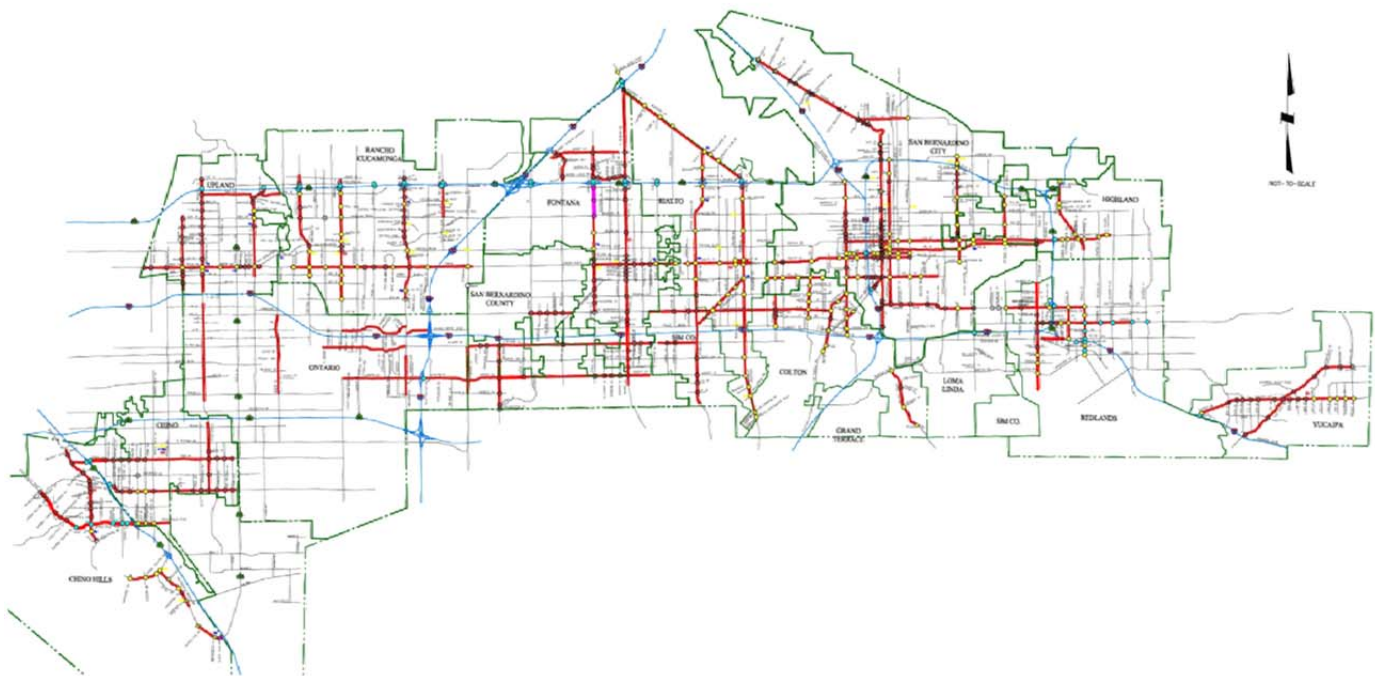


June 2014

San Bernardino Valley Coordinated Traffic Signal System

Tier 3 & 4

Final Report



Prepared for:
San Bernardino Associated Governments

Governments
SANBAG
Working Together

Prepared by:

 **ADVANTEC**
Consulting Engineers

June 2014

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Executive Summary

SANBAG's San Bernardino Valley Coordinated Traffic Signal System Tier 3 & 4 project has successfully proven to be a cost-effective way of improving traffic flow and reducing congestion along arterial corridors, thereby reducing fuel consumption, pollutant and greenhouse gas emissions, as well as providing other tangible benefits to the travelers. This report documents the improvements and benefits resulting from this project as well as the subsequent Maintenance and Monitoring project.

For the first year of implementation, this project has resulted in fuel savings of **2,467,157** gallons per year; with corresponding reduction in Green House Gases (GHG) and other pollutants emissions of about **6,949** tons. A reduction in overall Travel Time hours is estimated at **1,271,060** vehicle-hours per year.

The overall monetary savings for the first year of traffic signal synchronization implementation is estimated to be **\$25,441,645**. This can be broken down into \$706,166 in emissions reduction, \$9,666,247 in fuel savings and \$15,069,232 in overall vehicle travel time reduction. At a total cost of \$1,589,237, the Benefit/Cost ratio of this project is estimated to be **16:1** for the *first year* of implementation.

Background

In 2009, SANBAG has commissioned ADVANTEC Consulting Engineers to perform the San Bernardino Valley Coordinated Traffic Signal System - Tier 3 & 4 project. In this project, ADVANTEC has designed and implemented communications hardware to allow each local agency to monitor and adjust signal timings from their central traffic signal system, as well as developed and implemented signal coordination plans for AM and PM periods for a total of 691 traffic signals at over 40 corridors in the San Bernardino Valley. In 2013, SANBAG has further commissioned ADVANTEC to perform the subsequent Maintenance and Monitoring project. This project included troubleshooting of the communications hardware, maintenance and rectification of hardware issues, fine-tuning and monitoring of traffic signal timings, and conduct of an 'After' Study to establish the benefits of the Tier 3 and 4 project.

Project Objectives

The main objective of this project is to improve arterial traffic conditions by implementing inter-jurisdictional traffic signal synchronization, thereby reducing travel times, number of stops and delay. As a result, arterial traffic progression at key arterials are optimized during peak periods and a significant amount of fuel consumption, GHG and other pollutant emissions were reduced. Drivers in San Bernardino Valley would experience less driving stress with smoother traffic flow and faster travel times.

During the Maintenance and Monitoring Project, the objectives are to maintain the hardware provided in Tier 3 and 4, and to fine-tune the signal timing parameters being implemented. Since construction of Tier 3 and 4 was completed in June 2012, a number of hardware failures had occurred. ADVANTEC has troubleshot the cause of these hardware failures, and resolved all the hardware issues for equipment installed through in Tier 3 and 4 Project. (For details, refer to *'Hardware Status Final Report'*)

Project Methodology

The project tasks included:

- Data collection
- Filed Review
- Hardware improvements and system upgrade
- 'Before' Study
- Signal Timing Optimization
- Implementation and Fine-tuning
- 'After' Study

Project Results

The Tier 3 and 4 project has resulted in an overall improvement of **15%** in travel time, **36%** in delay, **35%** in the number of stops, and **19%** in average speed, as shown in table below.

% Improvement	Measures of Effectiveness (MOE)			
	Travel Time	Delay	Number of Stops	Average Speed
AM	13%	34%	34%	17%
PM	16%	39%	35%	21%
Overall	15%	36%	35%	19%

Reduction in Emissions, Fuel Consumption and Travel Time (measured in Vehicle-hours travelled, VHT) were calculated based on "Before" & "After" runs using GPS trip log data, and shown in the table below. Most notably, there are **6,949 tons** of GHG emissions reduced and **2.5 Million gallons** of fuel saved during the first year of implementation. The travelers in San Bernardino Valley have saved a cumulative total of about **1.3 Million vehicle-hours** in the first year.

Annual Reduction of Emissions, Fuel Consumption & Vehicle Hours Travelled					
Emissions (lb)				Fuel (gal)	VHT (veh-hr)
CO	NOx	CO2	VOC		
93,657	52,832	13,656,678	93,995	2,467,157	1,271,060
Total:	6,949 tons				

1. Introduction

ADVANTEC Consulting Engineers was commissioned by SANBAG to conduct the **San Bernardino Valley Coordinated Traffic Signal System - Tier 3 and 4**. Between September 2009 and June 2010, ADVANTEC designed communications and hardware upgrades for the 15 agencies involved in the project. In July 2010, ADVANTEC started the signal synchronization phase of the project, developing signal timing for 691 intersections. Construction of field hardware infrastructure was completed in June 2012, and implementation of the initial optimized signal timings was completed in December 2012. In April 2013, ADVANTEC Consulting Engineers was commissioned by SANBAG to perform a one-year monitoring, fine-tuning and maintenance of hardware Contract C12027 **"San Bernardino Valley Coordinated Traffic Signal System Maintenance and Monitoring - Tier 3 and 4**. This report provides a summary of the traffic signal synchronization results of both projects. A separate 'Hardware Status Report' is prepared to summarize the results of the hardware troubleshooting and maintenance.

1.1 Project Description

Tier 3 & 4 project consists of synchronization of over 40 corridors with 691 intersections in the San Bernardino Valley, traversing the cities of Chino Hills, Chino, Ontario, Upland, Rancho Cucamonga, Fontana, Rialto, Colton, San Bernardino, Redlands, Loma Linda, Yucaipa, and County of San Bernardino. Tier 3 & 4 corridors are also coordinated with Caltrans freeway ramp signals at SR-71, SR-60, I-210, I-10, I-15 and I-215 freeways.

Figure 1.1 depicts the project limits and Tier 3 & 4 corridors are highlighted in blue. Corridors highlighted in yellow correspond to the previous Tier 1 & 2 project.

1.2 Project Objectives

ADVANTEC has established clear goals and objectives for the project team to achieve. The main objectives of the project were:

- Provide communications and hardware infrastructure for local jurisdictions to operate and monitor the traffic signal operations from their respective traffic signal systems.
- Improve traffic flow performance on major corridors through the development, implementation, fine-tuning and monitoring of signal coordination plans, to reduce vehicle travel time and stops, fuel consumption and emissions of greenhouse gases (GHG) and other air pollutants from automobiles.
- Assist agencies to resolve hardware maintenance, traffic signal system and traffic operations issues.

1.3 Scope of Work

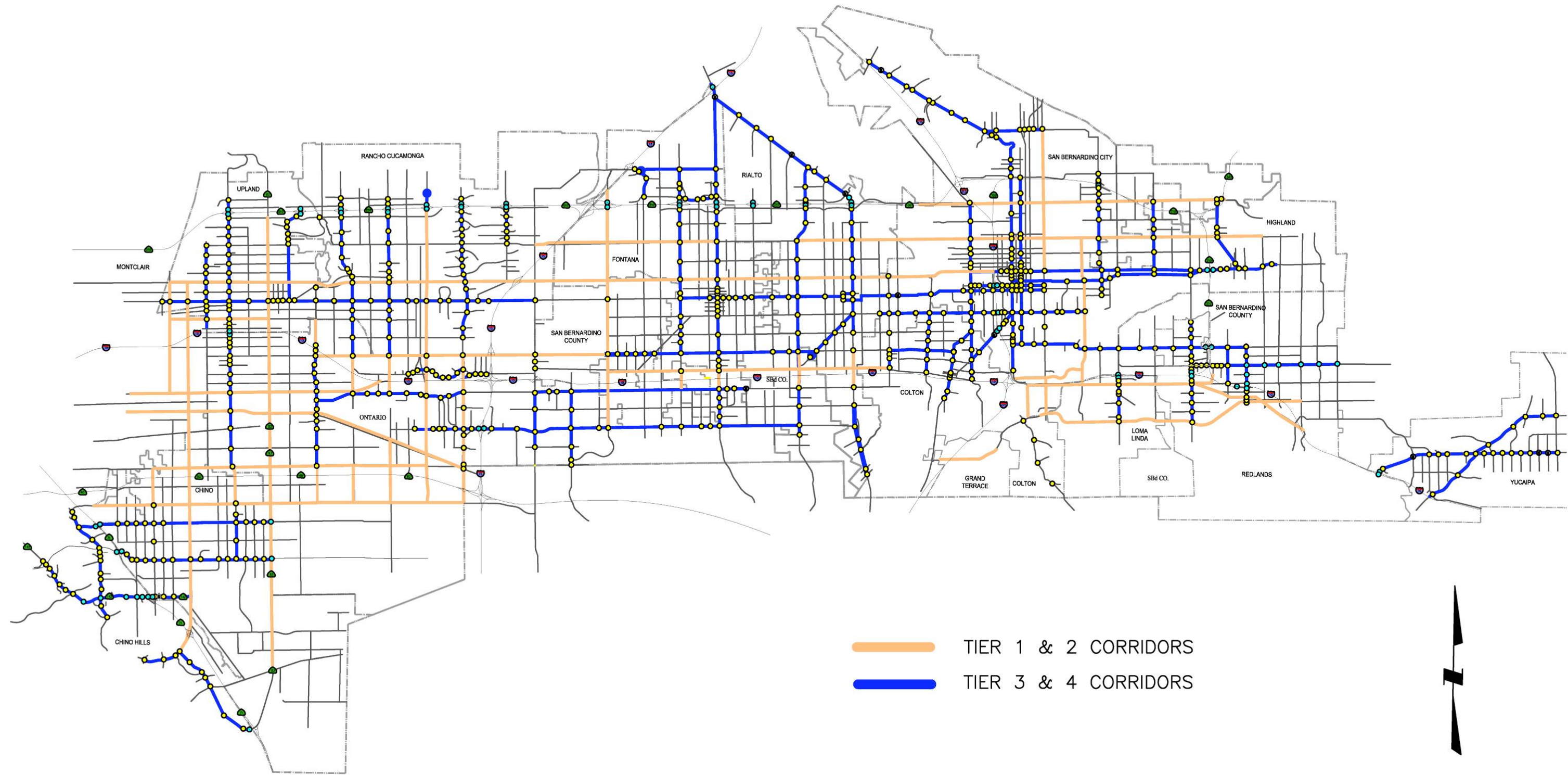
Per the contract with SANBAG, the scope of work of Tier 3 & 4 Implementation and Monitoring projects are defined as follow:

- Conduct data collection of as built plans, timing sheets and turning movement counts

- Perform 'Before-Study' to establish existing traffic conditions
- Conduct field reviews of traffic signal configuration, signal timing parameters, intersection lane configuration and posted speed limit. Review signal operations at Traffic Management Centers (TMC).
- Conduct field reviews of hardware, communication status and clocks; review controller timings.
- Provide communications and traffic signal hardware upgrades to allow the local agencies to monitor traffic operations from their respective central traffic signal system.
- Troubleshoot hardware and communication problems and resolve hardware maintenance issues.
- Develop, implement and fine-tune signal timing coordination parameters.
- Monitor coordination timing plans, intersection operations and TMC operations. Respond to jurisdictions and resident comments.
- Provide revised signal timing sheets (that reflect the change on coordination timing), Updated Time-Space diagrams and central traffic signal system database for local agencies to maintain.
- Perform 'After-Study' and compare results with 'Before Study' to evaluate the 'Measures of Effectiveness' (MOE).
- Conduct project benefit analysis and provide estimate of 'Benefit/Cost ratio'.
- Prepare final report and present project results to SANBAG and the local jurisdictions.



Figure 1.1 - Tier 3 & 4 Project Arterial Corridors



2. Data Collection and Field Review

2.1 Data Collection

ADVANTEC conducted a series of data collection activities through agency contact and field reviews in the early phase of the project. Intersection signal plans and signal timing sheets were collected from each agency. Intersection lane geometry and corridor posted speed limit information was collected through field survey and the use of satellite maps, such as Google Earth. Vehicular traffic counts, such as intersection turn movement counts, at freeway ramps and major intersections were obtained by collecting new counts or using recently collected count data provided by the local jurisdictions.

ADVANTEC has performed extensive field review to verify traffic signal phasing and configuration, traffic signal operation, intersection geometry, and posted speed limits in each city.

In the Maintenance & Monitoring Phase, ADVANTEC performed extensive field review to assess traffic signal and communications hardware condition in each city. Hardware problems were troubleshot and repair solutions were recommended. A *'Hardware Status Report'* was compiled and reported to SANBAG under separate cover.

2.2 Cross-Corridor Coordination

Prior to Tier 3 & 4, Tier 1 & 2 project implemented coordination timing on about half of all major corridors in the San Bernardino Valley. Such existing coordination timing restricted the development of coordination timing at locations where both Tier 1 & 2 and Tier 3 & 4 corridors intersect. Thus, the information on existing cross-coordination timing from Tier 1 & 2 are critical. ADVANTEC collected coordination timing information for all such locations and used them as reference points in our Synchro software models. During the fine-tuning phase of the project, ADVANTEC performed field reviews to ensure that the cross-coordinated intersections were running the coordination timing as defined on the timing sheets.

2.3 Peak Hour Turning Movement Counts

In order to build the Synchro model and optimize the signal timings, recent traffic volume data is needed. In order to preserve project funds, and under direction of SANBAG, ADVANTEC collected new intersection turn movement counts through field data counting, and used available and recently counted data from local agencies, and estimated traffic volumes on minor intersections using Synchro software volume balancing. Turning movement data was used to determine the signal coordination timing parameters for each intersection.

3. Traffic Signal Communications Infrastructure

3.1 Summary of Hardware Installations

Through the Tier 3 and 4 project, all the signalized intersections were equipped with suitable communications equipment to communicate with their city's central traffic signal system, while using IP technology wherever available. In this process, communication equipment requested by an agency or hardware upgrades were implemented, such as controllers, and fiber optic switches. Cellular modems were provided at most freeway ramps due to the dispersed nature of these locations needing to communicate back to Caltrans TMC. GPS time source units were provided where time-based coordination was needed, as a last resort, to maintain the same time clock with adjacent intersections. In summary, the hardware provided include:

1. 170 controllers - 38 units
2. 170 master controllers - 21 units
3. 2070 controllers - 10 units
4. ASC/3 controllers - 15 units
5. ASC/2 controllers - 7 units
6. M50 Type Eagle controllers - 3 units
7. 233/2033 prom modules - 3 units
8. Controller/side cabinet - 14 units
9. Encom 5.8ghz wireless radio - 156 units
10. Encom 8 Port 10/100 switch - 34 units
11. Terminal Servers - 61 units
12. Fiber optic switches - 5 units
13. 3G cellular modems - 59 units
14. GDI 400 Series/FSK modems - 14 units
15. QuicNet Pro Central System - 1 system
16. Copper Interconnect - 2 agencies
17. Ethernet Extenders - 8 units
18. Encom 900 Series wireless radios - 24 units
19. GPS time source units - 54 units

Table 3.1 summarizes the hardware installations at each agency.

Table 3.1 Traffic Signal Hardware Implemented by Tier 3&4

Traffic Signal Hardware Improvements		AGENCIES														Tier 3 & 4 TOTAL
		Caltrans	Chino	Chino Hills	Colton	Fontana	Highland	Loma Linda	Rancho Cucamonga	Redlands	Rialto	City San Bernardino	County San Bernardino	Upland	Yucaipa	
1	170 Controller				7		1				29		1			38
2	170 Master Controller	3			3		4				3	3		4	1	21
3	2070 Controller									2	1			7		10
4	ASC/3 Controller		1	1					13							15
5	ASC/2 Master Controller			2		1			4							7
6	M50 Type Eagle Controller									3						3
7	233/2033 Prom module						3									3
8	Controller/Side Cabinet		1		1		3		4		2			3		14
9	Encom 5.8ghz Wireless Radio			10	17		18		21	8	34	38		6	4	156
10	Encom 8 Port 10/100 Switch			2	4		4		3	3	7	8		1	2	34
11	Terminal Server - Internal/External	15		3	11		4		2	8	6	11			1	61
12	Fiber Optic Switch					1		4								5
13	Wireless 3G Cellular Modem	11		4	7		4		7	5	6	10	1	3	1	59
14	GDI 400 Series/FSK modem		3			1			2	8						14
15	QuicNet Pro Central System														1	1
16	Copper Interconnect		1												1	2
17	Ethernet Extender			2	2										4	8
18	Encom 900 series Wireless Radio	12	4			4			2			2				24
19	GPS Time Source Unit	25			2				6	1	3		16	1		54
TOTAL per Agency		66	10	24	54	7	41	4	64	38	91	72	18	25	15	529

3.2 Hardware Troubleshooting during Monitoring Phase

In April 2013, ADVANTEC has troubleshooted all of the hardware issues that were causing communications to drop offline. At the end of the construction period, communication was operational, however, due to the maintenance and monitoring contract being delayed, equipment warranty expired, changes been made by the local agency, a variety of issues like faulty manufacturer's equipment, wrong intersection assignment at the central traffic system, cabinet knock down from an accident, an unplugged communication cable, etc. were encountered. Through the troubleshooting process, ADVANTEC identified the communication status of all Tier 3 & 4 intersections by conducting hardware field review in cooperation with the following agencies: Caltrans, Chino Hills, Chino, Colton, Fontana, Highland, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Upland, and Yucaipa. As a result, it was noted that 69% of the intersections were not communicating with the central server, or a total of 313 intersections being offline.

Since April 2013, ADVANTEC has performed extensive field work to troubleshoot and repair the offline issues. ADVANTEC worked closely with each agency to resolve the hardware/communication issues encountered and brought many traffic signal communications back online. By February 2014, ADVANTEC has resolved all the hardware issues related to equipment installed through the Tier 3 and 4 project. The number of intersections offline has decreased from 313 to 135, or from 69% to 30%. The remaining issues are to be resolved by the agencies due to their existing infrastructure, that was communicating, is getting old and deteriorating. The details are provided in a separate '*Hardware Status Report*'. See **Table 3.2** for the current communications status as compared to the beginning of the Monitoring project.

Table 3.2 Communications Status Summary

City	Apr-13			Feb-14			
	No. online	No. offline	% offline	No. online	No. Offline		% offline
					Tier 3 & 4	CITY	
Chino	20	13	39%	33	0	0	0%
Chino Hills	5	26	83%	21	0	10	32%
Colton	0	25	100%	21	0	4	16%
Fontana	41	37	47%	41	0	37	47%
Highland	2	20	91%	14	0	8	41%
Rancho Cucamonga	17	42	71%	41	0	18	31%
Redlands	2	19	90%	15	0	6	29%
Rialto	0	37	100%	34	0	3	8%
City of San Bernardino	18	68	79%	49	0	37	43%
Upland	32	8	20%	36	0	4	10%
Yucaipa	2	18	90%	12	0	8	40%
TOTAL	139	313	69%	317	0	135	30%

4. Signal Timing Synchronization

4.1 Signal Timing Optimization

To evaluate and develop optimized signal timing plans, ADVANTEC conducted a review of existing signal controller timings, traffic demand patterns, timing sheets, cross intersection coordination timings on Tier 1 & 2 corridors, as well as field verification and observation. Intersection turning movement counts were collected for all freeway ramps and major intersections.

4.1.1 Software Modeling

Synchro and Tru-Traffic software were used to develop computer models of the traffic signal network, and for signal timing optimization. Intersection lane geometry, signal phasing configuration, controller timing parameters, speed limits and turn movement counts were used as input to both Synchro and Tru-traffic models. With these system parameters, intersection capacity was analyzed and an optimized cycle length was derived for each intersection. Based on intersection capacity and natural cycle length, Synchro software then is then used to optimize the cycle lengths for each corridor. Tru-traffic models were used to optimize offsets and produce enhanced Time-Space diagrams. The Tier 3 & 4 intersections, a total of 691 locations, were divided in 5 geographical areas, each with its own Synchro model. The five areas are defined based on natural traffic operations boundaries, and generally lies within the following cities:-

Area 1 – Chino, Chino Hills, Caltrans

Area 2 – Upland, Ontario, Rancho Cucamonga, SB County, Caltrans

Area 3 – Fontana, Rialto, SB County

Area 4 – Colton, Redlands, Highlands, SB City

Area 5 – Redlands, SB County, Yucaipa, Loma Linda, Caltrans

4.1.2 Cycle Length and Splits

For each corridor, the cycle length of each coordination plan was determined based on traffic demand for the peak period being analyzed, and also by taking into account the existing cycle length of Tier 1 & 2 intersections along the corridor. Cycle length and intersection phase splits are designed to ensure the effectiveness of coordination and efficiency of intersection traffic flow. Intersections with light traffic on the side streets are coordinated with half-cycle to reduce the delay to side street traffic.

Tier 3 & 4 corridors coordination was completed with cycle lengths that range from 90 to 130 seconds for all AM, Mid-day and PM plans. Phase splits, or the time allotted for each phase within the cycle length, are developed based on traffic volume and time to for concurrent pedestrian phase timing. Individual intersection phase splits were adjusted as needed during fine-tuning with field observation and monitoring.

The implemented cycle lengths for AM and PM plans for each area are shown in Figures 4.1 to 4.10. Tier 1 & 2 corridor cycle lengths are also shown on map as they are relevant to the design of Tier 3 & 4 corridor cycle lengths.

Figure 4.1 - Area 1:Implemented Cycle Lengths – AM

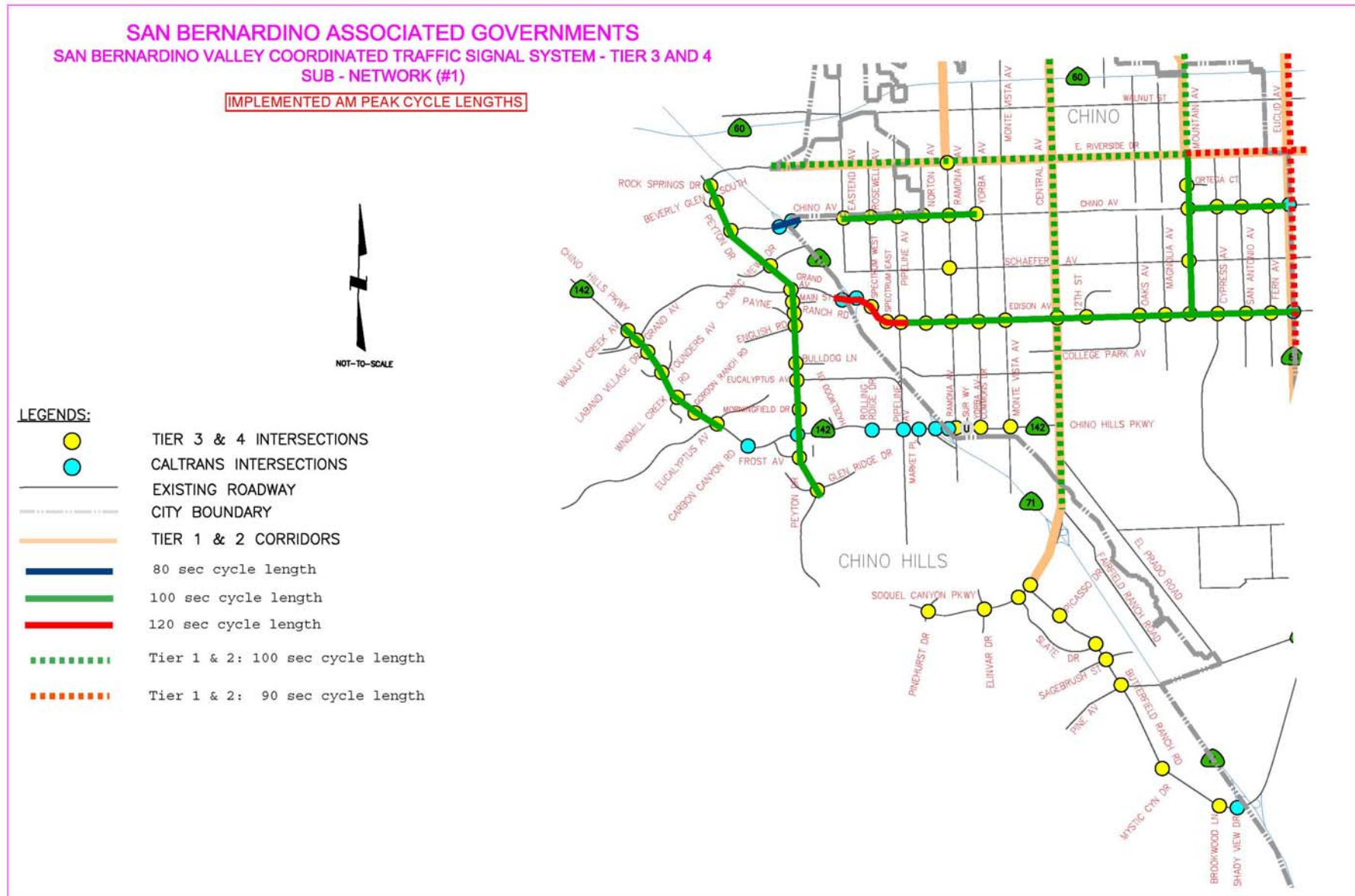


Figure 4.2 - Area 1: Implemented Cycle Lengths – PM

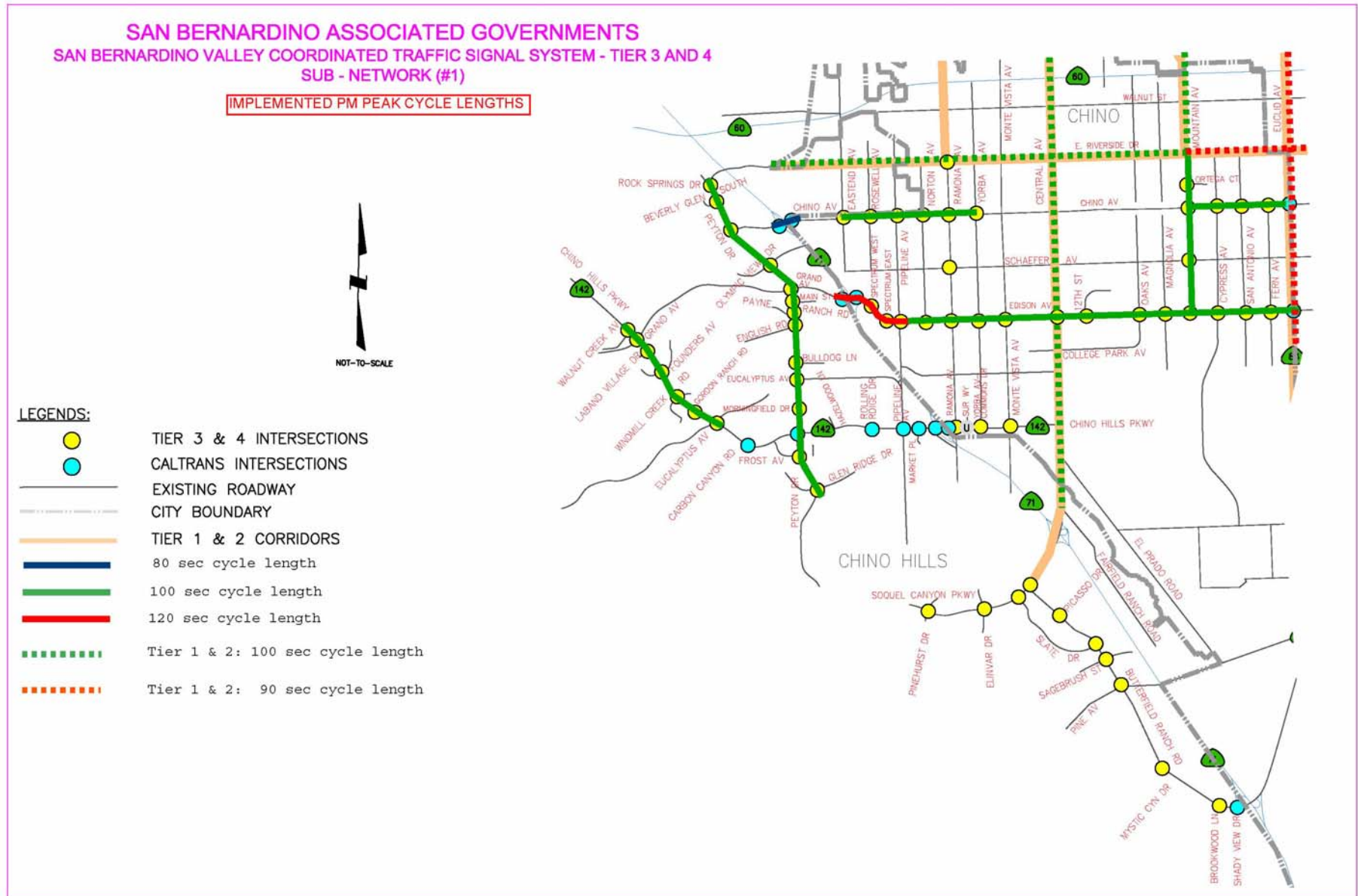


Figure 4.3 - Area 2: Implemented Cycle Lengths – AM

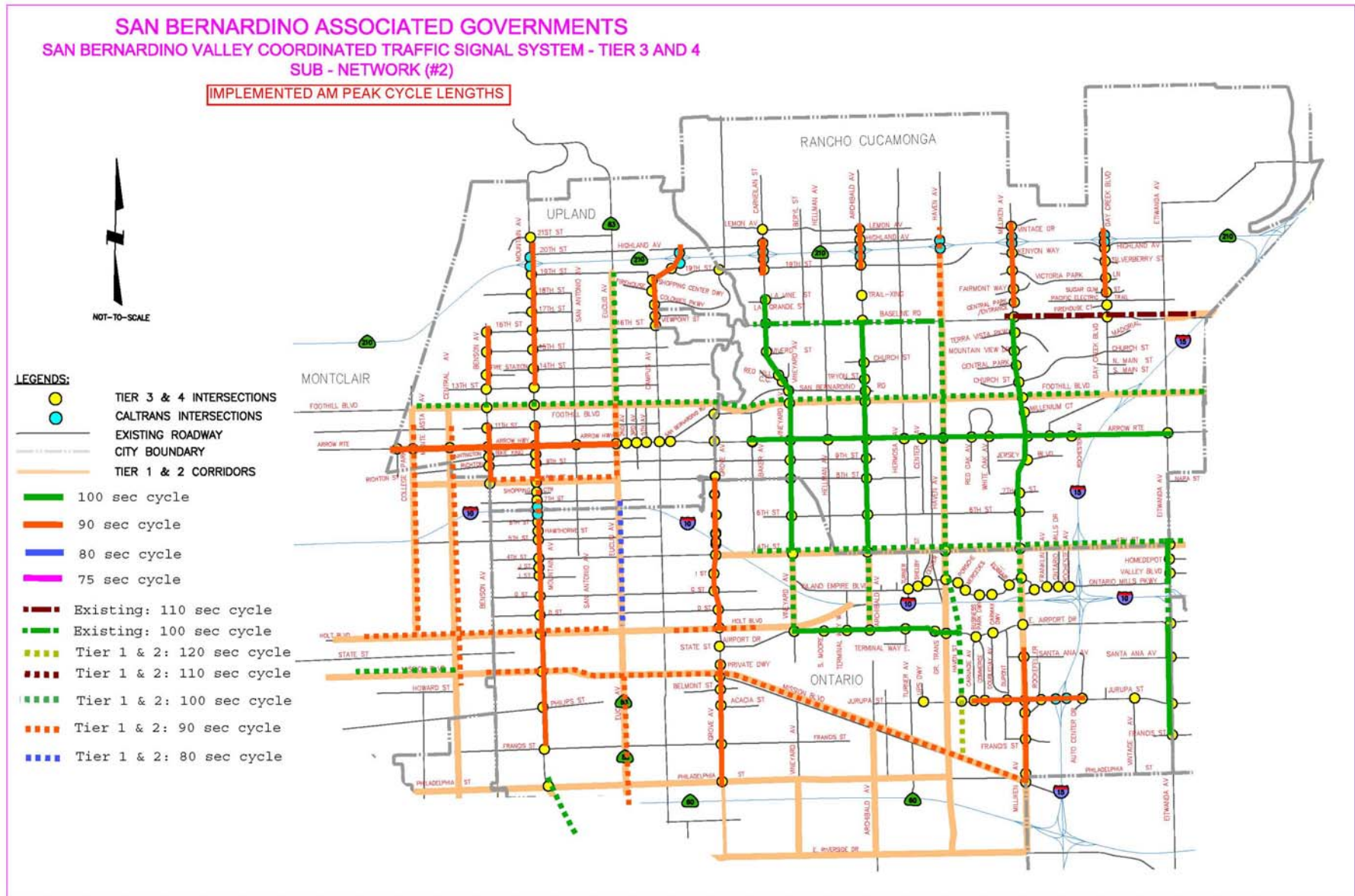


Figure 4.4 - Area 2: Implemented Cycle Lengths – PM

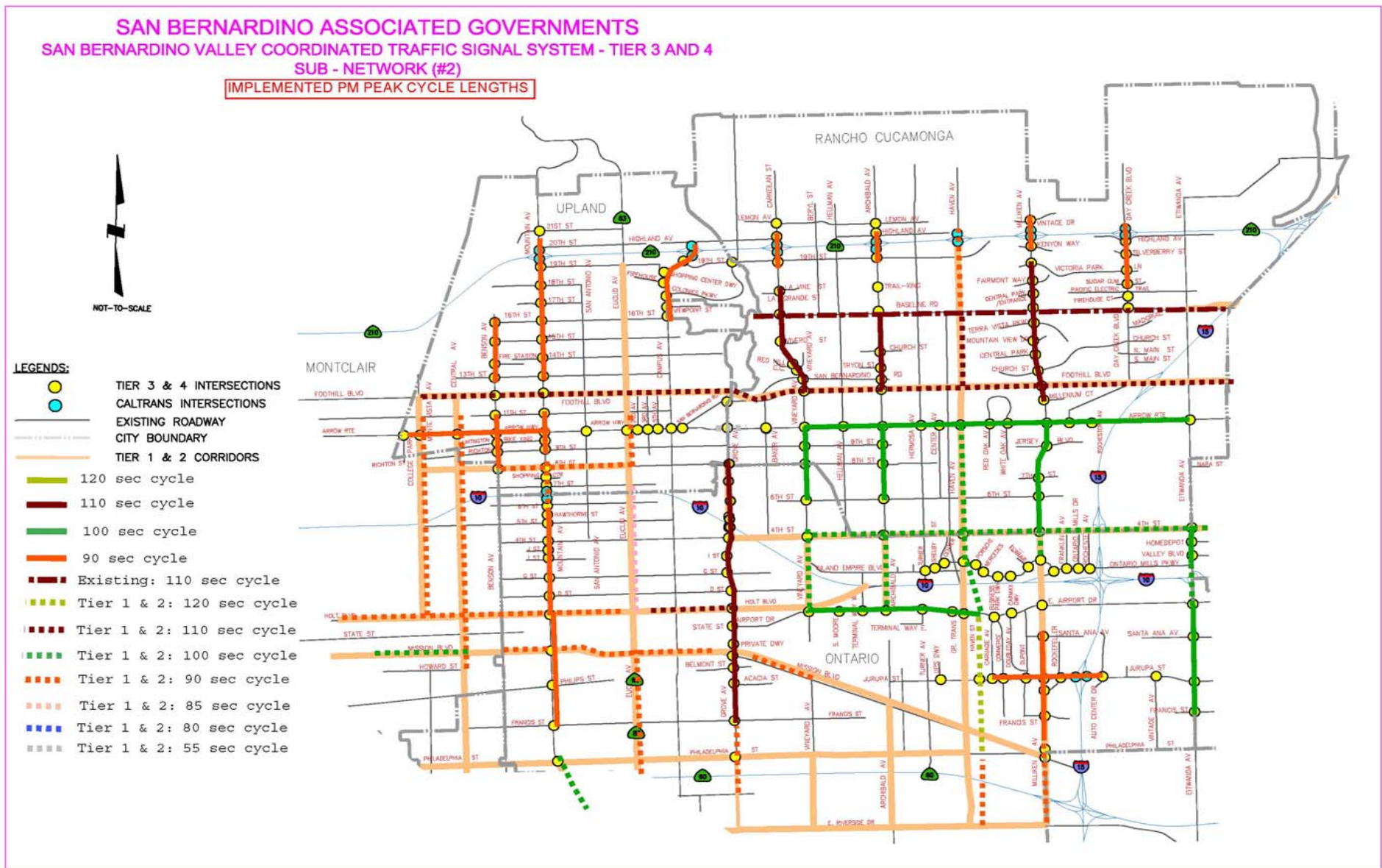


Figure 4.5 - Area 3: Implemented Cycle Lengths – AM

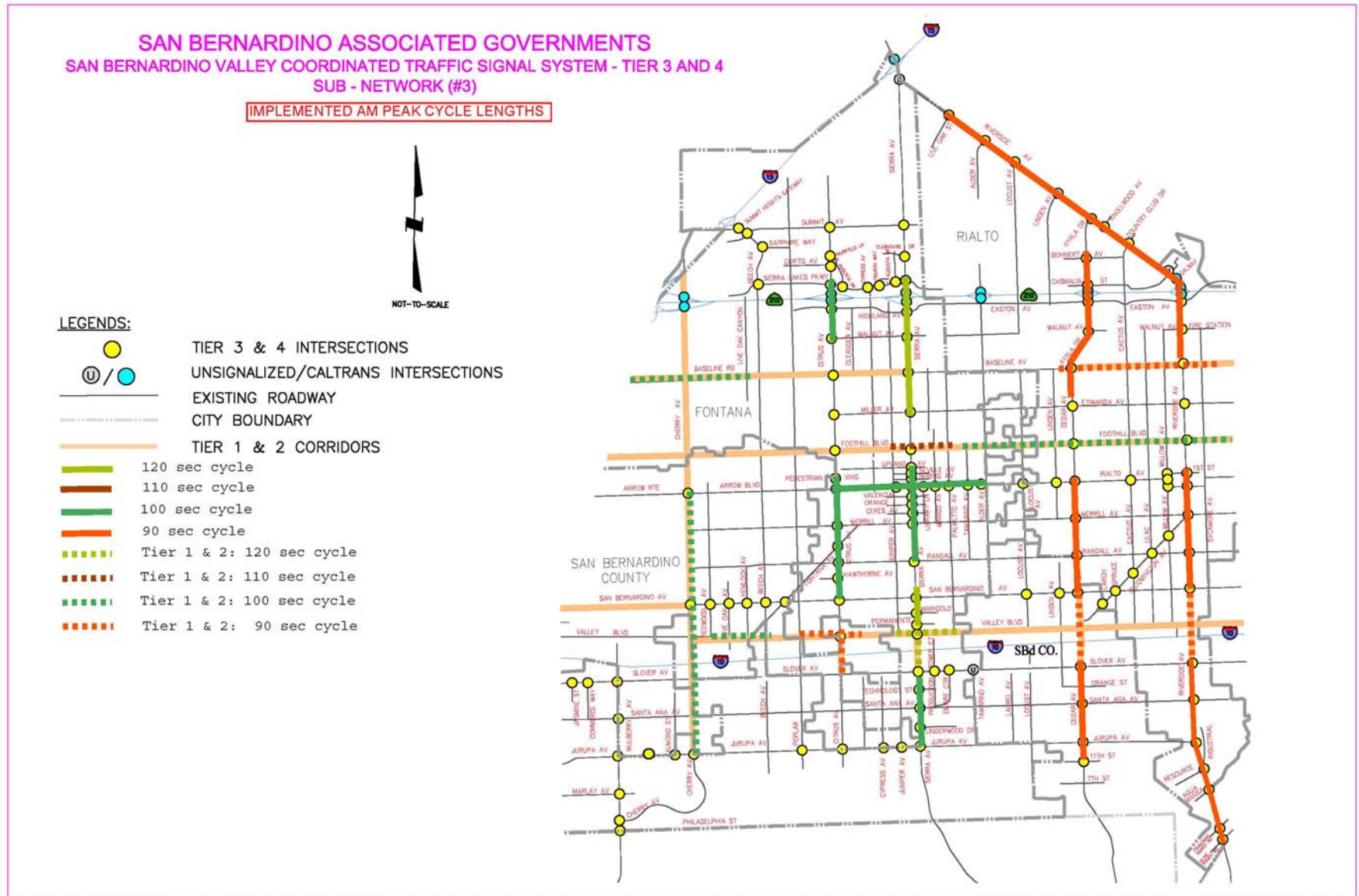


Figure 4.6 - Area 3: Implemented Cycle Lengths – PM

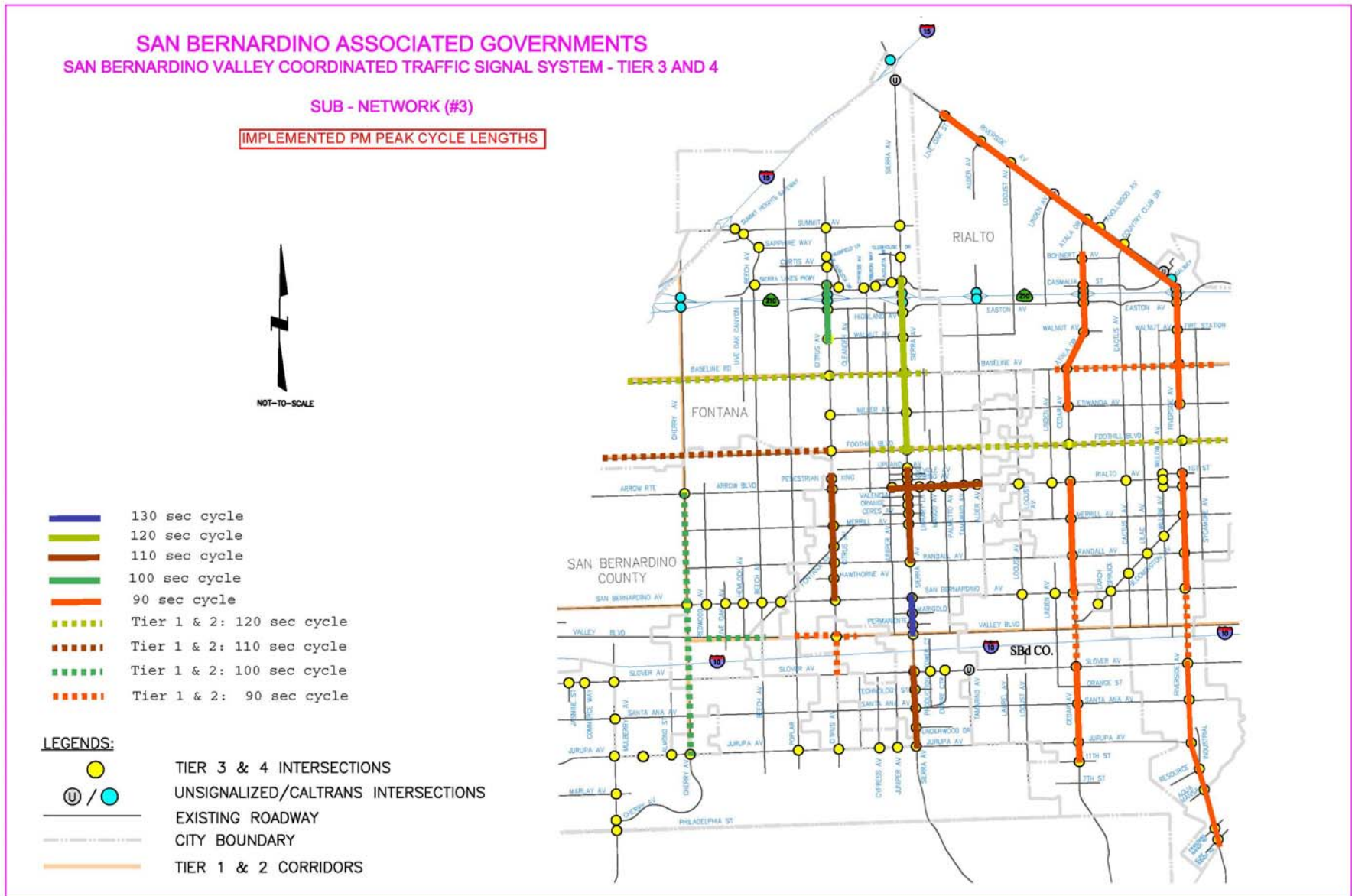


Figure 4.7 - Area 4: Implemented Cycle Lengths – AM

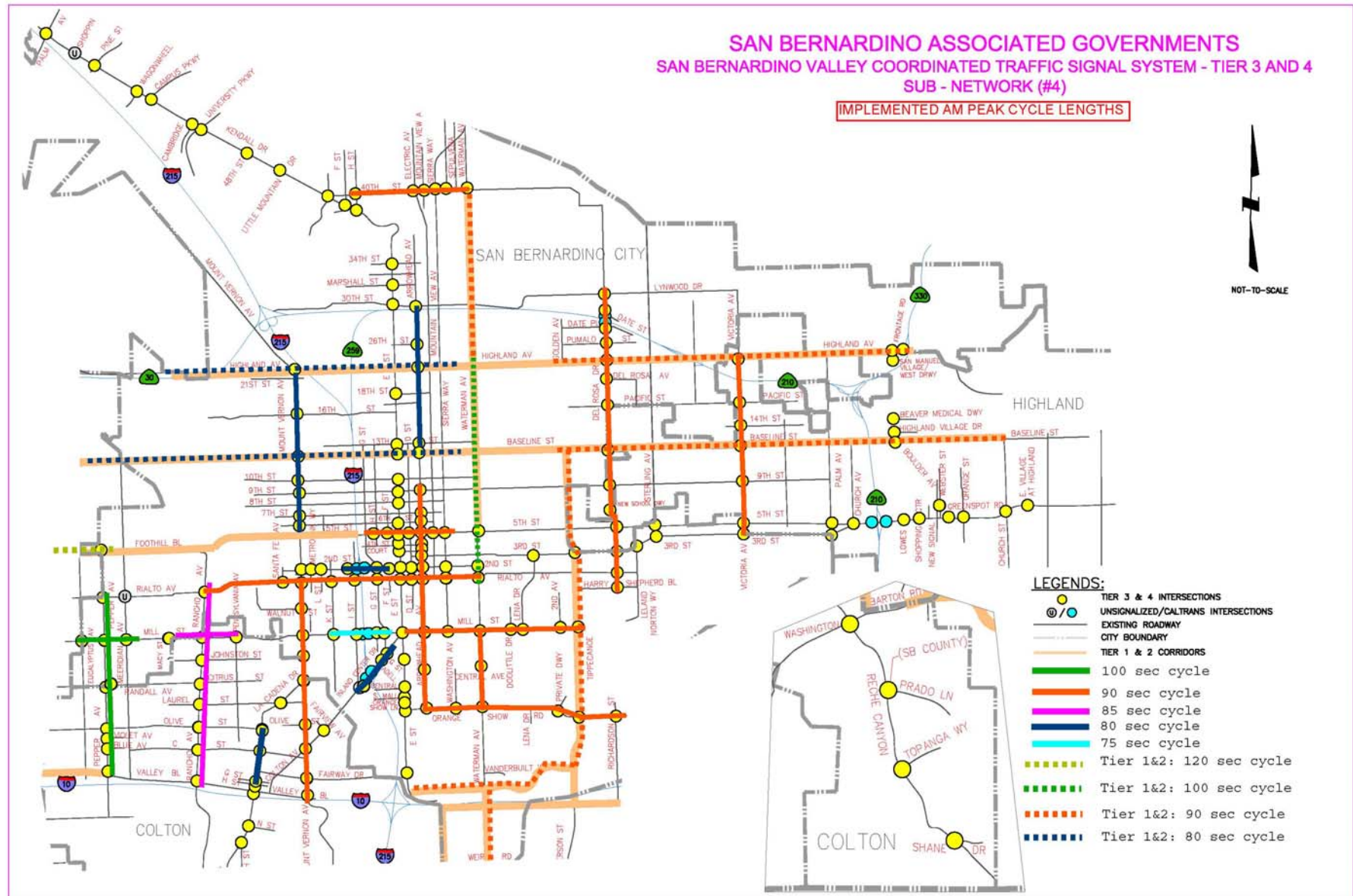


Figure 4.8 - Area 4: Implemented Cycle Lengths – PM

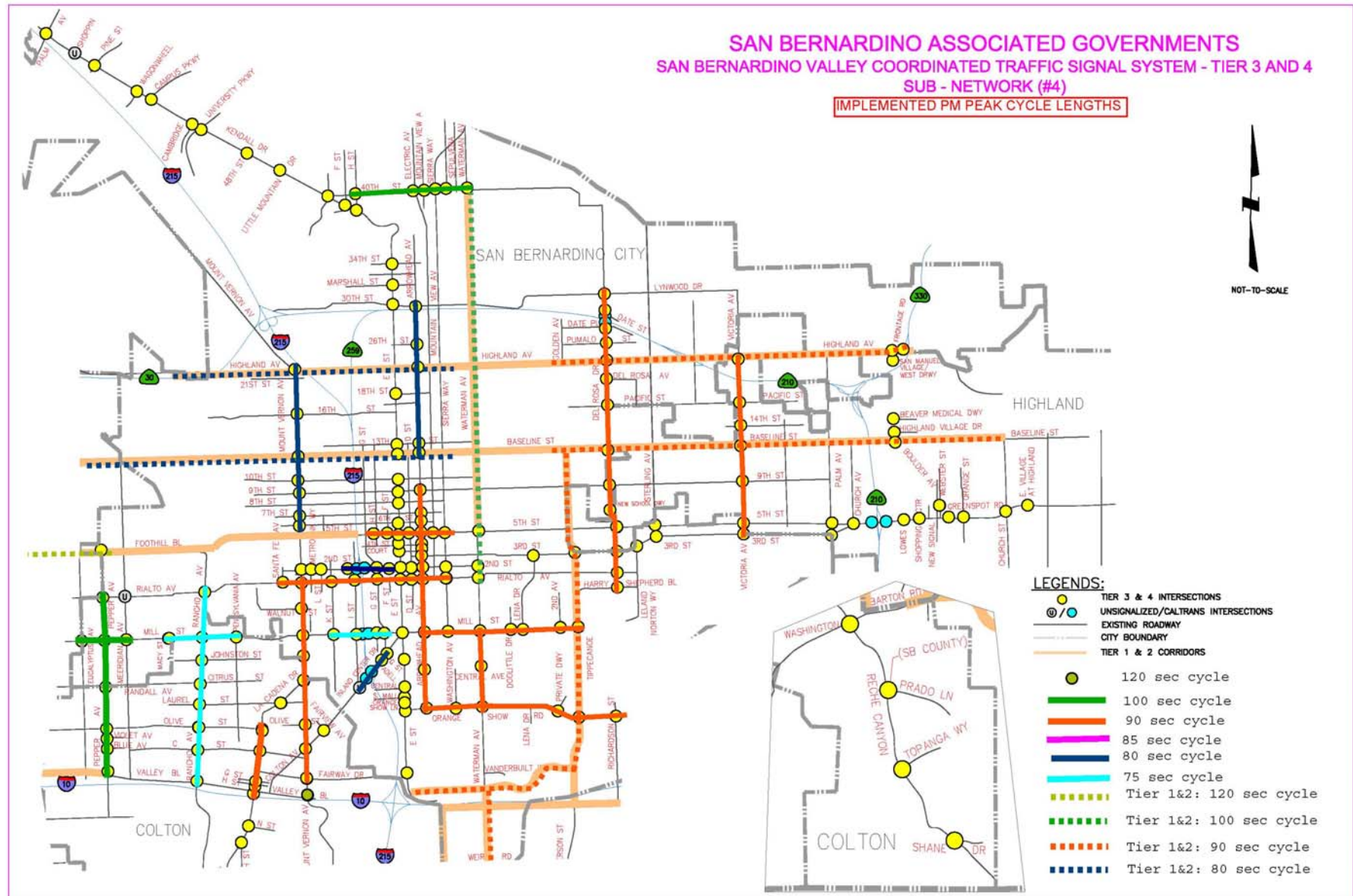


Figure 4.9 - Area 5: Implemented Cycle Lengths – AM

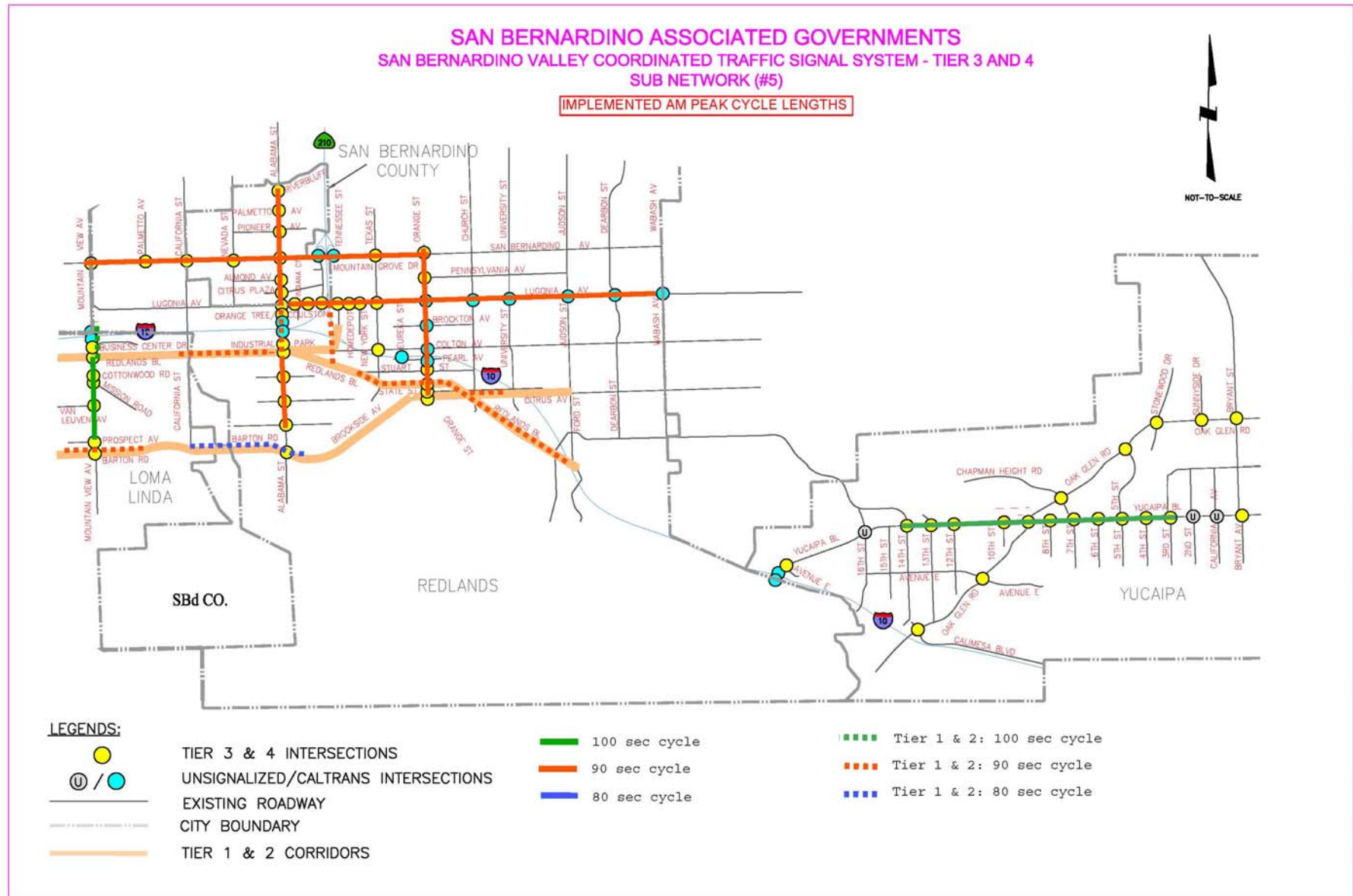
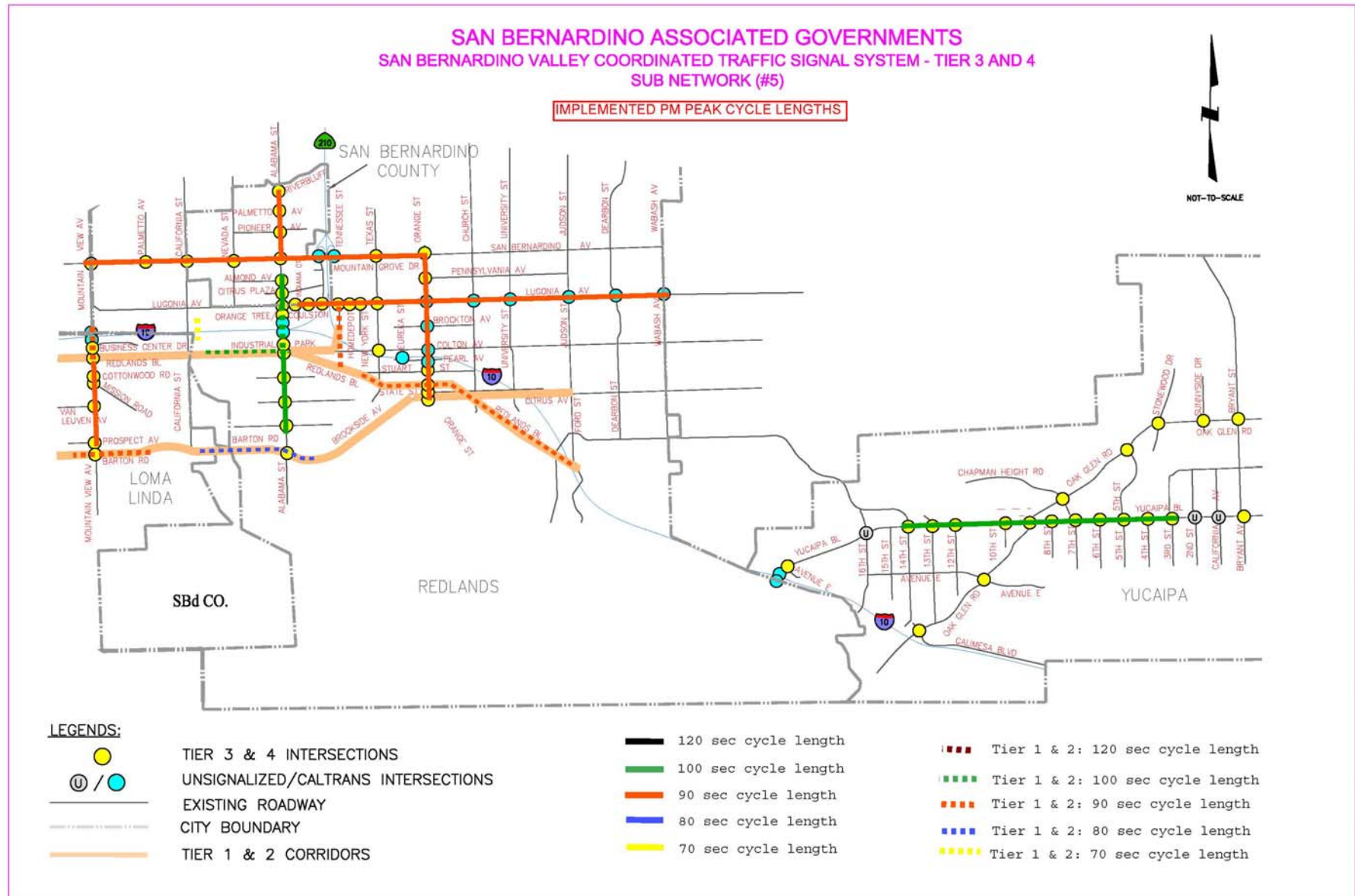


Figure 4.10 - Area 5: Implemented Cycle Lengths – PM



4.1.3 Implementation Schedule and Fine-tuning

After the development of the coordination plans and once hardware improvements were completed, ADVANTEC coordinated with each agency for the implementation and fine-tuning of the new timing. Implementation was performed in the field, at the central system, or remote VPN access from ADVANTEC's offices to the agency's central system.

During fine-tuning, ADVANTEC adjusted offsets and splits to accommodate traffic conditions in the field and to achieve better traffic signal coordination. ADVANTEC also identified and fixed controller programming and cabinet configuration issues that were impeding coordination timing to run properly.

Time-Of-Day (TOD) schedules were first determined during implementation for each corridor based on normal traffic hours, and then adjusted as traffic demand was observed in the field during fine-tuning phase. As a result, TOD schedule would either be extended or shortened for the peak periods.

Table 4.1 to Table 4.16 summarize the implemented cycle lengths, pattern numbers used, and Time-of-Day (TOD) schedule for each intersection in each agency, in alphabetical order.

4.1.4 Time-Space Diagrams

ADVANTEC has prepared Time-Space diagrams for each corridor and separate coordination plans, AM, MD and PM, for all Tier 3 & 4 corridors, utilizing Tru-Traffic software. Time-Space diagrams are provided in CD-ROM as part of each agency's report. **Figure 4.17** and **Figure 4.18** shows examples of Time-Space-Diagrams

Table 4.1 Caltrans Traffic Signal Coordination Schedule

Caltrans									
Area (#)	No.	Intersections	City	Weekday					
				Cycle Length (Sec)			Signal Coordination Schedule		
				AM	MD	PM	AM	MD	PM
1	1	Chino Hills Pkwy @ Carbon Canyon Rd/Rustic Dr	Chino Hills	Free			Free		
	2	Chino Hills Pkwy @ Peyton Dr		Free			Free		
	3	Chino Hills Pkwy @ Rolling Ridge Dr		Free			Free		
	4	Chino Hills Pkwy @ Pipeline Ave		Free			Free		
	5	Chino Hills Pkwy @ Market Place		Free			Free		
	6	Chino Hills Pkwy @ SR-71 SB Ramp		Free			Free		
	7	Chino Hills Pkwy @ SR-71 NB Ramp		Free			Free		
	8	SR-71 SB Ramp @ Grand Ave		120	Free	120	6:30am-9:00am	Free	3:30pm-6:30pm
	9	SR-71 NB Ramp/Roswell Ave @ Grand Ave		120	Free	120	6:30am-9:00am	Free	3:30pm-6:30pm
	10	SR-71 SB Ramp @ Chino Ave	Chino	85	Free	85	6:30m-9:00am	Free	3:30pm-6:30pm
	11	SR-71 NB Ramp @ Chino Ave		85	Free	85	6:30am-9:00am	Free	3:30pm-6:30pm
2	12	I-15 NB Ramps @ Jurupa Ave	Ontario	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
	13	I-15 SB Ramps @ Jurupa Ave		90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
	14	I-210 WB Ramps @ Mountain Ave	Upland	90	100	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
	15	I-210 EB Ramps @ Mountain Ave		90	100	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
	16	I-210 WB Ramps @ Campus Ave		90	90		6:30am-9:00am	11:00am-7:00pm	
	17	I-210 EB Ramps @ Campus Ave		90	90		6:30am-9:00am	11:00am-7:00pm	
	18	I-210 WB Ramps @ Carnelian St	Rancho Cucamonga	90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
	19	I-210 EB Ramps @ Carnelian St		90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
	20	I-210 WB Ramps @ Archibald Ave		90	Free	90	5:30am-9:00am	Free	4:00pm-7:00pm
	21	I-210 EB Ramps @ Archibald Ave		90	Free	90	5:30am-9:00am	Free	4:00pm-7:00pm
	22	I-210 WB Ramps @ Milliken Ave		90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
	23	I-210 EB Ramps @ Milliken Ave		90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
	24	I-210 WB Ramps @ Day Creek Blvd		90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
	25	I-210 EB Ramps @ Day Creek Blvd		90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm

Table 4.1(cont.) - Caltrans Traffic Signal Coordination Schedule

Caltrans									
Area (#)	No.	Intersections	City	Weekday					
				Cycle Length (Sec)			Signal Coordination Schedule		
				AM	MD	PM	AM		MD
3	26	I-15 SB Ramps @ Sierra Ave	Fontana	-			Free		
	27	I-210 WB Ramps @ Cherry Ave		-			Free		
	28	I-210 EB Ramps @ Cherry Ave		-			Free		
	29	I-210 WB Ramps @ Citrus Ave		100	Free	100	6:30am-9:30am	Free	3:00pm-7:00pm
	30	I-210 EB Ramps @ Citrus Ave		100	Free	100	6:30am-9:30am	Free	3:00pm-7:00pm
	31	I-210 EB Ramps @ Sierra Ave		110	120		6:30am-11:30am	11:30am-7:00pm	
	32	I-210 WB Ramps @ Sierra Ave		110	120		6:30am-11:30am	11:30am-7:00pm	
	33	I-210 EB Ramps @ Alder Ave	Rialto	-			Free		
	34	I-210 WB Ramps @ Alder Ave		-			Free		
	35	I-210 WB Ramps @ Ayala Dr		90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
	36	I-210 EB Ramps @ Ayala Dr		90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
	37	I-210 WB Ramps @ Riverside Ave		90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
38	I-210 WB Ramps @ Riverside Ave	90		Free	90	6:30am-9:00am	Free	4:00pm-6:00pm	
4	39	I-215 SB Ramps @ 2nd St	San Bernardino	80	80		6:30am-1:00pm	1:00pm-6:00pm	
	40	I-215 NB Ramps @ 2nd St		80	80		6:30am-1:00pm	1:00pm-6:00pm	
	41	I-215 NB Ramps @ Mill St		75	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
	42	I-215 SB Ramps @ Mill St		75	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
	43	I-215 NB Ramps @ Inland Center Dr		80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
	44	I-215 SB Ramps @ Inland Center Dr		80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
	45	SR-30 NB Ramps @ Del Rosa Ave		90	70,80	90	5:45am-9:00am	9:00am-2:00pm	2:00pm-7:00pm
	46	SR-30 SB Ramps @ Del Rosa Ave		90	70,80	90	5:45am-9:00am	9:00am-2:00pm	2:00pm-7:00pm
	47	SR-30 NB Ramps @ 5th St	Highland	-			Free		
	48	SR-30 SB Ramps @ 5th St		-			Free		

Table 4.1(cont.) - Caltrans Traffic Signal Coordination Schedule

Caltrans									
Area (#)	No.	Intersections	City	Weekday					
				Cycle Length (Sec)			Signal Coordination Schedule		
				AM	MD	PM	AM	MD	PM
5	49	I-10 @ Eureka/Peral St EB	Redlands	-			Free		
	50	Orange St (SR-38) @ Pearl St		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	51	Orange St (SR-38) @ Colton Ave		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	52	Orange St (SR-38) @ Brockton Ave		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	53	Lugonia Ave (SR-38) @ Orange St		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	54	Lugonia Ave (SR-38) @ Church St		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	55	Lugonia Ave (SR-38) @ University St		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	56	Lugonia Ave (SR-38) @ Judson St		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	57	Lugonia Ave (SR-38) @ Wabash Ave		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	58	Lugonia Ave (SR-38) @ Dearborn St		90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
	59	SR-30 NB Ramp @ Tennessee St		-			Free		
	60	SR-30 SB Ramp @ Citrus		-			Free		
	61	I-10 EB Ramp @ Yucaipa Blvd	Yucaipa	90	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
	62	I-10 WB Ramp @ Yucaipa Blvd		90	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm

Table 4.2 City of Chino Traffic Signal Coordination Schedule

City of Chino											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Chino Ave	Chino Ave @ East End Ave	7	-	9	50	Free	50	7:00am-8:30am	Free	3:30pm-6:30pm
2		Chino Ave @ Roswell Ave	7	-	9	50	Free	50	7:00am-8:30am	Free	3:30pm-6:30pm
3		Chino Ave @ Pipeline Ave	7	-	9	100	Free	100	7:00am-8:30am	Free	3:30pm-6:30pm
4		Chino Ave @ Norton Ave	7	-	9	50	Free	50	7:00am-8:30am	Free	3:30pm-6:30pm
5		Chino Ave @ Ramona Ave	7	-	9	100	Free	100	7:00am-8:30am	Free	3:30pm-6:30pm
6		Chino Ave @ Yorba Ave	7	-	9	50	Free	50	7:00am-8:30am	Free	3:30pm-6:30pm
7		Chino Ave @ Mountain Ave	7	-	9	100	Free	100	7:15am-9:00am	Free	3:30pm-6:30pm
8		Chino Ave @ Cypress Ave	7	-	9	50	Free	100	7:15am-9:00am	Free	3:30pm-5:45pm
9		Chino Ave @ San Antonio Ave	7	-	9	50	Free	50	7:15am-9:00am	Free	3:30pm-5:45pm
10		Chino Ave @ Fern Ave	7	-	9	100	Free	100	7:15am-9:00am	Free	3:30pm-5:45pm
11	Grand Ave/ Edison Ave	Grand Ave @ Spectrum West	7	11	9	120	120	120	6:30am-9:00am	9:00am-3:30pm	3:30pm-6:30pm
12		Grand Ave @ Spectrum East	7	11	9	120	120	120	6:30am-9:00am	9:00am-3:30pm	3:30pm-6:30pm
13		Grand Ave/Edison Ave @ Pipeline Ave	7	11	9	120	120	120	6:30am-9:00am	9:00am-3:30pm	3:30pm-6:30pm
14		Edison Ave @ Norton Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
15		Edison Ave @ Ramona Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
16		Edison Ave @ Yorba Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
17		Edison Ave @ Monte Vista	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
18		Edison Ave @ 12th St	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
19		Edison Ave @ Oaks Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
20		Edison Ave @ Magnolia Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
21		Edison Ave @ Mountain Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
22		Edison Ave @ Cypress Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
23		Edison Ave @ San Antonio Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
24		Edison Ave @ Fern Ave	7	-	9	100	-	100	6:30am-9:00am	Free	3:30pm-6:30pm
25	Chino Hills Pkwy	Chino Hills Pkwy @ Ramona Ave	-			Free			Free		
27		Chino Hills Pkwy @ Monte Vista	-			Free			Free		
28	Misc.	Ramona Ave @ Schaefer Ave	-			Free			Free		
29		Mountain Ave @ Ortega Ct	7	2	9	100	100	100	6:30am-8:30am	11:00am-3:30pm	3:30pm-6:30pm
30		Mountain Ave @ Schaefer Ave	7	-	9	100	Free	100	6:30am-9:00am	Free	3:30pm-6:30pm

Table 4.3 City of Chino Hills Traffic Signal Coordination Schedule

City of Chino Hills											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Chino Hills Pkwy	Chino Hills Pkwy @ Walnut Creek	7	-	9	100	Free	100	7:00am-9:00am	Free	4:00pm-6:00pm
2		Chino Hills Pkwy @ Grand Ave	7	-	9	100	Free	100	7:00am-9:00am	Free	4:00pm-6:00pm
3		Chino Hills Pkwy @ LaBand Village	7	-	9	100	Free	100	7:00am-9:00am	Free	4:00pm-6:00pm
4		Chino Hills Pkwy @ Founders Ave	7	-	9	100	Free	100	7:00am-9:00am	Free	4:00pm-6:00pm
5		Chino Hills Pkwy @ Windmill Creek Rd	-	-	-	-	Free	-	-	Free	-
6		Chino Hills Pkwy @ Gordon Ranch	7	-	9	100	Free	100	7:00am-9:00am	Free	4:00pm-6:00pm
7		Chino Hills Pkwy @ Eucalyptus Ave	-	-	-	-	Free	-	-	Free	-
8		Chino Hills Pkwy @ Yorba Commons	-	-	-	-	Free	-	-	Free	-
9	Peyton Dr	Peyton Dr @ Rock Springs Dr	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
10		Peyton Dr @ Beverly Glen South	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
11		Peyton Dr @ Chino Ave	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
12		Peyton Dr @ Olympic View Dr	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
13		Peyton Dr @ Grand Ave	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
14		Peyton Dr @ Main	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
15		Peyton Dr @ Payne Ranch	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
16		Peyton Dr @ English Rd	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
17		Peyton Dr @ Bulldog Lane	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
18		Peyton Dr @ Eucalyptus Ave	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
19		Peyton Dr @ Morningfield Dr	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
20		Peyton Dr @ Frost Ave	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
21		Peyton Dr @ Glen Ridge Dr	7	-	9	100	Free	100	7:00am-8:30am	Free	5:00pm-7:00pm
22	Soquel Cyn Rd	Soquel Cyn Rd @ Pinehurst Dr	-	-	-	-	Free	-	-	Free	-
23		Soquel Cyn Rd @ Elinvar Dr/Cypress Point	-	-	-	-	Free	-	-	Free	-
24		Soquel Cyn Rd @ Slate Dr	-	-	-	-	Free	-	-	Free	-
25	Butterfield Ranch Rd	Butterfield Ranch Rd @ Picasso Dr	-	-	-	-	Free	-	-	Free	-
26		Butterfield Ranch Rd @ Salte Dr	-	-	-	-	Free	-	-	Free	-
27		Butterfield Ranch Rd @ Sagebush St	-	-	-	-	Free	-	-	Free	-
28		Butterfield Ranch Rd @ Pine Ave	-	-	-	-	Free	-	-	Free	-
29		Butterfield Ranch Rd @ Sunny Meadow/Mystic Cyn	-	-	-	-	Free	-	-	Free	-
30		Butterfield Ranch Rd @ Brookwood Lane	-	-	-	-	Free	-	-	Free	-
31		Butterfield Ranch Rd @ Shady View Dr	-	-	-	-	Free	-	-	Free	-

Table 4.4 City of Colton Traffic Signal Coordination Schedule

No.	Corridor	Intersections	City of Colton								
			Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Pepper Ave	Pepper @ San Bernardino Ave	7	-	9	100	Free	100	6:45am-9:00am	Free	3:45pm-6:00pm
2		Pepper Ave @ Randall Ave	7	-	9	100	Free	100	6:45am-9:00am	Free	3:45pm-6:00pm
3		Pepper Ave @ Violet Ave	7	-	9	100	Free	100	6:45am-9:00am	Free	3:45pm-6:00pm
4		Pepper Ave @ Blue Ave	7	-	9	100	Free	100	6:45am-9:00am	Free	3:45pm-6:00pm
5	Rancho Ave	Rancho Ave @ Johnson St	7	-	9	85	Free	75	6:45am-9:00am	Free	3:45pm-6:00pm
6		Rancho Ave @ Citrus St	7	-	9	85	Free	75	6:45am-9:00am	Free	3:45pm-6:00pm
7		Rancho Ave @ Laurel St	7	-	9	85	Free	75	6:45am-9:00am	Free	3:45pm-6:00pm
8		Rancho Ave @ Olive St	7	-	9	85	Free	75	6:45am-9:00am	Free	3:45pm-6:00pm
9		Rancho Ave @ C St	7	-	9	85	Free	75	6:45am-9:00am	Free	3:45pm-6:00pm
10	La Cadena Dr	La Cadena Dr/Citrus @ Mount Vernon	1	-	3	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
11		La Cadena Dr @ Laurel St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
12		La Cadena Dr @ Olive St	7	2	9	80	80	80	7:00am-9:00am	9:00am-4:00pm	4:00pm-6:00pm
13		La Cadena Dr @ C St	7	2	9	80	80	80	7:00am-9:00am	9:00am-4:00pm	4:00pm-6:00pm
14		La Cadena @ N St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
15		La Cadena @ 7th St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
16	Mount Vernon Ave	Mount Vernon Ave @ Johnson St	7	-	9	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
17		Mount Vernon Ave @ Olive St	7	-	9	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
18		Mount Vernon Ave @ Colton Ave	7	-	9	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
19		Mount Vernon Ave @ Fairway Dr	7	-	9	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
20		Mount Vernon Ave @ Valley Blvd/I-10 WB	7	-	9	120	Free	120	6:45am-9:00am	Free	3:45pm-6:00pm
21	Reche Canyon	Reche Cyn @ Barton Rd	-			Free			Free		
22		Reche Cyn @ Topanga Way	-			Free			Free		
23		Reche Cyn @ Shane Dr	-			Free			Free		
24	Misc.	Mill St @ Pennsylvania Ave	7	-	9	85	Free	75	7:00am-9:00am	Free	4:00pm-6:00pm
25		Colton Ave @ Fairview Ave	-			Free			Free		

Table 4.5 City of Fontana Traffic Signal Coordination Schedule

City of Fontana											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Mulberry Ave	Mulberry Ave @ Slover Ave	-			Free			Free		
2		Mulberry Ave @ Santa Ana Ave	-			Free			Free		
3		Mulberry Ave @ Marlay Ave	-			Free			Free		
4		Mulberry Ave @ Cherry Ave	-			Free			Free		
5		Mulberry Ave @ Philadelphia St	-			Free			Free		
6	Citrus Ave	Citrus Ave @ Summit Ave	-			Free			Free		
7		Citrus Ave @ Murifield Ln	-			Free			Free		
8		Citrus Ave @ Curtis Ave	-			Free			Free		
9		Citrus Ave @ South Highland Ave	21	-	23	100	Free	100	6:30am-11:00am	Free	3:00pm-7:00pm
10		Citrus Ave @ Walnut Ave	4	-	6	100	Free	100	6:30am-9:30am	Free	3:00pm-7:00pm
11		Citrus Ave @ Miller Ave	-			Free			Free		
12		Citrus Ave @ Pacific Bike Trail	21	-	23	100	Free	110	Free		
13		Citrus Ave @ Merrill Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
14		Citrus Ave @ Fontana Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
15		Citrus Ave @ Randall Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
16		Citrus Ave @ Hawthorne Ave	21	-	23	100	Free	110	6:30am-11:00am	Free	3:00pm-7:00pm
17		Citrus Ave @ San Bernardino Ave	21	-	23	100	Free	110	6:30am-11:00am	Free	3:00pm-7:00pm
18	Sierra Ave	Sierra Ave @ Summit Ave	-			Free			Free		
19		Sierra Ave @ Clubhouse Dr	-			Free			Free		
20		Sierra Ave @ Sierra Lakes Pkwy	11	12		110	120		6:30am-11:30am	11:30am-7:00pm	
21		Sierra Ave @ South Highland Ave	11	12		110	120		9:30am-11:30am	11:30am-7:00pm	
22		Sierra Ave @ Walnut Ave	11	12		110	120		6:30am-11:30am	11:30am-7:00pm	
23		Sierra Ave @ Miller Ave	11	12		110	120		6:30am-11:30am	11:30am-7:00pm	
24		Sierra Ave @ Upland Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
25		Sierra Ave @ Seville Ave/Spring Ave	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
26		Sierra Ave @ Valencia Ave	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
27		Sierra Ave @ Orange Way	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
28		Sierra Ave @ Ceres Ave	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
29		Sierra Ave @ Merrill Ave	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
30		Sierra Ave @ Randall Ave	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
31		Sierra Ave @ San Bernardino Ave	21	23	24	120	120	130	6:30am-11:00am	11:00am-2:45pm	2:45pm-8:00pm
32		Sierra Ave @ Marygold Ave	21	23	24	120	120	130	6:30am-11:00am	11:00am-2:45pm	2:45pm-8:00pm
33		Sierra Ave @ Permanente	21	23	24	120	120	130	6:30am-11:00am	11:00am-2:45pm	2:45pm-8:00pm

Table 4.5 (cont.) City of Fontana Traffic Signal Coordination Schedule

City of Fontana											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
34	Sierra Ave (Cont.)	Sierra Ave @ Technology	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
35		Sierra Ave @ Santa Ana Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
36		Sierra Ave @ Underwood Dr	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
37		Sierra Ave @ Jurupa Ave	21	-	23	100	Free	110	8:00am-9:30am	Free	3:00pm-7:00pm
38	Arrow Blvd	Arrow Blvd @ Citrus Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
39		Arrow Blvd @ Juniper Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
40		Arrow Blvd @ Sierra Ave	21	23		100	110		6:30am-11:00am	11:00am-7:30pm	
41		Arrow Blvd @ Library Ln	4	-	6	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
42		Arrow Blvd @ Mango Ave	21	-	23	100	Free	110	6:30am-7:00am, 7:40am-9:30am	Free	3:00pm-7:00pm
43		Arrow Blvd @ Palmetto Ave	21	-	23	100	-	110	6:30am-9:30am	Free	3:00pm-7:00pm
44		Arrow Blvd @ Tamarind Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
45		Arrow Blvd @ Alder Ave	21	-	23	100	Free	110	6:30am-9:30am	Free	3:00pm-7:00pm
46		Arrow Blvd @ Locust Ave	-			Free			Free		
47	Slover Ave	Slover Ave @ Jasmine Ave	-			Free			Free		
48		Slover Ave @ Commerce Way	-			Free			Free		
49		Slover Ave @ Tower Court/Production	-			Free			Free		
50		Slover Ave @ Empire Center	-			Free			Free		
51	Jurupa Ave	Jurupa Ave @ Mulberry Ave	-			Free			Free		
52		Jurupa Ave @ Almond St	-			Free			Free		
53		Jurupa Ave @ Citrus Ave	-			Free			Free		
54		Jurupa Ave @ Poplar	-			Free			Free		
55		Jurupa Ave @ Cypress Ave	-			Free			Free		
56		Jurupa Ave @ Juniper Ave	-			Free			Free		
57	Sierra Lakes Pkwy	Sierra Lakes Pkwy @ Beech Ave	-			Free			Free		
58		Sierra Lakes Pkwy @ Citrus Ave	21	-	23	100	Free	100	6:30am-9:30am	Free	3:00pm-7:00pm
59		Sierra Lakes Pkwy @ West Augusta Dr	-			Free			Free		
60		Sierra Lakes Pkwy @ Cypress	-			Free			Free		
61		Sierra Lakes Pkwy @ Tiburon Way	-			Free			Free		
62		Sierra Lakes Pkwy @ East Augusta Dr	-			Free			Free		
63	Beech	Beech @ Summit Heights Gateway	-			Free			Free		
64		Beech @ Summit /Frontage Rd	-			Free			Free		
65		Beech @ Sapphire Way	-			Free			Free		

Table 4.6 City of Highland Traffic Signal Coordination Schedule

City of Highland											
No.	Corridor	Intersections	Coordination Plan/Pattern			Weekday					
						Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Victoria Ave	Victoria Ave @ Pacific St	7	-	9	90	Free	90	7:00am-9:00am	Free	3:45pm-6:00pm
2		Victoria Ave @ 14th St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
3		Victoria Ave @ 9th St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
4		Victoria Ave @ 5th St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
5		Victoria Ave @ 3rd St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
6	Boulder Ave	Boulder Ave @ West Driveway	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
7		Boulder Ave @ Beaver Medical Center	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
8		Boulder Ave @ Highland Village Plaza	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
9		Boulder Ave @ Webster St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
10	5th St/ Greenspot Rd	5th St @ Palm Ave	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
11		5th St @ Church Ave	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
12		5th st @ Del Rosa Dr	7	-	9	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
13		5th St @ Sterling	7	-	9	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
14		Greenspot Rd @ Lowe's	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
15		Greenspot Rd @ Shopping Center Driveway	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
16		Greenspot Rd @ Boulder Ave	-			Free			Free		
15		Greenspot Rd @ Orange St	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
16		Greenspot Rd @ Church St	1	-	3	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
17		Greenspot Rd @ E. Village/Highland	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm

Table 4.7 City of Loma Linda Traffic Signal Coordination Schedule

City of Loma Linda											
No.	Corridor	Intersections	Coordination Plan/Pattern			Weekday					
						Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Mountain View Ave	Mountain View Ave @ Mission Rd/Cottonwood	1	-	3	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
2		Mountain View Ave @ Van Leuven St	1	-	3	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
3		Mountain View Ave @ Prospect Ave	1	-	3	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm

Table 4.8 City of Ontario Traffic Signal Coordination Schedule

City of Ontario											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Mountain Ave	Mountain Ave @ 5th St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
2		Mountain Ave @ 4th St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
3		Mountain Ave @ J St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
4		Mountain Ave @ I St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
5		Mountain Ave @ G St	51	52	53	90	90	90	5:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
6		Mountain Ave @ D St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
7		Mountain Ave @ Phillips St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
8		Mountain Ave @ Francis St	51	52	53	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
9	Grove Ave	Grove Ave @ I St	-			Free			Free		
10		Grove Ave @ G St	-			Free			Free		
11		Grove Ave @ D St	51	52	53	90	90	110	6:00am-10:00am	11:00am-3:00pm	3:00pm-7:00pm
12		Grove Ave @ Airport Dr/Slate St	21	52	25	90	90	110	6:15am-8:15am	11:30am-3:00pm	3:00pm-6:30pm
13		Grove Ave @ Lowe's Dwy	-			Free			Free		
14		Grove Ave @ Belmont St	-			Free			Free		
15		Grove Ave @ Acacia St	51	52	53				6:15am-9:15am	11:00am-1:00pm	3:00pm-5:30pm
16		Grove Ave @ Francis St	51	52	53	90	90	110	6:15am-11:00am	11:00am-3:00pm	3:00pm-6:30pm
17	Vineyard Ave	Vineyard Ave @ 8th St	1	2	3	100	90	120	5:30am-9:00am	11:30am-1:15pm	3:45pm-6:30pm
18		Vineyard Ave @ 6th St	-			Free			Free		
19	Milliken Ave	Milliken Ave @ Santa Ana St	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
20		Milliken Ave @ Jurupa St	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
21		Milliken Ave @ Rockefeller Way	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
22		Milliken Ave @ Francis St	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
23	Etiwanda Ave	Etiwanda Ave @ Distribution Way	4	-	6	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
24		Etiwanda Ave @ Santa Ana St	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
25		Etiwanda Ave @ Jurupa St	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
26		Etiwanda Ave @ Francis St	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm

Table 4.8 (cont.) City of Ontario Traffic Signal Coordination Schedule

City of Ontario											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
27	Inland Empire Blvd	Inland Empire Blvd @ Turner Ave	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
28		Inland Empire Blvd @ Shelby Ave	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
29		Inland Empire Blvd @ Center Ave	4	-	6	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
30		Inland Empire Blvd @ Porsche Ave	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
31		Inland Empire Blvd @ Mercedes Ave	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
32		Inland Empire Blvd @ Business Park Drwy/Benihana	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
33		Inland Empire Blvd @ Carnax-Mathis Borthier Drwy	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
34		Inland Empire Blvd @ Ferrari Ave	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
35		Inland Empire Blvd @ Ontario Mills Pkwy									
36	Ontario Mills Pkwy	Ontario Mills Pkwy @ Franklin Ave	-			Free			Free		
37		Ontario Mills Pkwy @ Ontario Mills Dr	-			Free			Free		
38		Ontario Mills Pkwy @ Rochester Ave	-			Free			Free		
39	Airport Dr	Airport Dr @ Vineyard Ave	-			Free			Free		
40		Airport Dr @ S. Moore Way	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
41		Airport Dr @ Terminal Way (West)	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
42		Airport Dr @ Terminal Way (East)	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
43		Airport Dr @ Ground Transportation	31	-	33	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
44		Airport Dr @ Camiege Commerce	-			Free			Free		
45		Airport Dr @ Doubleday Ave	-			Free			Free		
46		Jurupa St @ UPS Driveway	-			Free			Free		
47	Jurupa St	Jurupa St @ Carnegie Ave	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
48		Jurupa St @ Commerce Pkwy	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
49		Jurupa St @ Dupont Ave	4	-	6	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
50		Jurupa St @ Rockefeller Dr	31	-	33	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
51		Jurupa St @ Auto Center Dr	-			Free			Free		
52		Jurupa St @ Vintage Ave (East)	-			Free			Free		

Table 4.9 City of Rancho Cucamonga Traffic Signal Coordination Schedule

City of Rancho Cucamonga											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Grove Ave	Grove Ave @ San Bernardino Rd	-			Free			Free		
2	Carnelian St	Carnelian St @ Lemon	4	-	6	90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
3		Carnelian St @ Highland	4	-	6	90	Free	90	5:30am-8:30am	Free	4:00pm-6:30pm
4		Carnelian St @ 19th St	4	-	6	90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
5		Carnelian St @ La Vine St/ La Garnde	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
6		Carnelian St @ Baseline Rd	7	-	9	100	Free	110	6:30am-9:00am	Free	4:00pm-7:30pm
7		Carnelian St @ Vivero St	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
8		Carnelian St @ Red Hill C.C.	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
9	Vineyard	Vineyard Ave @ Carnelian St	4	-	6	100	Free	110	6:30am-9:00am	Free	3:00pm-7:30pm
10		Vineyard Ave @ San Bernardino Rd	4	-	6	100	Free	110	6:30am-9:00am	Free	3:00pm-7:30pm
11		Vineyard Ave @ Arrow Rte	4	-	6	100	Free	100	6:30am-9:00am	Free	3:00pm-7:30pm
12		Vineyard Ave @ 9th St	4	-	6	100	Free	100	6:30am-9:00am	Free	3:00pm-7:30pm
13	Archibald Ave	Archibald Ave @ Lemon	-			Free			Free		
14		Archibald Ave @ Highland	-			Free			Free		
15		Archibald Ave @ 19th St	4	-	6	90	Free	90	5:30am-9:00am	Free	4:00pm-7:00pm
16		Archibald Ave @ Pacific Electric Bike Trail	4	-	6	90	Free	90	6:30am-9:00am	Free	4:00pm-7:00pm
17		Archibald Ave @ Baseline Rd	4	-	6	100	Free	110	6:30am-9:00am	Free	4:00pm-7:00pm
18		Archibald Ave @ Church St	7	-	9	100	Free	110	6:30am-9:00am	Free	4:00pm-7:30pm
19		Archibald Ave @ Tryon	4	-	6	100	Free	110	6:30am-9:30am	Free	4:00pm-7:30pm
20		Archibald Ave @ San Bernardino Rd	4	-	6	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
21		Archibald Ave @ Arrow Rte	4	-	6	100	Free	100	6:30am-9:00am	Free	4:00pm-7:00pm
22		Archibald Ave @ 9th St	4	-	6	100	Free	100	6:30am-9:00am	Free	4:00pm-7:30pm
23		Archibald Ave @ 8th St	4	-	6	100	Free	100	6:30am-9:00am	Free	4:00pm-7:30pm
24		Archibald Ave @ 6th St	4	-	6	100	Free	100	6:30am-9:00am	Free	4:00pm-7:30pm
25	Milliken Ave	Milliken Ave @ Vintage	4	-	6	90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
26		Milliken Ave @ Kenyon	4	-	6	90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
27		Milliken Ave @ Victoria Park Ln	4	-	6	90	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm

Table 4.9 (cont.) City of Rancho Cucamonga Traffic Signal Coordination Schedule

City of Rancho Cucamonga											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
28	Milliken Ave (Cont.)	Milliken Ave @ Fairmont	4	-	6	90	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
29		Milliken Ave @ Central Park Entrance	7	-	9	90	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
30		Milliken Ave @ Baseline Rd	7	-	9	110	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
31		Milliken Ave @ Terra Vista Pkwy	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
32		Milliken Ave @ Mountain View Dr	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
33		Milliken Ave @ Central Park	4	-	6	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
34		Milliken Ave @ Church St	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:30pm
35		Milliken Ave @ Millennium Ct	7	-	9	100	Free	110	6:30am-8:30am	Free	4:00pm-7:00pm
36		Milliken Ave @ Arrow Rte	7	-	9	100	Free	100	6:30am-8:30am	Free	4:00pm-7:30pm
37		Milliken Ave @ Jersey	7	-	9	100	Free	100	6:30am-8:30am	Free	4:00pm-7:30pm
38		Milliken Ave @ 7th St	7	-	9	100	Free	100	6:30am-9:00am	Free	3:45pm-7:00pm
39		Milliken Ave @ 6th St	7	-	9	100	Free	100	6:30am-9:00am	Free	3:45pm-7:00pm
40	Day Creek Blvd	Day Creek Blvd @ Highland	4	-	6	135	Free	135	6:30am-9:00am	Free	3:45pm-7:30pm
41		Day Creek Blvd @ Silverberry St	7	-	9	90	Free	90	6:30am-8:30am	Free	4:00pm-7:30pm
42		Day Creek Blvd @ Victoria Park Ln	7	-	9	90	Free	90	6:30am-9:00am	Free	3:45pm-7:30pm
43		Day Creek Blvd @ Sugar Gum St	7	-	9	90	Free	90	6:30am-9:00am	Free	3:45pm-7:30pm
44		Day Creek Blvd @ Firehouse	7	-	9	90	Free	90	7:00am-9:00am	Free	3:45pm-7:00pm
45		Day Creek Blvd @ Baseline Rd	7	2	9	110	110	110	6:30am-8:30am	11:00am-1:00pm	4:00pm-7:30pm
46	Arrow Rte	Arrow Rte @ Baker Ave	-			Free			Free		
47		Arrow Rte @ Hellman Ave	7	-	9	100	Free	100	6:30am-8:30am	Free	4:00pm-7:30pm
48		Arrow Rte @ Hermosa Ave	4	-	6	100	Free	100	6:30am-8:30am	Free	4:00pm-7:30pm
49		Arrow Rte @ Center Ave	4	-	6	100	Free	100	6:30am-8:30am	Free	4:00pm-7:30pm
50		Arrow Rte @ Red Oak St	7	-	9	100	Free	100	6:30am-9:00am	Free	4:00pm-7:00pm
51		Arrow Rte @ White Oak	7	-	9	100	Free	100	6:30am-9:00am	Free	4:00pm-7:00pm
52		Arrow Rte @ Rochester Ave	4	-	6	100	Free	100	6:30am-8:30am	Free	4:00pm-7:30pm
53		Arrow Rte @ Etiwanda	7	-	9	100	Free	100	6:30am-8:30am	Free	4:00pm-7:00pm

Table 4.10 City of Redlands Traffic Signal Coordination Schedule

City of Redlands											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	San Bernardino Ave	San Bernardino Ave @ Mountain View Ave	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
2		San Bernardino Ave @ Palmetto Ave/Marigold	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
3		San Bernardino Ave @ California St	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
4		San Bernardino Ave @ Texas St	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
5	Alabama St	Alabama St @ Park Ave	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
6		Alabama St @ Citrus Ave/Slate	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
7		Alabama St @ Orange Ave	1/1/1	-	1/3/1	90	Free	90	6:30am-8:30am	Free	4:00pm-7:00pm
8	Orange St	Orange St @ San Bernardino Ave	1/1/1	-	1/3/1	90	Free	90	6:00am-9:00am	Free	2:45pm-6:00pm
9		Orange St @ Pennsylvania Ave	1/1/1	-	1/3/1	90	Free	90	6:00am-9:00am	Free	2:45pm-6:00pm
10		Orange St @ Stuart St	1/1/1	-	1/3/1	90	Free	90	6:00am-9:00am	Free	2:45pm-6:00pm
11	Lugonia Ave	Lugonia Ave @ Citrus Pl	1/1/1	-	1/3/1	90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
12		Lugonia Ave @ Home Depot	1/1/1	-	1/3/1	90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
13		Lugonia Ave @ New York St	1/1/1	-	1/3/1	90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
14		Lugonia Ave @ Texas St	1/1/1	-	1/3/1	90	Free	90	6:30am-9:00am	Free	2:45pm-6:00pm
15	Misc	Texas St @ Colton Ave	-			Free			Free		

Table 4.11 City of Rialto Traffic Signal Coordination Schedule

No.	Corridor	Intersections	City of Rialto								
			Coordination Plan			Cycle Length (Sec)			Weekday		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Cedar Ave/ Ayala Dr	Ayala Dr & Bohnert Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
2		Ayala Dr & Casmalia	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
3		Ayala Dr & Easton Ave	7	-	9	90	Free	90	7:00am-9:00am	Free	4:00pm-6:00pm
4		Ayala Dr & Walnut/Fire Station	7	-	9	Free			Free		
5		Cedar Ave & Etiwanda Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
6		Cedar Ave & Rialto Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
7		Cedar Ave & Merrill Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
8	Riverside Ave	Riverside Ave & Live Oak	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
9		Riverside Ave & Alder Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
10		Riverside Ave & Locust Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
11		Riverside Ave & Cedar/Ayala Dr	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
12		Riverside Ave & Knollwood Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
13		Riverside Ave & Country Club/Cactus Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
14		Riverside Ave & Eatson Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
15		Riverside Ave & Walnut St	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
16		Riverside Ave & Etiwanda Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
17		Riverside Ave & 1st St	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
18		Riverside Ave & Rialto Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
19		Riverside Ave & Merrill Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
20		Riverside Ave & Randall Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
21		Riverside Ave & Santa Ana Ave	7	-	9	90	Free	90	6:30am-8:30am	Free	4:00pm-6:00pm
22		Riverside Ave & Jurupa Ave	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
23		Riverside Ave & Industrial Dr	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
24		Riverside Ave & Agua Manza Rd	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
25		Riverside Ave & Franzman Ranch	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
26		Riverside Ave & Klein Ranch Rd	7	-	9	90	Free	90	6:30am-9:00am	Free	4:00pm-6:00pm
27	Willow Ave	Willow Ave @ 1st St	-			Free			Free		
28		Willow Ave @ Rialto Ave	-			Free			Free		
29	Bloomington Ave	Bloomington Ave @ Willow Ave	-			Free			Free		
30		Bloomington Ave @ Lilac Ave/Randall Ave	-			Free			Free		
31		Bloomington Ave @ Cactus Ave	-			Free			Free		
32		Bloomington Ave @ Spruce/San Bernardino Ave	-			Free			Free		
33	Misc.	Rialto Ave @ Linden	-			Free			Free		
34		Cactus Ave @ Rialto Ave	-			Free			Free		

Table 4.12 City of San Bernardino Traffic Signal Coordination Schedule

City of San Bernardino											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Mount Vernon Ave	Mount Vernon Ave @ 21st St	1	-	3	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
2		Mount Vernon Ave @ 16th St	1	-	3	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
3		Mount Vernon Ave @ 10th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
4		Mount Vernon Ave @ 9th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
5		Mount Vernon Ave @ 7th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
6		Mount Vernon Ave @ 6th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
7		Mount Vernon Ave @ 2nd St	-			Free			Free		
8		Mount Vernon Ave @ Rialto Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
9		Mount Vernon Ave @ Walnut	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
10		Mount Vernon Ave @ Mill St	-			Free			Free		
11	Inland Center Dr	Inland Center Dr @ G St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
12		Inland Center Dr @ Adell	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
13		Inland Center Dr @ I St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
14	Arrowhead Ave	Arrowhead Ave @ 30th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
15		Arrowhead Ave @ 26th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-6:00pm
16		Arrowhead Ave @ 13th St	7	-	9	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
17		Arrowhead Ave @ 9th St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
18		Arrowhead Ave @ 7th St	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
19		Arrowhead Ave @ 6th St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
20		Arrowhead Ave @ 5th St	1	2,9	3	90	70,60	90	6:00am-9:00am	00am-1:00pm-3:00pm	3:00pm-7:00pm
21		Arrowhead Ave @ 4th St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
22		Arrowhead Ave @ Court St	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
23		Arrowhead Ave @ 3rd St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
24		Arrowhead Ave @ 2nd St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
25		Arrowhead Ave @ Rialto Ave	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
26		Arrowhead Ave @ Mill St	-			Free			Free		

Table 4.12 (cont.) City of San Bernardino Traffic Signal Schedule

City of San Bernardino											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
27	Del Rosa Ave	Del Rosa Dr @ Lynwood	1	-	3	90	Free	90	5:45am-9:00am	Free	3:00pm-7:00pm
28		Del Rosa Dr @ Date St	7	1,2	9	90	70,80	90	5:45am-9:00am	9:00am-2:00pm	2:00pm-7:00pm
29		Del Rosa Dr @ Date Pl	7	1,2	9	90	70,80	90	5:45am-9:00am	9:00am-2:00pm	2:00pm-7:00pm
30		Del Rosa Dr @ Pumalo	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
31		Del Rosa Dr @ Del Rosa Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
32		Del Rosa Dr @ 9th St	1	-	3	90	Free	90	6:45am-9:00am	Free	3:45pm-6:00pm
33		Del Rosa Dr @ 6th St	7	-	9	90	Free	90	6:00am-9:15am	Free	3:00pm-7:00pm
34		Del Rosa Dr @ 3rd St	1	-	3	90	Free	90	6:00am-9:15am	Free	3:00pm-7:00pm
35		Del Rosa Dr @ Rialto Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
36		Del Rosa Dr @ Harry Shepard	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
37	40th St	40th St @ H St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
38		40th St @ Electric	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
39		40th St @ Mountain View	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
40		40th St @ Sierra Way	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
41		40th St @ Sepulveda	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
42	5th St	5th St @ G St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
43		5th St @ F St	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
44		5th St @ D St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
45		5th St @ Mountain View	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
46		5th St @ Sierra Way	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
47		5th St @ Sterling	-			Free			Free		
48		5th St @ Mount Vernon	-			Free			Free		
49	3rd St	3rd St @ Leland Norton Way	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-6:00pm
50		3rd St @ Sterling	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-6:00pm

Table 4.12 (cont.) City of San Bernardino Traffic Signal Coordination Schedule

City of San Bernardino											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
51	2nd St	2nd St @ Metrolink	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
52		2nd St @ L St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
53		2nd St @ I St	1	-	3	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
54		2nd St @ G St	1	-	3	80	Free	80	6:00am-9:00am	Free	3:00pm-7:00pm
55		2nd St @ F St	7	-	9	80	Free	80	5:30am-9:00am	Free	3:00pm-6:00pm
56		2nd St @ D St	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
57		2nd St @ Sierra Way	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
58		2nd St @ Waterman Ave	-			Free			Free		
59	Rialto Ave	Rialto Ave @ Pepper Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
60		Rialto Ave @ Rancho Ave	1	-	3	90	Free	90	5:45am-9:00am	Free	3:00pm-7:00pm
61		Rialto Ave @ Santa Fe Way	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
62		Rialto Ave @ K St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
63		Rialto Ave @ I St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
64		Rialto Ave @ G St	1	2	3	90	70	90	6:00am-9:00am	9:00am-3:00pm	3:00pm-7:00pm
65		Rialto Ave @ D St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
66		Rialto Ave @ Sierra Way	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
67		Rialto Ave @ Waterman Ave	1	2	4	90	80	90	6:00am-9:00am	9:00am-3:00pm	3:00pm-7:00pm

Table 4.12 (cont.) City of San Bernardino Traffic Signal Coordination Schedule

City of San Bernardino											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
68	Mill St	Mill St @ Eucalyptus	7	-	9	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
69		Mill St @ Pepper Ave	1	-	3	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
70		Mill St @ Meridian Ave	7	-	9	100	Free	100	6:00am-9:00am	Free	3:00pm-7:00pm
71		Mill St @ Macy	1	-	3	85	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
72		Mill St @ Rancho Ave	1	-	3	85	Free	75	5:45am-9:00am	Free	3:00pm-7:00pm
73		Mill St @ K St	7	-	9	75	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
74		Mill St @ I St	7	-	9	75	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
75		Mill St @ Crescent Ave	7	-	9	75	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
76		Mill St @ G St	7	-	9	75	Free	75	6:00am-9:00am	Free	3:00pm-7:00pm
77		Mill St @ Sierra Way	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
78		Mill St @ Waterman Ave	4	-	6	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
79		Mill St @ Doolittle St	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
80		Mill St @ Lena Rd	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
81		Mill St @ 2nd Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
82	Orange Show Rd/ San Bernardino Ave	Orange Show Rd @ Arrowhead Ave	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
83		Orange Show Rd @ Washington Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
84		Orange Show Rd @ Waterman Ave	7	-	9	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
85		Orange Show Rd @ Private Driveway	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm
86		San Bernardino Ave @ Richardson St	1	-	3	90	Free	90	6:00am-9:00am	Free	3:00pm-7:00pm

Table 4.13 County of San Bernardino Traffic Signal Coordination Schedule

San Bernardino County								
Area (#)	No.	Intersections	Weekday					
			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM
3	1	Cedar Ave @ Randall Ave	90	-	90	6:30am-9:00am	Free	4:00pm-6:00pm
	2	Cedar Ave @ Santa Ana Ave	90	-	90	6:00am-9:00am	Free	3:00pm-7:00pm
	3	Cedar Ave @ Jurupa Ave	90	-	90	6:00am-9:00am	Free	3:00pm-7:00pm
	4	Cedar Ave @ 11th St	90	-	90	6:00am-9:00am	Free	3:00pm-7:00pm
	5	Bloomington Ave @ Larch Ave	-			Free		
	6	San Bernardino Ave @ Redwood Ave	100	-	100	7:30am-8:30am	Free	2:30pm-4:00pm
	7	San Bernardino Ave @ Live Oak	100	-	100	7:30am-8:30am	Free	2:30pm-4:00pm
	8	San Bernardino Ave @ Hemlock Ave	100	-	100	7:30am-8:30am	Free	2:30pm-4:00pm
	9	San Bernardino Ave @ Beech Ave	100	-	100	7:30am-8:30am	Free	2:30pm-4:00pm
	10	San Bernardino Ave @ Fontana Ave/Elm	100	-	100	7:30am-8:30am	Free	2:30pm-4:00pm
	11	San Bernardino Ave @ Locust Ave	-			Free		
	12	San Bernardino Ave @ Linden Ave	-			Free		
4	13	Del Rosa Dr @ Pacific St	90	-	90	6:45am-9:00am	Free	3:45pm-6:00pm
	14	Reche Cyn @ Prado Ln	-			Free		
	15	3rd St @ Lena Dr	-			Free		
5	16	Alabama St @ River Bluff Ave	90	-	90	6:30am-8:30am	Free	4:00pm-7:00pm
	17	Alabama St @ Palmetto	90	-	90	6:30am-8:30am	Free	4:00pm-6:00pm
	18	Alabama St @ Pioneer Ave	90	-	90	6:30am-8:30am	Free	4:00pm-6:00pm
	19	Alabama St @ San Bernardino Ave	90	-	90	6:30am-8:30am	Free	4:00pm-6:00pm
	20	Alabama St @ Almond St	90	-	100	6:30am-8:30am	Free	4:00pm-7:00pm
	21	Alabama St @ Citrus Plaza	90	-	100	6:30am-8:30am	Free	4:00pm-7:00pm
	22	Lugonia Ave @ Citrus Way	90	-	90	6:30am-8:30am	Free	4:00pm-7:00pm
	23	San Bernardino Ave @ Nevada St	90	-	90	6:30am-8:30am	Free	4:00pm-7:00pm
	24	Lugonia Ave @ Indiana Ct	90	-	90	6:30am-8:30am	Free	4:00pm-7:00pm

Table 4.14 City of Upland Traffic Signal Coordination Schedule

City of Upland											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Arrow Rte	Arrow Rte @ College Park	-			Free			Free		
2		Arrow Rte/Arrow Hwy St @ Benson Ave	1	3		90	90		6:00am-10:00am	10:00am-9:00pm	
3	Arrow Hwy	Arrow Hwy @ Mountain Ave	1	2	3	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-10:00pm
4		Arrow Hwy @ San Antonio Ave	-			Free			Free		
5		Arrow Hwy @ 2nd Ave	-			Free			Free		
6		Arrow Hwy @ 3rd Ave	-			Free			Free		
7		Arrow Hwy @ 5th Ave	-			Free			Free		
8		Arrow Hwy @ Campus Ave	-			Free			Free		
9		Arrow Hwy @ San Bernardino Rd	-			Free			Free		
10	Benson Ave	Benson Ave @ 16th St	1	-	3	90	Free	90	5:00am-9:00am	Free	2:30pm-7:00pm
11		Benson Ave @ 15th St	1	3		90	90		6:00am-10:00am	10:00am-7:00pm	
12		Benson Ave @ Fire Station	-			Free			Free		
13		Benson Ave @ 13th St	1	3		90	90		6:45am-10:00am	10:00am-7:00pm	
14		Benson Ave @ 11th St	1	3		90	90		7:00am-10:00am	10:00am-7:00pm	
15		Benson Ave @ Bike Crossing/Huntington	-			Free			Free		
16		Benson Ave @ 9th St	1	3		90	90		7:00am-10:00am	10:00am-7:00pm	
17	Mountain Ave	Mountain Ave @ 21st St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
18		Mountain Ave @ 19th St	1	2	3	90	100	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
19		Mountain Ave @ 18th St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
20		Mountain Ave @ 17th St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
21		Mountain Ave @ 16th St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
22		Mountain Ave @ 15th St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
23		Mountain Ave @ 14th St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
24		Mountain Ave @ 13th St	1	2	3	90	90	90	6:00am-9:00am	9:00am-2:00pm	2:00pm-8:00pm
25		Mountain Ave @ 11th St	1	2	3	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-10:00pm
26		Mountain Ave @ Bike Crossing	-			Free			Free		
27		Mountain Ave @ 9th St	1	2	3	90	90	90	6:00am-10:00am	10:00am-2:00pm	2:00pm-7:00pm
28	Campus Ave	Campus Ave @ 19th St (East)	7	9		90	90		6:30am-9:00am	11:00am-7:00pm	
29		Campus Ave @ Shopping Center (Crossroads Dr)	7	9		90	90		6:30am-9:00am	11:00am-7:00pm	
30		Campus Ave @ 19th St (West)/Fire House	7	9		90	90		6:30am-9:00am	11:00am-7:00pm	
31		Campus Ave @ Colonies	7	9		90	90		6:30am-9:00am	11:00am-7:00pm	
32		Campus Ave @ Viewpoint	7	8	9	90	70	90	6:30am-8:30am	11:00am-2:00pm	4:00pm-7:00pm
33		Campus Ave @ 16th St	7	8	9	90	70	90	6:30am-8:30am	11:00am-2:00pm	4:00pm-7:00pm
34	Misc	Colonies Pkwy @ 19th St	-			Free			Free		

Table 4.15 City of Yucaipa Traffic Signal Coordination Schedule

City of Yucaipa											
No.	Corridor	Intersections	Weekday								
			Coordination Plan/Pattern			Cycle Length (Sec)			Signal Coordination Schedule		
			AM	MD	PM	AM	MD	PM	AM	MD	PM
1	Yucaipa Blvd	Yucaipa Blvd @ Hampton Rd/Avenue E	7	-	9	90	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
2		Yucaipa Blvd @ 14th St/Sand Canyon Rd	7	-	9	110	Free	110	6:30am-8:30am	Free	3:30pm-6:30pm
3		Yucaipa Blvd @ 13th St	7	-	9	110	Free	110	6:30am-7:15am, 8:00am-9:00am	Free	3:30pm-6:00pm
4		Yucaipa Blvd @ 12th St	7	-	9	110	Free	110	6:30am-7:15am, 8:00am-9:00am	Free	3:30pm-6:00pm
5		Yucaipa Blvd @ 10th St	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
6		Yucaipa Blvd @ Oak Glen Rd	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
7		Yucaipa Blvd @ Yucaipa Valley Circle	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
8		Yucaipa Blvd @ 7th St	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
9		Yucaipa Blvd @ 6th St	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
10		Yucaipa Blvd @ 5th St	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
11		Yucaipa Blvd @ 4th St	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
12		Yucaipa Blvd @ 3rd St	7	-	9	110	Free	110	6:30am-9:00am	Free	3:30pm-6:00pm
13		Yucaipa Blvd @ Bryant St	-			Free			Free		
14	Oak Glen Rd	Oak Glen Rd @ 14th St/Calimesa Blvd	-			Free			Free		
15		Oak Glen Rd @ Avenue E	-			Free			Free		
16		Oak Glen Rd @ Chapman Heights Rd	-			Free			Free		
17		Oak Glen Rd @ 5th St	-			Free			Free		
18		Oak Glen Rd @ Stonewood Dr	-			Free			Free		
19		Oak Glen Rd @ Sunnyside Dr	-			Free			Free		
20		Oak Glen Rd @ Bryant St	-			Free			Free		

Figure 4.17 - Example of Time-Space Diagram -- Grand / Edison Ave AM

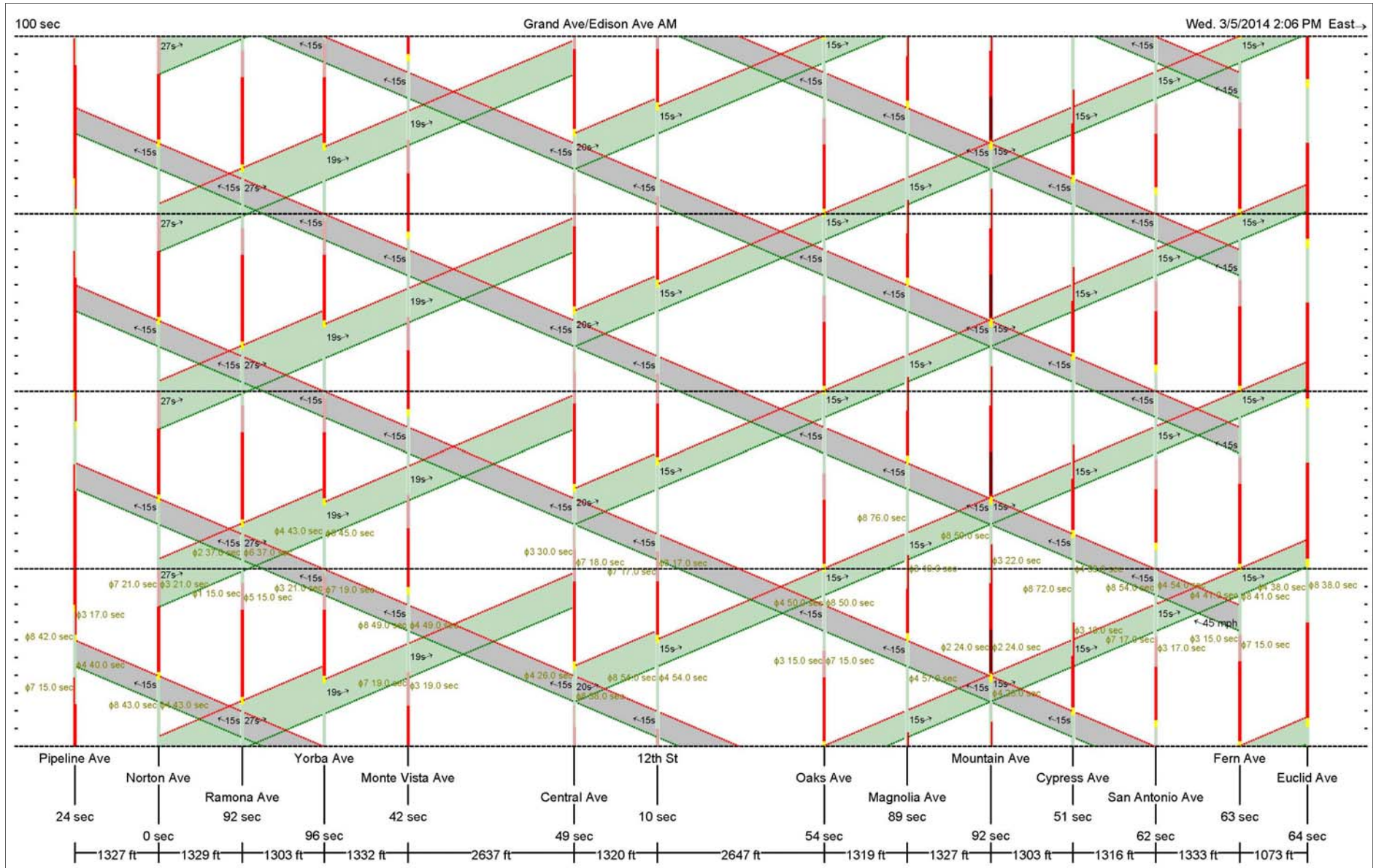
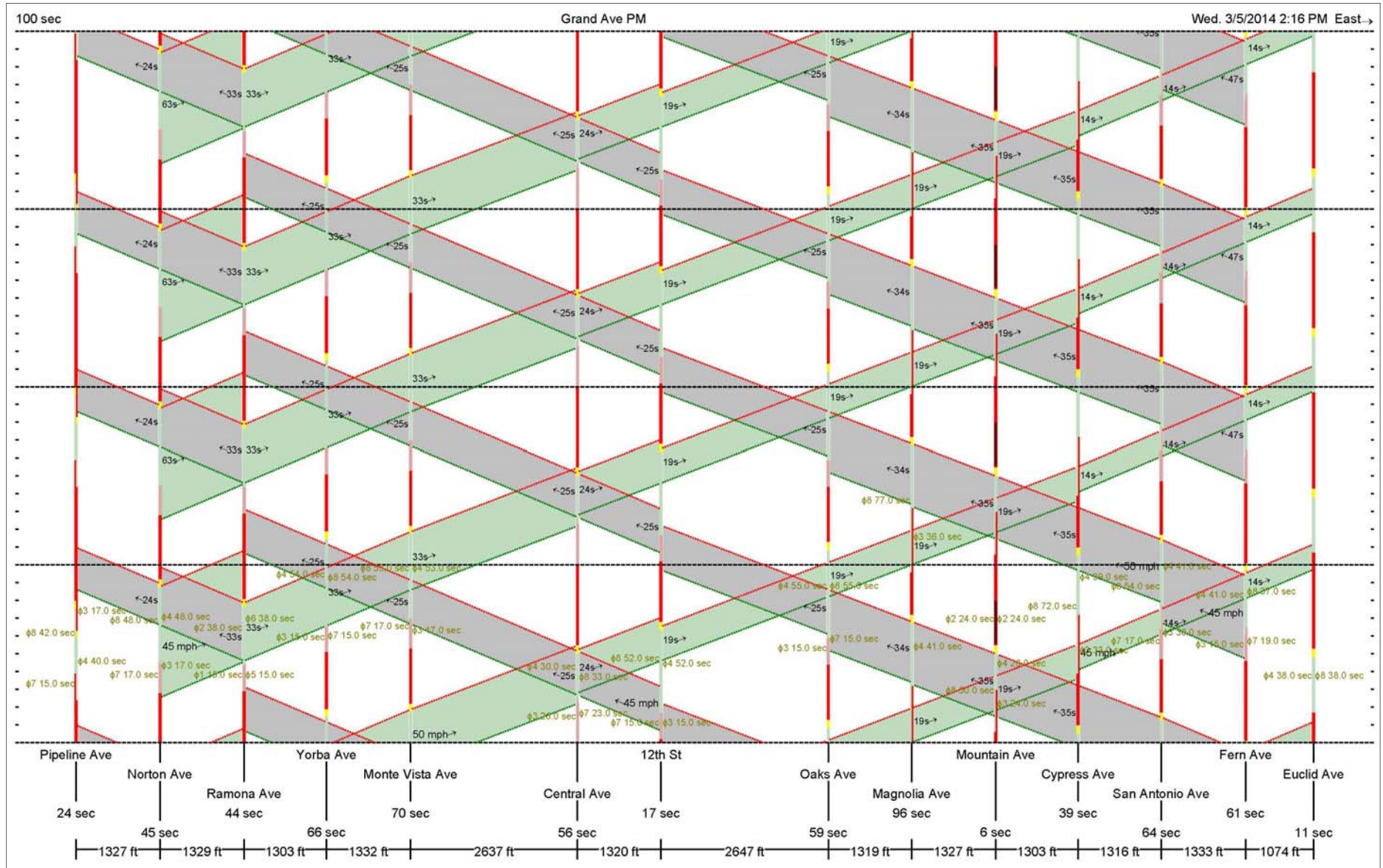


Figure 4.18 - Example of Time-Space Diagram -- Grand / Edison Ave PM



5. Synchronization Results

ADVANTEC conducted 'Before' and 'After' studies to evaluate the results from implementation of synchronized signal timings and to determine the measures of effectiveness (MOE). 'Before' study was performed in the Fall of 2011, while 'After' study was done from October 2013 to February 2014.

5.1 'Before' Study

Prior to implementation of coordination timings, ADVANTEC performed an Arterial Travel Time Study using a "floating car" survey along Tier 3 & 4 corridors. The purpose of this study was to establish baseline 'Measures of Effectiveness (MOE)' values to determine benefits resulting from synchronization. The survey was conducted using Tru-Traffic software and a GPS receiver connected to a laptop computer in a moving vehicle that 'floats' with prevailing traffic, hence this is sometimes called the 'floating car' survey. The GPS receiver outputs global coordinates (latitude and longitude) of the vehicle every second. The software then uses the GPS coordinates to calculate the speed and distance of the surveying vehicle. ADVANTEC staff performed five or more 'floating car' survey runs for each corridor in both directions during peak traffic periods. The resulting MOE parameters are obtained pertaining to travel characteristics, such as travel time, delay, number of stops and average speed.

5.2 'After' Study

After implementation and fine-tuning of coordination timings on each corridor, ADVANTEC performed a follow-up 'After' Study in the same manner as was done for the 'Before' study. The purpose of this study is to establish post-project MOE values to determine the benefits resulting from synchronization of each corridor. Similar to the 'Before' Study, a minimum of five runs were conducted in each direction within the heaviest 2 hours of traffic (some corridors may have peak periods shorter than 2 hours). In general, AM peak period is from 7AM to 9PM, midday peak is from 11:30AM to 1:30PM, and PM peak is from 4 PM to 6 PM. For shorter corridors, with time permitting, more than 5 runs were collected.

It should be noted that both 'Before' and 'After' Studies were conducted only from Tuesdays to Thursdays that represent typical weekday commuter traffic. Holidays and school break time are excluded from 'Before' or 'After' study scheduling.

5.3 Measures of Effectiveness (MOE)

ADVANTEC evaluated the following travel characteristics as measures of travel performance, which were computed based on each GPS trip log data from 'Before' and 'After' runs:

- Travel time
- Delay (travel time difference from user-specified speed and distance)
- Number of Stops
- Average Speed

Evaluation of improvement for each corridor is performed by comparing the travel time performance results of 'Before' and 'After' conditions. For each parameter, average round-trip results was computed to estimate the overall improvement from both directions in each corridor. Average Speed is the Space-Mean-Speed of a round trip (Time-Mean-Speed is a biased estimator and not used in this calculation). ADVANTEC strived to achieve optimal improvements in both directions throughout the course of work from design to implementation and fine-tuning, with priority given to the heavier traffic direction. The objective is to reduce travel times and delay, and reduce the number of stops for the highest number of drivers. The results for each corridor are presented in Section 6.

5.4 Fuel Consumption and Vehicle Emissions

In addition to reducing vehicular travel time on the road, fuel savings and reduction of emissions from motor vehicles are the other major goals of the project. Therefore, the quantification of fuel consumption and Emissions for 'Before' and 'After' conditions is needed in order to evaluate the benefits of the project.

ADVANTEC utilized Tru-Traffic software to estimate fuel consumption and emissions, using intersection peak hour turn movement count and GPS trip log data as inputs to calculate the hourly rates of fuel consumption, major greenhouse gas (CO₂) and other air pollutants emissions, such as CO, NO_x and Volatile Oxygen Compounds (VOC) and the cumulative vehicle travel time, and vehicle-hour-traveled (VHT). Only the through movement traffic volumes were used in the calculation of cumulative fuel consumption and emissions.

5.4.1 Estimation Algorithms

Vehicle Travel Time

Vehicle-Hour-Traveled (VHT), is the measure of cumulative travel time spent on the road. The hourly rate is calculated as:

$$VHT \text{ (veh-hr/ hr)} = \text{Travel Time (per Trip)} \times \text{Volume (vph)}$$

Fuel Consumption Estimation Models

A simple way of estimating fuel consumption is through the use of Vehicle-Mile-Traveled and Vehicle-Hour-Traveled. However, to achieve a higher level of accuracy, ADVANTEC used the average of the results from the following two estimation models, which are both based on engine characteristics of acceleration, and loss of energy during deceleration. The average of these two analysis is used.

- Fuel Consumption is based on the number of stops, delay, travel distance, free-flow speed (or design speed), and through volumes, using University of Florida model with TRANSYT7F-10 default coefficients.
- Fuel Consumption is based on the number of stops, delay, travel distance, free-flow speed (or design speed), and through volumes, using Penic & Upchurch model with TRANSYT7F-10 default coefficients.

Emissions Estimation Models

Emissions of CO and NO_x in (g/hr), and CO₂ in (kg/hr) are based on the instantaneous speed and acceleration data contained in the Tru-Traffic trip logs, using the formulas from the *Comprehensive Modal Emissions Model (CMEM) NCHRP Project 25-11*, and the coefficients from Table 4.4 for Vehicle Technology Category #4: "3-way Catalyst, FI, >50K miles, low power/weight".

VOC emissions was estimated using Synchro software (from unpublished Oak Ridge National Labs letter to Federal Highway Administration) and Penic & Upchurch for Fuel Consumption estimation.

It should be noted that such model estimation of CO and NO_x emissions is not a linear function of instantaneous speed and acceleration, so improvements on overall travel time does not necessarily reflect a reduction in emissions. Emissions of CO and NO_x may fluctuate with 'After' conditions depending on which range the 'After' average speed lies on. However, it is important to evaluate the 'Before' and 'After' emissions of CO and NO_x as these compounds are major components of air pollutants contributed by motor vehicles.

5.4.2 Peak Period, Daily and Annual Rate Calculations

Peak Period Rate

As hourly emissions and fuel consumption were computed, peak period emissions and fuel consumption were calculated by multiplication of hourly rate and the average number of hours per period when the timing plans were implemented. The core implementation hours for each peak period are listed below:

- AM Peak Period: 6:30am - 9:00am (2.5 hours)
- Mid-day Peak Period: 10:00 am - 2:00 pm (4 hours)
- PM Peak Period: 3:00pm - 6:30 pm (3.5 hours)

It should be noted that many corridors actually have longer implemented peak periods that are listed above while a few has shorter peak periods. ADVANTEC calculated the benefits using the time periods listed above, to derive a conservative estimation of benefits.

Daily Rate and Annual Rate

Daily Vehicle Travel Time, Fuel Consumption and Emission rates are calculated as the sum of each peak period results for a typical day.

Midday plans were developed or optimized for agencies that already had a midday plan, or have requested it. Midday plans were implemented for Campus Ave, Mountain Ave, Grove Ave and Sierra Ave.

Assuming 250 weekdays per year, the annual Vehicle Travel Time, Fuel Consumption and Emission rates were calculated accordingly. They were calculated for each corridor, and the results were compared and benefits were estimated from the improvements.

5.5 Monetary Equivalent of Parameters

To serve as a platform for comparing the benefits of this project as they impact the environment and quality of travel, it is customary to convert all MOEs to a monetary equivalent unit of dollars. In this manner, the overall 'benefit/cost' (B/C) ratio of the whole project can also be derived.

Monetary measures of annual savings are derived from reduction of vehicle travel time, fuel consumption and emissions.

The California Benefit-Cost (Cal B-C) model is accepted by the California Transportation Commission and many Metropolitan Planning Organizations as a basis for converting different MOEs to monetary terms. The Cal B-C model has been used to establish the cost effectiveness of many transportation infrastructure projects. For example, addition of HOV lanes to an existing freeway without reduction of general purpose lanes typically has a B/C ratio of 1.8 to 1. Ramp metering typically has a B/C of 7 to 1.

In this project, it was decided to adopt monetary values used to calculate traffic signal synchronization project benefits both in Northern and Southern California by the Metropolitan Transportation Commission (MTC - PASS program) and Orange County Transportation Authority (OCTA - Project P). **Table 5.5** shows the parameter values adopted and comparison with the Cal B-C model values.

Table 5.1 Economic Values of Parameters

Parameters	MTC & OCTA	Cal_BC v5.0		
		CA Urban	CA Rural	L.A. / South Coast
Fuel Cost (per gallon)	\$3.90	\$3.71	\$3.71	\$3.71
Value of Time (per hour)	\$11.84	\$12.50	\$12.50	\$12.50
ROG / VOC (per ton)	\$1,259	\$1,210	\$950	\$3,675
NOx (per ton)	\$17,997	\$17,300	\$12,900	\$59,100
CO (per ton)	\$77	\$75	\$70	\$145
CO2 (per ton)	\$23	\$23	\$23	\$23

Summary of monetary savings results is presented in **Section 6**.

6. Project Benefits

This section summarizes the benefits resulting from Tiers 3 & 4 project. Based on the 'Before' and 'After' study results, ADVANTEC has evaluated the project benefits and compared it against the project cost.

Tangible project benefits resulting from synchronization were evaluated based on 'Before-After' study results. Project benefits that were evaluated as part of this project included:

- **Travel Time Savings** – These savings apply to automobile, truck and transit passengers, who benefit from reduced costs according to their “value of time”.
- **Fuel Consumption Savings** – These are primarily the reduction in fuel consumption for all types of vehicles as a function of distance and time.
- **Vehicle Maintenance Savings** – These are savings associated with the reduction in wear and tear on vehicles correlated to the reduction in number of stops.
- **Greenhouse Gas Emission Reduction** – These are savings in environmental related costs due to reduction in greenhouse gases (CO₂ emissions).
- **Health Cost of other Air Pollutants Emissions** – These are the health cost savings from the reduction in air pollutant emissions, such as CO, NO_x and VOC.

6.1 Benefits of Each Arterial Corridor

This section displays the results of 'Before' and 'After' studies and related calculations for individual corridors. MOE results and benefits quantification and monetary results are provided for each corridor. Corridors results are organized by regional areas (Area 1 to Area 5). Summary tables of each area corridors are displayed prior to individual corridor results, which include MOE summary, 'Quantification of Savings' summary and 'Monetary Savings' summary.

Corridors that cross city boundaries had 'Before-After' studies results processed by city limits and included separately in each city report. However, in the area summary tables displayed below, if an agency has 2 or less intersections on a corridor, 'Before-After' studies results were not processed separately for that agency.

Area 1 Corridor Results

Table 6.1.1 Area 1 Corridors - Measures of Effectiveness (MOE) Summary

Agency	Corridor Limits	Length (mile)	Num. of Signals	Peak Period	Measures of Effectiveness (MOE)			
					Travel Time Reduction	Delay Improvement	# of Stop Improvement	Ave. Speed Improvement
	Grand Ave/Edison Ave							
Chino	Spectrum West to Fern Ave	3.86	15	AM	11%	42%	42%	12%
Caltrans (2)				PM	14%	42%	35%	16%
	West Chino Ave							
Chino	71 SB Ramp to Yorba Ave	1.8	8	AM	5%	8%	12%	3%
Caltrans (2)				PM	6%	27%	17%	6%
	East Chino Ave							
Chino	Mountain Ave to Euclid Ave	1	5	AM	9%	36%	44%	11%
				PM	17%	59%	31%	22%
	Chino Hills Parkway							
Chino Hills	Walnut Creek Dr to Eucalyptus	1.23	7	AM	28%	59%	50%	40%
				PM	19%	40%	26%	24%
	Peyton Dr							
Chino Hills	Rock Spring Dr to Glen Ridge Dr	3.24	14	AM	9%	22%	13%	10%
				PM	10%	23%	32%	13%
Overall Average % Improvement:					13%	36%	30%	16%

Table 6.1.2 Area 1 Corridors - Quantification of Annually Savings Summary

Corridor Information		Quantification of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel (gal)	VHT (veh-hr)
		CO (lb)	Nox (lb)	CO2 (lb)	VOC (lb)		
	Grand Ave/Edison Ave						
Chino Caltrans (2)	Spectrum West to Fern Ave (15)	12,622	4,016	569,788	1,751	45,469	25,713
	West Chino Ave						
Chino Caltrans (2)	71 SB Ramp to Yorba Ave (8)	3,933	827	129,963	101	3,613	5,363
	East Chino Ave						
Chino	Mountain Ave to Euclid Ave (5)	546	208	41,502	225	5,481	2,325
	Chino Hills Parkway						
Chino Hills	Walnut Creek Dr to Eucalyptus (7)	341	-9	100,504	708	17,744	15,413
	Peyton Dr						
Chino Hills	Rock Spring Dr to Glen Ridge Dr (14)	2,603	1,482	232,754	1,852	43,406	23,638
Area Project Total:		553				115,713	72,452
		(Tons)				(gal)	(veh-hr)

Table 6.1.3 Area 1 Corridor - Annual Monetary Savings Summary

Corridor Information		Monetary Measures of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel	VHT
		CO	Nox	CO2	VOC		
	Grand Ave/Edison Ave						
Chino Caltrans (2)	Spectrum West to Fern Ave (15)	\$488	\$36,138	\$6,553	\$1,102	\$177,328	\$304,436
	West Chino Ave						
Chino Caltrans (2)	71 SB Ramp to Yorba Ave (8)	\$152	\$7,445	\$1,495	\$64	\$14,089	\$63,492
	East Chino Ave						
Chino	Mountain Ave to Euclid Ave (5)	\$21	\$1,872	\$477	\$141	\$21,377	\$27,528
	Chino Hills Parkway						
Chino Hills	Walnut Creek Dr to Eucalyptus (7)	\$13	-\$81	\$1,156	\$445	\$69,201	\$182,484
	Peyton Dr						
Chino Hills	Rock Spring Dr to Glen Ridge Dr (14)	\$101	\$13,331	\$2,677	\$1,165	\$169,284	\$279,868
Area Project Total:		\$74,755				\$451,279	\$857,808
		\$1,383,842					

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Edison Avenue (SR71 to Eucild Ave)

"Before and After" Study Results

Jurisdiction: Chino
 Length (mile): 3.86
 Number of Signals: 15

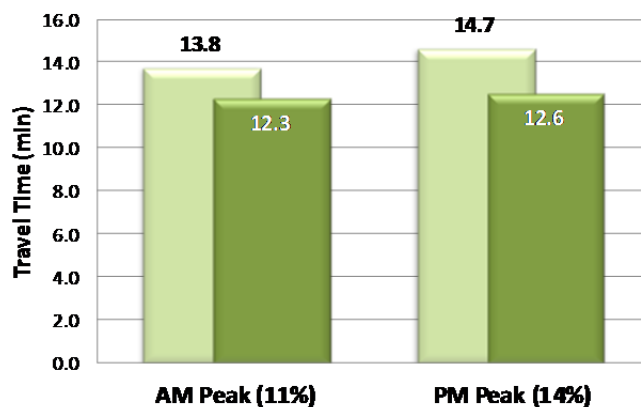
1. Measures of Effectiveness (MOE) Summary

AM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	7.0	6.8	13.8	1.9	1.6	3.5	4.0	2.3	6.3	33.1	34.6	33.7			
AFTER	6.4	5.9	12.3	1.2	0.8	2.0	2.3	1.3	3.7	36.3	38.9	37.7			
% Improvement	9%	12%	11%	34%	52%	42%	42%	43%	42%	10%	12%	12%			

PM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	7.3	7.4	14.7	2.4	2.5	4.9	2.8	3.2	6.0	32.3	31.7	31.8			
AFTER	6.2	6.4	12.6	1.3	1.5	2.8	1.9	2.0	3.9	37.4	36.1	36.9			
% Improvement	15%	14%	14%	44%	41%	42%	34%	37%	35%	16%	14%	16%			

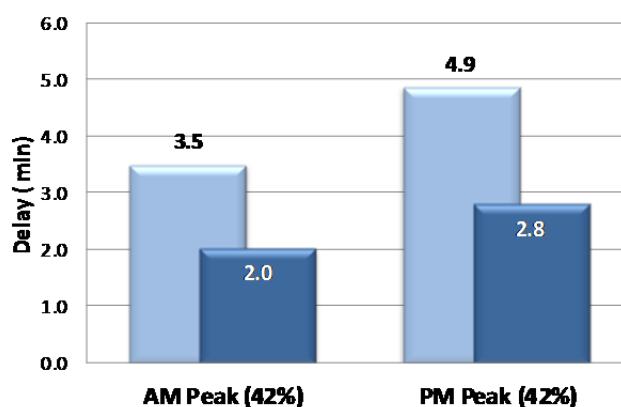
Travel Time

■ Before ■ After



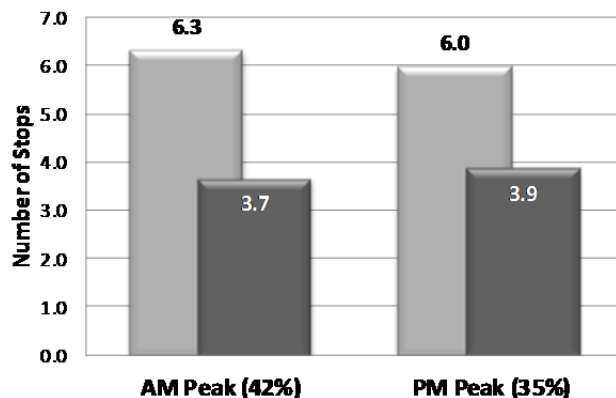
Delay

■ Before ■ After



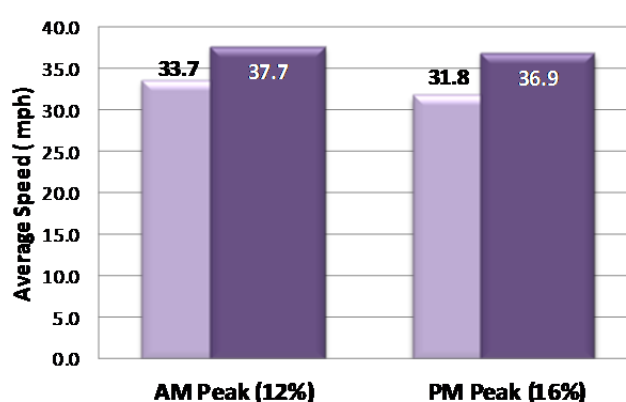
Number of Stops

■ Before ■ After



Average Speed

■ Before ■ After



Edison Avenue (SR71 to Eucild Ave) "Before and After" Study Results

Jurisdiction: Chino

Length (mile): 3.86

Number of Signals: 15

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	5859	8850	14710	3097	4692	7790	449	671	1120	1656	1959	3615	95	117	211	49	70	119
AFTER	4208	6166	10374	2560	3714	6274	377	553	930	1298	1780	3078	77	106	183	44	63	108
% Reduction	28%	30%	29%	17%	21%	19%	16%	18%	17%	22%	9%	15%	19%	9%	14%	10%	10%	10%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	8951	7999.5	16951	4858.8	4117.1	8976	730.1	613.9	1344	2418	1958	4375	144	117	261	85	71	157
AFTER	7405	6099	13504	4405.5	3571	7977	650.5	533.7	1184	2089	1761	3851	125	105	229	73	62	136
% Reduction	17%	24%	20%	9%	13%	11%	11%	13%	12%	14%	10%	12%	14%	10%	12%	14%	12%	13%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	1651	2684	4336	537	978	1516	72	118	190	358	179	537	18.1	10.6	28.7	4.7	6.9	11.6
PM	1546	1901	3446	453	546	999	80	80	160	328	196	524	19.5	12.1	31.5	12.2	8.9	21.1

Emission, Fuel and Travel Time Savings

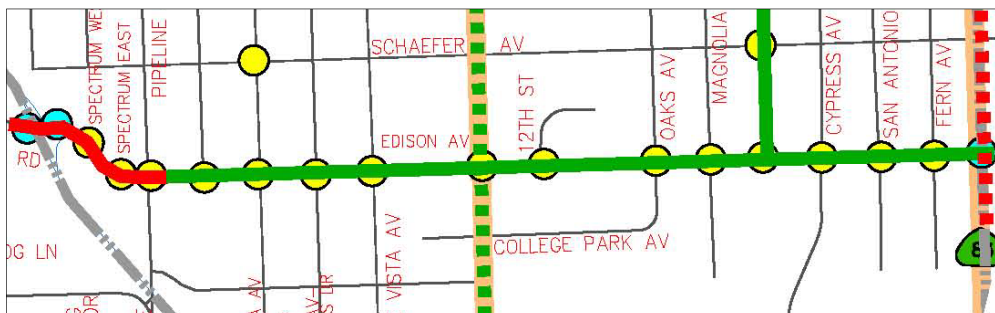
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	50.5	16.1	2279.2	7.0	181.9	102.9
Annually	12,622	4,016	569,788	1,751	45,469	25,713

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$1.95	\$144.55	\$26.21	\$4.41	\$709.31	\$1,217.74
Annually (\$)	\$488	\$36,138	\$6,553	\$1,102	\$177,328	\$304,436

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$2,104
Annually: \$526,045



Chino Avenue (SR71 to Yorba Ave)

"Before and After" Study Results

Jurisdiction: Chino
 Length (mile): 1.80
 Number of Signals: 8

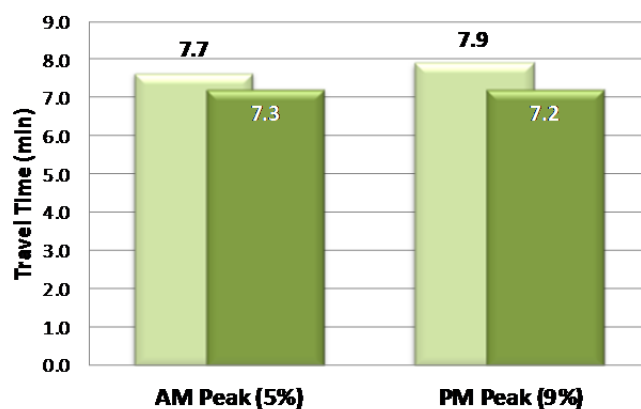
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		3.9	3.8	7.7	1.1	1.1	2.3	2.0	1.6	3.6	28.8	30.2	28.9
AFTER		3.6	3.7	7.3	1.1	1.0	2.1	1.8	1.3	3.2	31.1	30.5	29.8
% Improvement		8%	3%	5%	6%	11%	8%	8%	17%	12%	8%	1%	3%

PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		4.4	3.5	7.9	1.9	0.9	2.8	3.0	1.4	4.4	25.7	31.3	27.5
AFTER		3.9	3.3	7.2	1.2	0.7	1.8	2.4	1.2	3.6	28.6	33.8	30.0
% Improvement		11%	6%	9%	37%	25%	33%	19%	17%	19%	11%	8%	9%

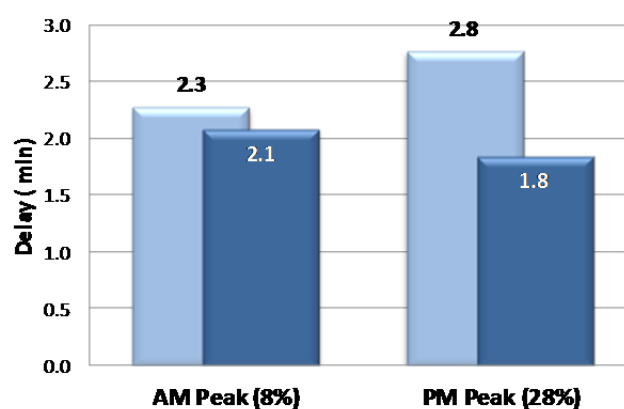
Travel Time

Before After



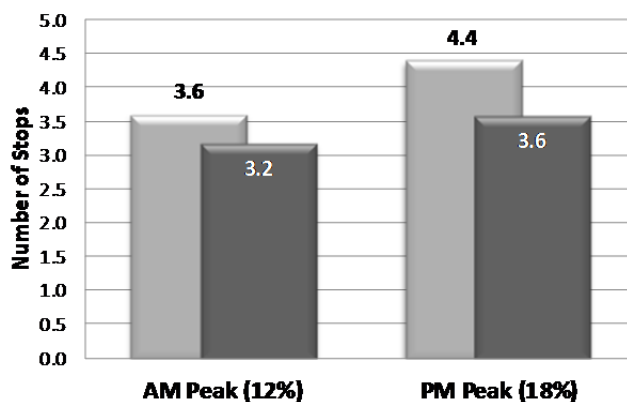
Delay

Before After



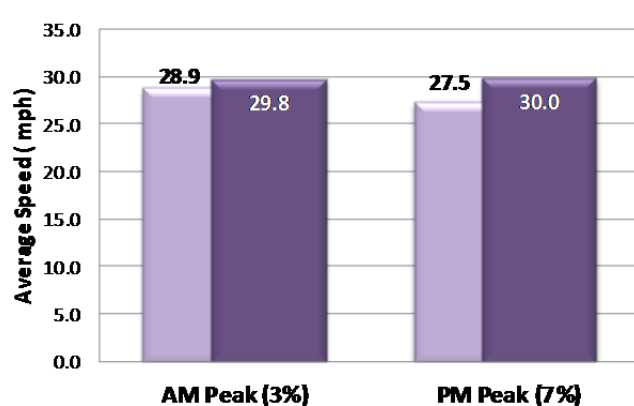
Number of Stops

Before After



Average Speed

Before After



Chino Avenue (SR71 to Yorba Ave)
"Before and After" Study Results

Jurisdiction: Chino

Length (mile): 1.80

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2859	2239	5098	1328	1249	2577	196	196	392	630	623	1253	37	38	75	23	25	48
AFTER	2420	2308	4728	1164	1271	2435	174	192	366	645	677	1322	38	40	78	22	24	46
% Reduction	15%	-3%	7%	12%	-2%	6%	11%	2%	7%	-2%	-9%	-6%	-1%	-6%	-3%	5%	4%	4%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	4722	2046	6768	1891	1181	3072	286.8	183	470	1059	576.3	1635	62	35	96	37	22	59
AFTER	3100	1894	4994	1638	1107	2745	251.2	169.8	421	1004	529.7	1534	58	32	91	32	22	54
% Reduction	34%	7%	26%	13%	6%	11%	12%	7%	10%	5%	8%	6%	5%	7%	6%	12%	2%	8%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	439.0	-69.0	370.0	164.0	-22.0	142.0	22.0	4.0	26.0	-15.0	-54.0	-69.0	-0.4	-2.2	-2.6	1.1	0.9	2.0
PM	1622.4	151.9	1774.3	253.5	74.0	327.5	35.6	13.2	48.8	55.0	46.6	101.6	3.4	2.6	6.0	4.3	0.4	4.7

Emission, Fuel and Travel Time Savings

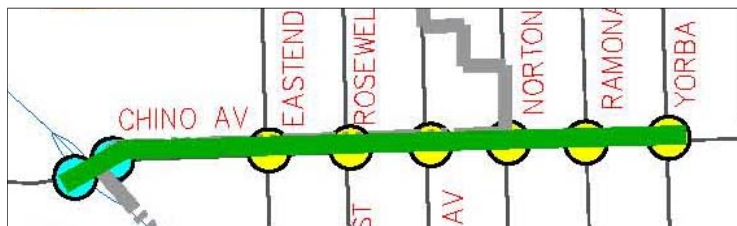
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	15.7	3.3	519.9	0.4	14.5	21.5
Annually	3,933	827	129,963	101	3,613	5,363

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.61	\$29.78	\$5.98	\$0.25	\$56.35	\$253.97
Annually (\$)	\$152	\$7,445	\$1,495	\$64	\$14,089	\$63,492

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$347
Annually: \$86,736



Chino Avenue (Mountain Ave to Euclid Ave)**"Before and After" Study Results**

Jurisdiction: Chino

Length (mile): 1.00

Number of Signals: 5

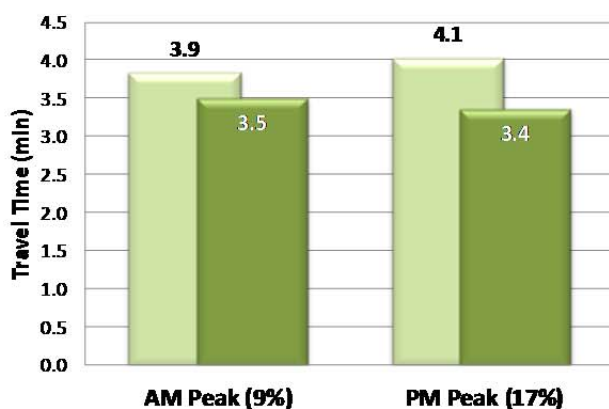
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	2.2	1.7	3.9	0.7	0.3	1.0	1.8	0.8	2.6	27.3	34.4	31.4
AFTER	1.8	1.7	3.5	0.3	0.3	0.6	0.7	0.8	1.4	33.3	34.2	34.9
% Improvement	17%	-1%	9%	51%	-6%	36%	63%	3%	44%	22%	0%	11%

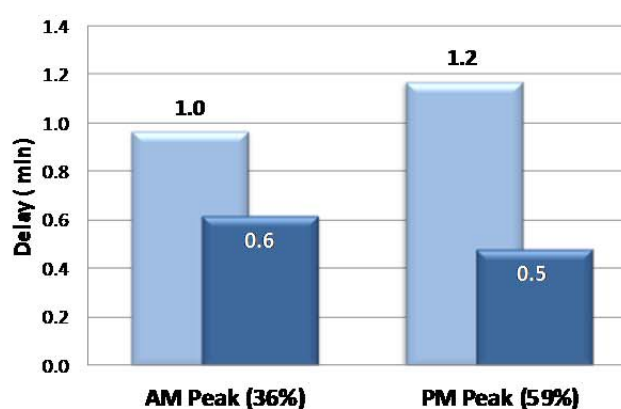
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	2.1	1.9	4.1	0.7	0.5	1.2	1.4	1.0	2.4	27.9	30.6	29.8
AFTER	1.6	1.7	3.4	0.2	0.3	0.5	0.6	1.1	1.7	35.9	34.7	36.3
Improvement	24%	9%	17%	72%	38%	59%	58%	-8%	31%	29%	13%	22%

Travel Time

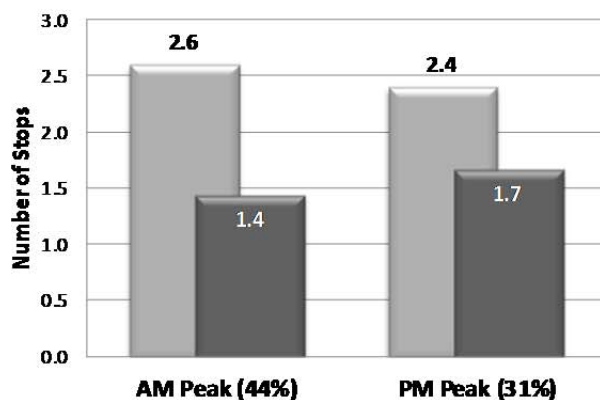
■ Before ■ After

**Delay**

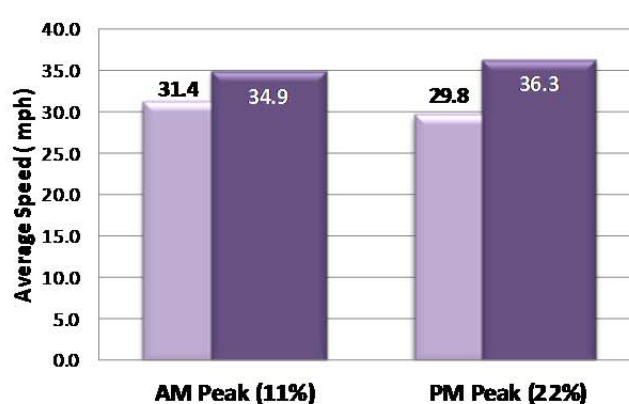
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Chino Avenue (Mountain Ave to Euclid Ave)**"Before and After" Study Results**

Jurisdiction: Chino

Length (mile): 1.00

Number of Signals: 5

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	616	999	1615	300	487	787	44	69	113	160	199	359	9	12	21	5	7	12
AFTER	402	826	1228	235	443	678	34	64	98	103	198	301	6	12	18	4	7	11
% Reduction	35%	17%	24%	22%	9%	14%	23%	7%	13%	36%	1%	16%	31%	-1%	13%	14%	-3%	4%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	764	480	1244	428.9	273.3	702	65.4	41.1	107	226.8	134.1	361	13	8	21	8	5	13
AFTER	710	527	1237	393.4	278.8	672	56.5	39.2	96	165	120.9	286	10	7	17	6	4	11
% Reduction	7%	-10%	1%	8%	-2%	4%	14%	5%	10%	27%	10%	21%	26%	11%	20%	23%	8%	18%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	214.0	173	387	65.0	44.0	109.0	10.0	5.0	15.0	57.0	1.0	58.0	2.9	-0.1	2.8	0.7	-0.2	0.5
PM	53.6	-47.0	6.6	35.5	-5.5	30.0	8.9	1.9	10.8	61.8	13.2	75.0	3.5	0.9	4.3	1.9	0.4	2.3

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	2.2	0.8	166.0	0.9	21.9	9.3
Annually	546	208	41,502	225	5,481	2,325

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.08	\$7.49	\$1.91	\$0.57	\$85.51	\$110.11
Annually (\$)	\$21	\$1,872	\$477	\$141	\$21,377	\$27,528

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$206****Annually: \$51,396**

Chino Hills Pkwy (Walnut Creek to Eucalyptus)**"Before and After" Study Results**

Jurisdiction: Chino Hills

Length (mile): 1.23

Number of Signals: 7

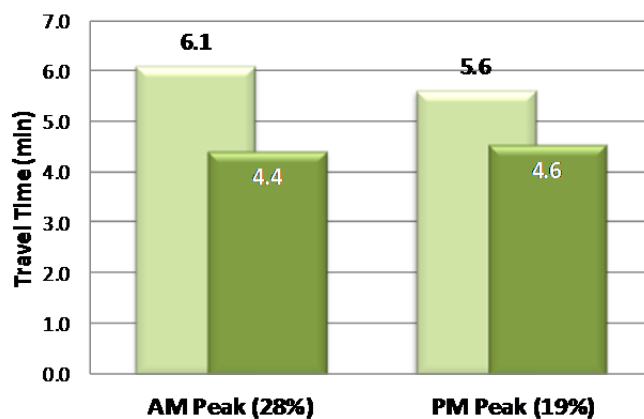
1. Measures of Effectiveness (MOE) Summary

AM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	2.7	3.4	6.1	1.1	1.8	2.9	1.0	2.4	3.4	29.1	22.6	24.4	29.1	22.6	24.4
AFTER	2.4	2.0	4.4	0.8	0.4	1.2	1.2	0.5	1.7	32.7	38.2	34.2	32.7	38.2	34.2
% Improvement	12%	41%	28%	29%	78%	59%	-20%	79%	50%	13%	69%	40%	13%	69%	40%

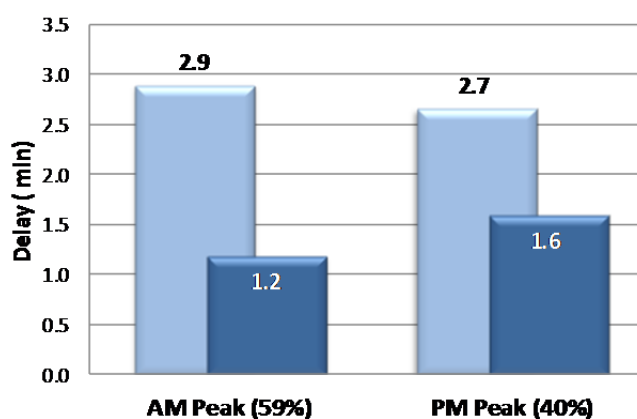
PM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	2.5	3.1	5.6	1.0	1.6	2.7	1.0	1.4	2.4	31.9	24.2	27.0	31.9	24.2	27.0
AFTER	2.1	2.4	4.6	0.7	0.9	1.6	1.0	0.8	1.8	35.3	33.0	33.5	35.3	33.0	33.5
% Improvement	15%	22%	19%	36%	43%	40%	0%	44%	26%	11%	36%	24%	11%	36%	24%

Travel Time

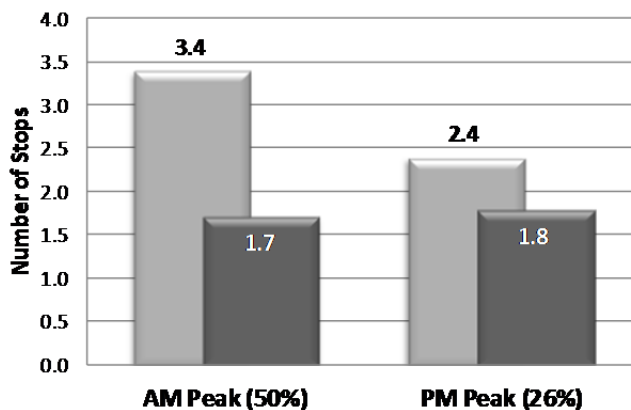
■ Before ■ After

**Delay**

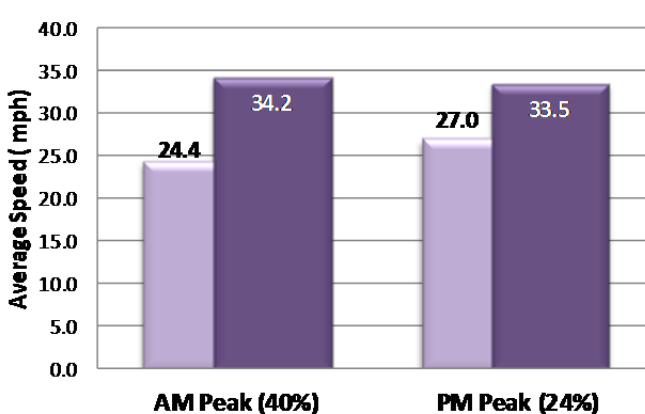
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Chino Hills Pkwy (Walnut Creek to Eucalyptus) "Before and After" Study Results

Jurisdiction: Chino Hills

Length (mile): 1.23

Number of Signals: 7

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	EB	WB	Total
BEFORE	2839	1932	4771	1629	968	2597	251	144	395	783	568	1351	48	33	81	32	17	49
AFTER	3135	1224	4359	1769	729	2498	252	105	358	854	294	1149	50	18	68	28	11	39
% Reduction	-10%	37%	9%	-9%	25%	4%	-1%	27%	9%	-9%	48%	15%	-4%	45%	16%	12%	36%	21%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	EB	WB	Total
BEFORE	1532	3130	4662	890	1807	2697	134.7	291.1	426	491	948.3	1439	29	58	87	17	38	55
AFTER	1836	2943	4779	1038.4	1733.9	2772	145.3	254.9	400	406.2	810.3	1217	27	49	76	14	30	45
% Reduction	-20%	6%	-3%	-17%	4%	-3%	-8%	12%	6%	17%	15%	15%	7%	16%	13%	14%	21%	19%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	EB	WB	Total
AM	-296.5	708	412	-140.8	239.7	98.9	-1.3	38.4	37.1	-71.7	273.5	201.8	-1.8	14.7	12.9	3.9	6.2	10.1
PM	-303.7	186.4	-117.3	-148.4	73.1	-75.3	-10.6	36.2	25.6	84.8	138.0	222.8	2.0	9.2	11.1	2.4	8.0	10.4

Emission, Fuel and Travel Time Savings

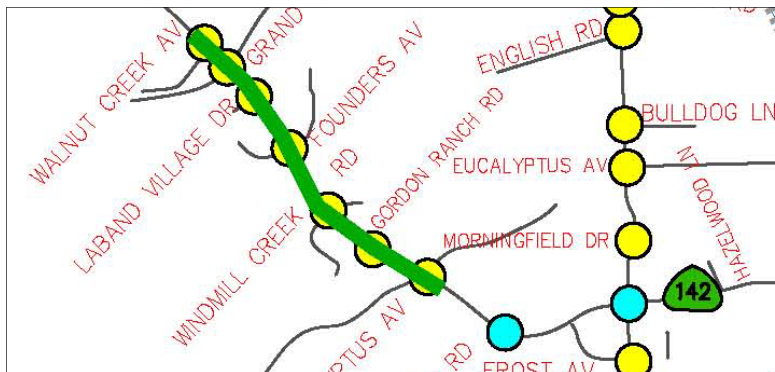
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	1.4	0.0	402.0	2.8	71.0	61.7
Annually	341	-9	100,504	708	17,744	15,413

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.05	(\$0.32)	\$4.62	\$1.78	\$276.80	\$729.94
Annually (\$)	\$13	(\$81)	\$1,156	\$445	\$69,201	\$182,484

Fuel and Emission Monetary Savings Summary

Daily: \$1,013
Annually: \$253,218



Peyton (Rock Springs Dr to Glen Ridge Dr)

"Before and After" Study Results

Jurisdiction: Chino Hills

Length (mile): 3.24

Number of Signals: 14

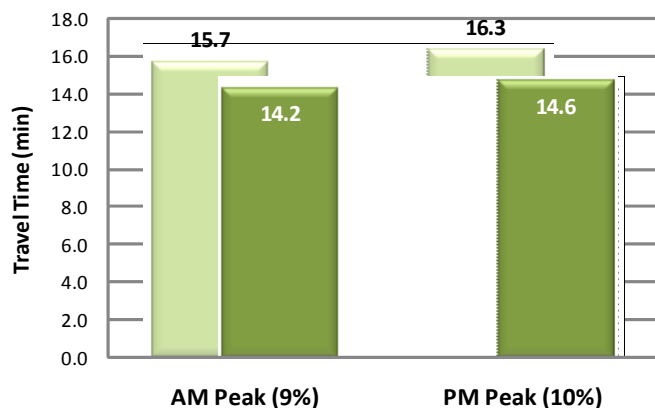
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		7.9	7.7	15.7	3.6	3.4	6.9	4.0	5.0	9.0	26.0	25.7	25.5
AFTER		7.3	7.0	14.2	2.8	2.6	5.4	3.8	4.0	7.8	28.2	28.5	28.0
% Improvement		8%	10%	9%	20%	23%	22%	5%	20%	13%	8%	11%	10%

PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		8.1	8.2	16.3	3.7	3.8	7.6	5.4	4.4	9.8	24.3	23.9	23.9
AFTER		7.5	7.1	14.6	3.1	2.8	5.9	3.5	3.2	6.7	26.3	27.8	26.9
% Improvement		8%	13%	10%	17%	28%	23%	35%	28%	32%	8%	17%	13%

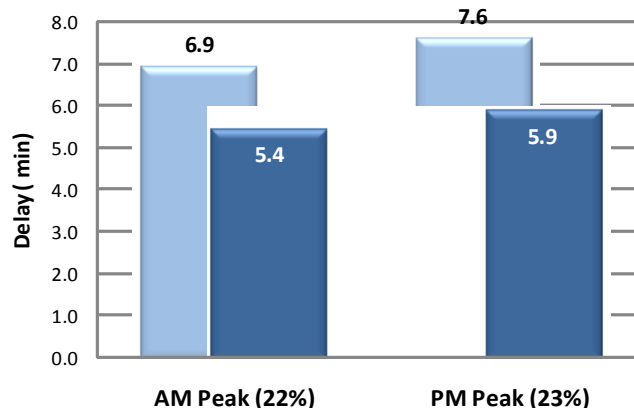
Travel Time

■ Before ■ After



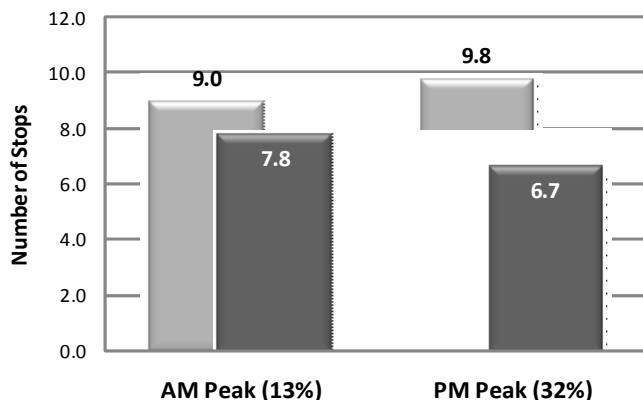
Delay

■ Before ■ After



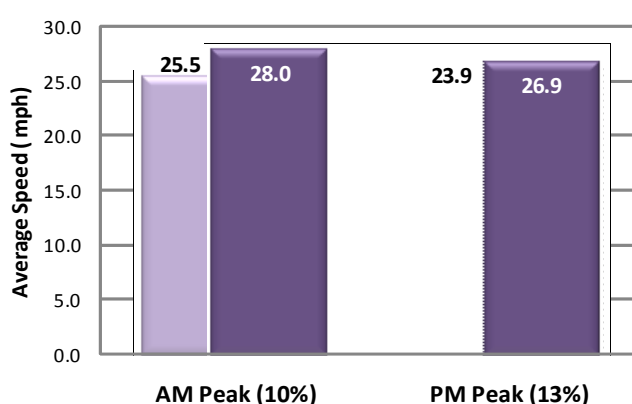
Number of Stops

■ Before ■ After



Average Speed

■ Before ■ After



Peyton (Rock Springs Dr to Glen Ridge Dr)
"Before and After" Study Results

Jurisdiction: Chino Hills

Length (mile): 3.24

Number of Signals: 14

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	7509	4601	12110	3939	2423	6362	591	371	962	2036	1356	3392	120	79	199	70	46	116
AFTER	7026	4867	11893	3662	2444	6106	576	362	938	1974	1241	3214	119	73	192	62	42	104
% Reduction	6%	-6%	2%	7%	-1%	4%	3%	2%	2%	3%	9%	5%	1%	8%	4%	12%	8%	11%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	7123	7829	14952	3840	4288	8128	598.1	662.8	1261	2285	2329	4614	133	139	272	76	85	161
AFTER	6580	7177	13757	3563	3980	7543	549.1	608	1157	1800	1981	3781	108	119	227	69	74	143
% Reduction	8%	8%	8%	7%	7%	7%	8%	8%	8%	21%	15%	18%	19%	14%	16%	10%	13%	11%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr / hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	482.7	-266	217	277.3	-20.8	256.5	15.2	8.4	23.6	62.4	115.4	177.8	0.9	6.6	7.5	8.3	3.9	12.2
PM	543.1	651.7	1194.8	276.8	308.0	584.8	49.0	54.8	103.8	484.1	348.7	832.8	24.7	19.6	44.3	7.6	10.7	18.3

Emission, Fuel and Travel Time Savings

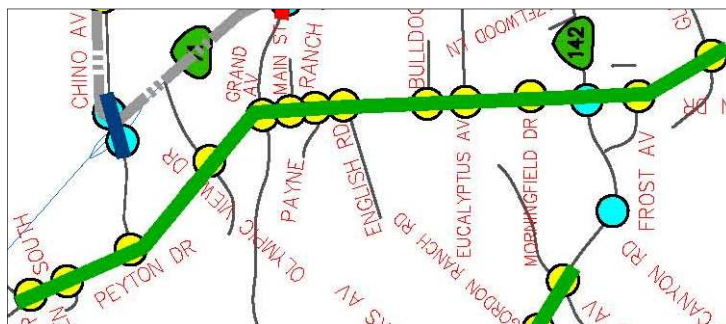
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	10.4	5.9	931.0	7.4	173.6	94.6
Annually	2,603	1,482	232,754	1,852	43,406	23,638

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.40	\$53.33	\$10.71	\$4.66	\$677.14	\$1,119.47
Annually (\$)	\$101	\$13,331	\$2,677	\$1,165	\$169,284	\$279,868

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,865
Annually: \$466,326



Area 2 CorridorResults

Table 6.2.1 Area 2 Corridors - Measures of Effectiveness (MOE) Summary

Agency	Corridor Limits	Length (mile)	Num. of Signals	Peak Period	Measures of Effectiveness (MOE)			
					Travel Time Reduction	Delay Improvement	# of Stop Improvement	Ave. Speed Improvement
	Benson Ave							
Upland	From 8th/Arrow Hwy to 16th	2.02	10	AM	4%	12%	27%	5%
				PM	21%	49%	45%	26%
	Campus Ave							
Upland	From I-210 WB to 16th St	1.15	8	AM	25%	59%	55%	32%
				MID	22%	51%	58%	25%
				PM	29%	56%	53%	52%
	Mountain Ave							
Upland	From 21st St to Phillidelphia	7.3	33	AM	12%	29%	23%	13%
Ontario				MID	15%	23%	30%	18%
Caltrans (1)				PM	19%	38%	49%	31%
	Jurupa St							
Ontario	From Haven Ave to Etiwanda Ave	3.48	11	AM	11%	25%	24%	13%
				PM	19%	38%	35%	47%
	Milliken South							
Ontario	From Mission Blvd to Guasti Rd	2.19	8	AM	9%	25%	37%	10%
				PM	19%	25%	24%	12%
	Grove Ave							
Ontario	From 4th St to Philadelphia St	3.06	12	AM	24%	24%	48%	31%
				MID	4%	4%	9%	4%
				PM	16%	14%	29%	11%
	Airport Dr							
Ontario	From Haven Ave to Vineyard Ave	2.03	7	AM	20%	64%	29%	24%
				PM	10%	37%	29%	11%
	Arrow Route							
Rancho Cucamonga	From Baker St to Etiwanda Ave	5.51	12	AM	5%	15%	42%	5%
				PM	13%	33%	47%	15%
	Archibald Ave							
Rancho Cucamonga	From 4th St to Lemon Ave	4.31	16	AM	19%	41%	25%	24%
				PM	23%	46%	43%	30%
	Carnelian Ave/Vineyard Ave							
Rancho Cucamonga	From Highland Ave to 6th St	3.63	16	AM	13%	27%	36%	14%
Ontario (1)				PM	19%	41%	39%	25%
	Day Creek Blvd							
Rancho Cucamonga	From Baseline Rd to I-210 WB ON RAMP	1.11	8	AM	9%	16%	3%	9%
				PM	6%	11%	11%	10%
	Milliken North							
Rancho Cucamonga	From 4th Mills Pkwy to Vintage Dr	4.34	19	AM	17%	37%	42%	20%
				PM	12%	24%	32%	14%
Overall Average % Improvement:					15%	32%	34%	20%

Table 6.2.2 Area 2 Corridors Quantification of Annually Savings Summary

Corridor Information		Quantification of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel (gal)	VHT (veh-hr)
		CO (lb)	Nox (lb)	CO2 (lb)	VOC (lb)		
	Benson Ave						
Upland	From 8th/Arrow Hwy to 16th (10)	1,703	732	296,854	1,235	31,819	19,100
	Campus Ave						
Upland	From I-210 WB to 16th St (8)	4,239	2,412	511,420	4,333	105,541	48,825
	Mountain Ave						
Upland, Ontario, Caltrans (1)	From 21st St to Phillidelphia (33)	369	5,281	2,066,525	16,515	415,155	207,290
	Jurupa St						
Ontario	From Haven Ave to Etiwanda Ave (11)	1,022	1,375	407,279	2,387	62,081	31,100
	Milliken South						
Ontario	Mission Blvd to Guasti Rd (8)	1,105	503	124,975	457	10,313	4,675
	Grove Ave						
Ontario	From 4th St to Philadelphia St (12)	22,114	9,212	1,431,452	7,616	187,273	60,388
	Airport Dr						
Ontario	From Haven Ave to Vineyard Ave (7)	589	800	157,934	615	16,088	8,988
	Arrow Route						
Rancho Cucamonga	From Baker Ave to Etiwanda Ave (12)	5,801	2,510	509,656	5,012	215,950	42,688
	Archibald Ave						
Rancho Cucamonga	From 4th St to Lemon Ave (16)	-994	1,797	774,405	5,966	157,669	94,238
	Carnelian Ave/Vineyard Ave						
Rancho Cucamonga, SB County (1)	From Highland Ave to 6th St (16)	1,703	732	296,854	1,235	31,819	72,463
	Day Creek Blvd						
Rancho Cucamonga	From Baseline Rd to I-210 WB ON RAMP (8)	-5,253	-136	122,550	975	22,106	5,113
	Milliken North						
Rancho Cucamonga	From 4th Mills Pkwy to Vintage Dr (19)	-1,891	3,549	1,071,259	8,505	230,966	78,200
Area Project Total:		3,943				1,486,779	673,068
		(Tons)				(gal)	(veh-hr)

Table 6.2.3 Area 2 Corridors Monetary Measures of Annually Savings Summary

Corridor Information		Monetary Measures of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel	VHT
		CO	Nox	CO2	VOC		
	Benson Ave						
Upland	From 8th/Arrow Hwy to 16th (10)	\$66	\$6,591	\$3,414	\$777	\$124,093	\$226,144
	Campus Ave						
Upland	From I-210 WB to 16th St (8)	\$164	\$21,701	\$5,881	\$2,727	\$411,611	\$578,088
	Mountain Ave						
Upland, Ontario, Caltrans (1)	From 21st St to Phillidelphia (33)	\$14	\$47,519	\$23,765	\$10,393	\$1,619,105	\$2,454,314
	Jurupa St						
Ontario	From Haven Ave to Etiwanda Ave (11)	\$40	\$12,376	\$4,684	\$1,502	\$242,117	\$368,224
	Milliken South						
Ontario	Mission Blvd to Guasti Rd (8)	\$43	\$4,526	\$1,437	\$288	\$40,219	\$55,352
	Grove Ave						
Ontario	From 4th St to Philadelphia St (12)	\$855	\$82,895	\$16,462	\$4,793	\$730,363	\$714,988
	Airport Dr						
Ontario	From Haven Ave to Vineyard Ave (7)	\$23	\$7,200	\$1,816	\$387	\$62,741	\$106,412
	Arrow Route						
Rancho Cucamonga	From Baker Ave to Etiwanda Ave (12)	\$224	\$22,587	\$5,861	\$3,154	\$842,205	\$525,420
	Archibald Ave						
Rancho Cucamonga	From 4th St to Lemon Ave (16)	-\$38	\$16,169	\$8,906	\$3,755	\$614,908	\$1,115,772
	Carnelian Ave/Vineyard Ave						
Rancho Cucamonga, SB County (1)	From Highland Ave to 6th St (16)	\$66	\$6,591	\$3,414	\$777	\$124,093	\$857,956
	Day Creek Blvd						
Rancho Cucamonga	From Baseline Rd to I-210 WB ON RAMP (8)	-\$47	\$529	\$1,065	\$133	\$86,214	\$60,532
	Milliken North						
Rancho Cucamonga	From 4th Mills Pkwy to Vintage Dr (19)	-\$73	\$31,938	\$12,319	\$5,353	\$900,766	\$925,888
Area Project Total:		\$385,022				\$5,798,434	\$7,989,090
		\$6,176,437					

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Benson Avenue (8th St/Arrow Hwy to 16th St)**"Before and After" Study Results**

Jurisdiction: Upland

Length (mile): 2.02

Number of Signals: 10

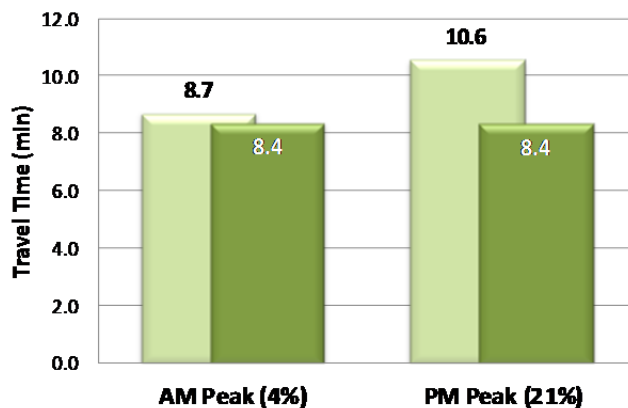
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	4.2	4.5	8.7	1.3	1.4	2.7	2.3	2.8	5.2	29.1	27.5	27.9
AFTER	4.4	4.0	8.4	1.4	1.0	2.4	2.1	1.7	3.8	28.7	30.6	29.2
% Improvement	-3%	10%	4%	-11%	32%	12%	10%	41%	27%	-1%	11%	5%

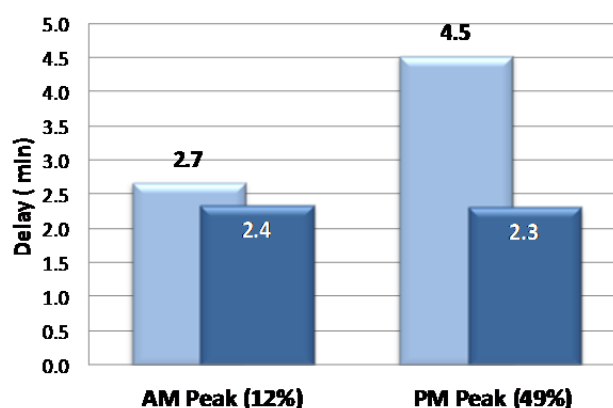
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	5.3	5.3	10.6	2.3	2.3	4.5	2.7	3.8	6.5	23.2	23.2	23.2
AFTER	4.2	4.2	8.4	1.2	1.1	2.3	1.7	1.9	3.6	29.0	29.6	29.2
% Improvement	20%	21%	21%	47%	51%	49%	38%	51%	45%	25%	28%	26%

Travel Time

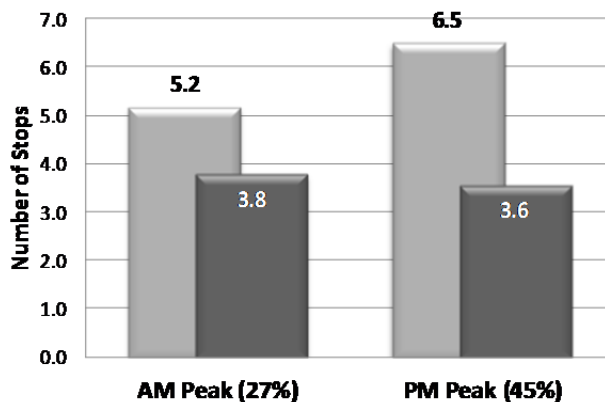
■ Before ■ After

**Delay**

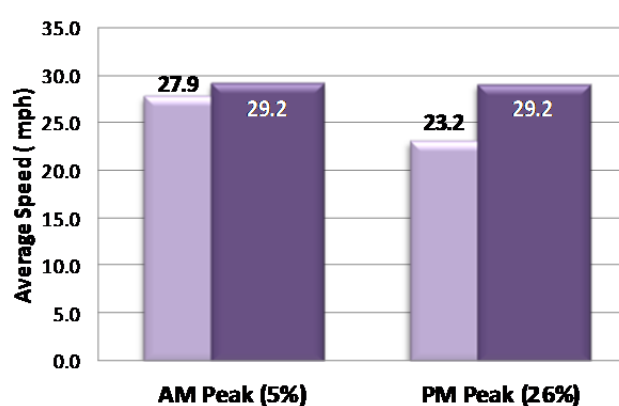
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Benson Avenue (8th St/Arrow Hwy to 16th St)

"Before and After" Study Results

Jurisdiction: Upland

Length (mile): 2.02

Number of Signals: 10

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1987	3608	5595	1198	2009	3207	187	305	492	625	1046	1671	37	61	99	24	37	60
AFTER	1888	3366	5253	1128	1917	3045	173	281	455	592	872	1464	36	53	88	23	34	57
% Reduction	5%	7%	6%	6%	5%	5%	7%	8%	8%	5%	17%	12%	4%	14%	11%	2%	8%	6%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3524	3792	7316	2135	2166	4301	352.3	394.6	747	1195	1293	2488	73	77	150	51	48	99
AFTER	3264	3413	6677	2033	2004	4037	320	299.8	620	1024	970.7	1995	62	59	121	42	38	80
% Reduction	7%	10%	9%	5%	7%	6%	9%	24%	17%	14%	25%	20%	15%	24%	19%	18%	21%	20%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	99.6	242.2	341.8	70.0	92.0	162.0	13.4	24.1	37.5	32.7	173.7	206.4	1.6	8.9	10.5	0.5	2.9	3.4
PM	260.1	378.6	638.7	102.0	162.0	264.0	32.3	94.8	127.1	171.2	321.8	493.0	10.9	18.0	28.9	9.2	10.2	19.4

Emission, Fuel and Travel Time Savings

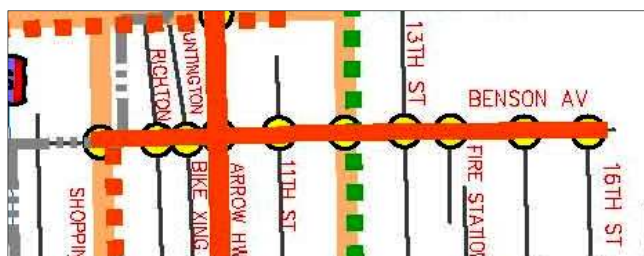
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	6.8	2.9	1187.4	4.9	127.3	76.4
Annually	1,703	732	296,854	1,235	31,819	19,100

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.26	\$26.36	\$13.66	\$3.11	\$496.37	\$904.58
Annually (\$)	\$66	\$6,591	\$3,414	\$777	\$124,093	\$226,144

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,444
Annually: \$361,085



Campus Avenue (I-210 WB to 16th St)

"Before and After" Study Results

Jurisdiction: Upland
 Length (mile): 1.15
 Number of Signals: 8

1. Measures of Effectiveness (MOE) Summary

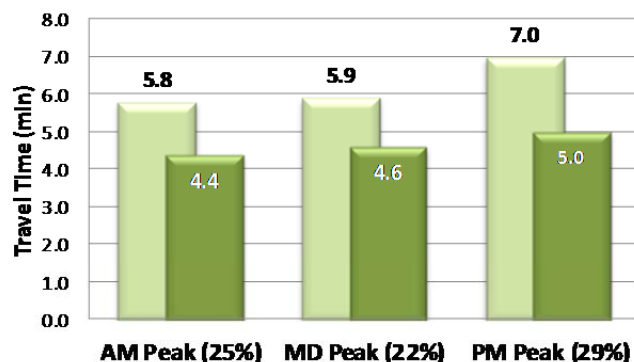
AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	2.6	3.2	5.8	0.9	1.5	2.4	1.5	2.7	4.2	27.3	22.0	24.2
AFTER	2.0	2.4	4.4	0.3	0.7	1.0	0.2	1.7	1.9	35.6	28.9	31.8
% Improvement	25%	24%	25%	70%	52%	59%	88%	37%	55%	30%	31%	32%

MD	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	2.7	3.2	5.9	1.0	1.6	2.5	1.6	3.2	4.8	28.4	21.9	24.2
AFTER	2.3	2.3	4.6	0.6	0.6	1.2	1.0	1.0	2.0	30.4	31.5	30.3
% Improvement	12%	30%	22%	33%	63%	51%	38%	69%	58%	7%	44%	25%

PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	3.3	3.7	7.0	1.6	2.0	3.6	2.6	3.6	6.2	21.0	19.4	19.9
AFTER	2.8	2.2	5.0	1.1	0.5	1.6	1.8	1.2	2.9	26.2	31.7	28.3
% Improvement	16%	40%	29%	32%	75%	56%	32%	68%	53%	25%	63%	42%

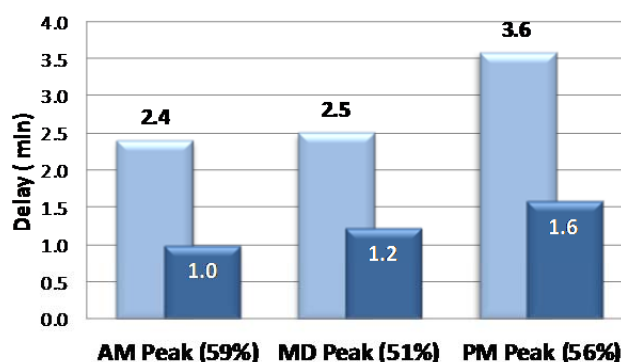
Travel Time

Before After



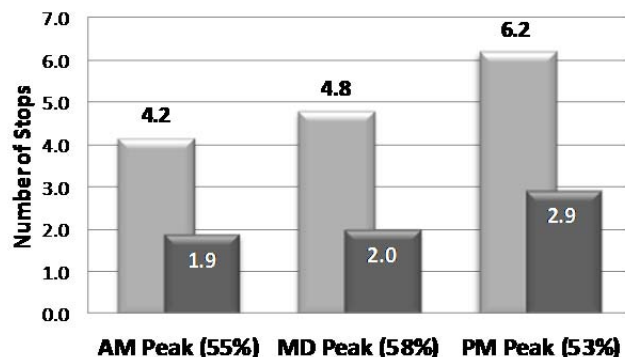
Delay

Before After



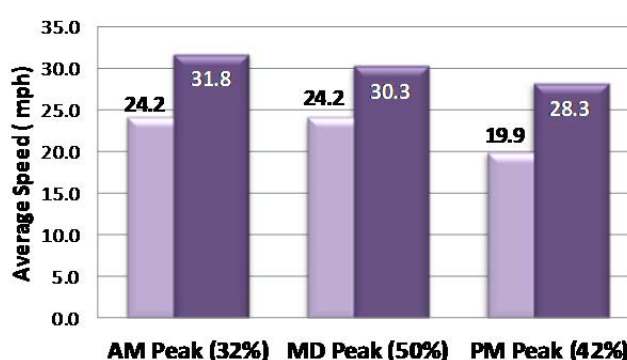
Number of Stops

Before After



Average Speed

Before After



Campus Avenue (I-210 WB to 16th St)**"Before and After" Study Results**

Jurisdiction: Upland

Length (mile): 1.15

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1724	3621	5345	1070	1942	3012	174	301	475	635	1161	1796	38	67	105	23	38	61
AFTER	1556	3583	5139	948	1677	2625	146	244	390	378	858	1236	24	50	74	18	28	46
% Reduction	10%	1%	4%	11%	14%	13%	16%	19%	18%	40%	26%	31%	35%	25%	29%	24%	26%	25%

MD Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2586	3525	6111	1562	1896	3458	255	288	543	943	1217	2160	56	69	125	35	36	71
AFTER	2532	2895	5427	1551	1554	3105	238	228	466	663	669	1332	41	40	81	28	25	53
% Reduction	2%	18%	11%	1%	18%	10%	7%	21%	14%	30%	45%	38%	26%	42%	35%	18%	31%	25%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3136	3454	6590	1799	1861	3660	301	297	598	1271	1313	2584	74	75	149	44	41	85
AFTER	2443	2722	5165	1480	1529	3009	238	226	464	784	711	1495	48	42	90	31	25	56
% Reduction	22%	21%	22%	18%	18%	18%	21%	24%	22%	38%	46%	42%	36%	44%	40%	28%	40%	34%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	168.0	38.0	206.0	122.0	265.0	387.0	28.0	57.0	85.0	257.0	303.0	560.0	13.3	17.0	30.3	5.6	9.8	15.4
MD	43.2	504.0	547.2	8.8	273.6	282.4	13.6	48.0	61.6	224.0	438.4	662.4	11.8	23.0	34.8	4.9	9.1	14.0
PM	693.0	732.0	1425.0	319.0	332.0	651.0	63.0	71.0	134.0	487.0	602.0	1089.0	26.4	32.9	59.3	12.5	16.3	28.8

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	17.0	9.6	2045.7	17.3	422.2	195.3
Annually	4,239	2,412	511,420	4,333	105,541	48,825

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.66	\$86.80	\$23.53	\$10.91	\$1,646.44	\$2,312.35
Annually (\$)	\$164	\$21,701	\$5,881	\$2,727	\$411,611	\$578,088

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$4,081****Annually: \$1,020,171**

Mountain Avenue (21st St to Philadelphia Ave)**"Before and After" Study Results**

Jurisdiction: Upland & Ontario

Length (mile): 7.30

Number of Signals: 33

1. Measures of Effectiveness (MOE) Summary

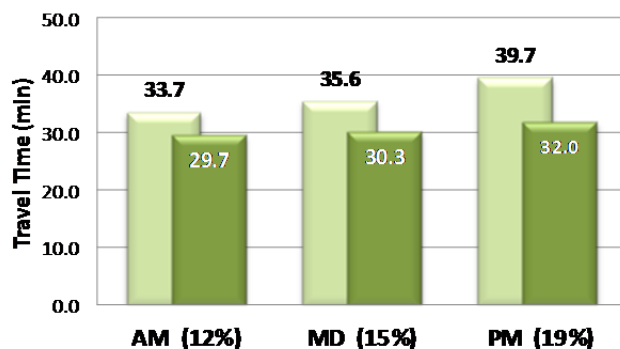
AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		17.1	16.6	33.7	7.0	6.6	13.5	7.6	10.4	18.0	26.4	26.6	26.2
AFTER		15.5	14.2	29.7	5.4	4.2	9.6	7.6	6.2	13.8	28.8	31.0	29.7
% Improvement		9%	14%	12%	22%	36%	29%	0%	40%	23%	9%	17%	13%

MD		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		17.7	17.9	35.6	7.7	7.9	15.5	8.8	13.0	21.8	24.8	24.7	20.1
AFTER		14.4	15.9	30.3	6.1	5.9	12.0	6.2	9.0	15.2	29.9	28.0	28.1
%		19%	11%	15%	21%	25%	23%	30%	31%	30%	21%	14%	40%

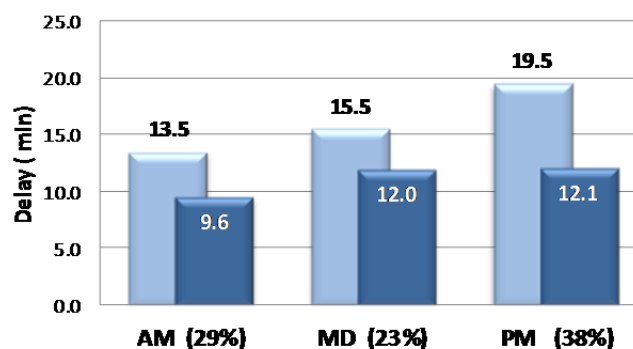
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		19.8	19.9	39.7	9.7	9.8	19.5	12.6	13.4	26.0	22.3	22.4	22.2
AFTER		16.0	16.0	32.0	6.2	5.9	12.1	6.8	6.5	13.3	27.0	27.8	27.5
Improvement		19%	20%	19%	36%	40%	38%	46%	51%	49%	21%	24%	24%

Travel Time

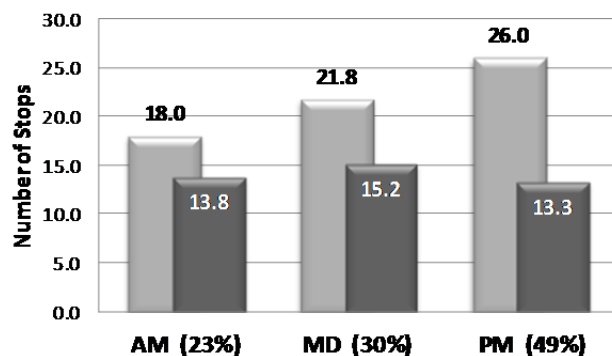
Before After

**Delay**

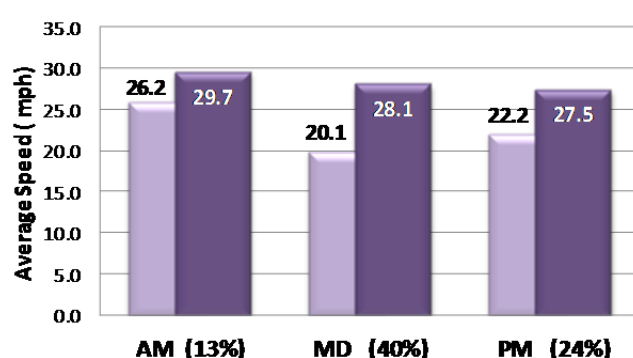
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Mountain Avenue (21st St to Philadelphia Ave)**"Before and After" Study Results**

Jurisdiction: Upland & Ontario

Length (mile): 7.30

Number of Signals: 33

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	16165	21238	37403	9477	12063	21540	1558	1882	3440	5586	7405	12992	338	432	770	222	249	472
AFTER	18303	21313	39616	10219	11582	21801	1527	1729	3256	5308	6034	11343	318	357	675	199	214	413
% Reduction	-13%	0%	-6%	-8%	4%	-1%	2%	8%	5%	5%	19%	13%	6%	17%	12%	10%	14%	12%

MD	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	20234	29436.7	49670	11699	13491	25190	1954	2099	4052	7322	8747.7	16070	443	504	946	292	279	571
AFTER	20249	31191.2	51441	11552	12496	24048	1770	1864	3634	5971.3	6992.6	12964	361	411	772	237	245	482
% Reduction	0%	-6%	-4%	1%	7%	5%	9%	11%	10%	18%	20%	19%	19%	18%	18%	19%	12%	16%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	21911	22539.9	44451	12462	12603	25065	2088	2080	4168	8569.1	8646.6	17216	508	510	1018	316	312	628
AFTER	20204	20855.8	41060	11564	11621	23185	1808	1802	3611	6207.2	6464.7	12672	380	391	771	259	255	515
% Reduction	8%	7%	8%	7%	8%	7%	13%	13%	13%	28%	25%	26%	25%	23%	24%	18%	18%	18%

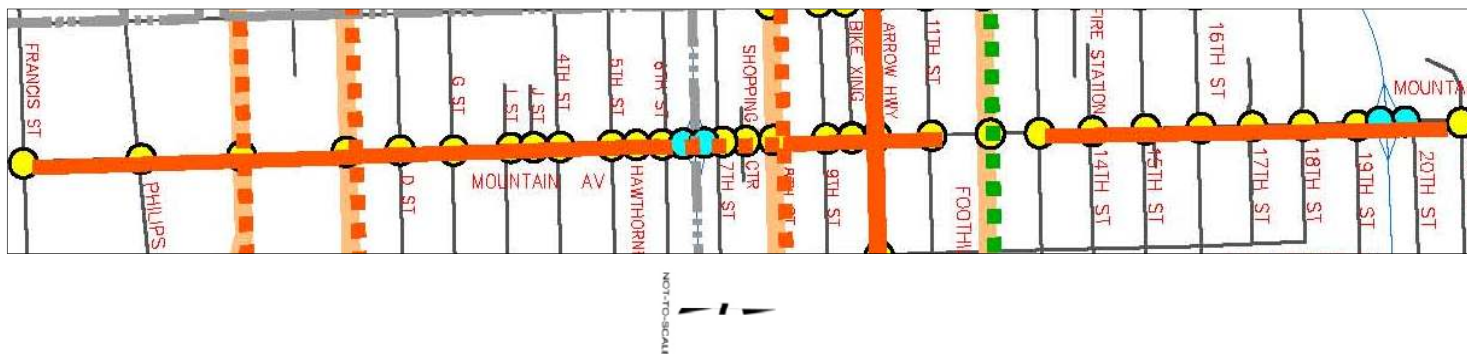
Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-2138.1	-75.0	-2213.1	-741.5	481.0	-260.5	30.7	153.4	184.1	278.1	1371.0	1649.1	20.7	74.7	95.4	23.0	35.6	58.6
MD	-12.6	-1403.6	-1416.2	117.4	796.0	913.4	146.7	187.8	334.5	1080.6	1404.1	2484.6	65.7	73.8	139.5	43.8	27.6	71.4
PM	1706.3	1684.1	3390.4	897.7	982.0	1879.7	279.3	278.2	557.5	2361.9	2181.9	4543.8	127.7	119.3	247.0	56.3	57.1	113.4

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	1.5	21.1	8266.1	66.1	1660.6	829.2
Annually	369	5,281	2,066,525	16,515	415,155	207,290

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.06	\$190.08	\$95.06	\$41.57	\$6,476.42	\$9,817.25
Annually (\$)	\$14	\$47,519	\$23,765	\$10,393	\$1,619,105	\$2,454,314

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$16,620****Annually: \$4,155,110**

Jurupa Street (Haven Ave to Etiwanda Ave)**"Before and After" Study Results**

Jurisdiction: Ontario

Length (mile): 3.48

Number of Signals: 11

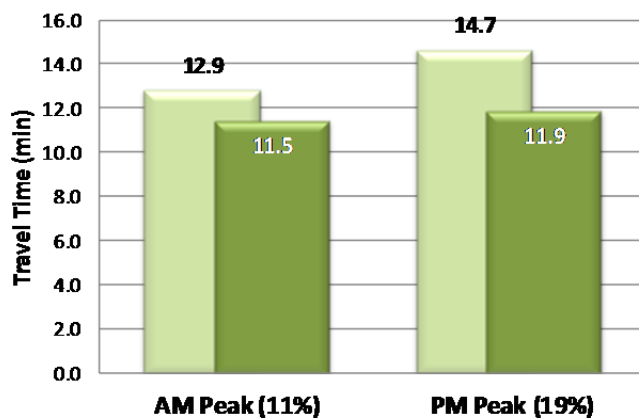
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		6.1	6.8	12.9	2.4	3.1	5.6	2.6	4.2	6.8	29.7	26.7	32.7
AFTER		5.4	6.0	11.5	1.8	2.4	4.2	2.4	2.7	5.1	33.7	30.2	37.1
% Improvement		11%	11%	11%	28%	23%	25%	7%	35%	24%	14%	13%	13%

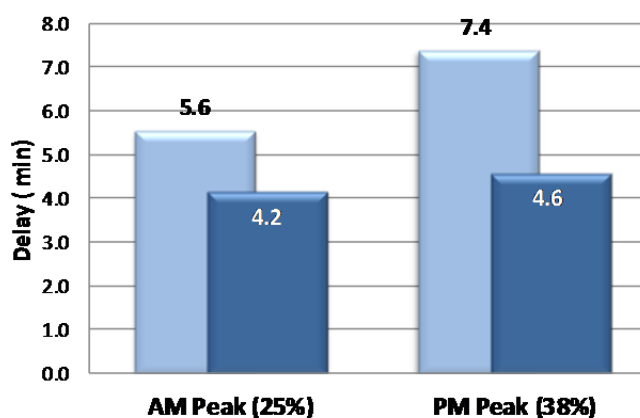
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		7.2	7.5	14.7	3.5	3.9	7.4	3.2	4.0	7.2	25.2	23.9	28.5
AFTER		6.3	5.6	11.9	2.6	2.0	4.6	2.7	2.0	4.7	29.0	31.9	35.4
Improvement		12%	25%	19%	26%	48%	38%	17%	50%	35%	15%	34%	24%

Travel Time

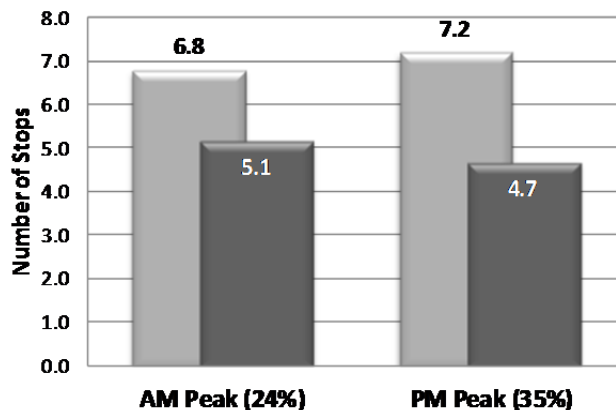
■ Before ■ After

**Delay**

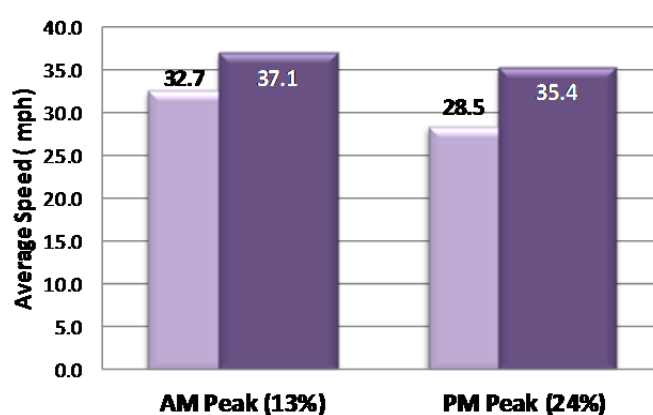
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Jurupa Street (Haven Ave to Etiwanda Ave)**"Before and After" Study Results**

Jurisdiction: Ontario

Length (mile): 3.48

Number of Signals: 11

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	4120	5989	10109	2391	3220	5611	366	494	860	1238	2071	3309	74	119	193	44	60	104
AFTER	4015	6216	10231	2293	3127	5419	337	445	783	1054	1591	2645	63	93	157	39	54	93
% Reduction	3%	-4%	-1%	4%	3%	3%	8%	10%	9%	15%	23%	20%	15%	21%	19%	12%	10%	11%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	7560	7096.9	14657	3863	3847	7710	603.8	608.5	1212	2182	2387	4569	131	141	271	79	81	161
AFTER	7008	7033.1	14041	3500	3634	7134	539.3	517.3	1057	2153	1653	3806	128	99	226	75	58	133
% Reduction	7%	1%	4%	9%	6%	7%	11%	15%	13%	1%	31%	17%	2%	30%	17%	5%	29%	17%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	105.5	-226.9	-121.4	98.5	93.3	191.8	28.8	48.8	77.6	184.5	479.5	664.0	11.0	25.1	36.1	5.5	5.9	11.4
PM	552.9	63.8	616.7	363.0	213.0	576.0	64.5	91.2	155.7	28.7	734.3	763.0	3.0	42.2	45.2	4.1	23.3	27.4

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	4.1	5.5	1629.1	9.5	248.3	124.4
Annually	1,022	1,375	407,279	2,387	62,081	31,100

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.16	\$49.51	\$18.73	\$6.01	\$968.47	\$1,472.90
Annually (\$)	\$40	\$12,376	\$4,684	\$1,502	\$242,117	\$368,224

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$2,516
Annually: \$628,943



Milliken Avenue South (Mission Blvd to Guasti Rd)**"Before and After" Study Results**

Jurisdiction: Ontario

Length (mile): 2.19

Number of Signals: 8

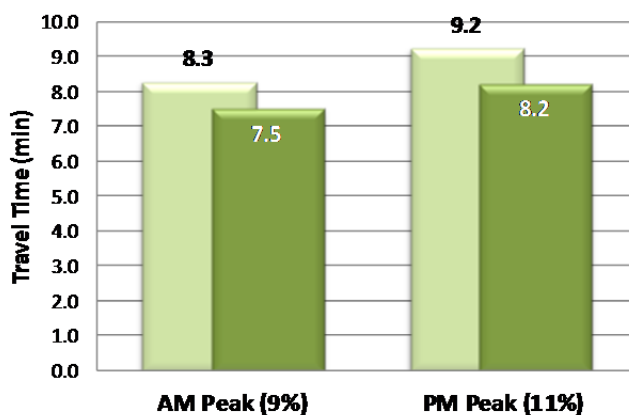
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	4.2	4.1	8.3	1.6	1.4	3.1	2.2	2.0	4.2	31.6	33.4	31.9
AFTER	3.8	3.8	7.5	1.1	1.1	2.3	1.3	1.3	2.7	34.9	35.8	35.2
% Improvement	11%	7%	9%	29%	21%	25%	39%	33%	37%	10%	7%	10%

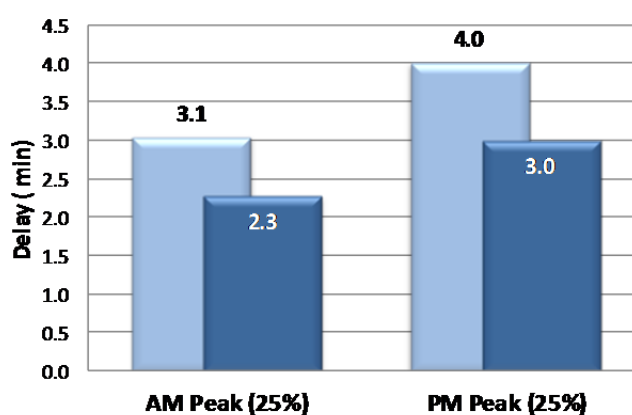
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	5.3	4.0	9.2	2.7	1.4	4.0	2.6	1.8	4.4	25.4	33.6	28.8
AFTER	4.4	3.9	8.2	1.7	1.3	3.0	1.8	1.5	3.3	32.8	34.3	32.3
Improvement	17%	2%	11%	35%	6%	25%	29%	17%	24%	29%	2%	12%

Travel Time

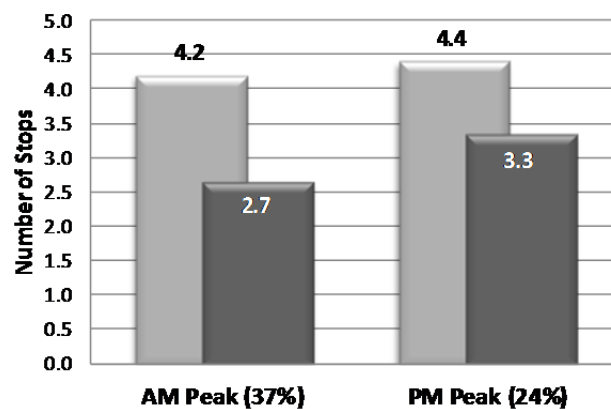
Before After

**Delay**

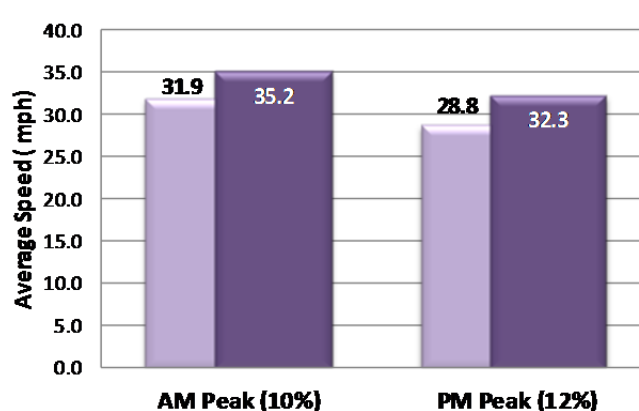
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Milliken Avenue South (Mission Blvd to Guasti Rd)

"Before and After" Study Results

Jurisdiction: Ontario

Length (mile): 2.19

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3041	2723	5765	1703	1478	3181	240	213	453	803	723	1526	47	42	89	24	23	47
AFTER	2779	2906	5685	1567	1515	3082	220	211	432	633	722	1355	38	42	81	23	22	45
% Reduction	9%	-7%	1%	8%	-3%	3%	8%	1%	5%	21%	0%	11%	18%	-1%	9%	7%	3%	5%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3668	3873.8	7542	2073	2022	4095	335.4	294.1	630	1327	1088	2415	79	63	142	46	33	80
AFTER	3602	3424.6	7026	1992	1913	3905	291.3	288.7	580	1171	1128	2300	69	67	136	37	39	76
% Reduction	2%	12%	7%	4%	5%	5%	13%	2%	8%	12%	-4%	5%	13%	-6%	4%	21%	-18%	5%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	262.0	-182.1	79.9	136.0	-37.0	99.0	19.7	1.7	21.4	169.4	0.7	170.1	8.5	-0.4	8.1	1.6	0.7	2.3
PM	66.6	449.2	515.8	81.0	109.0	190.0	44.1	5.4	49.5	155.3	-39.9	115.4	9.9	-3.9	6.0	9.6	-5.9	3.7

Emission, Fuel and Travel Time Savings

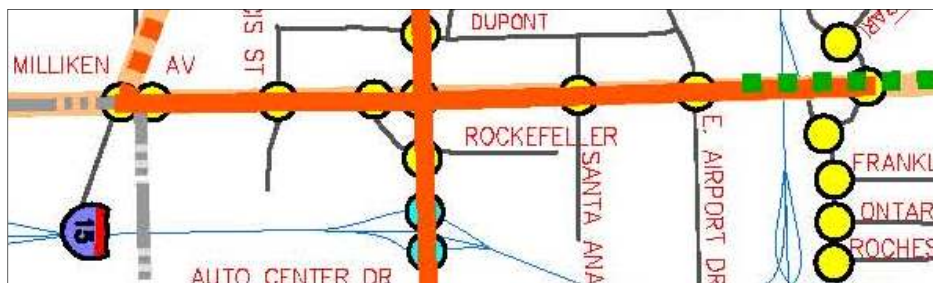
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	4.4	2.0	499.9	1.8	41.3	18.7
Annually	1,105	503	124,975	457	10,313	4,675

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.17	\$18.10	\$5.75	\$1.15	\$160.88	\$221.41
Annually (\$)	\$43	\$4,526	\$1,437	\$288	\$40,219	\$55,352

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$407
Annually: \$101,864



Grove Avenue (4th St to Philadelphia St)**"Before and After" Study Results**

Jurisdiction: Ontario

Length (mile): 3.06

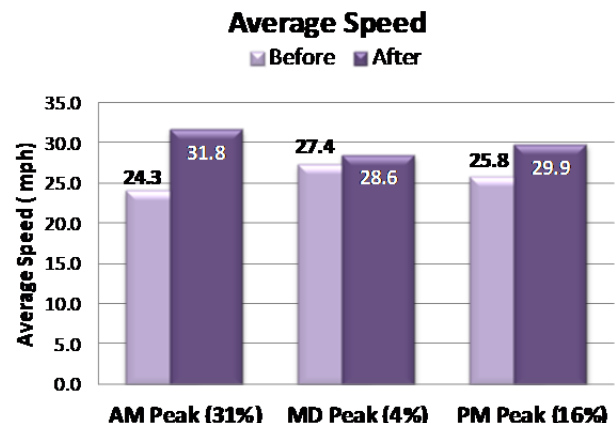
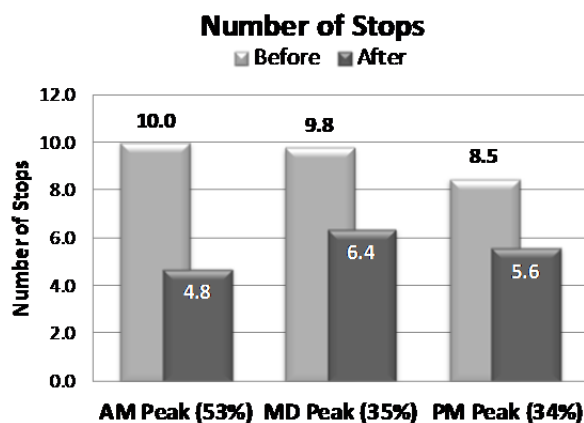
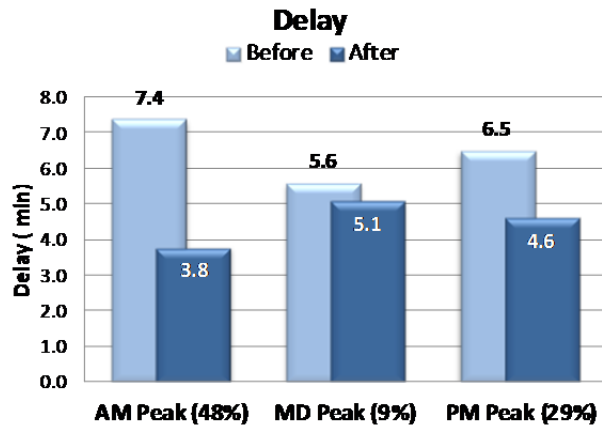
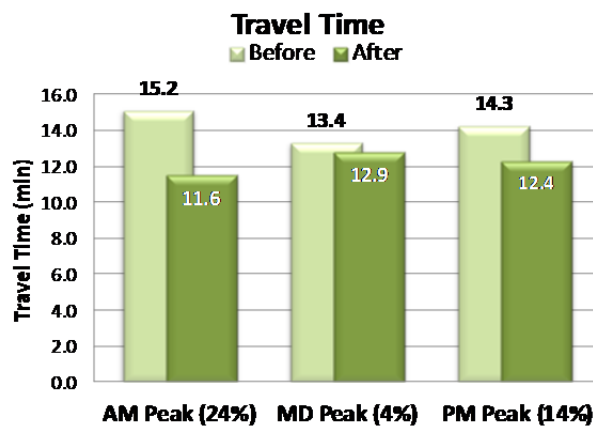
Number of Signals: 12

1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		7.7	7.5	15.2	3.8	3.6	7.4	5.0	5.0	10.0	24.0	24.8	24.3
AFTER		5.8	5.8	11.6	1.9	1.9	3.8	2.5	2.3	4.8	31.8	31.9	31.8
% Improvement		25%	23%	24%	50%	46%	48%	50%	55%	53%	32%	29%	31%

MD		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		6.5	7.0	13.4	2.5	3.1	5.6	4.0	5.8	9.8	28.5	26.7	27.4
AFTER		6.0	6.8	12.9	2.2	3.0	5.1	2.8	3.6	6.4	31.0	27.1	28.6
%		6%	2%	4%	15%	3%	9%	30%	38%	35%	9%	2%	4%

PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		7.5	6.8	14.3	3.6	2.9	6.5	4.2	4.3	8.5	24.8	27.3	25.8
AFTER		6.9	5.5	12.4	3.0	1.7	4.6	3.4	2.2	5.6	28.9	33.5	29.9
%		9%	19%	14%	18%	43%	29%	18%	49%	34%	16%	23%	16%



Grove Avenue (4th St to Philadelphia St)
"Before and After" Study Results

Jurisdiction: Ontario

Length (mile): 3.06

Number of Signals: 12

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	7803	11462	19265	4392	6273	10665	668	954	1622	2365	3733	6098	141	215	356	86	111	197
AFTER	8336	10163	18499	4144	5605	9748	603	805	1408	2091	2752	4844	123	164	286	70	97	167
% Reduction	-7%	11%	4%	6%	11%	9%	10%	16%	13%	12%	26%	21%	13%	24%	20%	19%	12%	15%

MD	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	14358	15727	30085	6996	6482	13478	1014	895	1909	3642	3754	7396	212	211	422	117	99	216
AFTER	10767	11810.3	22577	6026	5281.1	11307	870	757.9	1628	2941	2753.2	5694	174	163	337	101	97	199
% Reduction	25%	25%	25%	14%	19%	16%	14%	15%	15%	19%	27%	23%	18%	23%	20%	14%	1%	8%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	13344	11297.1	24641	6969.6	5862.2	12832	1062	867.5	1930	4144.8	3157.4	7302	248	189	438	135	103	237
AFTER	12637	7951.7	20589	6085.8	4609.8	10696	912.5	684.6	1597	3393.9	2412.2	5806	206	146	352	121	84	205
% Reduction	5%	30%	16%	13%	21%	17%	14%	21%	17%	18%	24%	20%	17%	23%	20%	10%	18%	13%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-533.1	1299.0	765.9	248.2	668.2	916.4	65.0	148.7	213.7	273.7	980.9	1254.6	18.3	51.4	69.7	16.4	13.8	30.2
MD	2872.8	3133.4	6006.2	776.0	960.7	1736.7	115.2	109.7	224.9	560.8	800.6	1361.4	30.2	38.2	68.4	12.6	1.0	13.6
PM	706.8	3345.4	4052.2	883.8	1252.4	2136.2	149.5	182.9	332.4	750.9	745.2	1496.1	42.8	43.4	86.2	13.3	18.6	31.9

Emission, Fuel and Travel Time Savings

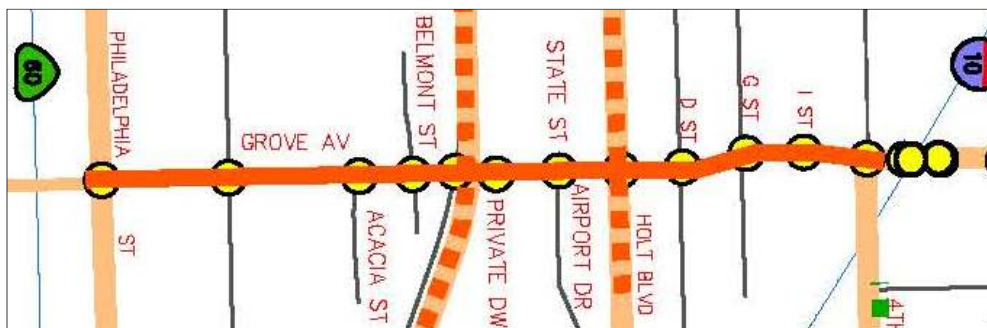
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	88.5	36.8	5725.8	30.5	749.1	241.6
Annually	22,114	9,212	1,431,452	7,616	187,273	60,388

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$3.42	\$331.58	\$65.85	\$19.17	\$2,921.45	\$2,859.95
Annually (\$)	\$855	\$82,895	\$16,462	\$4,793	\$730,363	\$714,988

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$6,201
Annually: \$1,550,356



Airport Dr (From Haven Ave to Vineyard)**"Before and After" Study Results**

Jurisdiction: Ontario

Length (mile): 2.03

Number of Signals: 7

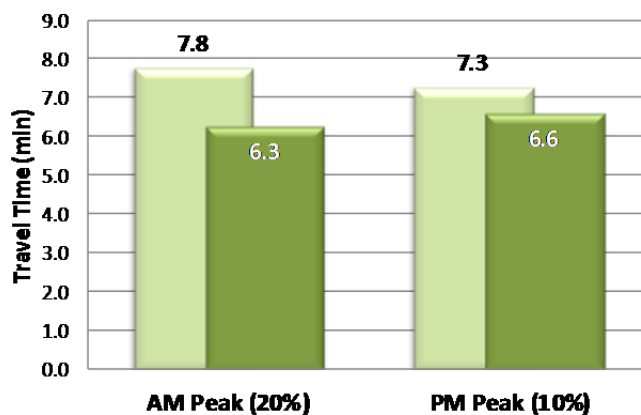
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		4.6	3.2	7.8	1.9	0.5	2.4	3.3	0.7	4.0	27.3	38.5	31.4
AFTER		3.6	2.7	6.3	0.9	0.0	0.9	2.5	0.3	2.8	34.7	45.2	38.9
% Improvement		23%	15%	20%	55%	98%	64%	25%	50%	29%	27%	17%	24%

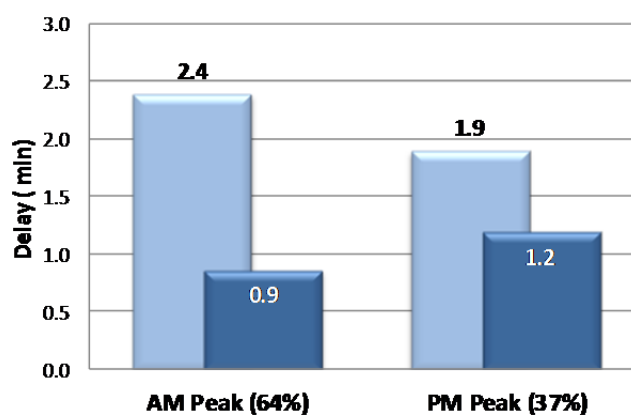
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		3.7	3.6	7.3	1.0	0.9	1.9	1.8	1.4	3.2	33.6	34.2	33.4
AFTER		3.6	3.0	6.6	0.9	0.3	1.2	2.0	0.3	2.3	35.1	42.4	37.1
% Improvement		1%	18%	10%	4%	72%	37%	-11%	80%	29%	4%	24%	11%

Travel Time

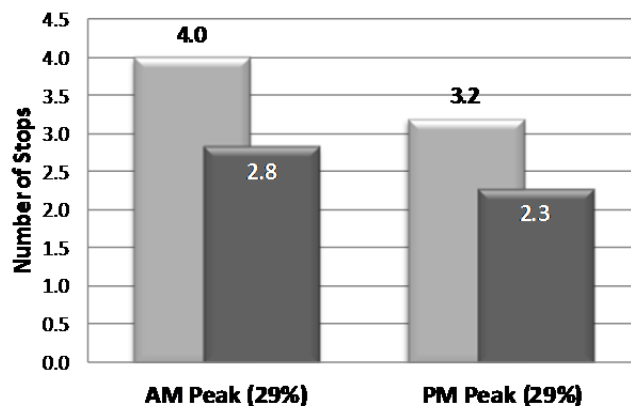
Before After

**Delay**

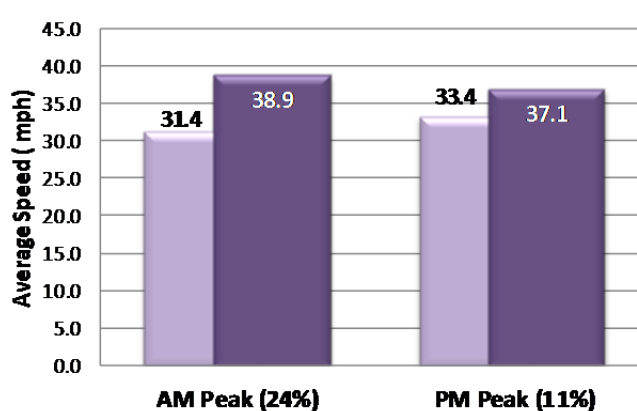
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Airport Dr (From Haven Ave to Vineyard)**"Before and After" Study Results**

Jurisdiction: Ontario

Length (mile): 2.03

Number of Signals: 7

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2906	1117	4023	1435	649	2084	210	94	304	728	301	1029	42	18	60	23	10	33
AFTER	2738	1360	4098	1418	603	2022	194	83	278	667	224	891	38	14	51	19	8	28
% Reduction	6%	-22%	-2%	1%	7%	3%	8%	11%	9%	8%	26%	13%	10%	23%	14%	18%	15%	17%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	3358	3270.8	6629	1753	1888	3641	244.5	276.7	521	714.6	908.4	1623	42	54	96	24	30	54
AFTER	2897	3373.1	6270	1500	1771	3271	212.3	246.1	458	762.7	640.3	1403	44	39	83	23	25	48
% Reduction	14%	-3%	5%	14%	6%	10%	13%	11%	12%	-7%	30%	14%	-4%	27%	13%	4%	17%	12%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	168.3	-243.3	-75.0	16.7	46.0	62.7	16.1	10.6	26.7	60.9	77.5	138.4	4.3	4.1	8.5	4.2	1.5	5.7
PM	461.0	-102.3	358.7	253.0	117.0	370.0	32.2	30.6	62.8	-48.1	268.1	220.0	-1.9	14.3	12.4	1.0	5.2	6.2

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	2.4	3.2	631.7	2.5	64.4	36.0
Annually	589	800	157,934	615	16,088	8,988

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.09	\$28.80	\$7.26	\$1.55	\$250.97	\$425.65
Annually (\$)	\$23	\$7,200	\$1,816	\$387	\$62,741	\$106,412

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$714
Annually: \$178,579



Arrow Route (Baker Ave to Etiwanda Ave)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 5.51

Number of Signals: 12

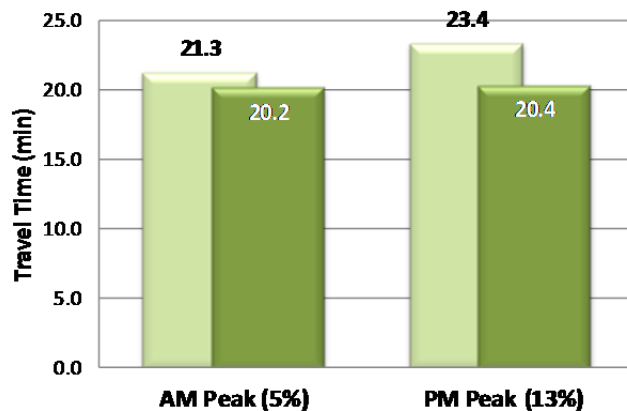
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	11.2	10.1	21.3	4.0	3.2	7.2	6.6	5.2	11.8	30.0	32.9	31.1
AFTER	10.2	10.0	20.2	3.1	3.0	6.1	3.0	3.9	6.9	32.5	33.4	32.8
% Improvement	9%	1%	5%	24%	5%	15%	55%	25%	42%	8%	1%	5%

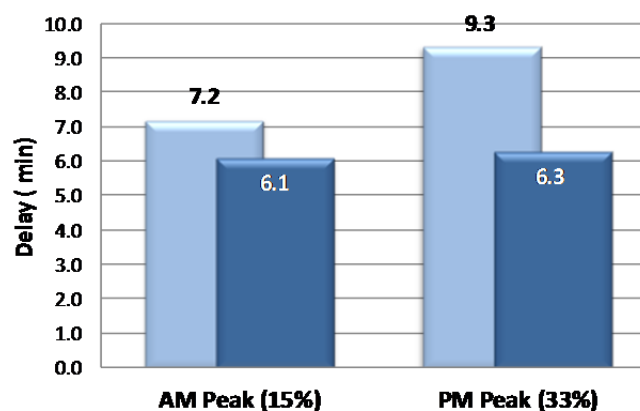
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	12.0	11.4	23.4	4.9	4.5	9.3	6.8	6.7	13.5	27.7	29.3	28.3
AFTER	10.1	10.3	20.4	2.9	3.4	6.3	3.3	3.8	7.1	33.2	32.5	32.6
Improvement	16%	10%	13%	40%	25%	33%	52%	43%	47%	20%	11%	15%

Travel Time

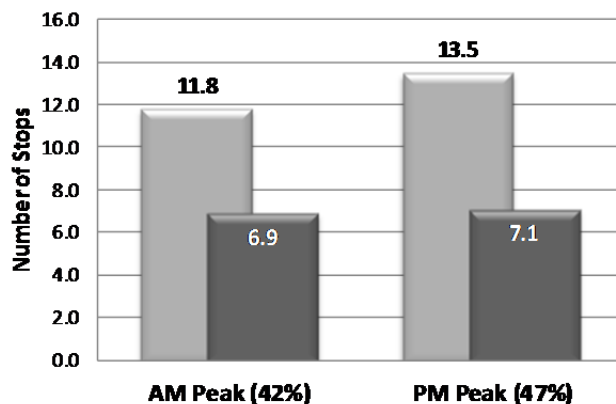
Before After

**Delay**

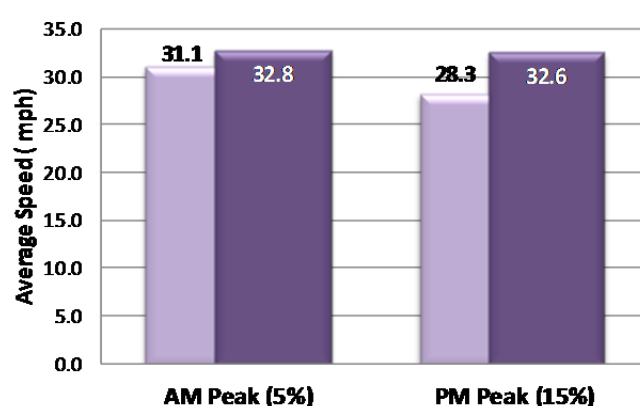
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Arrow Route (Baker Ave to Etiwanda Ave)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 5.51

Number of Signals: 12

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	7605	11676	19281	3796	4693	8489	558	686	1244	2157	2538	4695	180	264	445	68	88	156
AFTER	7292	9366	16658	3347	4613	7960	479	665	1144	1404	2203	3606	86	131	216	56	76	131
% Reduction	4%	20%	14%	12%	2%	6%	14%	3%	8%	35%	13%	23%	52%	51%	51%	19%	14%	16%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	11979	9472.6	21452	6446	5243	11689	992.3	790.5	1783	3984.1	3218	7202	230	185	416	123	98	222
AFTER	11083	9235.8	20318	5888	4878	10766	861.1	728.5	1590	2788.9	2593	5382	172	160	332	101	89	191
% Reduction	7%	2%	5%	9%	7%	8%	13%	8%	11%	30%	19%	25%	25%	14%	20%	18%	9%	14%

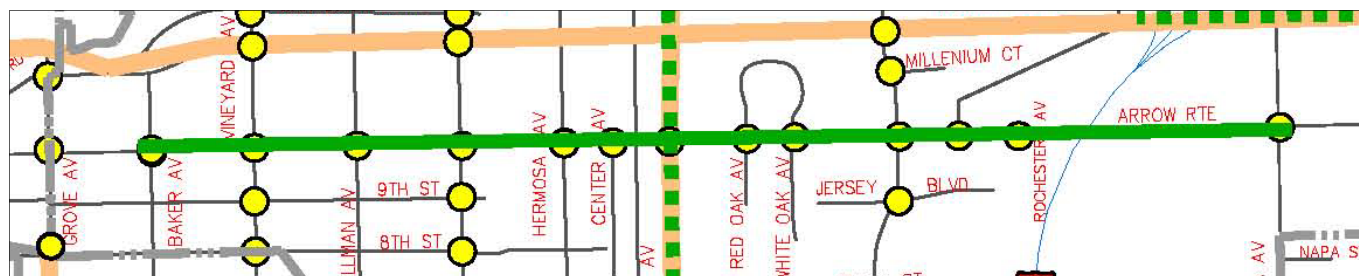
Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	313.1	2310.2	2623.3	449.0	80.0	529.0	78.2	21.2	99.4	753.4	335.3	1088.7	94.6	134.0	228.6	12.7	12.2	24.9
PM	896.4	236.8	1133.2	558.3	365.1	923.4	131.2	62.0	193.2	1195.2	625.5	1820.7	58.3	25.3	83.6	22.0	9.0	31.0

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	23.2	10.0	2038.6	20.0	863.8	170.8
Annually	5,801	2,510	509,656	5,012	215,950	42,688

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.90	\$90.35	\$23.44	\$12.62	\$3,368.82	\$2,021.68
Annually (\$)	\$224	\$22,587	\$5,861	\$3,154	\$842,205	\$505,420

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$5,518****Annually: \$1,379,452**

Archibald Avenue (4th St to Lemon Ave)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 4.31

Number of Signals: 16

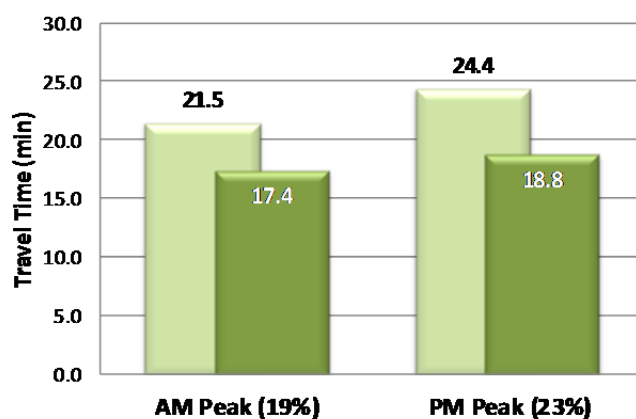
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	10.8	10.7	21.5	5.1	5.0	10.1	5.8	6.4	12.2	24.0	24.3	24.2
AFTER	8.5	8.9	17.4	2.8	3.2	6.0	4.2	4.9	9.1	30.8	29.6	30.0
% Improvement	21%	17%	19%	46%	36%	41%	28%	23%	25%	28%	22%	24%

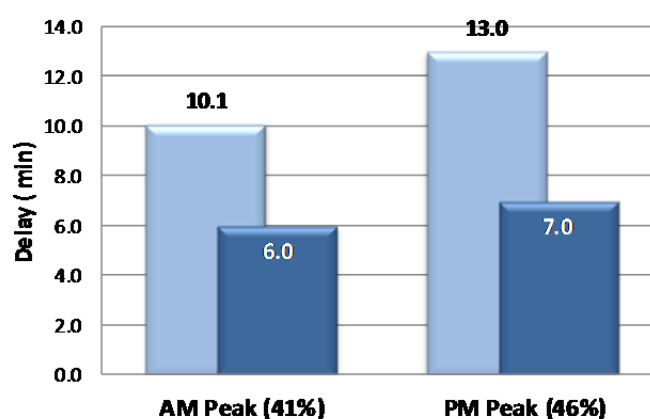
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	13.1	11.3	24.4	7.4	5.6	13.0	7.8	7.6	15.4	20.0	22.9	21.4
AFTER	9.6	9.2	18.8	3.7	3.3	7.0	5.0	3.8	8.8	27.5	28.1	27.8
Improvement	27%	19%	23%	50%	41%	46%	36%	50%	43%	37%	23%	30%

Travel Time

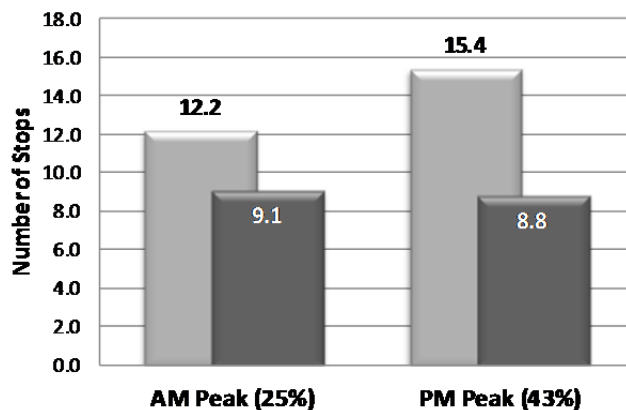
■ Before ■ After

**Delay**

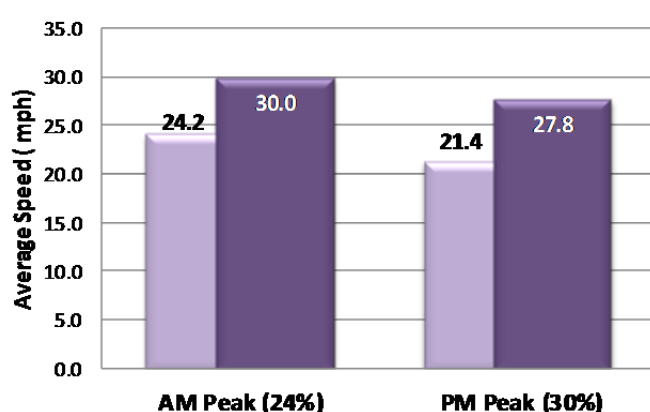
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Archibald Avenue (4th St to Lemon Ave) "Before and After" Study Results

Jurisdiction: Rancho Cucamonga

Length (mile): 4.31

Number of Signals: 16

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	8137	12301	20438	4871	7118	11989	795	1141	1936	3027	4488	7515	180	264	445	111	157	268
AFTER	8176	12338	20514	4679	6770	11449	715	1027	1742	2484	3824	6308	147	224	372	88	132	220
% Reduction	-0.5%	-0.3%	-0.4%	4.0%	4.9%	4.5%	10%	10%	10%	18%	15%	16%	18%	15%	16%	21%	16%	18%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	12350	12055	24405	7040	6564	13604	1224	1035	2259	5016.2	4175	9191	301	244	545	191	140	332
AFTER	12109	12757	24866	6907	6152	13059	1082	914.5	1997	3980.5	2980.3	6961	236	181	417	142	117	259
% Reduction	2%	-6%	-2%	2%	6%	4%	12%	12%	12%	21%	29%	24%	22%	26%	23%	26%	17%	22%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-39.2	-36.5	-75.7	192.6	347.9	540.5	80.6	113.5	194.1	543.3	663.9	1207.2	33.2	40.2	73.4	23.5	24.8	48.3
PM	241.0	-702.0	-461.0	133.4	412.0	545.4	142.0	120.8	262.8	1035.7	1194.7	2230.4	64.9	62.9	127.8	49.6	23.6	73.2

Emission, Fuel and Travel Time Savings

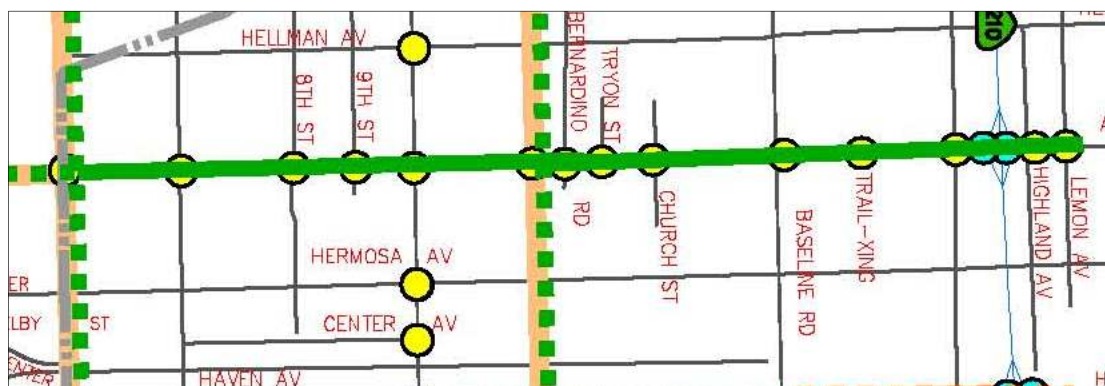
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	-4.0	7.2	3097.6	23.9	630.7	377.0
Annually	-994	1,797	774,405	5,966	157,669	94,238

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	(\$0.15)	\$64.67	\$35.62	\$15.02	\$2,459.63	\$4,463.09
Annually (\$)	(\$38)	\$16,169	\$8,906	\$3,755	\$614,908	\$1,115,772

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$7,038
Annually: \$1,759,471



Carnelian Street/Vineyard Avenue (Highland Ave to 6th St)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 3.63

Number of Signals: 16

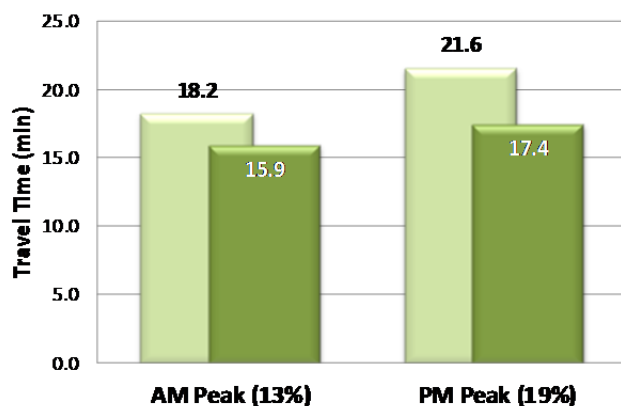
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	9.6	8.7	18.2	4.7	3.9	8.6	6.6	5.2	11.8	23.7	25.5	24.3
AFTER	8.1	7.9	15.9	3.2	3.1	6.3	3.2	4.4	7.6	27.8	28.3	27.7
% Improvement	16%	9%	13%	32%	20%	27%	52%	15%	36%	17%	11%	14%

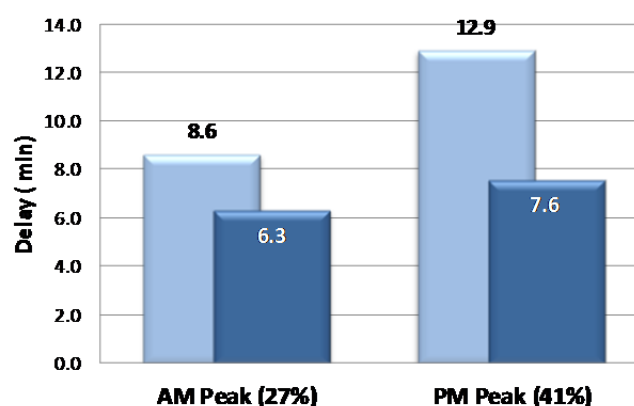
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	11.1	10.5	21.6	7.2	5.7	12.9	8.2	8.6	16.8	20.0	20.9	20.2
AFTER	9.8	7.7	17.4	4.8	2.8	7.6	4.4	5.8	10.2	27.8	28.3	25.2
Improvement	12%	27%	19%	33%	52%	41%	46%	33%	39%	39%	35%	25%

Travel Time

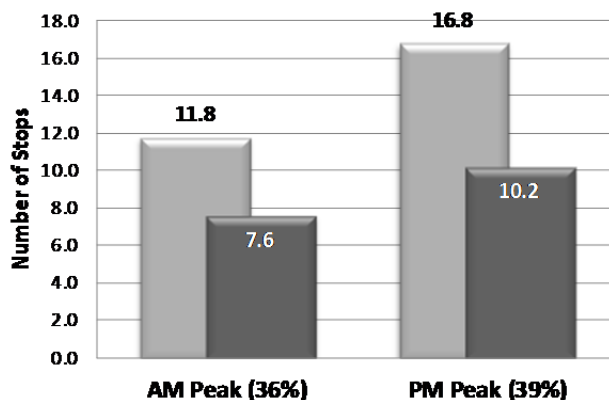
Before After

**Delay**

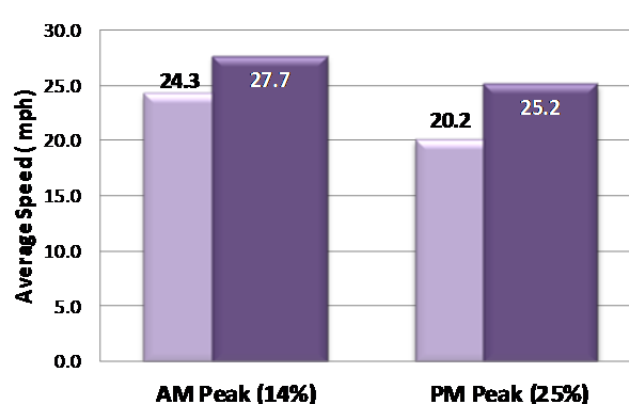
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Carnelian Street/Vineyard Avenue (Highland Ave to 6th St)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 3.63

Number of Signals: 16

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1987	3608	5595	1198	2009	3207	187	305	492	625	1046	1671	37	61	99	101	138	239
AFTER	1888	3366	5253	1128	1917	3045	173	281	455	592	872	1464	36	53	88	87	123	210
% Reduction	5%	7%	6%	6%	5%	5%	7%	8%	8%	5%	17%	12%	4%	14%	11%	14%	11%	12%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3524	3792	7316	2135	2166	4301	352.3	394.6	747	1195	1293	2488	73	77	150	174	136	310
AFTER	3264	3413	6677	2033	2004	4037	320	299.8	620	1024	970.7	1995	62	59	121	150	98	248
% Reduction	7%	10%	9%	5%	7%	6%	9%	24%	17%	14%	25%	20%	15%	24%	19%	14%	28%	20%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	99.6	242.2	341.8	70.0	92.0	162.0	13.4	24.1	37.5	32.7	173.7	206.4	1.6	8.9	10.5	14.3	14.7	29.0
PM	260.1	378.6	638.7	102.0	162.0	264.0	32.3	94.8	127.1	171.2	321.8	493.0	10.9	18.0	28.9	23.9	38.2	62.1

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	6.8	2.9	1187.4	4.9	127.3	289.9
Annually	1,703	732	296,854	1,235	31,819	72,463

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.26	\$26.36	\$13.66	\$3.11	\$496.37	\$3,431.82
Annually (\$)	\$66	\$6,591	\$3,414	\$777	\$124,093	\$857,956

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$3,972
Annually: \$992,897



Day Creek Boulevard (Baseline Rd to I-210 WB)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 1.11

Number of Signals: 8

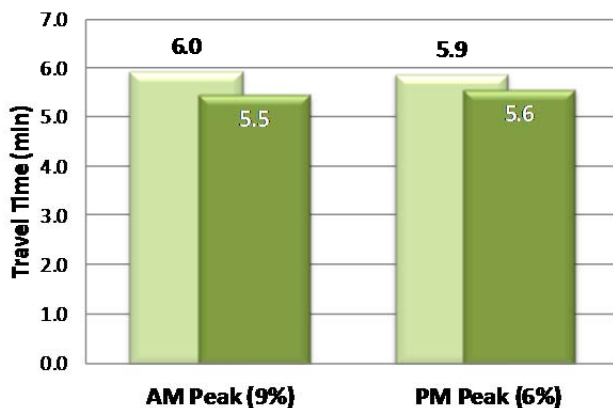
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	2.8	3.2	6.0	1.4	1.9	3.3	2.1	2.0	4.1	24.7	22.2	22.5
AFTER	2.7	2.7	5.5	1.4	1.4	2.8	1.9	2.1	4.0	26.5	24.8	24.5
% Improvement	2%	14%	9%	3%	25%	16%	13%	-6%	3%	8%	12%	9%

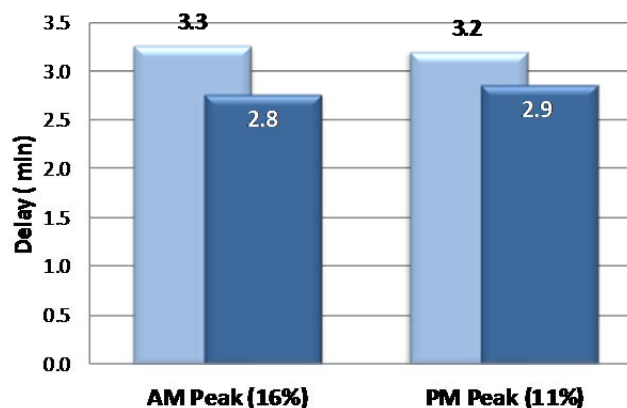
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	2.7	3.2	5.9	1.4	1.9	3.2	1.9	2.9	4.7	25.2	21.1	22.8
AFTER	2.5	3.1	5.6	1.1	1.7	2.9	1.1	2.1	3.3	30.4	24.0	25.2
Improvement	8%	4%	6%	16%	7%	11%	39%	26%	31%	21%	14%	10%

Travel Time

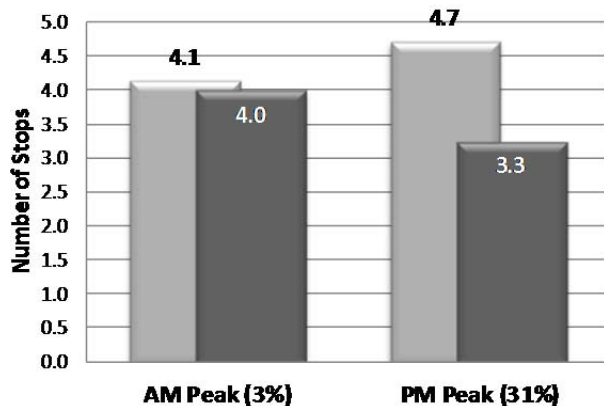
Before After

**Delay**

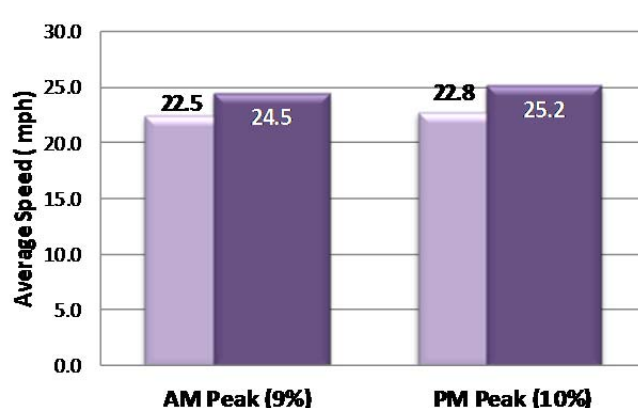
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Day Creek Boulevard (Baseline Rd to I-210 WB)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 1.11

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2453	2442	4895	1420	1317	2737	225	207	433	1061	819	1881	60	48	108	30	28	58
AFTER	2726	2687	5413	1475	1319	2794	224	193	416	1076	911	1987	61	52	113	29	25	54
% Reduction	-11%	-10%	-11%	-4%	0%	-2%	1%	7%	4%	-1%	-11%	-6%	-2%	-8%	-5%	1%	12%	6%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2971	3157.6	6129	1718	1668	3386	272	250.9	523	1188	1191	2378	68	67	135	35	32	68
AFTER	3758	2626.3	6384	1898.7	1416	3315	274.5	211.9	486	1221	971.3	2193	71	57	129	32	32	64
% Reduction	-26%	17%	-4%	-11%	15%	2%	-1%	16%	7%	-3%	18%	8%	-5%	14%	5%	8%	1%	5%

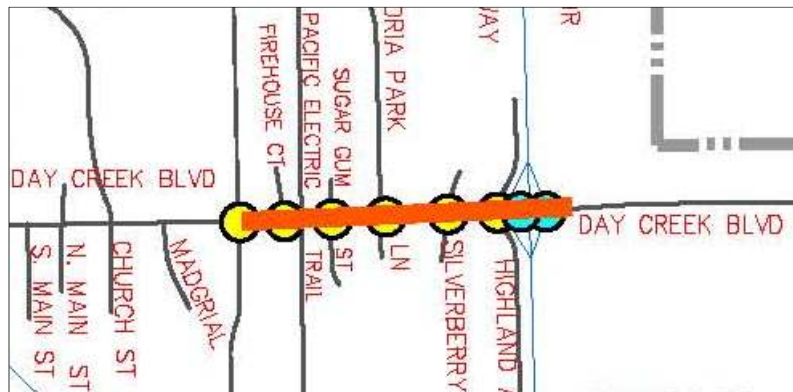
Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-273.0	-244.8	-517.8	-54.6	-2.0	-56.6	1.7	14.4	16.1	-14.9	-91.5	-106.4	-1.4	-3.8	-5.2	0.4	3.3	3.7
PM	-787.2	531.3	-255.9	-180.7	251.6	70.9	-2.5	39.0	36.5	-33.8	219.6	185.8	-3.4	9.5	6.1	2.9	0.3	3.2

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	-4.8	0.2	370.4	0.8	8.5	20.5
Annually	-1,207	59	92,595	212	2,119	5,113

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	(\$0.19)	\$2.12	\$4.26	\$0.53	\$33.05	\$242.13
Annually (\$)	(\$47)	\$529	\$1,065	\$133	\$8,263	\$60,532

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$282****Annually: \$70,476**

Milliken Avenue North (4th St/Mills Pkwy to Vintage Dr)

"Before and After" Study Results

Jurisdiction: Rancho Cucamonga

Length (mile): 4.34

Number of Signals: 19

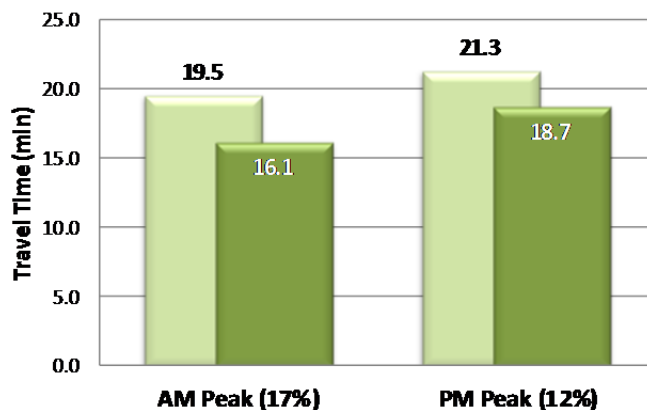
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	9.2	10.3	19.5	4.0	5.1	9.1	5.0	8.0	13.0	28.9	25.5	26.9
AFTER	8.2	8.0	16.1	3.0	2.8	5.7	4.4	3.2	7.6	31.9	33.0	32.4
% Improvement	11%	23%	17%	26%	46%	37%	12%	60%	42%	10%	29%	20%

PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	11.2	10.2	21.3	6.0	5.0	10.9	7.0	6.8	13.8	23.6	25.9	24.5
AFTER	9.3	9.4	18.7	4.1	4.2	8.3	4.0	5.4	9.4	28.5	27.8	27.9
% Improvement	17%	7%	12%	31%	15%	24%	43%	21%	32%	21%	7%	14%

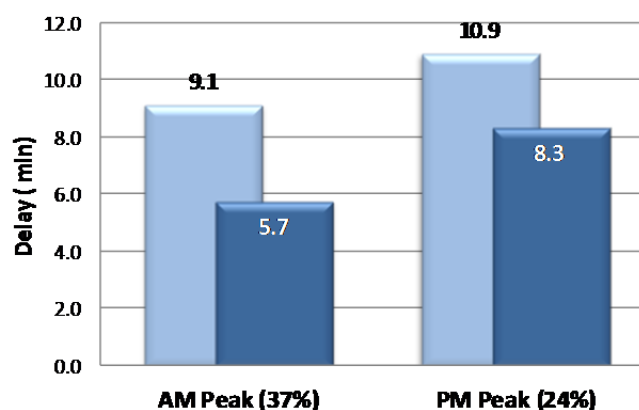
Travel Time

Before After



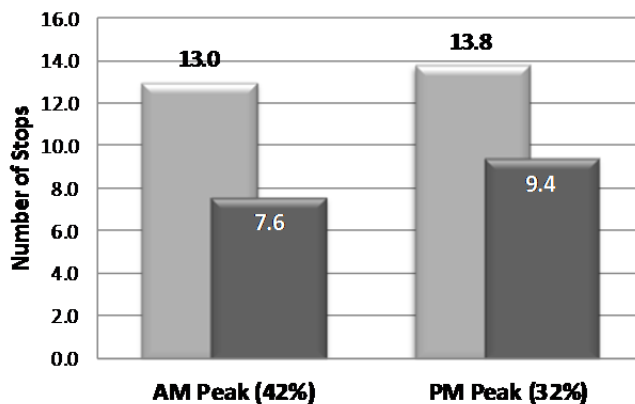
Delay

Before After



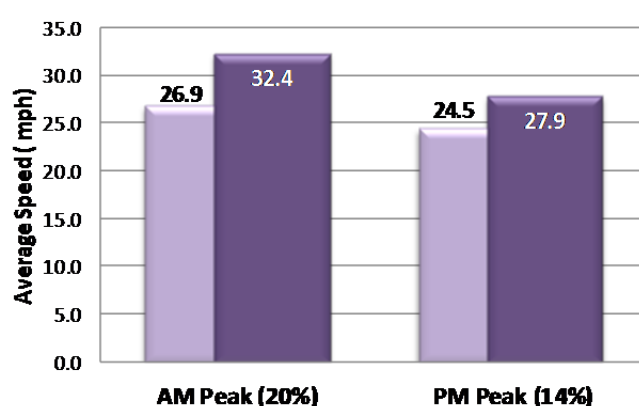
Number of Stops

Before After



Average Speed

Before After



Milliken Avenue North (4th St/Mills Pkwy to Vintage Dr)**"Before and After" Study Results**

Jurisdiction: Rancho Cucamonga

Length (mile): 4.34

Number of Signals: 19

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	8679	17207	25886	4841	8952	13793	722	1334	2057	2713	6023	8736	158	339	497	84	160	244
AFTER	10874	16039	26914	4920	7782	12702	693	1080	1772	2616	3361	5977	151	201	352	80	122	202
% Reduction	-25%	7%	-4%	-2%	13%	8%	4%	19%	14%	4%	44%	32%	4%	41%	29%	5%	24%	17%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	22203	14707.9	36910	11954	7536	19490	1852	1127	2979	7939.2	4493.4	12433	474	268	742	244	133	377
AFTER	22706	14450.9	37157	11417	7012	18430	1627	999.8	2626	5742.8	4251.8	9995	337	244	582	195	123	317
% Reduction	-2%	2%	-1%	4%	7%	5%	12%	11%	12%	28%	5%	20%	29%	9%	22%	20%	8%	16%

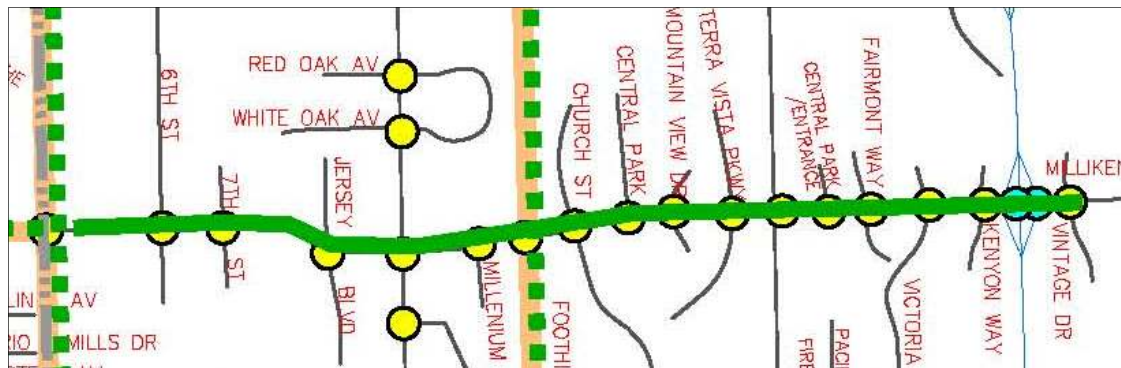
Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-2195.0	1167.6	-1027.4	-78.7	1170	1091.2	29.3	254.8	284.1	97.5	2661.9	2759.4	6.8	137.8	144.6	4.0	38.1	42.1
PM	-503.3	257.0	-246.3	536.7	523.8	1060.5	225.5	126.9	352.4	2196.4	241.6	2438.0	137.2	23.5	160.7	49.2	10.1	59.3

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	-7.6	14.2	4285.0	34.0	923.9	312.8
Annually	-1,891	3,549	1,071,259	8,505	230,966	78,200

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	(\$0.29)	\$127.75	\$49.28	\$21.41	\$3,603.06	\$3,703.55
Annually (\$)	(\$73)	\$31,938	\$12,319	\$5,353	\$900,766	\$925,888

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$7,505****Annually: \$1,876,191**

Area 3 Corridor Results

Table 6.3.1 Area 3 Corridors Measures of Effectiveness (MOE) Summary

Agency	Corridor Limits	Length (mile)	Num. of Signals	Peak Period	Measures of Effectiveness (MOE)			
					Travel Time Reduction	Delay Improvement	# of Stop Improvement	Ave. Speed Improvement
	Citrus Ave							
Fontana	From San Bernardino Ave to Summit Ave	5.4	18	AM	7%	18%	23%	10%
				PM	19%	44%	36%	23%
	Arrow Blvd							
Fontana	From Juniper Ave to Alder	1.2	6	AM	30%	48%	64%	49%
				PM	33%	87%	66%	53%
	Sierra Ave							
Fontana	From Sierra Lakes . to Jurupa Ave	6.3	27	AM	8%	19%	21%	27%
				MID	14%	29%	33%	16%
				PM	13%	25%	32%	23%
	Riverside Ave - North							
Rialto	From Live Oak Ave to San Bernardino Ave	8.02	19	AM	7%	22%	23%	8.0%
				PM	7%	19%	22%	7.0%
	Cedar Ave/Ayala Dr - North							
Rialto SB County (1)	From San Bernardino Ave to Riverside Ave	5.16	14	AM	8%	24%	10%	8%
				PM	5%	16%	10%	5%
Overall Average % Improvement:					14%	32%	31%	21%

Table 6.3.2 Area 3 Corridors Quantification of Annually Savings Summary

Corridor Information		Quantification of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel (gal)	VHT (veh-hr)
		CO (lb)	Nox (lb)	CO2 (lb)	VOC (lb)		
	Citrus Ave						
Fontana	From San Bernardino Ave to Summit Ave (18)	-2,910	46	510,952	3,352	85,669	56,113
	Arrow Blvd						
Fontana	From Juniper Ave to Alder (6)	1,324	614	164,548	792	22,269	18,550
	Sierra Ave						
Fontana	From Sierra Lakes . to Jurupa Ave (27)	15,990	5,802	1,454,788	8,951	216,300	136,535
	Riverside Ave - North						
Rialto	From Live Oak Ave to San Bernardino Ave (19)	740	1,034	350,785	2,369	59,000	28,750
	Cedar Ave/Ayala Dr - North						
Rialto, SB County (1)	From San Bernardino Ave to Riverside Ave (14)	2,872	734	267,670	968	16,313	13,500
Area Project Total:		1,396				399,551	253,448
		(Tons)				(gal)	(veh-hr)

Table 6.3.3 Area 3 Corridors Monetary Measures of Annually Savings Summary

Corridor Information		Monetary Measures of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel	VHT
		CO	Nox	CO2	VOC		
	Citrus Ave						
Fontana	From San Bernardino Ave to Summit Ave (18)	-\$53	\$2,207	\$5,929	\$2,109	\$334,108	\$664,372
	Arrow Blvd						
Fontana	From Juniper Ave to Alder (6)	\$51	\$5,523	\$1,892	\$499	\$86,848	\$219,632
	Sierra Ave						
Fontana	From Sierra Lakes . to Jurupa Ave (27)	\$618	\$52,205	\$16,730	\$5,633	\$843,570	\$1,616,574
	Riverside Ave - North						
Rialto	From Live Oak Ave to San Bernardino Ave (19)	\$29	\$9,304	\$4,036	\$1,491	\$237,180	\$340,400
	Cedar Ave/Ayala Dr - North						
Rialto, SB County (1)	From San Bernardino Ave to Riverside Ave (14)	\$111	\$6,602	\$3,078	\$609	\$100,888	\$159,840
Area Project Total:		\$118,603				\$1,602,594	\$3,000,818
		\$4,722,015					

Citrus Avenue (San Bernardino Ave to Summit Ave)**"Before and After" Study Results**

Jurisdiction: Fontana

Length (mile): 5.04

Number of Signals: 18

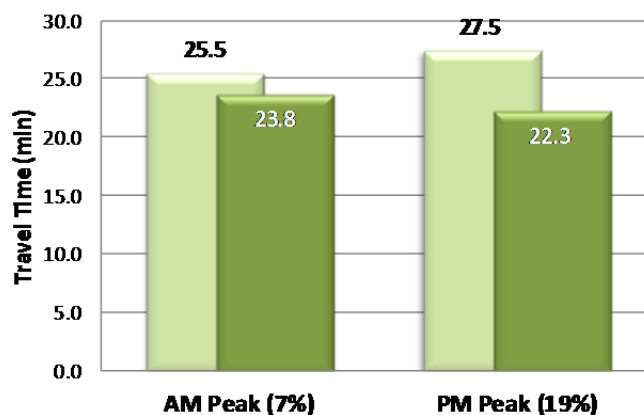
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	12.5	13.0	25.5	4.6	5.2	9.8	6.4	9.0	15.4	24.5	23.3	23.8
AFTER	11.0	12.7	23.8	3.1	4.9	8.0	4.8	7.0	11.8	28.3	24.5	26.2
% Improvement	12%	2%	7%	32%	7%	18%	25%	22%	23%	15%	5%	10%

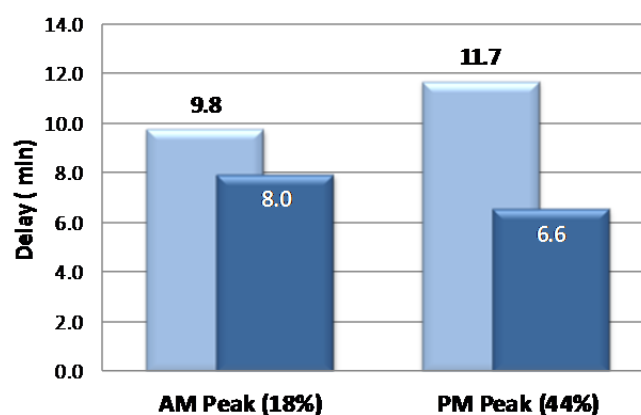
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	14.5	13.0	27.5	6.6	5.2	11.7	9.0	8.4	17.4	21.0	23.3	22.1
AFTER	11.2	11.1	22.3	3.3	3.3	6.6	6.0	5.2	11.2	26.9	27.7	27.2
% Improvement	22%	15%	19%	50%	37%	44%	33%	38%	36%	28%	19%	23%

Travel Time

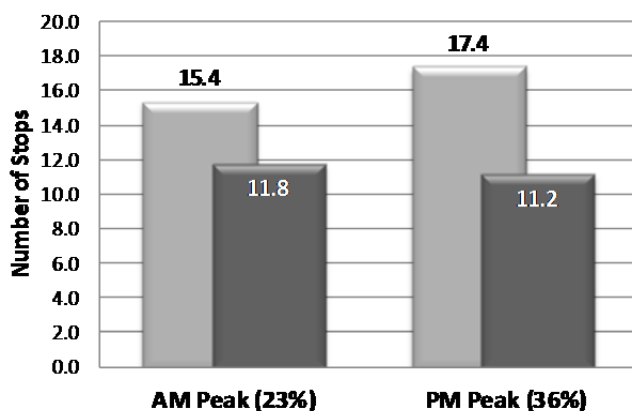
■ Before ■ After

**Delay**

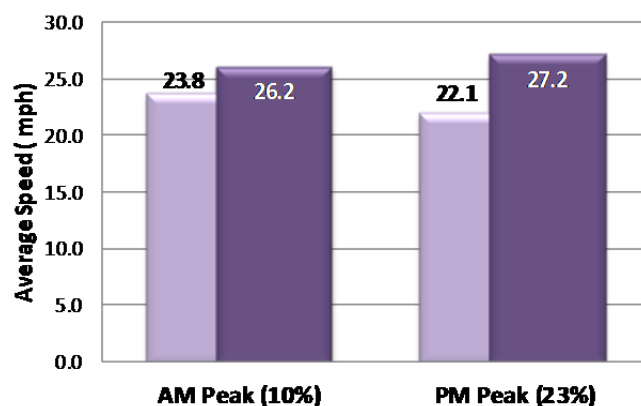
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Citrus Avenue (San Bernardino Ave to Summit Ave)**"Before and After" Study Results**

Jurisdiction: Fontana

Length (mile): 5.04

Number of Signals: 18

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	6901	9864	16765	3938	5468	9406	669	907	1577	2305	3424	5730	141	203	344	99	131	229
AFTER	7180	11784	18964	4036	5710	9746	627	878	1505	2073	3077	5150	128	190	317	87	130	217
% Reduction	-4%	-19%	-13%	-2%	-4%	-4%	6%	3%	5%	10%	10%	10%	10%	7%	8%	12%	1%	5%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	9106	9858.9	18965	5245	5142	10387	899.5	847.7	1747	3321	3116	6437	201	184	385	141	121	262
AFTER	8744	9365.6	18110	5073	4944	10017	787.9	743.1	1531	2702	2411	5113	161	146	307	106	100	207
% Reduction	4%	5%	5%	3%	4%	4%	12%	12%	12%	19%	23%	21%	20%	21%	20%	25%	17%	21%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-279.0	-1920.3	-2199.3	-98.0	-242.0	-340.0	42.4	29.1	71.5	232.3	347.6	579.9	13.6	13.9	27.5	11.8	0.7	12.5
PM	361.4	493.3	854.7	172.0	198.0	370.0	111.6	104.6	216.2	618.7	704.5	1323.2	40.0	38.4	78.3	34.9	20.3	55.2

Emission, Fuel and Travel Time Savings

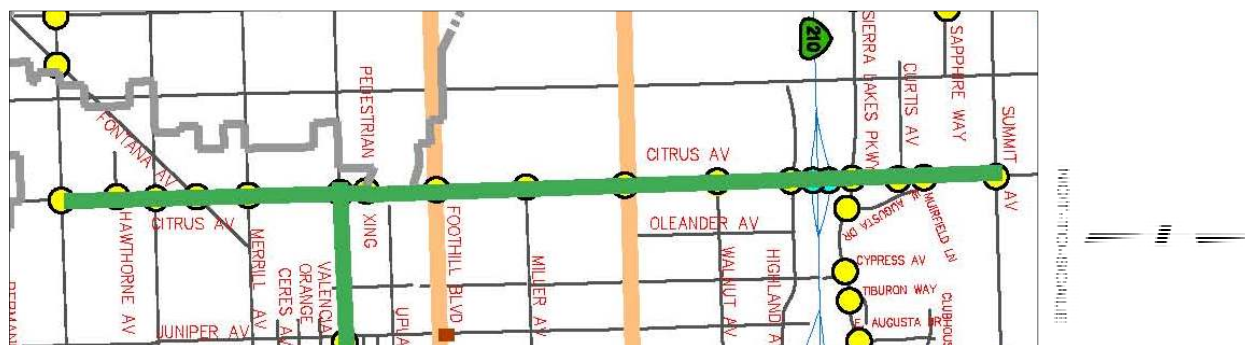
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	-5.5	1.0	2062.3	13.4	342.7	224.5
Annually	-1,382	245	515,581	3,352	85,669	56,113

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	(\$0.21)	\$8.83	\$23.72	\$8.44	\$1,336.43	\$2,657.49
Annually (\$)	(\$53)	\$2,207	\$5,929	\$2,109	\$334,108	\$664,372

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$4,035
Annually: \$1,008,672



Arrow Boulevard (Juniper Ave to Alder Ave)**"Before and After" Study Results**

Jurisdiction: Fontana

Length (mile): 1.20

Number of Signals: 6

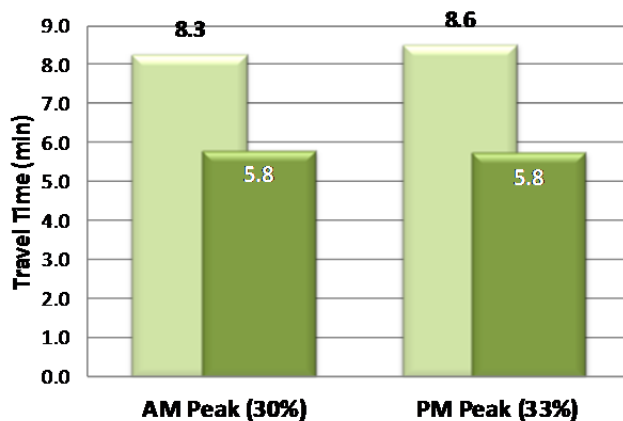
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	4.1	4.2	8.3	1.4	1.5	2.9	3.0	3.0	6.0	18.7	19.0	17.7
AFTER	3.1	2.7	5.8	1.0	0.6	1.5	1.3	0.9	2.1	24.7	29.1	25.4
% Improvement	24%	36%	30%	31%	63%	48%	57%	71%	64%	32%	53%	43%

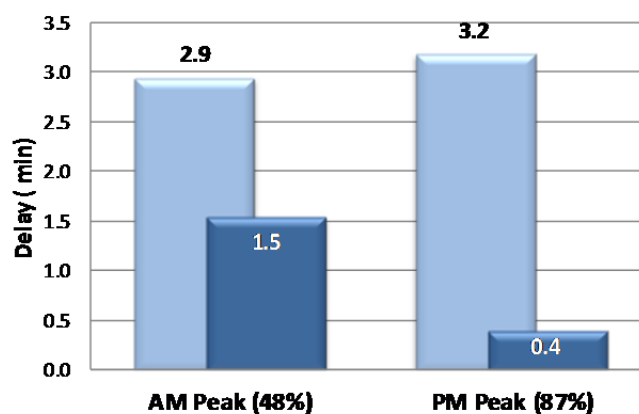
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	4.3	4.2	8.6	1.7	1.5	3.2	3.6	3.2	6.8	17.7	18.1	16.9
AFTER	3.3	2.5	5.8	0.6	-0.2	0.4	1.3	1.1	2.3	25.5	30.3	25.9
Improvement	25%	41%	33%	64%	113%	87%	65%	66%	66%	44%	68%	53%

Travel Time

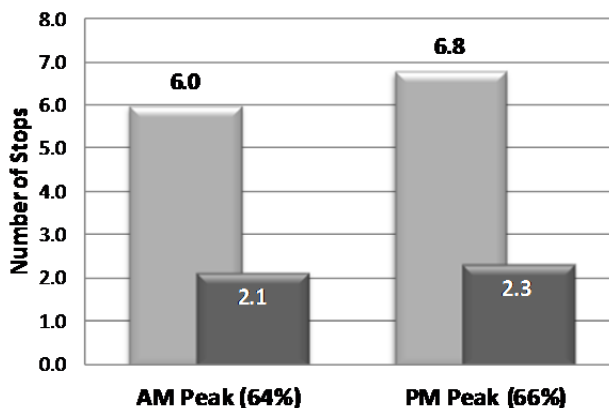
■ Before ■ After

**Delay**

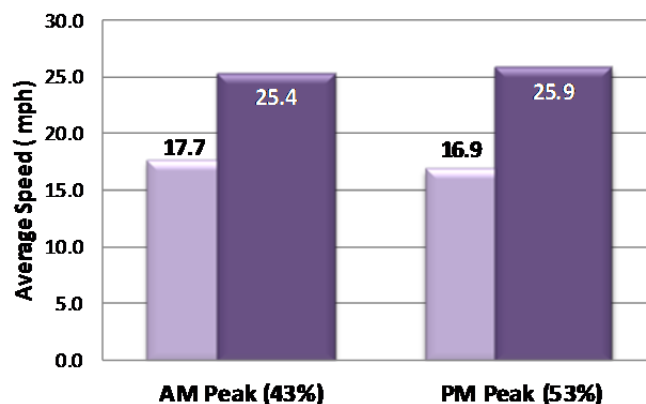
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Arrow Boulevard (Juniper Ave to Alder Ave)**"Before and After" Study Results**

Jurisdiction: Fontana

Length (mile): 1.20

Number of Signals: 6

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	805	1229	2034	461	686	1146	83	126	209	267	408	676	17	26	42	14	21	35
AFTER	723	1021	1744	433	618	1051	70	99	169	203	287	490	13	18	31	11	15	25
% Reduction	10%	17%	14%	6%	10%	8%	15%	22%	19%	24%	30%	27%	23%	30%	27%	23%	32%	28%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	1436	1246	2681	808.6	690.9	1500	141.7	122.5	264	482.3	395.3	878	30	25	55	24	20	44
AFTER	1248	954.2	2202	722	527.4	1249	115.7	91.7	207	323.2	276.2	599	21	17	38	18	12	30
% Reduction	13%	23%	18%	11%	24%	17%	18%	25%	21%	33%	30%	32%	30%	33%	31%	25%	41%	32%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	82.3	207.6	289.9	27.5	67.8	95.3	12.5	27.4	39.9	64.1	121.3	185.4	3.9	7.7	11.6	3.1	6.7	9.8
PM	187.9	291.6	479.5	86.6	163.5	250.1	26.0	30.8	56.8	159.1	119.1	278.2	9.1	8.1	17.2	6.0	8.2	14.2

Emission, Fuel and Travel Time Savings

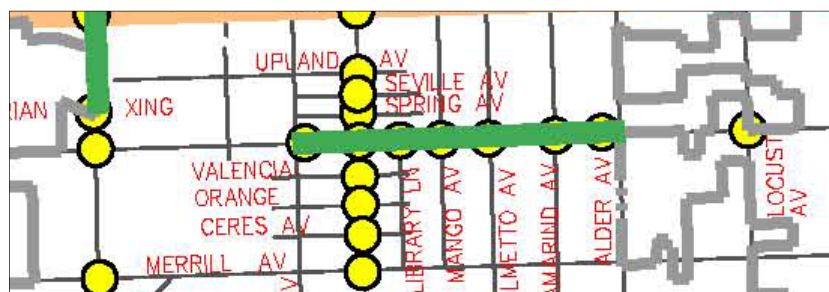
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	5.3	2.5	658.2	3.2	89.1	74.2
Annually	1,324	614	164,548	792	22,269	18,550

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.20	\$22.09	\$7.57	\$1.99	\$347.39	\$878.53
Annually (\$)	\$51	\$5,523	\$1,892	\$499	\$86,848	\$219,632

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,258
Annually: \$314,445



Sierra Avenue (Sierra Lakes Pkwy to Jurupa Ave)**"Before and After" Study Results**

Jurisdiction: Fontana

Length (mile): 6.30

Number of Signals: 27

1. Measures of Effectiveness (MOE) Summary

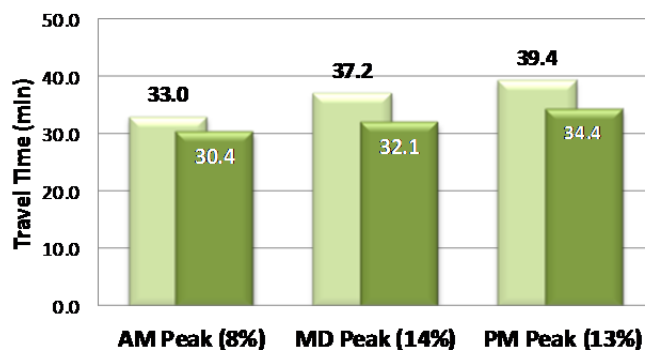
AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		16.6	16.5	33.0	6.8	7.0	13.8	10.0	10.8	20.8	23.1	23.1	22.9
AFTER		15.2	15.2	30.4	5.5	5.8	11.2	7.2	9.2	16.4	25.5	24.9	25.0
% Improvement		8%	8%	8%	20%	18%	19%	28%	15%	21%	10%	8%	9%

MD		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		18.2	19.1	37.2	8.3	9.3	17.6	12.0	13.0	25.0	20.9	20.1	20.4
AFTER		16.5	15.6	32.1	6.7	5.8	12.5	8.1	8.7	16.9	23.1	24.3	23.7
% Improvement		9%	18%	14%	20%	37%	29%	32%	33%	33%	11%	21%	16%

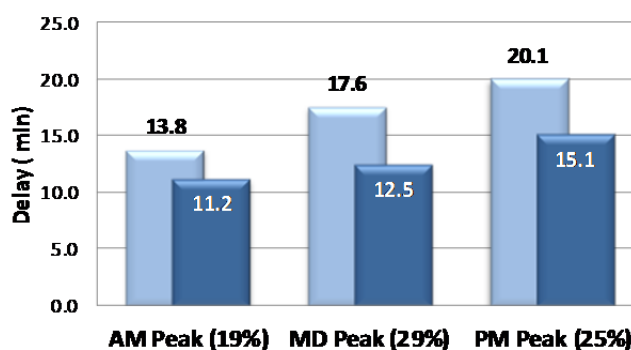
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		18.6	20.8	39.4	8.9	11.2	20.1	13.0	14.0	27.0	20.4	18.3	19.2
AFTER		19.6	14.9	34.4	9.9	5.2	15.1	11.0	7.4	18.4	19.5	25.8	22.1
% Improvement		-5%	28%	13%	-11%	53%	25%	15%	47%	32%	-4%	41%	15%

Travel Time

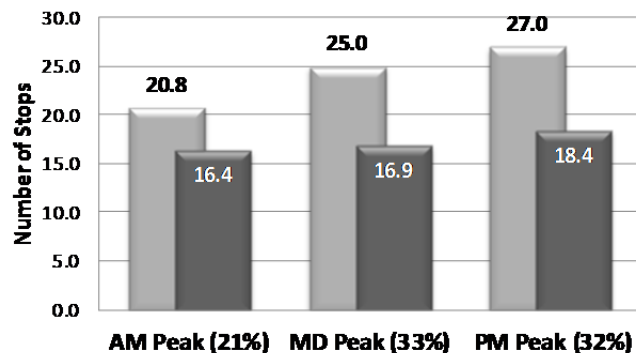
■ Before ■ After

**Delay**

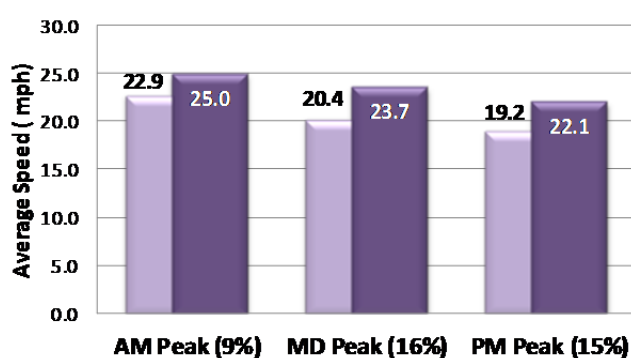
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



"Before and After" Study Results

Number of Signals: 27

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	15324	12291	27615	8161	6558	14719	1302	1038	2339	4932	3637	8569	292	218	510	182	140	321
AFTER	14508	11631	26139	7770	6378	14148	1201	996	2197	4450	3396	7846	264	206	470	164	137	301
% Reduction	5%	5%	5%	5%	3%	4%	8%	4%	6%	10%	7%	8%	10%	5%	8%	10%	2%	6%

MD	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	16660	14781.3	31442	9147.1	8695	17842	1541	1491	3032	5887.4	5850.4	11738	355	352	707	236	235	470
AFTER	14980	14509.9	29489	8503.1	8269	16772	1326	1349	2675	4670	4777.2	9447	285	297	582	138	219	357
% Reduction	10%	2%	6%	7%	5%	6%	14%	10%	12%	21%	18%	20%	20%	16%	18%	41%	7%	24%

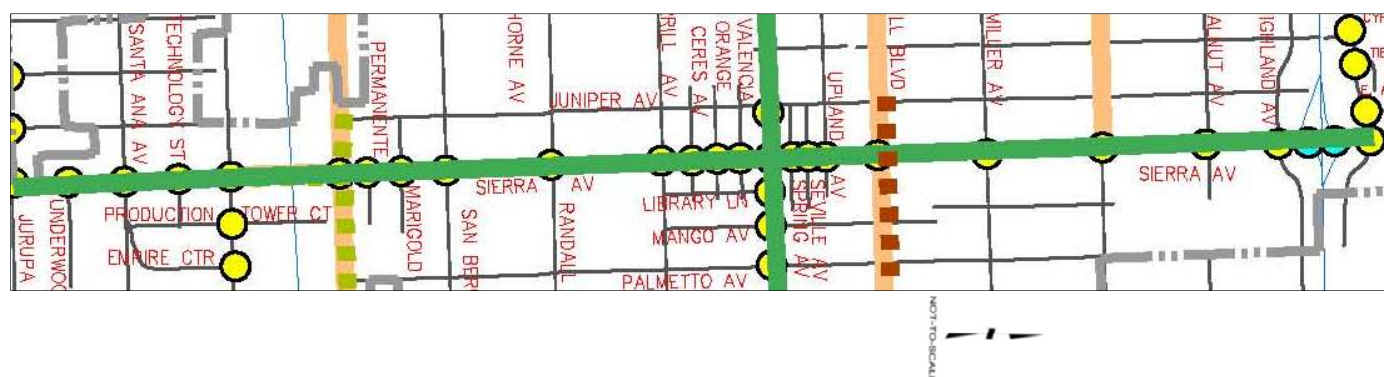
PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	19212	16773.8	35986	9303.8	9333	18637	1500	1587	3087	5528.7	6412.6	11941	335	384	719	225	253	477
AFTER	15188	15347.9	30536	8297.3	8718	17015	1299	1462	2760	4414.7	5497.4	9912	269	344	614	184	256	440
% Reduction	21%	9%	15%	11%	7%	9%	13%	8%	11%	20%	14%	17%	19%	10%	15%	18%	-1%	8%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	816.2	660.2	1476.4	390.8	180.0	570.8	101.0	41.5	142.5	481.8	241.6	723.4	28.2	11.4	39.7	17.4	2.6	20.0
MD	1344.6	217.1	1561.8	515.2	340.8	856.0	171.5	113.5	285.0	973.9	858.6	1832.5	55.6	44.0	99.6	78.1	12.9	91.0
PM	4023.7	1425.9	5449.6	1006.5	615.0	1621.5	201.0	125.6	326.6	1114.0	915.2	2029.2	65.3	39.8	105.1	40.7	-2.9	37.8

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	64.0	23.2	5819.2	35.8	865.2	546.1
Annually	15,990	5,802	1,454,788	8,951	216,300	136,535

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$2.47	\$208.82	\$66.92	\$22.53	\$3,374.28	\$6,466.30
Annually (\$)	\$618	\$52,205	\$16,730	\$5,633	\$843,570	\$1,616,574

Annually: \$2,535,330



Riverside Avenue (Live Oak Ave to San Bernardino Ave)**"Before and After" Study Results**

Jurisdiction: Rialto

Length (mile): 8.02

Number of Signals: 19

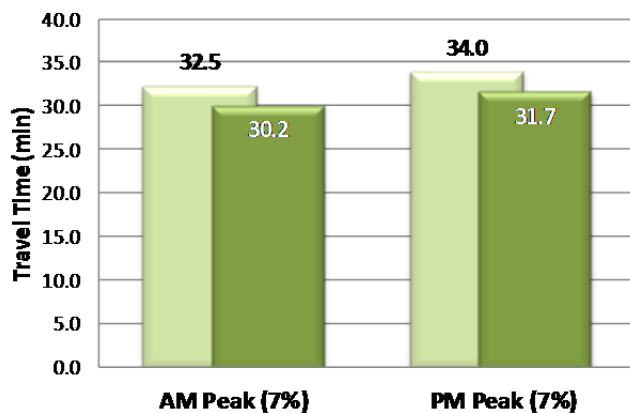
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.	
BEFORE	16.4	16.1	32.5	5.1	4.4	9.5	7.0	7.4	14.4	29.6	30.1	29.8	
AFTER	14.2	16.0	30.2	3.0	4.5	7.5	5.0	6.2	11.2	33.9	30.8	32.0	
% Improvement	13%	1%	7%	42%	-3%	22%	29%	16%	22%	15%	2%	8%	

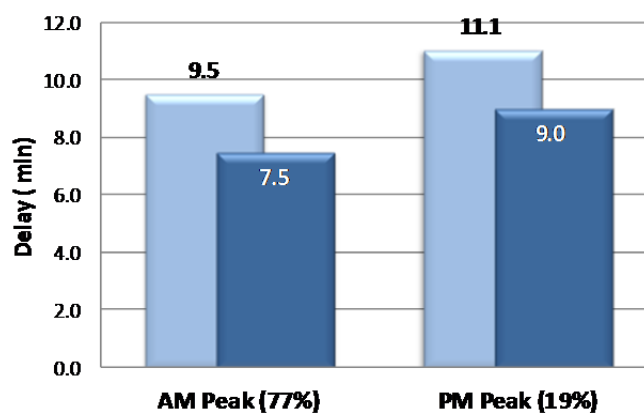
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	17.4	16.6	34.0	6.2	4.9	11.1	8.2	8.4	16.6	27.7	29.1	28.3
AFTER	15.9	15.9	31.7	4.6	4.4	9.0	6.6	6.2	12.8	30.4	30.5	30.5
Improvement	9%	4%	7%	25%	10%	19%	20%	26%	23%	10%	5%	7%

Travel Time

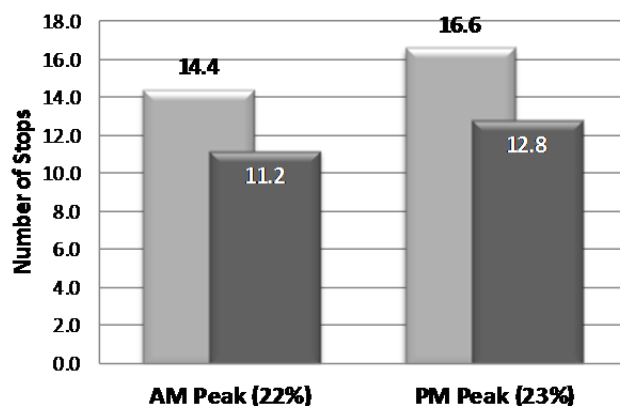
Before After

**Delay**

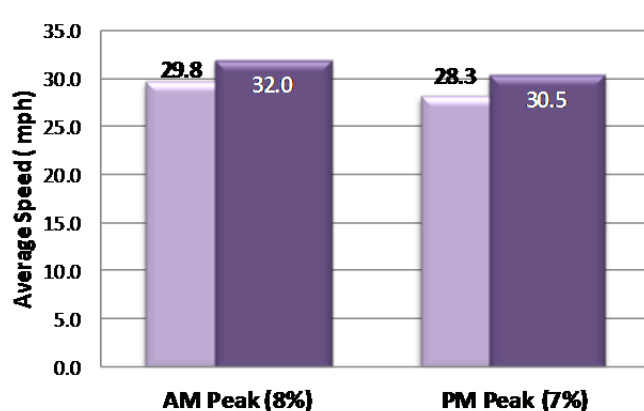
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Riverside Avenue (Live Oak Ave to San Bernardino Ave)**"Before and After" Study Results**

Jurisdiction: Rialto

Length (mile): 8.02

Number of Signals: 19

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	9492	13571	23063	5768	7535	13303	911	1163	2074	2969	3984	6953	180	237	417	117	148	265
AFTER	10246	13619	23865	5935	7536	13471	886	1145	2032	2653	3848	6501	160	233	394	102	153	255
% Reduction	-8%	0%	-3%	-3%	0%	-1%	3%	1%	2%	11%	3%	7%	11%	2%	6%	13%	-4%	4%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	14136	13135	27271	8172	7539	15711	1296	1184	2480	4604	4086	8690	277	243	520	179	152	330
AFTER	13319	12995	26314	7799	7256	15055	1209	1120	2329	3945	3840	7785	238	232	470	155	149	304
% Reduction	6%	1%	4%	5%	4%	4%	7%	5%	6%	14%	6%	10%	14%	5%	10%	13%	2%	8%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/ hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-754.0	-48.0	-802.0	-167.0	-1.0	-168.0	25.0	17.2	42.2	315.7	136.4	452.1	19.9	3.8	23.7	15.2	-5.6	9.6
PM	817.0	140.0	957.0	373.0	283.0	656.0	87.0	64.8	151.8	659.6	245.3	904.9	38.9	11.7	50.5	23.7	2.3	26.0

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	3.0	4.1	1403.9	9.5	236.0	115.0
Annually	741	1,034	350,978	2,369	59,000	28,750

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.11	\$37.22	\$16.14	\$5.96	\$920.40	\$1,361.60
Annually (\$)	\$29	\$9,304	\$4,036	\$1,491	\$230,100	\$340,400

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$2,341
Annually: \$585,359



Cedar Avenue/Ayala Drive (Riverside Ave to San Bernardino Ave)**"Before and After" Study Results**

Jurisdiction: Rialto

Length (mile): 5.13

Number of Signals: 14

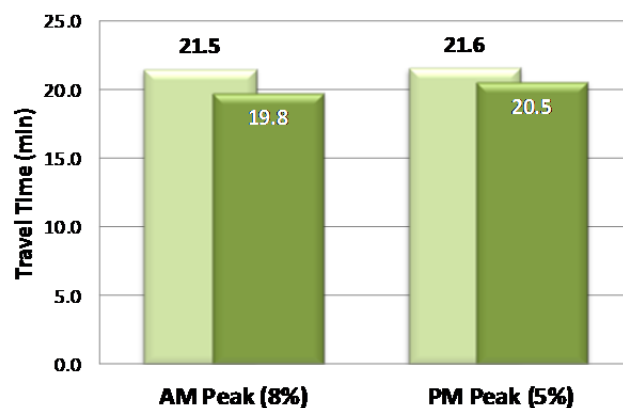
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	11.1	10.4	21.5	3.8	3.1	6.9	5.0	4.6	9.6	27.9	30.0	28.8
AFTER	9.2	10.7	19.8	1.8	3.4	5.2	3.8	4.8	8.6	34.0	29.2	31.2
% Improvement	18%	-3%	8%	52%	-8%	24%	24%	-4%	10%	22%	-3%	8%

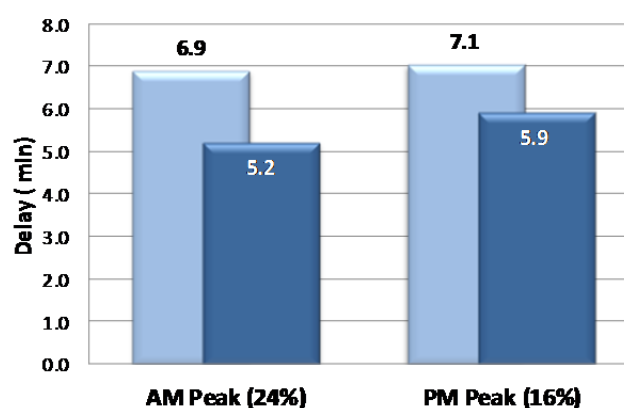
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	11.1	10.5	21.6	3.7	3.3	7.1	5.4	4.6	10.0	28.0	29.4	28.5
AFTER	11.0	9.5	20.5	3.7	2.3	5.9	4.8	4.3	9.0	28.1	32.5	30.0
Improvement	1%	9%	5%	2%	31%	16%	12%	8%	10%	0%	10%	5%

Travel Time

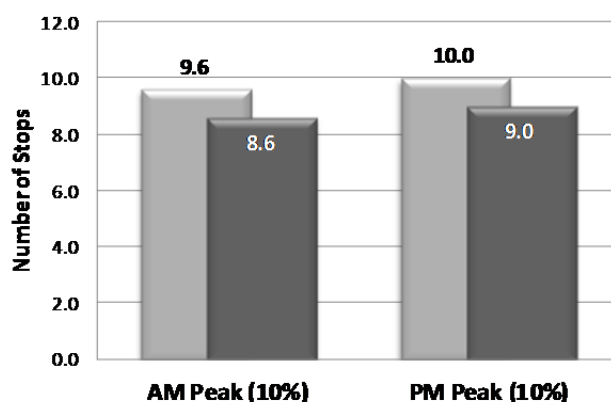
Before After

**Delay**

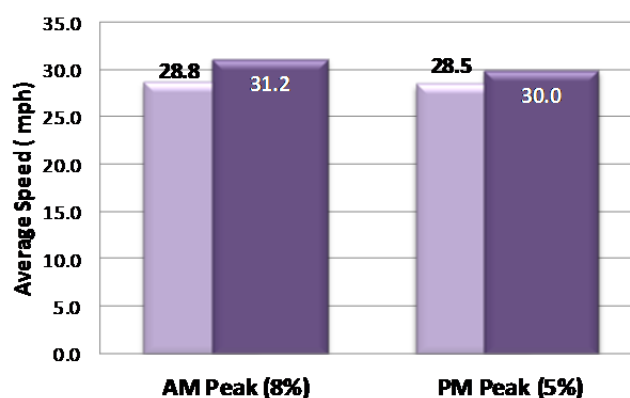
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Cedar Avenue/Ayala Drive (Riverside Ave to San Bernardino Ave)**"Before and After" Study Results**

Jurisdiction: Rialto

Length (mile): 5.13

Number of Signals: 14

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	7391	7148	14539	4153	4145	8298	641	662	1304	2085	2095	4179	125	128	253	79	85	165
AFTER	7407	6988	14394	4173	4100	8273	629	614	1243	1946	1796	3742	119	109	228	83	72	155
% Reduction	0%	2%	1%	0%	1%	0%	2%	7%	5%	7%	14%	10%	5%	15%	10%	-4%	15%	6%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	8355	9162	17517	4798	5030	9828	738	784.7	1523	2442	2565	5007	147	154	300	93	99	192
AFTER	7761	8370	16131	4644	4821	9465	705.5	721.8	1427	2283	2535	4817	140	149	289	93	90	183
% Reduction	7%	9%	8%	3%	4%	4%	4%	8%	6%	7%	1%	4%	5%	3%	4%	-1%	9%	4%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)			
	Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM		-16.3	160.8	144.5	-19.8	44.2	24.4	12.6	48.1	60.7	138.9	298.4	437.3	6.4	18.8	25.2	-3.5	13.2	9.7
PM		593.6	792.1	1385.7	154.0	208.9	362.9	32.5	62.9	95.4	158.9	30.7	189.6	6.9	4.7	11.6	-0.8	9.3	8.5

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (hourly)
Daily	11.5	2.9	1070.7	3.9	103.5	54.0
Annually	2,872	734	267,670	968	25,869	13,500

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.44	\$26.41	\$12.31	\$2.44	\$403.55	\$639.36
Annually (\$)	\$111	\$6,602	\$3,078	\$609	\$100,888	\$159,840

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,085
Annually: \$271,129



Area 4 Corridor Results

Table 6.4.1 Area 4 Corridors Measures of Effectiveness (MOE) Summary

Area Number	Agency	Corridor Limits	Length (mile)	Num. of Signals	Peak Period	Measures of Effectiveness (MOE)				
						Travel Time Reduction	Delay Improvement	# of Stop Improvement	Ave. Speed Improvement	
4		Mt. Vernon Ave South								
	SB City	From Vally Blvd to Rialto Ave	2.45	9	AM	12%	43%	21%	15%	
	Colton				PM	22%	56%	43%	28%	
		Rancho Ave								
	Colton	From Valley Blvd to Rialto Ave	2.15	8	AM	11%	43%	49%	13%	
	SB City (2)				PM	17%	65%	29%	21%	
		Mt. Vernon Ave North								
	SB City	6th St to 21st St	1.7	7	AM	14%	62%	68%	16%	
					PM	26%	83%	70%	34%	
		Arrowhead Ave								
	SB City	From Orangeshow Rd to 9th St	2.5	11	AM	13%	50%	64%	15%	
					PM	7%	30%	26%	8%	
		Del Rosa Ave								
	SB City Highland (1)	From Lynwood Dr to 3rd St	2.92	15	AM	21%	46%	53%	26%	
					PM	27%	50%	36%	37%	
		5th St								
	SB City	From G St to Sierra Way	0.77	7	AM	23%	42%	47%	29%	
					PM	28%	51%	40%	38%	
		Orangeshow Rd/San Bernardino Ave								
	SB City	From E St to Orange St	6.4	16	AM	6%	22%	31%	7%	
	Redlands				PM	10%	29%	56%	12%	
		Mill St								
	SB City	From Tippecanoe Ave to K St	2.75	9	AM	18%	43%	40%	23%	
					PM	13%	31%	23%	15%	
		40th St								
	SB City	From E/H St to Waterman Ave	1.25	6	AM	10%	26%	46%	11%	
					PM	13%	38%	56%	15%	
		Rialto Ave								
	SB City	From Santa Fe Way to Sierra Way	1.95	9	AM	7%	28%	15%	7%	
					PM	14%	41%	38%	16%	
		Victoria								
	Highland	From 3rd St to Highland Ave	2.01	7	AM	8%	11%	25%	4%	
					PM	10%	27%	40%	13%	
	Overall Average % Improvement:						15%	42%	42%	18%

Table 6.4.2 Area 4 Corridors Quantification of Annually Savings Summary

Corridor Information		Quantification of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel (gal)	VHT (veh-hr)
		CO (lb)	Nox (lb)	CO2 (lb)	VOC (lb)		
	Mt. Vernon Ave South						
SB City	Vally Blvd to Rialto Ave (9)	-1,024	-374	132	1,099	31,231	24,288
Colton							
	Rancho Ave						
Colton	From Valley Blvd to Rialto (8)	118	-50	114,503	841	24,394	17,063
SB City (2)							
	Mt. Vernon Ave North						
SB City	6th St to 21st St (7)	950	473	170	1,591	41,113	22,763
	Arrowhead Ave						
SB City	From Orangeshow Rd to 9th St (11)	594	280	95,461	403	10,206	6,213
	Del Rosa Ave						
SB City, Highland (1)	From Lynwood Dr to 3rd St (15)	-2,003	255	267,643	2,149	55,469	35,200
	5th St						
SB City	From G St to Sierra Way (7)	252	397	109,102	1,077	25,781	16,213
	Orangeshow Rd/San Bernardino Ave Ave						
Redlands	From E St to Orange St (16)	4,729	2,535	379	2,849	64,406	14,325
SB City							
	Mill St						
SB City	From Tippecanoe Ave to K St (9)	1,646	777	124,479	676	19,069	20,738
	40th St						
SB City	From E/H St to Waterman Ave (6)	3,456	155	73,497	567	12,806	6,500
	Rialto Ave						
SB City	From Santa Fe Way to Sierra Way (9)	1,648	777	124,617	674	19,069	9,425
	Victoria Ave						
Highland	From 3rd St to Highland Ave (7)	2,706	492	56,494	275	5,694	163
Area Project Total:		257				146,826	67,364
		(Tons)				(gal)	(veh-hr)

Table 6.4.3 Area 4 Corridors Monetary Measures of Annually Savings Summary

Corridor Information		Monetary Measures of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel	VHT
		CO	Nox	CO2	VOC		
	Mt. Vernon Ave South						
SB City	Vally Blvd to Rialto Ave (9)	-\$40	-\$3,363	\$1,514	\$618	\$121,802	\$287,564
Colton							
	Rancho Ave						
Colton	From Valley Blvd to Rialto (8)	\$5	\$201	\$1,394	\$546	\$95,136	\$202,020
SB City (2)							
	Mt. Vernon Ave North						
SB City	6th St to 21st St (7)	\$37	\$4,253	\$1,952	\$1,002	\$160,339	\$269,508
	Arrowhead Ave						
SB City	From Orangeshow Rd to 9th St (11)	\$23	\$2,510	\$1,082	\$252	\$39,804	\$73,556
	Del Rosa Ave						
SB City, Highland (1)	From Lynwood Dr to 3rd St (15)	-\$77	\$2,291	\$3,078	\$1,374	\$216,328	\$416,768
	5th St						
SB City	From G St to Sierra Way (7)	\$10	\$3,574	\$1,255	\$678	\$100,547	\$191,956
	Orangeshow Rd/San Bernardino Ave Ave						
Redlands	From E St to Orange St (16)	\$183	\$22,809	\$4,353	\$1,793	\$251,184	\$169,608
SB City							
	Mill St						
SB City	From Tippecanoe Ave to K St (9)	\$64	\$6,988	\$1,432	\$425	\$74,368	\$245,532
	40th St						
SB City	From E/H St to Waterman Ave (6)	\$134	\$1,399	\$845	\$357	\$49,944	\$76,960
	Rialto Ave						
SB City	From Santa Fe Way to Sierra Way (9)	\$64	\$6,988	\$1,432	\$425	\$74,368	\$111,592
	Victoria Ave						
Highland	From 3rd St to Highland Ave (7)	\$105	\$4,426	\$650	\$173	\$22,206	\$1,924
Area Project Total:		\$60,562				\$572,618	\$797,572
		\$1,401,268					

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South Mount Vernon Avenue (Valley Blvd to Rialto Ave)**"Before and After" Study Results**

Jurisdiction: San Bernardino City & Colton

Length (mile): 2.45

Number of Signals: 9

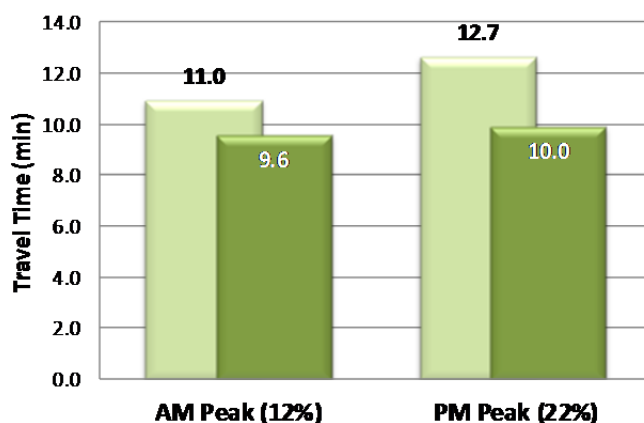
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		5.4	5.6	11.0	1.4	1.7	3.1	3.2	3.0	6.2	27.4	26.3	26.9
AFTER		4.7	4.9	9.6	0.8	0.9	1.8	2.8	2.1	4.9	31.3	30.4	30.8
% Improvement		11%	13%	12%	43%	44%	43%	14%	29%	21%	14%	15%	15%

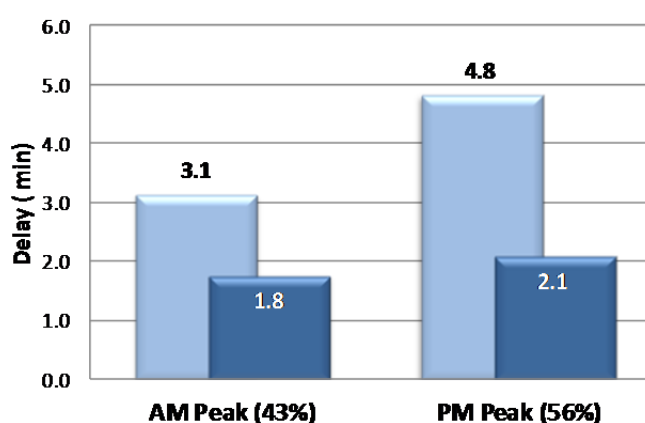
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		6.0	6.7	12.7	2.1	2.7	4.8	3.2	3.4	6.6	24.6	22.4	23.4
AFTER		4.9	5.0	10.0	1.0	1.1	2.1	1.8	2.0	3.8	30.1	30.1	29.9
Improvement		18%	25%	22%	52%	60%	56%	44%	41%	43%	23%	35%	28%

Travel Time

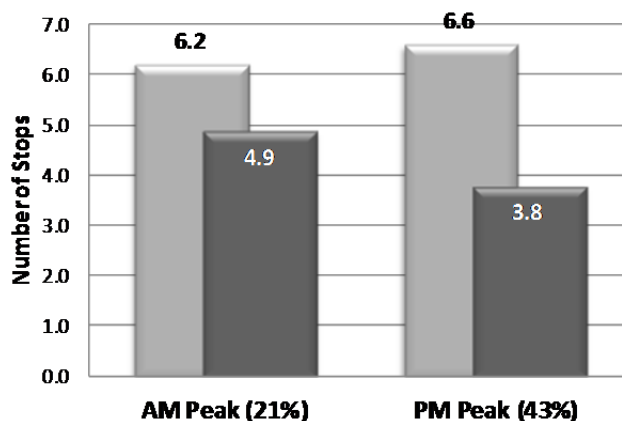
■ Before ■ After

**Delay**

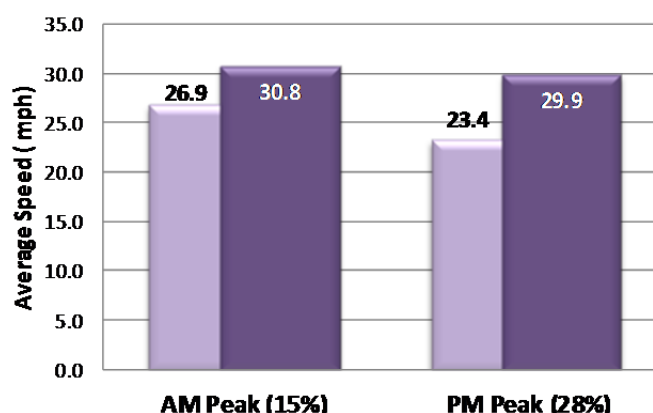
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



South Mount Vernon Avenue (Valley Blvd to Rialto Ave)**"Before and After" Study Results**

Jurisdiction: San Bernardino City & Colton

Length (mile): 2.45

Number of Signals: 9

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2111	2387	4498	1238	1361	2599	201	223	424	749	789	1538	44	47	91	27	31	58
AFTER	2340	2430	4770	1314	1391	2705	197	209	406	694	697	1391	40	42	82	24	27	51
% Reduction	-11%	-2%	-6%	-6%	-2%	-4%	2%	6%	4%	7%	12%	10%	8%	11%	10%	11%	12%	12%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3692	3204	6897	2300	1856	4156	399.3	329.9	729	1444	1140	2584	88	71	159	62	51	113
AFTER	3980	3253	7233	2382	1892	4274	382.1	291.2	673	1221	897.8	2119	75	55	130	51	39	90
% Reduction	-8%	-2%	-5%	-4%	-2%	-3%	4%	12%	8%	15%	21%	18%	16%	22%	18%	17%	24%	20%

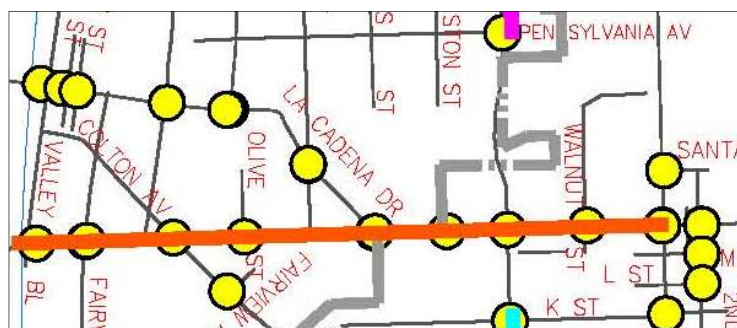
Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-229.5	-43.0	-272.5	-76.0	-30.0	-106.0	4.0	13.3	17.3	54.8	92.3	147.1	3.6	5.4	9.0	3.0	3.8	6.8
PM	-287.8	-48.5	-336.3	-82.0	-36.0	-118.0	17.2	38.7	55.9	223.1	241.7	464.8	13.8	15.6	29.3	10.5	12.4	22.9

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	-4.1	-1.5	526.7	4.4	124.9	97.2
Annually	-1,024	-374	131,672	1,099	31,231	24,288

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	(\$0.16)	(\$13.45)	\$6.06	\$2.47	\$487.21	\$1,150.26
Annually (\$)	(\$40)	(\$3,383)	\$1,514	\$618	\$121,802	\$287,564

Emissions, Fuel and Travel Time Monetary Savings Summary**Daily: \$1,632****Annually: \$408,096**

Rancho Avenue (Valley Blvd to Rialto Ave)**"Before and After" Study Results**

Jurisdiction: San Bernardino City & Colton

Length (mile): 2.15

Number of Signals: 8

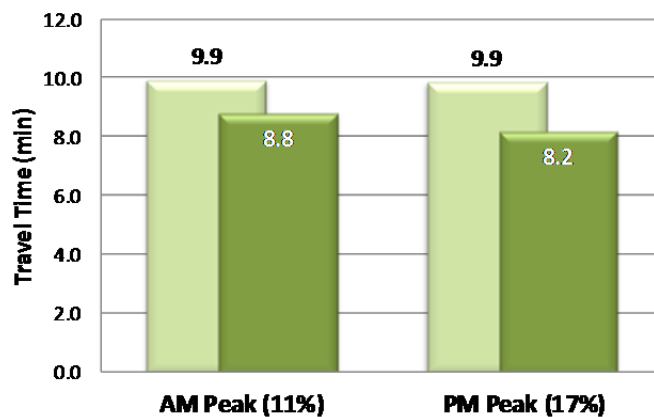
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		4.6	5.3	9.9	1.0	1.6	2.7	2.6	3.8	6.4	28.2	24.5	26.1
AFTER		4.5	4.3	8.8	1.0	0.6	1.5	1.6	1.6	3.3	29.2	30.5	29.6
% Improvement		2%	20%	11%	8%	65%	43%	38%	57%	49%	3%	24%	13%

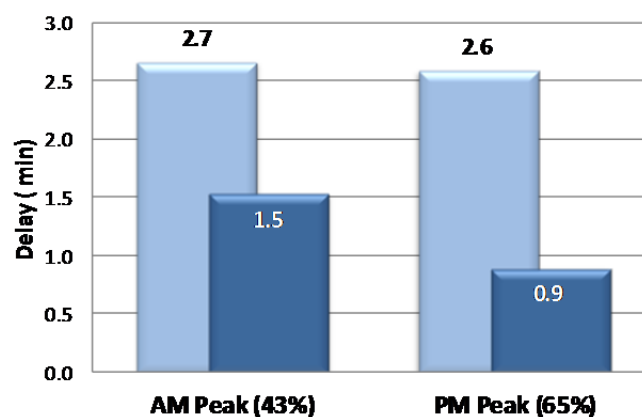
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		4.6	5.2	9.9	1.0	1.6	2.6	2.0	3.0	5.0	28.1	24.7	26.2
AFTER		4.0	4.2	8.2	0.4	0.5	0.9	1.3	2.3	3.6	32.3	31.1	31.6
% Improvement		13%	21%	17%	58%	71%	65%	36%	24%	29%	15%	26%	21%

Travel Time

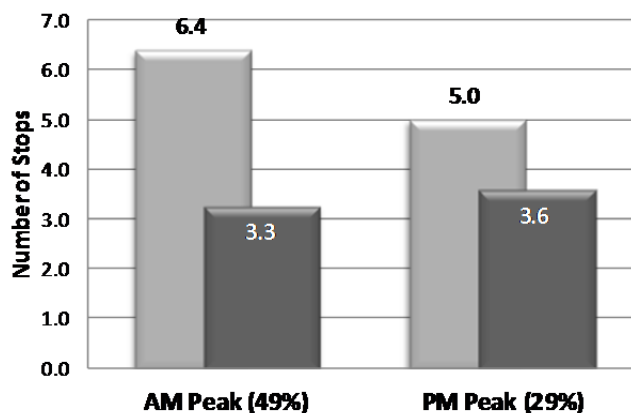
■ Before ■ After

**Delay**

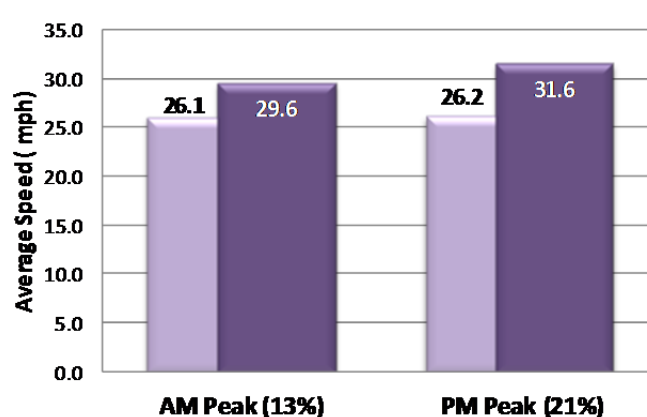
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Rancho Avenue (Valley Blvd to Rialto Ave)**"Before and After" Study Results**

Jurisdiction: San Bernardino City &

Length (mile): 2.15

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	1647	3258	4905	999	1863	2862	167	311	478	569	1141	1710	34	68	102	23	44	67
AFTER	1673	2830	4504	1017	1707	2724	161	270	431	485	859	1344	30	52	82	22	36	58
% Reduction	-2%	13%	8%	-2%	8%	5%	4%	13%	10%	15%	25%	21%	12%	23%	19%	5%	18%	14%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	1656	3040	4696	1018	1760	2778	167.9	300.9	469	540.9	1037	1578	33	64	97	23	44	67
AFTER	1829	3092	4921	1067	1798	2865	163.2	276.6	440	464.8	925.3	1390	28	55	83	20	35	54
% Reduction	-10%	-2%	-5%	-5%	-2%	-3%	3%	8%	6%	14%	11%	12%	14%	14%	14%	15%	21%	19%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	-25.8	427.3	401.5	-18.4	156.0	137.6	6.1	41.3	47.4	84.0	282.4	366.4	4.2	15.4	19.5	1.1	8.0	9.1
PM	-173.4	-52.0	-225.4	-48.7	-38.0	-86.7	4.7	24.3	29.0	76.1	111.9	188.0	4.8	9.2	14.0	3.6	9.4	13.0

Emission, Fuel and Travel Time Savings

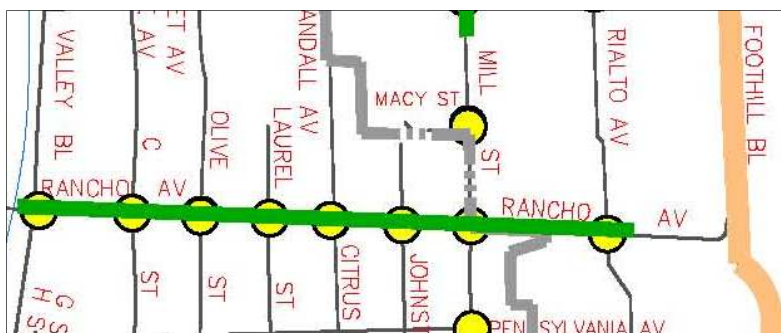
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	0.5	0.1	485.0	3.5	97.6	68.3
Annually	118	22	121,255	868	24,394	17,063

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.02	\$0.80	\$5.58	\$2.18	\$380.54	\$808.08
Annually (\$)	\$5	\$201	\$1,394	\$546	\$95,136	\$202,020

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,197
Annually: \$299,302



North Mount Vernon Avenue (6th St to 21st St)

"Before and After" Study Results

Jurisdiction: San Bernardino City

Length (mile): 1.70

Number of Signals: 7

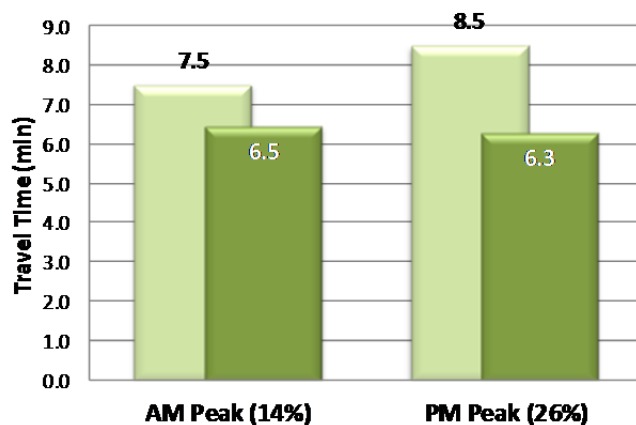
1. Measures of Effectiveness (MOE) Summary

AM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	3.9	3.6	7.5	1.0	0.7	1.7	2.4	1.8	4.2	26.3	28.0	27.2	26.3	28.0	27.2
AFTER	3.3	3.2	6.5	0.4	0.2	0.7	0.5	0.8	1.3	30.8	32.2	31.5	30.8	32.2	31.5
% Improvement	15%	13%	14%	58%	67%	62%	79%	54%	68%	17%	15%	16%	17%	15%	16%

PM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	4.4	4.2	8.5	1.7	1.3	3.0	3.3	3.0	6.3	22.1	24.9	24.3	22.1	24.9	24.3
AFTER	3.1	3.2	6.3	0.2	0.3	0.5	0.4	1.4	1.9	33.2	32.0	32.5	33.2	32.0	32.5
Improvement	28%	23%	26%	87%	78%	83%	87%	52%	70%	50%	29%	34%	50%	29%	34%

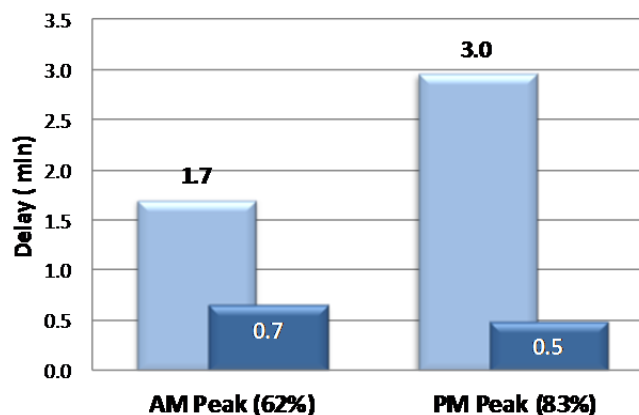
Travel Time

■ Before ■ After



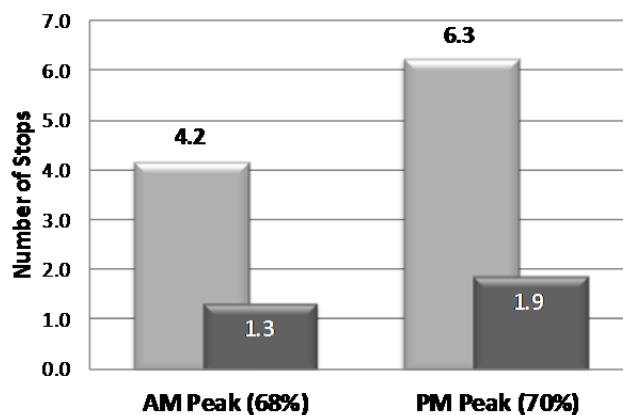
Delay

■ Before ■ After



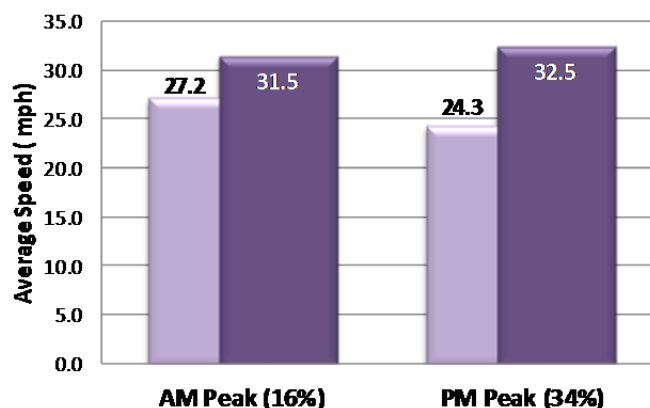
Number of Stops

■ Before ■ After



Average Speed

■ Before ■ After



North Mount Vernon Avenue (6th St to 21st St)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 1.70

Number of Signals: 7

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1162	3147	4309	684	1878	2562	114	309	423	391	814	1205	23	61	84	16	42	58
AFTER	1089	2914	4003	637	1761	2398	103	281	384	275	659	934	18	50	68	14	36	50
% Reduction	6%	7%	7%	7%	6%	6%	10%	9%	9%	30%	19%	22%	24%	17%	19%	11%	13%	13%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2192	2858	5049	1294	1682	2976	224.6	276.7	501	903.7	1020	1924	55	60	115	38	39	77
AFTER	2021	2755	4776	1245	1603	2848	196.4	244.9	441	516.4	776	1292	33	46	79	26	30	56
% Reduction	8%	4%	5%	4%	5%	4%	13%	11%	12%	43%	24%	33%	40%	23%	31%	32%	22%	27%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (hourly)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	72.7	233	306	46.8	117.0	163.8	10.8	28.4	39.2	115.6	155.0	270.6	5.7	10.5	16.2	1.8	5.5	7.3
PM	170.6	103.1	273.7	49.0	79.0	128.0	28.2	31.8	60.0	387.3	244.4	631.7	21.6	13.9	35.5	12.1	8.7	20.8

Emission, Fuel and Travel Time Savings

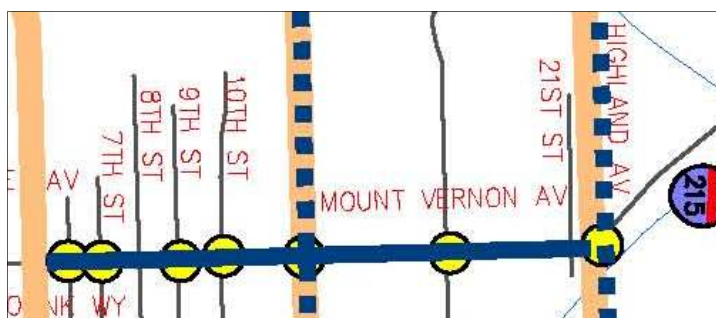
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (hourly)
Daily	3.8	1.9	679.0	6.4	164.5	91.1
Annually	950	473	169,757	1,591	41,113	22,763

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.15	\$17.01	\$7.81	\$4.01	\$641.36	\$1,078.03
Annually (\$)	\$37	\$4,253	\$1,952	\$1,002	\$160,339	\$269,508

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,748
Annually: \$437,090



Arrowhead Avenue (Orange Show Rd to 9th St)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 2.50

Number of Signals: 11

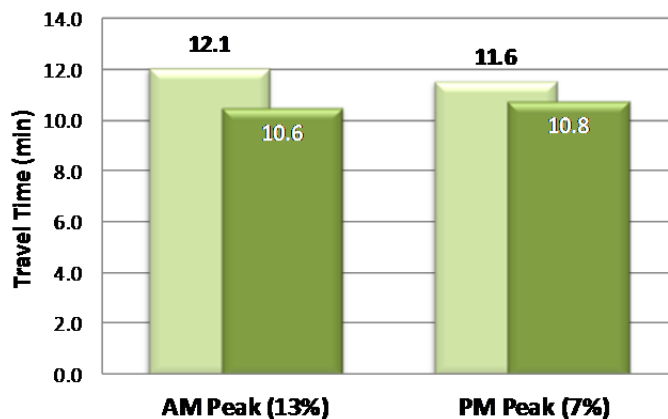
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		5.9	6.2	12.1	1.4	1.7	3.1	4.4	4.4	8.8	25.5	24.2	24.8
AFTER		5.4	5.2	10.6	0.9	0.7	1.5	1.8	1.3	3.2	27.9	29.2	28.5
% Improvement		9%	16%	13%	39%	59%	50%	58%	70%	64%	10%	20%	15%

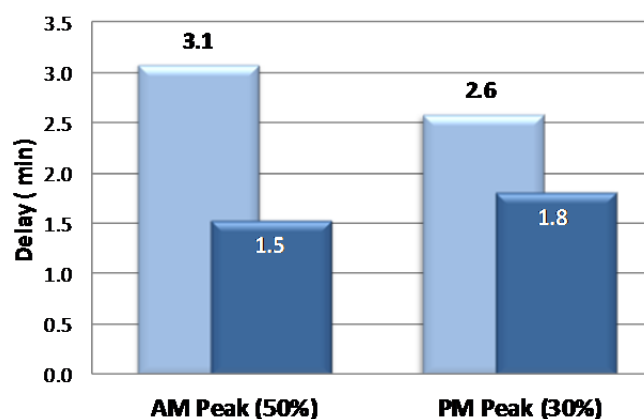
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		5.5	6.1	11.6	1.0	1.6	2.6	2.4	3.6	6.0	27.4	24.7	26.0
AFTER		5.2	5.6	10.8	0.7	1.1	1.8	2.1	2.3	4.4	29.3	26.8	28.0
% Improvement		5%	8%	7%	29%	30%	30%	11%	37%	26%	7%	9%	8%

Travel Time

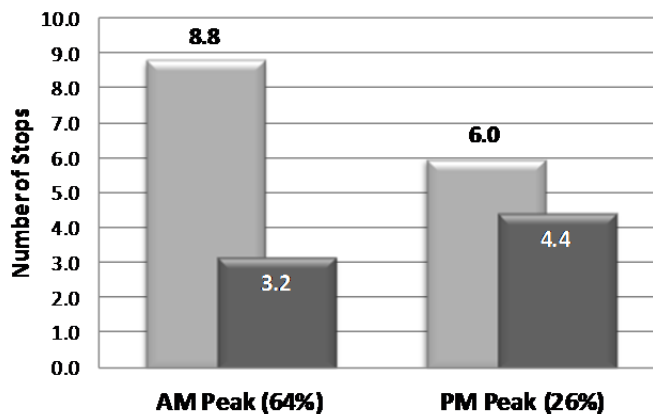
■ Before ■ After

**Delay**

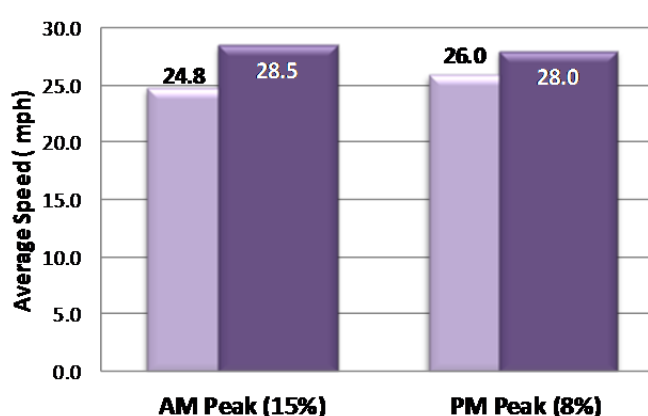
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Arrowhead Avenue (Orange Show Rd to 9th St)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 2.50

Number of Signals: 11

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2030	1555	3585	1212	911	2123	191	150	341	600	500	1100	36	30	66	25	21	46
AFTER	1774	1118	2891	1096	719	1815	179	120	299	576	350	926	35	22	57	25	17	42
% Reduction	13%	28%	19%	10%	21%	15%	6%	20%	12%	4%	30%	16%	2%	27%	14%	-2%	22%	9%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2994	1723	4717	1885	1067	2952	320.9	186.2	507	1055	616.2	1671	65	38	102	46	28	73
AFTER	3312	1593	4905	2035	992.4	3027	323.1	165.3	488	1025	562.8	1588	63	35	97	44	25	69
% Reduction	-11%	8%	-4%	-8%	7%	-3%	-1%	11%	4%	3%	9%	5%	3%	9%	5%	3%	10%	6%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	255.7	437.6	693.3	116.0	192.0	308.0	12.0	30.0	42.0	24.0	150.0	174.0	0.9	8.2	9.1	-0.4	4.6	4.2
PM	-318.0	130.0	-188.0	-150.0	74.6	-75.4	-2.2	20.9	18.7	30.0	53.4	83.4	2.0	3.3	5.2	1.3	2.8	4.1

Emission, Fuel and Travel Time Savings

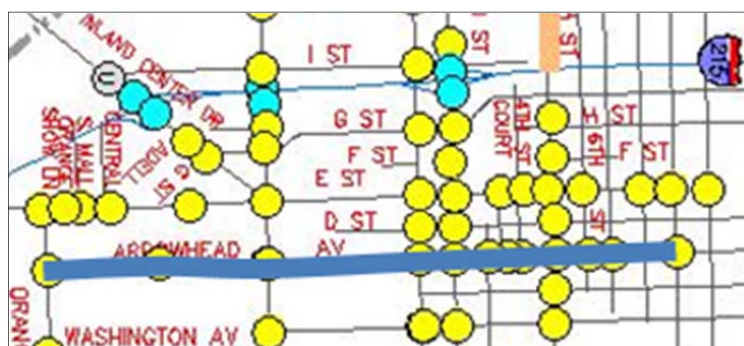
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	2.4	1.1	375.8	1.6	40.8	24.9
Annually	593	279	93,945	401	10,206	6,213

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.09	\$10.04	\$4.32	\$1.01	\$159.22	\$294.22
Annually (\$)	\$23	\$2,510	\$1,080	\$252	\$39,804	\$73,556

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$469
Annually: \$117,226



Del Rosa Drive (3rd St to Lynwood Dr)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 2.92

Number of Signals: 15

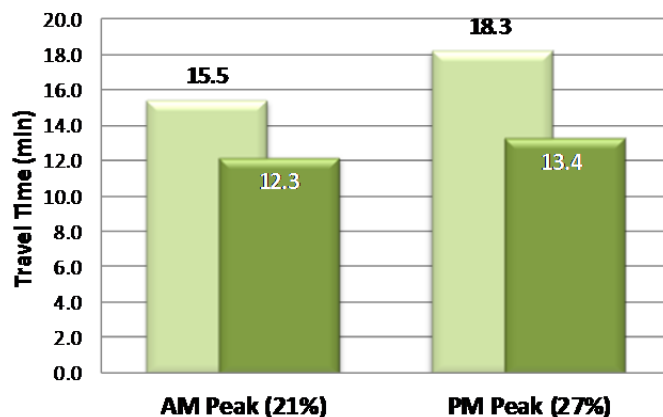
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	7.3	8.2	15.5	3.1	4.1	7.1	6.2	7.0	13.2	24.3	21.5	22.7
AFTER	6.0	6.3	12.3	1.8	2.1	3.9	3.2	3.0	6.2	29.4	28.2	28.6
% Improvement	17%	24%	21%	41%	49%	46%	48%	57%	53%	21%	31%	26%

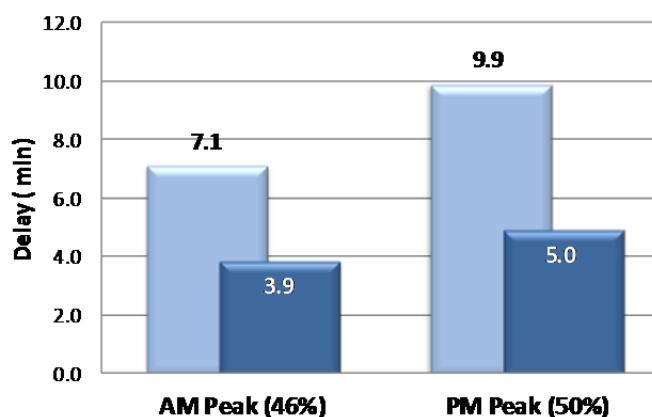
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)			
	Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		9.1	9.2	18.3	4.9	5.1	9.9	7.2	8.0	15.2	19.6	19.2	19.2
AFTER		6.6	6.8	13.4	2.4	2.6	5.0	4.8	4.8	9.7	26.6	26.3	26.3
% Improvement	27%	26%	27%	52%	49%	50%	33%	40%	36%	36%	37%	37%	

Travel Time

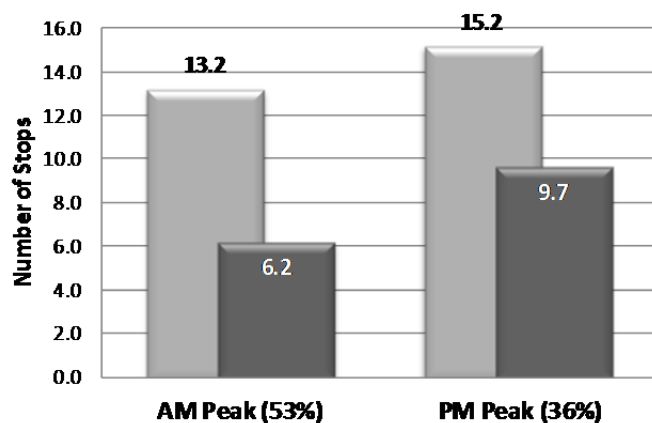
■ Before ■ After

**Delay**

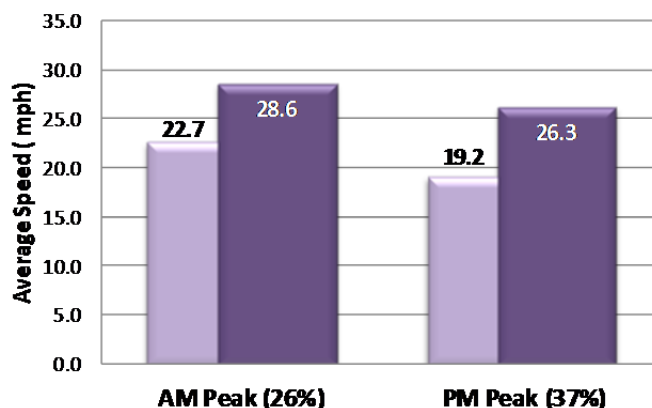
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Del Rosa Drive (3rd St to Lynwood Dr)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 2.92

Number of Signals: 15

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2564	3703	6267	1452	2046	3498	236	334	570	1002	1362	2364	57	80	137	32	48	80
AFTER	2758	4295	7053	1456	1923	3379	222	286	507	817	966	1782	48	58	105	29	38	67
% Reduction	-8%	-16%	-13%	0%	6%	3%	6%	14%	11%	18%	29%	25%	17%	28%	23%	9%	22%	17%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	4696	3385	8081	2636	1853	4489	455.3	311.5	767	2018	1433	3450	118	82	200	72	46	118
AFTER	5440	3117	8557	2763	1679	4442	416.7	256	673	1720	1015	2735	98	60	158	54	33	87
% Reduction	-16%	8%	-6%	-5%	9%	1%	8%	18%	12%	15%	29%	21%	17%	27%	21%	25%	28%	26%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	-194.7	-592	-786	-4.0	123.0	119.0	14.5	48.0	62.5	185.3	396.8	582.1	9.5	22.1	31.6	2.9	10.3	13.2
PM	-744.2	267.4	-476.8	-127.0	174.0	47.0	38.6	55.5	94.1	298.0	417.7	715.7	20.1	21.7	41.8	18.2	12.6	30.8

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	-8.0	1.0	1070.6	8.7	225.0	140.8
Annually	-2,003	255	267,643	2,183	56,250	35,200

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	(\$0.31)	\$9.17	\$12.31	\$5.49	\$877.50	\$1,667.07
Annually (\$)	(\$77)	\$2,291	\$3,078	\$1,374	\$219,375	\$416,768

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$2,572
Annually: \$642,886



5th Street (G St to Sierra Way)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 0.77

Number of Signals: 7

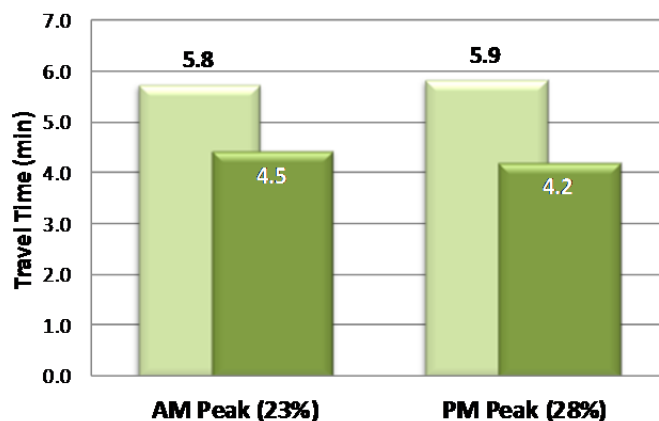
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	3.2	2.5	5.8	1.9	1.2	3.1	4.1	3.3	7.4	14.5	18.7	16.1
AFTER	2.4	2.0	4.5	1.1	0.7	1.8	2.3	1.6	3.9	20.0	23.9	21.1
% Improvement	25%	20%	23%	42%	43%	42%	45%	50%	47%	38%	28%	32%

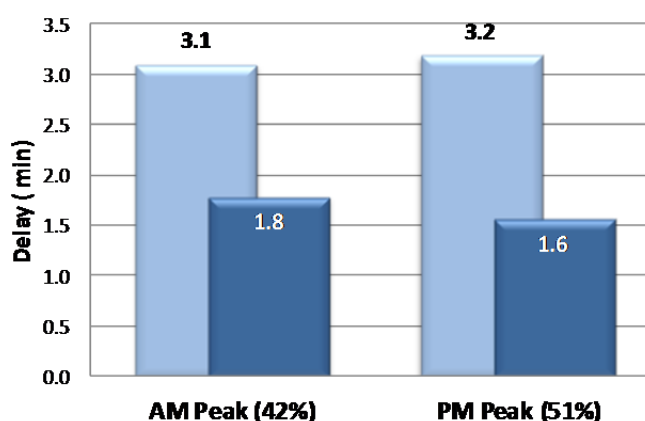
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	3.0	2.9	5.9	1.6	1.6	3.2	3.0	2.8	5.8	16.1	16.2	16.0
AFTER	2.2	2.0	4.2	0.9	0.7	1.6	2.0	1.5	3.5	22.0	25.0	22.3
% Improvement	24%	31%	28%	44%	58%	51%	33%	48%	40%	36%	54%	39%

Travel Time

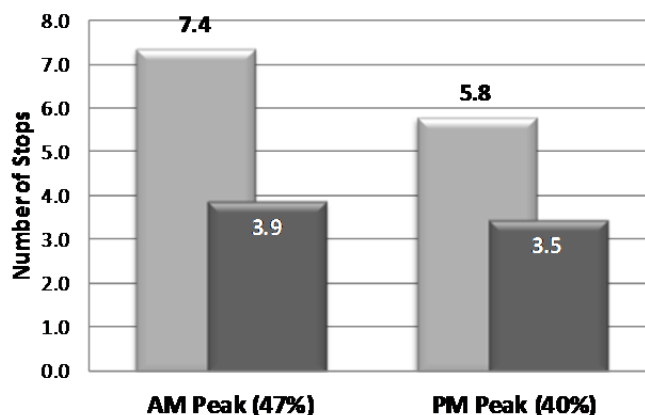
■ Before ■ After

**Delay**

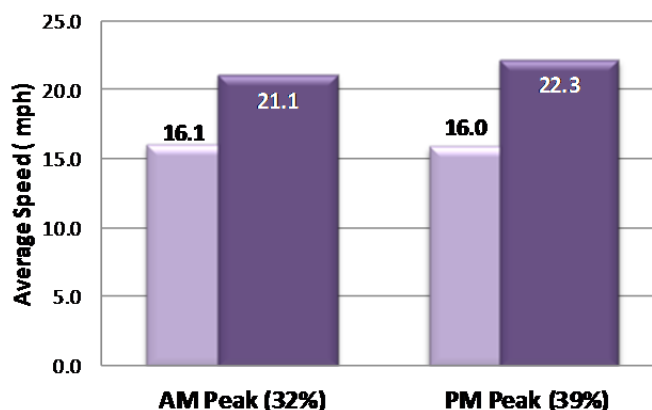
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



5th Street (G St to Sierra Way)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 0.77

Number of Signals: 7

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	1143	774	1917	649	441	1090	114	74	188	603	383	986	34	21	56	21	12	32
AFTER	928	691	1619	545	371	916	94	62	156	445	256	701	28	16	43	16	9	26
% Reduction	19%	11%	16%	16%	16%	16%	18%	16%	17%	26%	33%	29%	20%	26%	22%	21%	22%	21%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	1165	1410	2575	636.1	801.1	1437	110.1	140.1	250	533.6	647.4	1181	31	38	70	20	25	45
AFTER	1415	1242	2657	665.9	689.7	1356	103.1	113.4	217	415.1	411.3	826	24	25	49	15	17	32
% Reduction	-21%	12%	-3%	-5%	14%	6%	6%	19%	13%	22%	36%	30%	22%	36%	29%	24%	35%	30%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	215.0	83.0	298.0	104.0	70.0	174.0	20.0	12.0	32.0	158.0	127.0	285.0	6.9	5.7	12.6	4.3	2.6	6.9
PM	-250.0	168.0	-82.0	-29.8	111.4	81.6	7.0	26.7	33.7	118.5	236.1	354.6	6.9	13.6	20.5	4.8	8.8	13.6

Emission, Fuel and Travel Time Savings

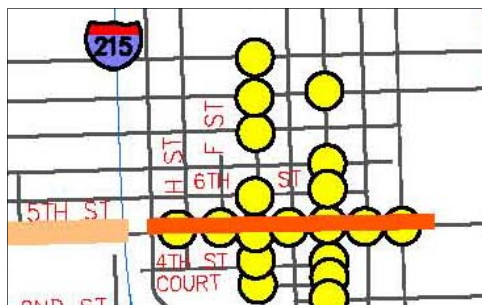
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	1.0	1.6	436.4	4.3	103.1	64.9
Annually	252	397	109,102	1,077	25,781	16,213

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.04	\$14.30	\$5.02	\$2.71	\$402.19	\$767.82
Annually (\$)	\$10	\$3,574	\$1,255	\$678	\$100,547	\$191,956

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,192
Annually: \$298,019



Orangeshow Rd/San Bernardino Ave (E St to Orange St)**"Before and After" Study Results**

Jurisdiction: San Bernardino City & Redlands

Length (mile): 6.40

Number of Signals: 16

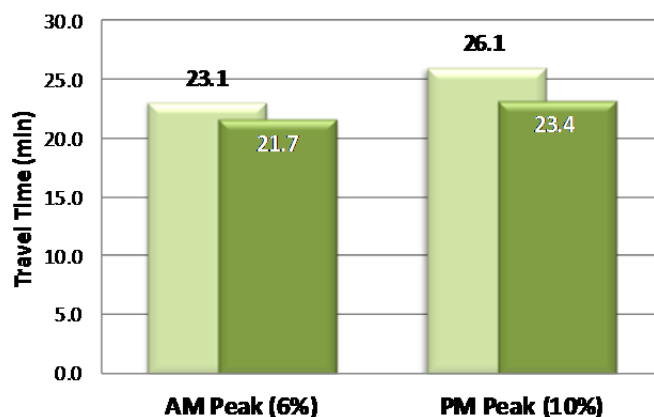
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		11.5	11.6	23.1	3.2	3.3	6.5	7.3	5.3	12.5	33.8	33.7	33.3
AFTER		11.0	10.7	21.7	2.7	2.4	5.1	4.2	4.4	8.6	35.2	36.5	35.5
% Improvement		4%	8%	6%	16%	29%	22%	42%	16%	31%	4%	8%	7%

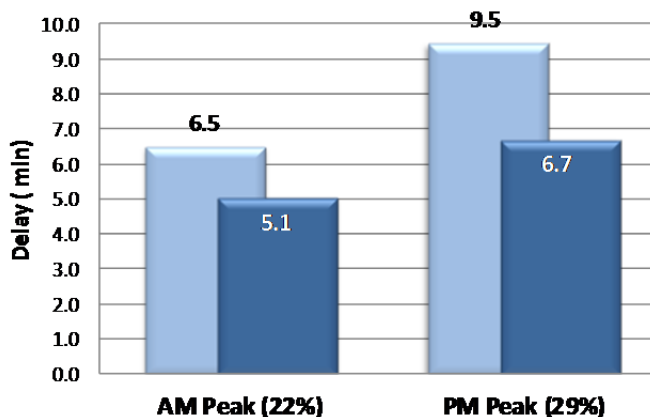
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		13.6	12.4	26.1	5.3	4.1	9.5	7.8	6.3	14.0	28.5	31.2	29.4
AFTER		11.9	11.5	23.4	3.6	3.1	6.7	2.8	3.4	6.2	32.8	34.0	33.0
Improvement		13%	8%	10%	33%	24%	29%	64%	46%	56%	15%	9%	12%

Travel Time

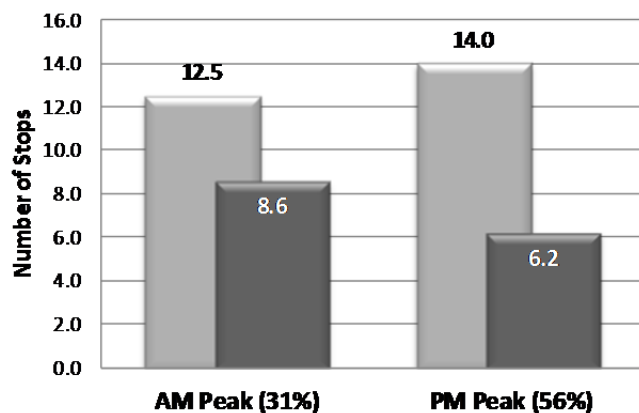
■ Before ■ After

**Delay**

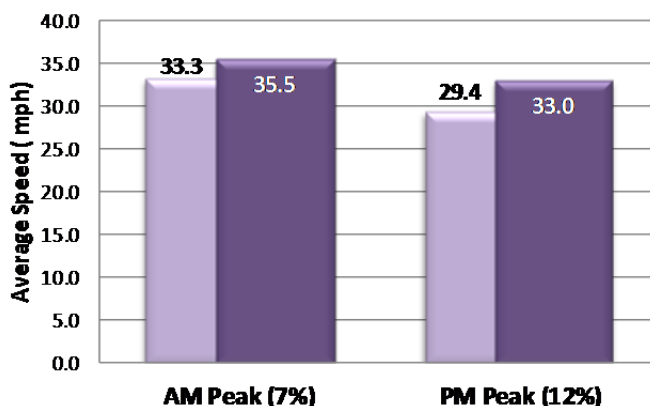
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Orangeshow Rd/San Bernardino Ave (E St to Orange St)

"Before and After" Study Results

Jurisdiction: San Bernardino City &

Length (mile): 6.40

Number of Signals: 16

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	3851	7023	10874	2172	3743	5915	316	546	862	1255	1958	3213	71	114	184	34	61	95
AFTER	4049	7551	11600	2170	3906	6076	306	551	858	1012	1820	2832	59	107	166	33	59	92
% Reduction	-5%	-8%	-7%	0%	-4%	-3%	3%	-1%	0%	19%	7%	12%	16%	6%	10%	5%	3%	4%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	10984	5159.6	16144	6197.7	2817	9015	925.9	422.1	1348	3519	1546	5065	205	90	294	112	49	161
AFTER	8830	4343.8	13174	5141.3	2444	7585	786.5	368.2	1155	2527	1334	3861	155	79	234	101	46	148
% Reduction	20%	16%	18%	17%	13%	16%	15%	13%	14%	28%	14%	24%	24%	12%	20%	10%	5%	9%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr/hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	-197.3	-528.3	-725.6	1.5	-163.0	-161.5	9.8	-5.7	4.1	243.0	138.4	381.4	11.7	7.1	18.7	1.6	2.0	3.6
PM	2154.0	815.8	2969.8	1056.4	373.0	1429.4	139.4	53.9	193.3	992.1	212.5	1204.6	49.5	10.8	60.3	11.2	2.6	13.8

Emission, Fuel and Travel Time Savings

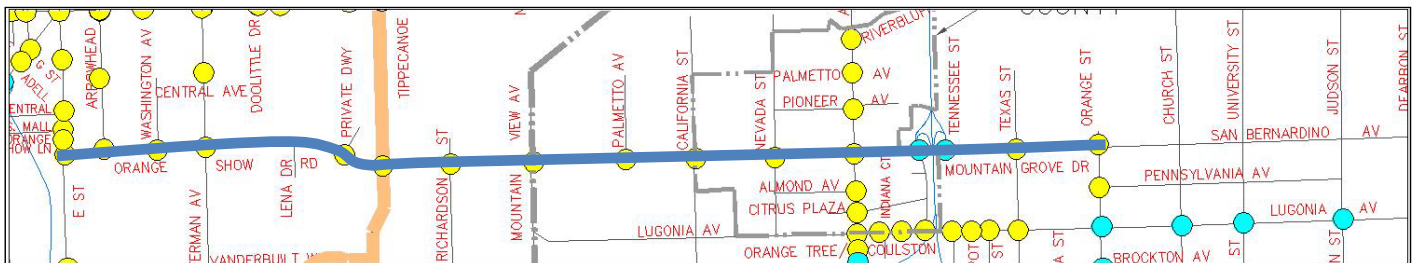
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	18.9	10.1	1514.1	11.4	257.6	57.3
Annually	4,729	2,535	378,536	2,849	64,406	14,325

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.73	\$91.24	\$17.41	\$7.17	\$1,004.74	\$678.43
Annually (\$)	\$183	\$22,809	\$4,353	\$1,793	\$251,184	\$169,608

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,800
Annually: \$449,931



Mill Street (Tippecanoe Ave to K St)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 2.75

Number of Signals: 9

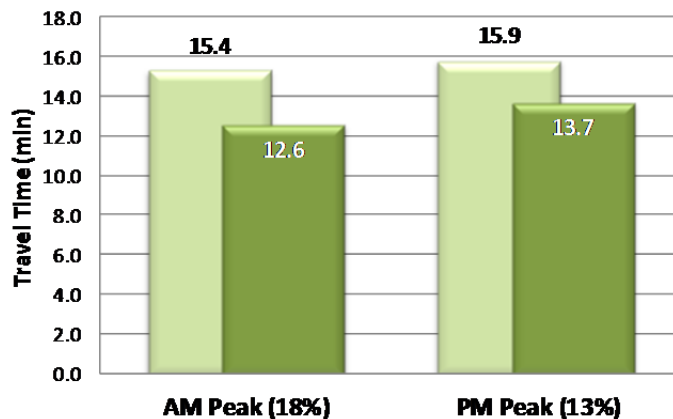
1. Measures of Effectiveness (MOE) Summary

AM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	8.9	6.5	15.4	4.4	2.0	6.4	6.0	3.0	9.0	18.8	26.0	21.5			
AFTER	6.4	6.3	12.6	1.9	1.8	3.7	2.6	2.8	5.4	26.7	26.5	26.4			
% Improvement	28%	3%	18%	57%	10%	43%	57%	7%	40%	42%	2%	23%			

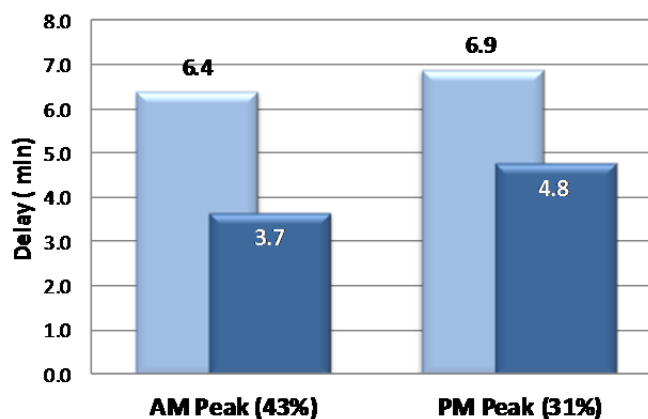
PM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	7.7	8.2	15.9	3.2	3.7	6.9	5.3	5.3	10.5	22.3	20.3	20.9			
AFTER	6.5	7.3	13.7	2.0	2.8	4.8	3.3	4.9	8.1	26.1	23.0	24.1			
% Improvement	16%	11%	13%	38%	24%	31%	38%	7%	23%	17%	13%	15%			

Travel Time

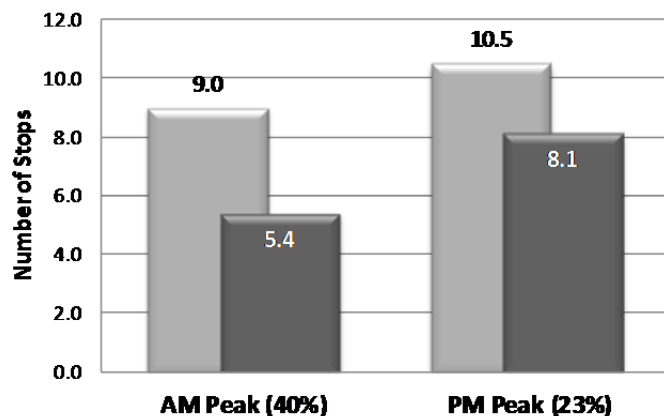
■ Before ■ After

**Delay**

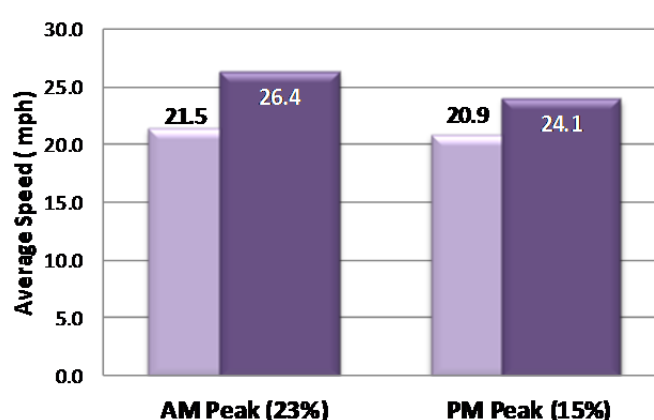
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Mill Street (Tippecanoe Ave to K St) "Before and After" Study Results

Jurisdiction: San Bernardino City

Length (mile): 2.75

Number of Signals: 9

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2616	1494	4110	1381	790	2171	219	120	339	772	380	1152	46	23	68	80	58	139
AFTER	2217	1204	3421	1271	692	1963	207	109	316	774	371	1145	46	22	68	65	58	123
% Reduction	15%	19%	17%	8%	12%	10%	5%	9%	7%	0%	2%	1%	-1%	4%	1%	19%	1%	12%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2088	3082	5170	1180	1719	2899	193.7	286.6	480	811.5	1047	1859	47	63	110	55	65	121
AFTER	2167	2642	4809	1140	1505	2645	180.4	251.8	432	621.7	891.6	1513	36	53	89	51	58	108
% Reduction	-4%	14%	7%	3%	12%	9%	7%	12%	10%	23%	15%	19%	24%	16%	19%	9%	11%	10%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	399.0	290.0	689.0	110.0	98.0	208.0	12.0	11.0	23.0	-2.0	9.0	7.0	-0.3	0.9	0.6	15.4	0.7	16.1
PM	-79.0	440.0	361.0	40.0	214.0	254.0	13.3	34.8	48.1	189.8	155.4	345.2	11.5	10.0	21.4	4.8	7.4	12.2

Emission, Fuel and Travel Time Savings

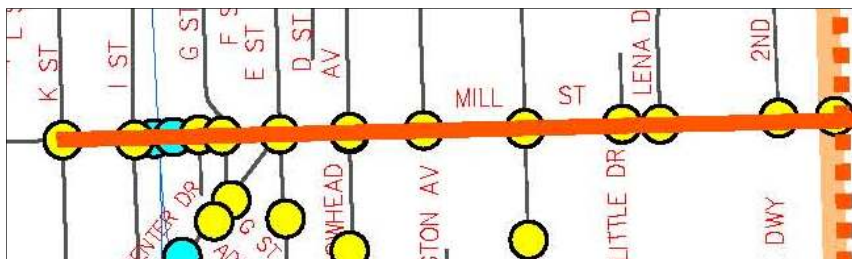
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	6.6	3.1	497.9	2.7	76.3	83.0
Annually	1,646	777	124,479	676	19,069	20,738

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.25	\$27.95	\$5.73	\$1.70	\$297.47	\$982.13
Annually (\$)	\$64	\$6,988	\$1,432	\$425	\$74,368	\$245,532

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$1,315
Annually: \$328,808



40th Street (E/H St to Waterman Ave)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 1.25

Number of Signals: 6

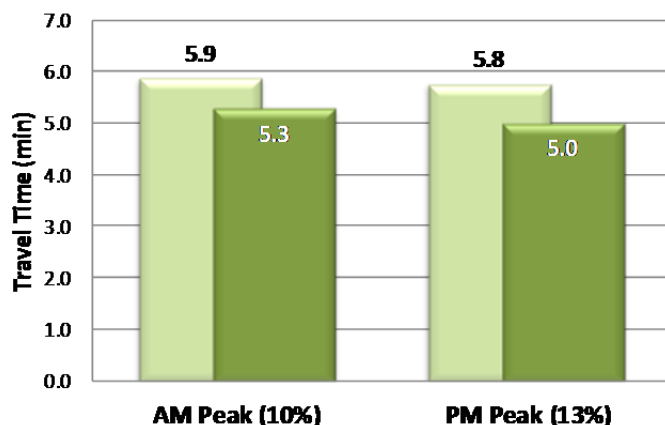
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	3.4	2.5	5.9	1.4	0.6	2.0	3.0	1.8	4.8	23.0	30.1	25.8
AFTER	2.9	2.4	5.3	1.0	0.5	1.5	1.8	0.8	2.6	26.3	31.4	28.6
% Improvement	14%	4%	10%	29%	19%	26%	40%	56%	46%	15%	4%	11%

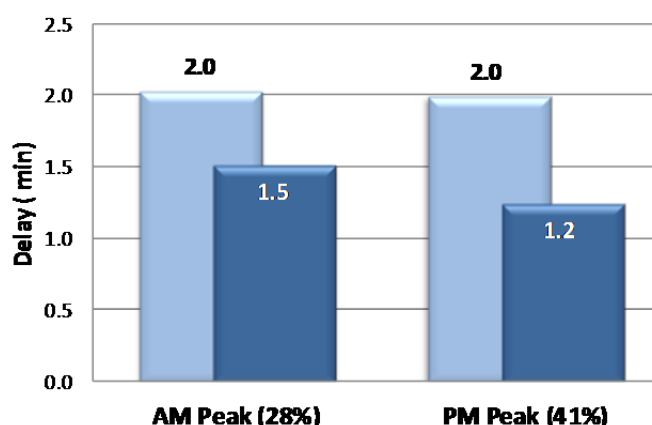
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	3.1	2.7	5.8	1.2	0.8	2.0	2.0	1.6	3.6	24.5	28.3	26.1
AFTER	2.7	2.3	5.0	0.8	0.4	1.2	1.1	0.5	1.6	29.1	32.8	30.5
% Improvement	14%	12%	13%	35%	41%	38%	45%	69%	56%	19%	16%	17%

Travel Time

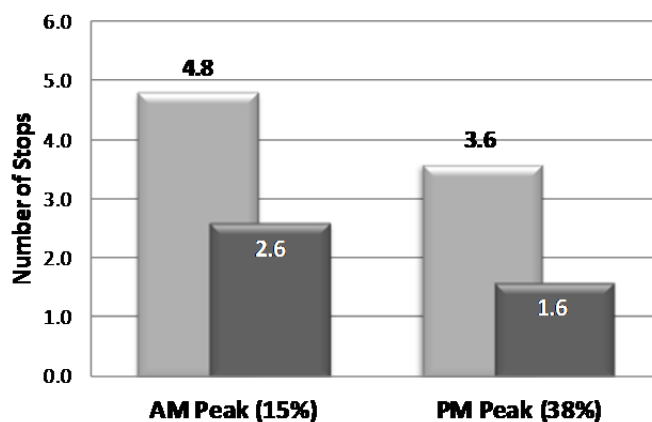
■ Before ■ After

**Delay**

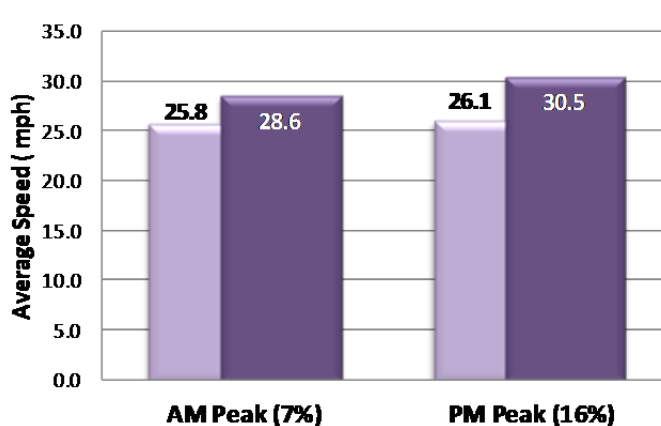
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



40th Street (E/H St to Waterman Ave) "Before and After" Study Results

Jurisdiction: San Bernardino City

Length (mile): 1.25

Number of Signals: 6

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2770	1542	4312	921	823	1744	163	123	286	542	430	972	31	23	54	18	14	32
AFTER	1307	1393	2700	745	803	1548	116	117	234	406	311	718	25	21	46	16	13	29
% Reduction	53%	10%	37%	19%	2%	11%	29%	5%	18%	25%	28%	26%	19%	9%	15%	12%	4%	9%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	1848	1662	3510	959.2	947.2	1906	156.9	146.3	303	563.9	473.6	1038	34	46	80	23	18	40
AFTER	1173	1696	2870	1000	965.8	1966	160.5	142.1	303	547.3	377.5	925	33	38	71	19	16	35
% Reduction	37%	-2%	18%	-4%	-2%	-3%	-2%	3%	0%	3%	20%	11%	2%	18%	11%	15%	12%	14%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	1463	148.7	1611.9	176.3	20.1	196.4	46.9	5.6	52.5	135.6	118.4	254.0	6.0	2.2	8.1	2.1	0.6	2.7
PM	674.6	-34.3	640.3	-41.1	-18.6	-59.7	-3.6	4.2	0.6	16.6	96.1	112.7	0.8	8.1	8.8	3.3	2.2	5.5

Emission, Fuel and Travel Time Savings

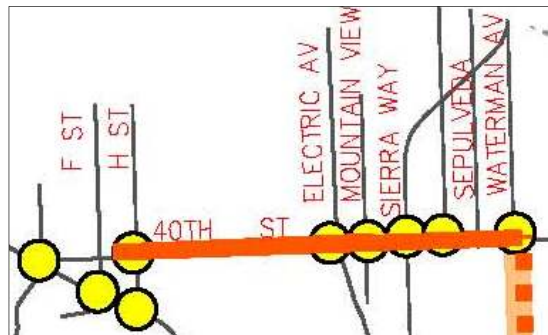
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	13.8	0.6	294.0	2.3	51.2	26.0
Annually	3,456	155	73,497	567	12,806	6,500

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.53	\$5.60	\$3.38	\$1.43	\$199.78	\$307.84
Annually (\$)	\$134	\$1,399	\$845	\$357	\$49,944	\$76,960

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$519
Annually: \$129,639



Rialto Avenue (Santa Fe Way to Sierra Way)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 1.95

Number of Signals: 9

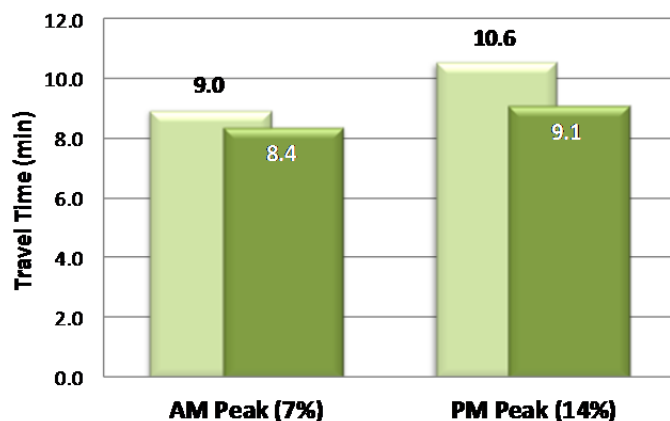
1. Measures of Effectiveness (MOE) Summary

AM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	4.4	4.6	9.0	1.0	1.2	2.1	2.8	2.6	5.4	28.9	27.7	26.1
AFTER	4.3	4.1	8.4	0.9	0.7	1.5	2.4	2.1	4.6	29.5	31.0	27.9
% Improvement	2%	11%	7%	10%	43%	28%	13%	18%	15%	2%	12%	7%

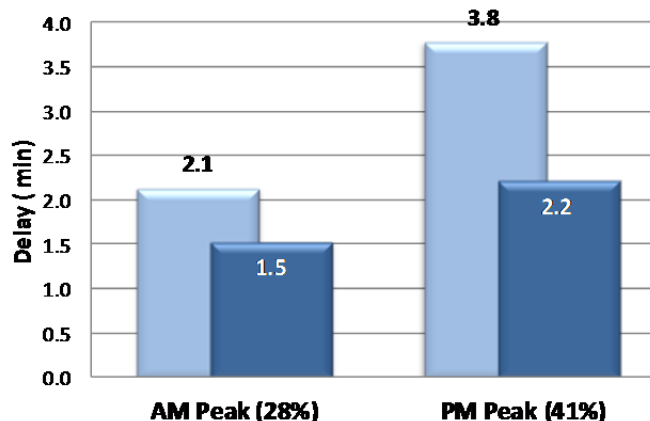
PM	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	5.3	5.3	10.6	1.9	1.9	3.8	4.2	3.7	7.8	24.0	23.7	22.2
AFTER	4.4	4.7	9.1	1.0	1.3	2.2	2.3	2.6	4.9	28.9	26.9	25.7
% Improvement	17%	11%	14%	48%	35%	41%	45%	30%	38%	21%	14%	16%

Travel Time

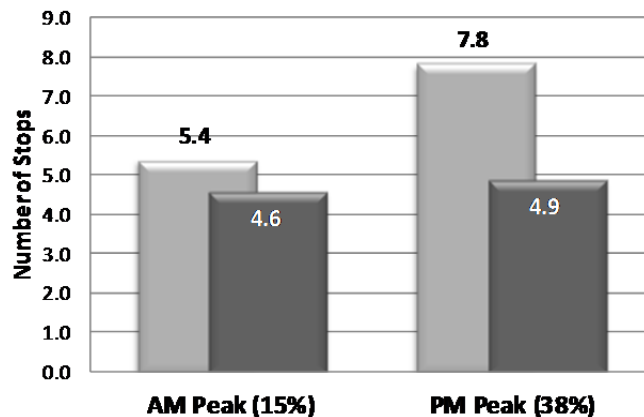
■ Before ■ After

**Delay**

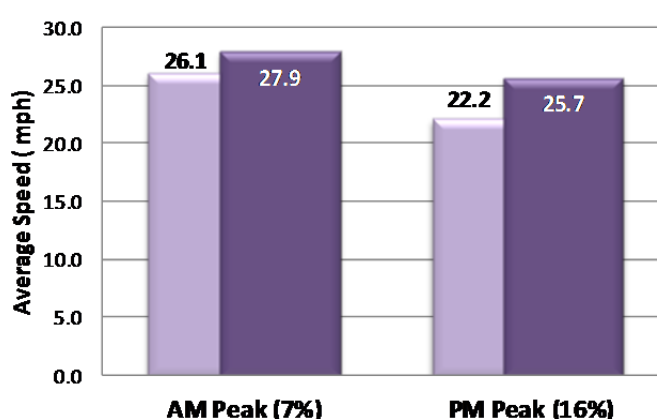
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Rialto Avenue (Santa Fe Way to Sierra Way)**"Before and After" Study Results**

Jurisdiction: San Bernardino City

Length (mile): 1.95

Number of Signals: 9

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2616	1494	4110	1381	790	2171	219	120	339	772	380	1152	46	23	68	29	15	44
AFTER	2217	1204	3421	1271	692	1963	207	109	316	774	371	1145	46	22	68	29	14	43
% Reduction	15%	19%	17%	8%	12%	10%	5%	9%	7%	0%	2%	1%	-1%	4%	1%	-1%	7%	2%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	2088	3082	5170	1180	1719	2899	193.7	286.6	480	811.5	1047	1859	47	63	110	29	42	71
AFTER	2167	2642	4809	1140	1505	2645	180.4	251.8	432	621.7	891.6	1513	36	53	89	24	37	61
% Reduction	-4%	14%	7%	3%	12%	9%	7%	12%	10%	23%	15%	19%	24%	16%	19%	17%	12%	14%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	399.0	290.0	689.0	110.0	98.0	208.0	12.0	11.0	23.0	-2.0	9.0	7.0	-0.3	0.9	0.6	-0.3	1.1	0.8
PM	-79.0	440.0	361.0	40.0	214.0	254.0	13.3	34.8	48.1	189.8	155.4	345.2	11.5	10.0	21.4	5.0	5.2	10.2

Emission, Fuel and Travel Time Savings

Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	6.6	3.1	497.9	2.7	76.3	37.7
Annually	1,646	777	124,479	676	19,069	9,425

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.25	\$27.95	\$5.73	\$1.70	\$297.47	\$446.37
Annually (\$)	\$64	\$6,988	\$1,432	\$425	\$74,368	\$111,592

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$779
Annually: \$194,868



Victoria Avenue (3rd St to Highland Ave)**"Before and After" Study Results**

Jurisdiction: Highland

Length (mile): 2.01

Number of Signals: 7

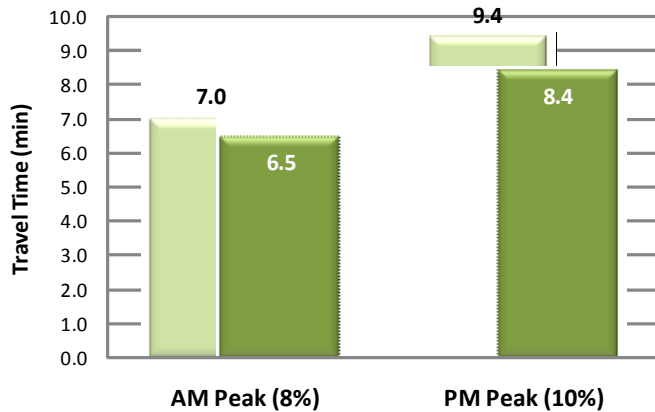
1. Measures of Effectiveness (MOE) Summary

AM Direction	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	3.5	3.5	7.0	1.3	1.3	2.6	2.8	3.0	5.8	29.0	28.7	28.8
AFTER	3.2	3.2	6.5	1.2	1.1	2.3	2.4	2.0	4.4	29.9	29.5	29.8
% Improvement	9%	7%	8%	11%	11%	11%	15%	33%	25%	3%	3%	4%

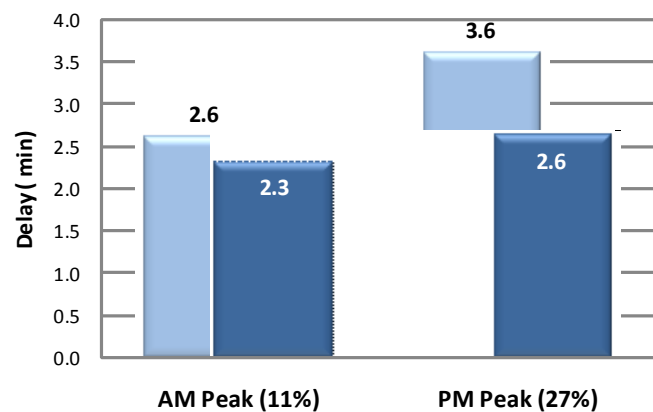
PM Direction	Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	4.6	4.8	9.4	1.7	1.9	3.6	3.2	3.2	6.4	26.3	25.3	25.8
AFTER	4.8	3.6	8.4	1.9	0.7	2.6	2.7	1.1	3.9	25.9	33.1	29.1
% Improvement	-4%	24%	10%	-11%	62%	27%	15%	64%	40%	-1%	31%	13%

Travel Time

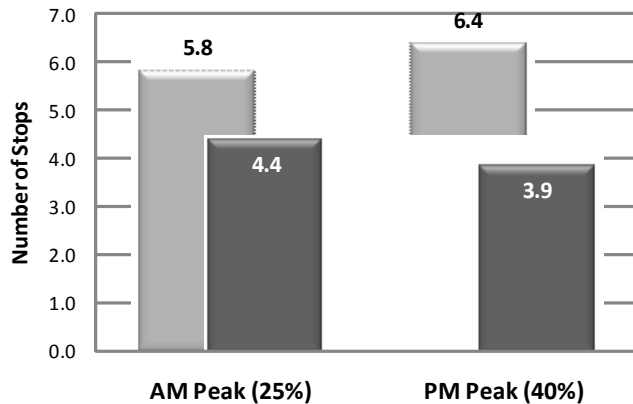
Before After

**Delay**

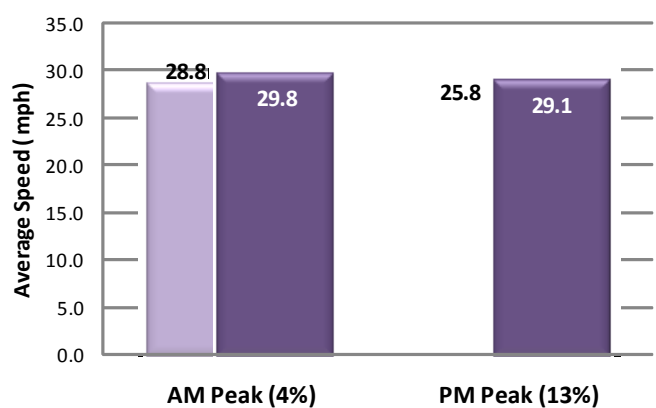
Before After

**Number of Stops**

Before After

**Average Speed**

Before After



Victoria Avenue (3rd St to Highland Ave)

"Before and After" Study Results

Jurisdiction: Highland

Length (mile): 2.01

Number of Signals: 7

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1135	1815	2950	600	917	1517	89	133	221	308	460	768	18	27	44	10	14	24
AFTER	859	1386	2245	502	810	1312	78	123	201	314	419	733	18	25	43	10	16	26
% Reduction	24%	24%	24%	16%	12%	14%	12%	8%	9%	-2%	9%	5%	-2%	4%	2%	-1%	-11%	-7%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1887	1572	3459	839.6	729.9	1570	124.1	108	232	477.6	383.5	861	28	23	50	15	14	29
AFTER	1092	1467	2559	819.3	641.6	1461	120.9	96.7	218	436.5	306.9	743	26	18	44	16	12	28
% Reduction	42%	7%	26%	2%	12%	7%	3%	10%	6%	9%	20%	14%	6%	19%	12%	-3%	14%	5%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	275.5	429	705	98.1	106.8	204.9	10.3	10.4	20.7	-6.0	40.9	34.9	-0.3	1.2	0.9	-0.1	-1.6	-1.7
PM	794.9	104.5	899.4	20.3	88.3	108.6	3.2	11.3	14.5	41.1	76.6	117.7	1.7	4.2	5.9	-0.5	1.9	1.4

Emission, Fuel and Travel Time Savings

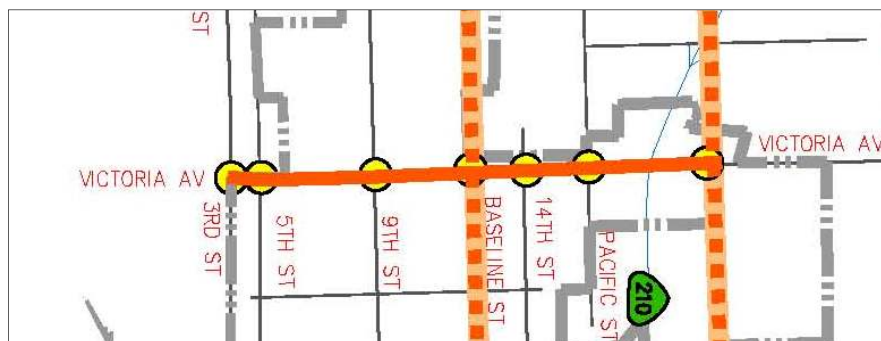
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	10.8	2.0	226.0	1.1	22.8	0.7
Annually	2,706	492	56,494	275	5,694	163

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.42	\$17.70	\$2.60	\$0.69	88.8225	\$7.70
Annually (\$)	\$105	\$4,426	\$650	\$173	\$22,206	\$1,924

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$118
Annually: \$29,378



Area 5 Corridor Results

Table 6.5.1 Area 5 Corridors Measures of Effectiveness (MOE) Summary

Agency	Corridor Limits	Length (mile)	Num. of Signals	Peak Period	Measures of Effectiveness (MOE)			
					Travel Time Reduction	Delay Improvement	# of Stop Improvement	Ave. Speed Improvement
	Lugonia Ave							
Redlands , SB County (3), Caltrans (6)	Alabama St to Wabash Ave	4.02	14	AM	14%	39%	29%	15%
				PM	17%	41%	41%	21'
	Orange St							
Redlands Caltrans (4)	State St to Pennsylvania Ave	1.2	8	AM	18%	45%	53%	19%
				PM	6%	13%	12%	5%
	Yucaipa Blvd							
Yucapia	14th Street to 3rd Street	2.75	11	AM	15%	46%	36%	21%
				PM	15%	45%	26%	17%
	Mountain View Ave							
Loma Linda Caltrans (2)	I-10 WB Ramps to Prospect Ave	1.15	8	AM	21%	44%	5%	24%
				PM	14%	23%	20%	14%
Overall Average % Improvement:					15%	37%	28%	16%

Table 6.5.2 Area5 Corridors Quantification of Annually Savings Summary

Corridor Information		Quantification of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel (gal)	VHT (veh-hr)
		CO (lb)	Nox (lb)	CO2 (lb)	VOC (lb)		
	Lugonia Ave						
Redlands, SB County (3), Caltrans (6)	Alabama St to Wabash Ave (14)	5,736	1,723	473,555	2,581	67,419	38,363
	Orange St						
Redlands Caltrans (4)	State St to Pennsylvania Ave (8)	2,371	768	145,864	477	12,513	5,650
	Yucaipa Blvd						
Yucapia	14th Street to 3rd Street (11)	1,719	1,021	285,803	1,764	47,725	33,550
	Mountain View Ave						
Loma Linda Caltrans (2)	I-10 WB Ramps to Prospect Ave (8)	2,190	82	190,563	1,052	28,219	21,638
Area Project Total:		559				155,876	99,201
		(Tons)				(gal)	(veh-hr)

Table 6.5.3 Area5 Corridors Monetary Measures of Annually Savings Summary

Corridor Information		Monetary Measures of Annual Savings					
Agency	Corridor Limits	Emissions				Fuel	VHT
		CO	Nox	CO2	VOC		
	Lugonia Ave						
Redlands, SB County (3), Caltrans (6)	Alabama St to Wabash Ave (14)	\$222	\$15,519	\$5,446	\$1,625	\$262,933	\$454,212
	Orange St						
Redlands Caltrans (4)	State St to Pennsylvania Ave (8)	\$92	\$6,907	\$1,677	\$300	\$48,799	\$66,896
	Yucaipa Blvd						
Yucapia	14th Street to 3rd Street (11)	\$66	\$9,180	\$3,287	\$1,110	\$186,128	\$397,232
	Mountain View Ave						
Loma Linda Caltrans (2)	I-10 WB Ramps to Prospect Ave (8)	\$7	\$347	\$2,174	\$613	\$110,053	\$256,188
Area Project Total:		\$1,449,840				\$607,913	\$1,174,528
		\$3,232,280					

Lugonia Avenue (Alabama St to Wabash Ave)**"Before and After" Study Results**

Jurisdiction: Redlands & San Bernardino County

Length (mile): 4.02

Number of Signals: 14

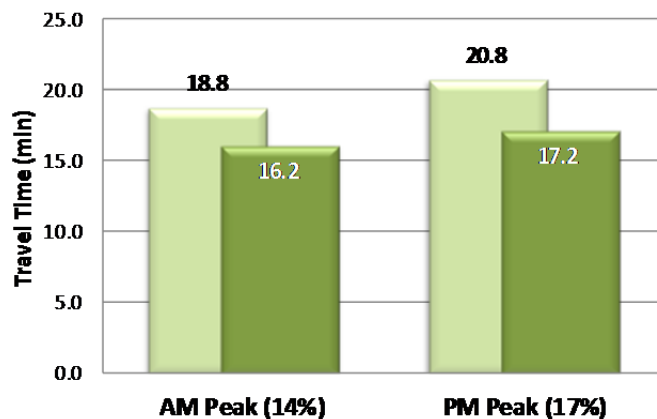
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		9.4	9.4	18.8	3.4	3.4	6.9	5.6	5.4	11.0	26.4	25.9	26.0
AFTER		8.2	8.0	16.2	2.2	2.0	4.2	3.8	3.8	7.7	29.6	30.6	29.9
% Improvement		13%	15%	14%	36%	42%	39%	32%	29%	30%	12%	18%	15%

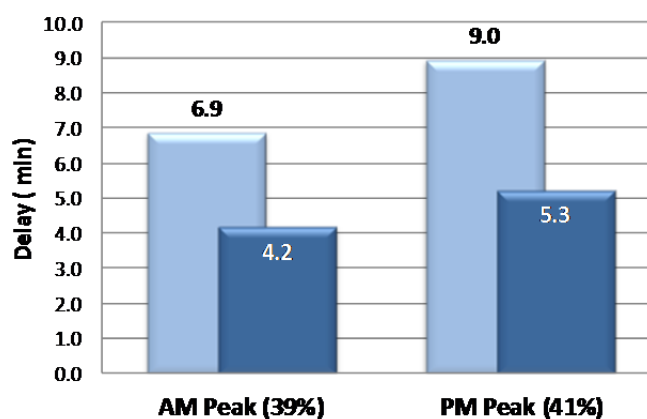
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE		10.9	9.9	20.8	5.1	3.9	9.0	5.5	7.0	12.5	22.2	24.4	23.2
AFTER		8.6	8.6	17.2	2.6	2.6	5.3	4.0	3.4	7.4	28.3	28.8	28.2
% Improvement		21%	13%	17%	48%	33%	41%	27%	51%	41%	28%	18%	21%

Travel Time

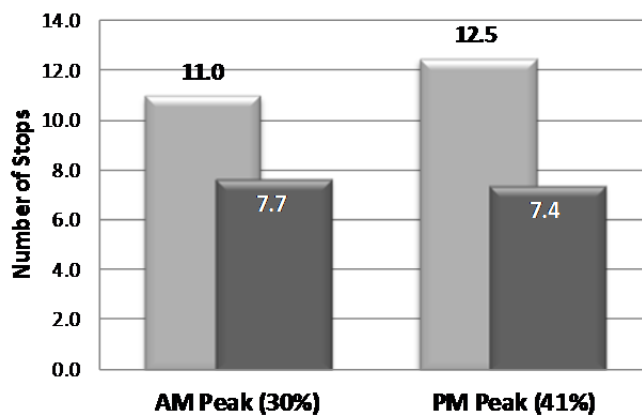
■ Before ■ After

**Delay**

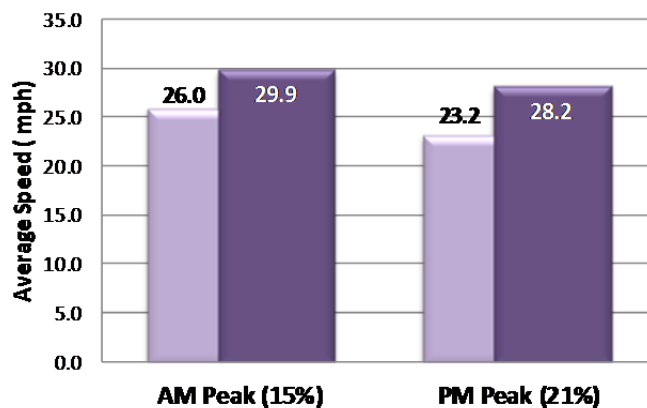
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Lugonia Avenue (Alabama St to Wabash Ave)**"Before and After" Study Results**

Jurisdiction: Redlands & San Bernardino

Length (mile): 4.02

Number of Signals: 14

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	3555	9696	13251	2091	4987	7078	328	766	1095	1109	2605	3714	66	155	221	41	96	137
AFTER	3664	8392	12055	2045	4689	6734	307	703	1010	971	2263	3234	58	135	193	37	83	120
% Reduction	-3%	13%	9%	2%	6%	5%	6%	8%	8%	13%	13%	13%	12%	13%	13%	10%	13%	12%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	9174	6061.3	15235	5029	3418	8447	845.3	542.2	1388	2942	2010	4951	181	117	298	126	66	192
AFTER	8099	5017.3	13116	4801	2998	7799	748.5	454.3	1203	2485	1472	3956	151	90	241	100	61	161
% Reduction	12%	17%	14%	5%	12%	8%	11%	16%	13%	16%	27%	20%	17%	23%	19%	21%	8%	16%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	-108.7	1304.2	1195.5	46.2	298.0	344.2	21.2	63.9	85.1	138.7	341.9	480.6	7.8	19.9	27.7	4.2	12.8	17.0
PM	1075.5	1044.0	2119.5	228.2	420.0	648.2	96.8	87.9	184.7	456.8	538.1	994.9	30.0	27.3	57.3	26.5	5.2	31.7

Emission, Fuel and Travel Time Savings

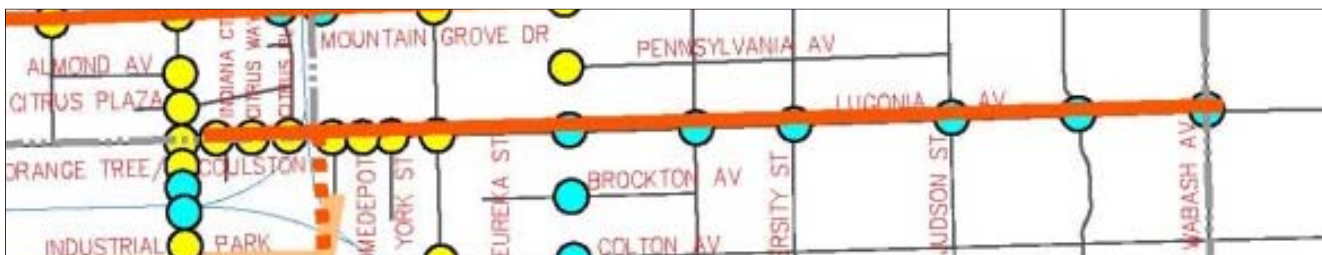
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	22.9	6.9	1894.2	10.3	269.7	153.5
Annually	5,736	1,725	473,555	2,581	67,419	38,363

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.89	\$62.08	\$21.78	\$6.50	\$1,051.73	\$1,816.85
Annually (\$)	\$222	\$15,519	\$5,446	\$1,625	\$262,933	\$454,212

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$2,960
Annually: \$739,956



Orange Street (State Ave to Pennsylvania Ave)

"Before and After" Study Results

Jurisdiction: Redlands

Length (mile): 1.20

Number of Signals: 8

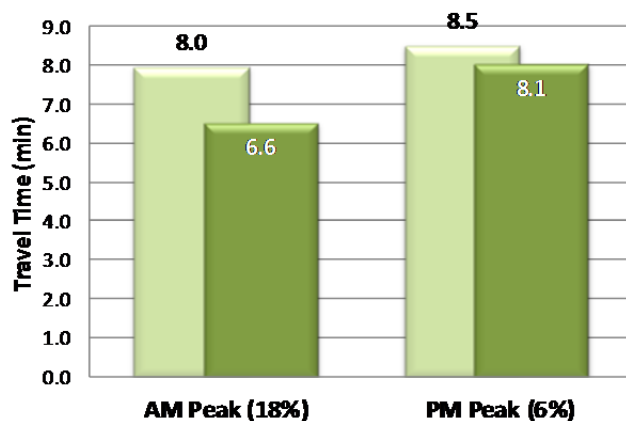
1. Measures of Effectiveness (MOE) Summary

AM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	4.5	3.5	8.0	2.1	1.1	3.2	4.6	3.0	7.6	16.3	21.7	18.2	16.3	21.7	18.2
AFTER	3.0	3.5	6.6	0.6	1.1	1.8	1.2	2.4	3.6	23.8	20.4	22.1	23.8	20.4	22.1
% Improvement	33%	-1%	18%	70%	-3%	45%	74%	20%	53%	47%	-6%	21%	47%	-6%	21%

PM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE	4.7	3.9	8.5	2.3	1.5	3.7	3.7	3.2	6.8	15.5	19.2	17.1	15.5	19.2	17.1
AFTER	4.5	3.6	8.1	2.0	1.2	3.3	4.0	2.0	6.0	23.8	20.4	18.0	23.8	20.4	18.0
Improvement	5%	7%	6%	10%	18%	13%	-9%	37%	12%	54%	6%	5%	54%	6%	5%

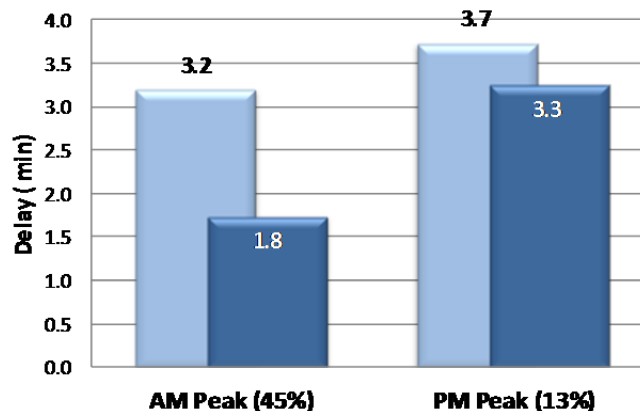
Travel Time

■ Before ■ After



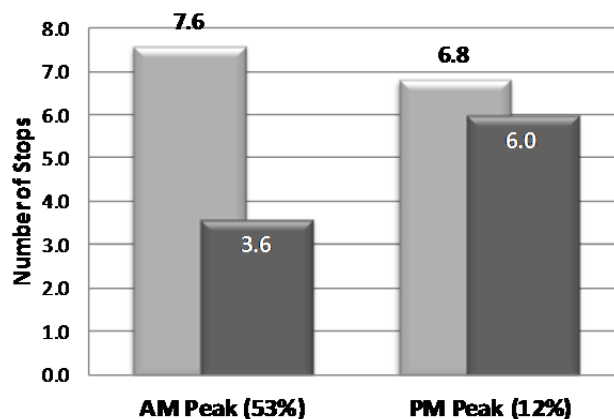
Delay

■ Before ■ After



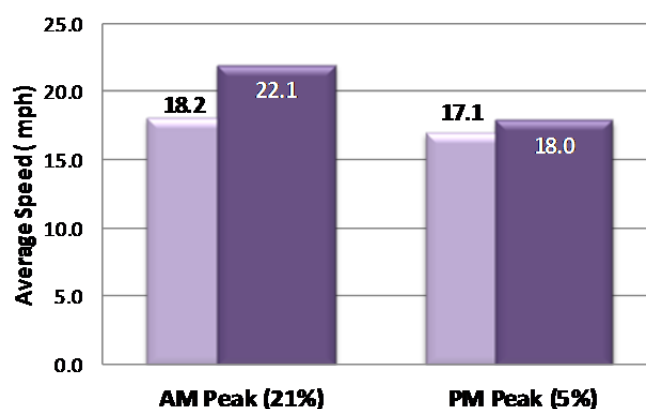
Number of Stops

■ Before ■ After



Average Speed

■ Before ■ After



Orange Street (State Ave to Pennsylvania Ave)

"Before and After" Study Results

Jurisdiction: Redlands

Length (mile): 1.20

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	1370	1234	2604	667	667	1334	128	121	248	471	445	917	29	27	56	25	20	45
AFTER	757	1050	1807	486	608	1094	89	114	203	256	454	710	17	28	44	22	20	42
% Reduction	45%	15%	31%	27%	9%	18%	31%	5%	18%	46%	-2%	23%	42%	-2%	21%	10%	0%	6%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2267	1348	3615	1218	748.6	1967	223.9	136.8	361	730.6	488.1	1219	47	30	77	40	23	63
AFTER	1901	1055	2956	1121	619.5	1740	201.6	116.2	318	746.6	372.2	1119	46	24	71	36	22	58
% Reduction	16%	22%	18%	8%	17%	12%	10%	15%	12%	-2%	24%	8%	1%	18%	8%	9%	4%	7%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM	613.5	183.8	797.3	180.7	59.0	239.7	39.3	6.5	45.8	215.6	-9.0	206.6	12.2	-0.7	11.6	2.6	0.0	2.6
PM	366.5	293.1	659.6	97.6	129.1	226.7	22.3	20.6	42.9	-16.0	115.9	99.9	0.6	5.5	6.1	3.7	0.9	4.6

Emission, Fuel and Travel Time Savings

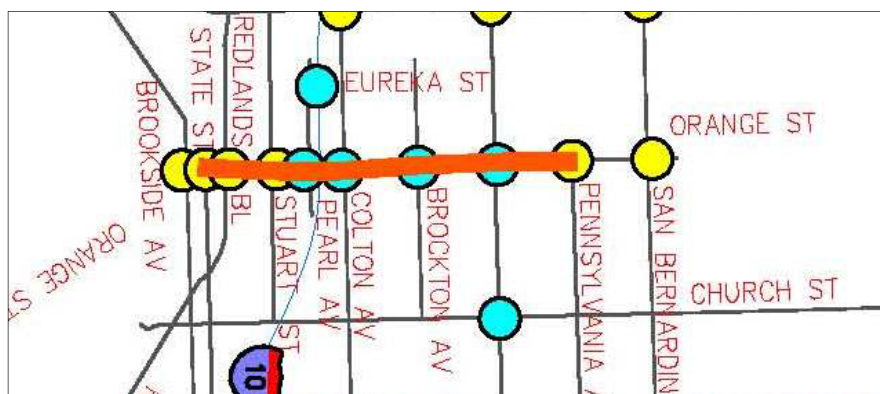
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	9.5	3.1	583.5	1.9	50.1	22.6
Annually	2,371	768	145,864	477	12,513	5,650

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.37	\$27.63	\$6.71	\$1.20	\$195.20	\$267.58
Annually (\$)	\$92	\$6,907	\$1,677	\$300	\$48,799	\$66,896

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$499
Annually: \$124,671



Yucaipa Boulevard (14th St to 3rd St)**"Before and After" Study Results**

Jurisdiction: Loma Linda

Length (mile): 2.75

Number of Signals: 11

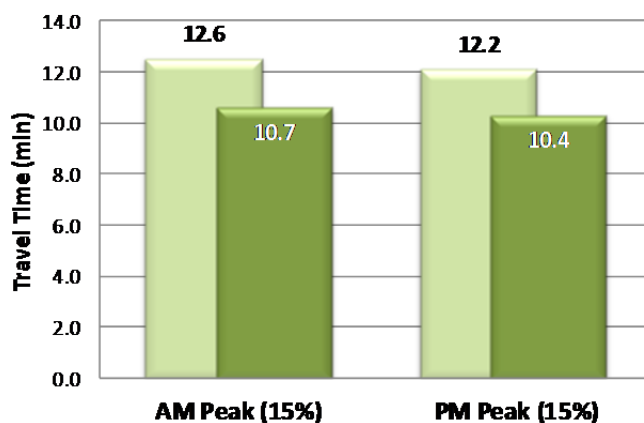
1. Measures of Effectiveness (MOE) Summary

AM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	6.2	6.4	12.6	2.0	2.2	4.2	3.2	3.6	6.8	27.7	26.7	27.0	27.7	26.7	27.0
AFTER	5.2	5.5	10.7	1.0	1.3	2.3	1.7	2.7	4.3	33.0	32.5	32.6	33.0	32.5	32.6
% Improvement	15%	15%	15%	49%	44%	46%	48%	26%	36%	19%	22%	21%	19%	22%	21%

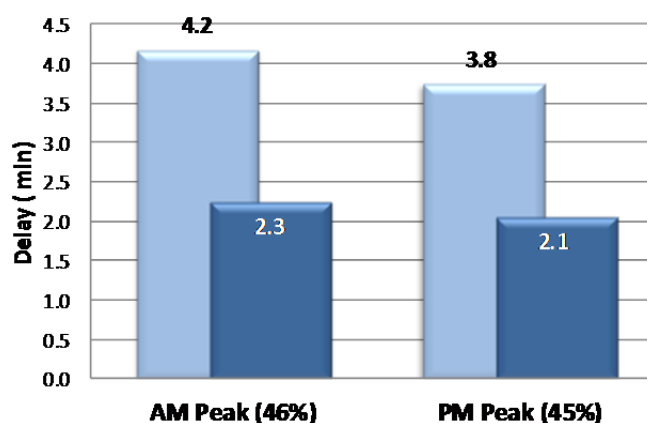
PM				Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	R/T Avg.
BEFORE	6.3	5.9	12.2	2.1	1.7	3.8	3.3	2.5	5.8	26.6	28.3	27.3	26.6	28.3	27.3
AFTER	5.8	4.5	10.4	1.7	0.4	2.1	2.8	1.5	4.3	28.6	36.7	32.0	28.6	36.7	32.0
Improvement	7%	23%	15%	18%	78%	45%	15%	40%	26%	7%	29%	17%	7%	29%	17%

Travel Time

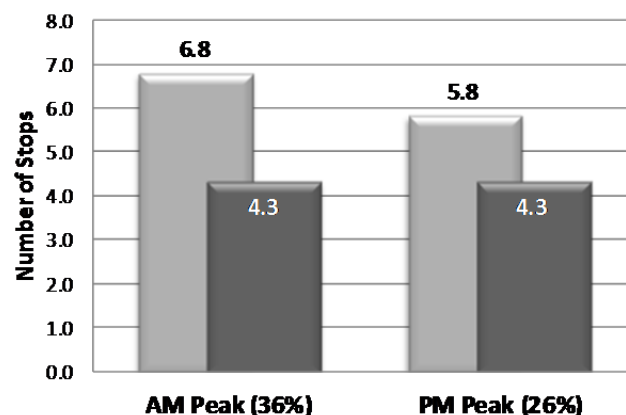
■ Before ■ After

**Delay**

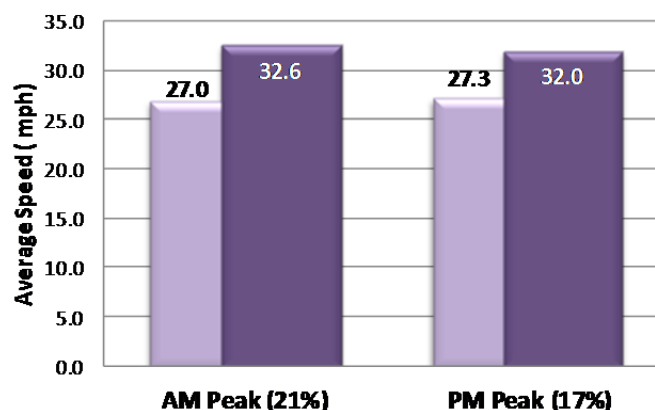
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Yucaipa Boulevard (14th St to 3rd St)**"Before and After" Study Results**

Jurisdiction: Loma Linda

Length (mile): 2.75

Number of Signals: 11

2. Emissions, Fuel and Travel Time (VHT)

AM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	4909	8349	13258	2622	4759	7381	417	744	1161	1440	2659	4099	86	158	245	56	101	156
AFTER	4484	7720	12204	2539	4360	6899	383	683	1065	1180	2211	3391	72	134	206	48	87	134
% Reduction	9%	8%	8%	3%	8%	7%	8%	8%	8%	18%	17%	17%	17%	15%	16%	14%	14%	14%

PM Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
BEFORE	4474	8068.6	12543	2598	4646	7244	417.4	721.7	1139	1469	2248	3717	88	137	225	57	91	149
AFTER	4192	8213.2	12405	2472	4588	7060	391.3	668	1059	1389	1920	3309	83	115	198	54	72	126
% Reduction	6%	-2%	1%	5%	1%	3%	6%	7%	7%	5%	15%	11%	5%	16%	12%	6%	21%	15%

Reduction Rate Direction	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
AM	425.2	629	1054	83.0	399.0	482.0	34.6	61.1	95.7	260.1	448.1	708.2	14.6	24.5	39.1	7.8	14.1	21.9
PM	282.8	-144.6	138.2	126.6	58.0	184.6	26.1	53.7	79.8	80.2	328.3	408.5	4.8	21.9	26.7	3.3	19.4	22.7

Emission, Fuel and Travel Time Savings

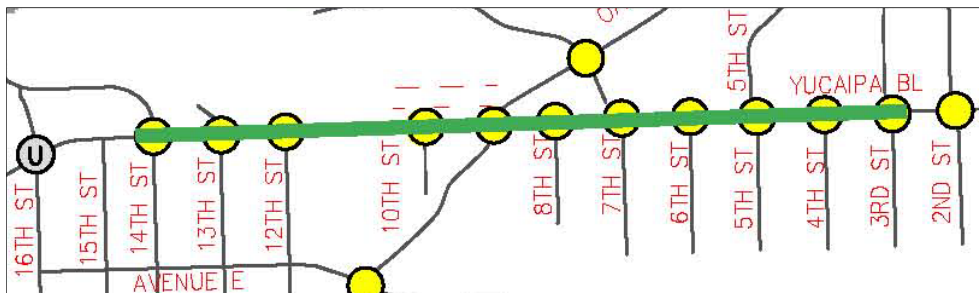
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	6.9	4.1	1143.2	7.1	190.9	134.2
Annually	1,719	1,020	285,803	1,764	47,725	33,550

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.27	\$36.72	\$13.15	\$4.44	\$744.51	\$1,588.93
Annually (\$)	\$66	\$9,180	\$3,287	\$1,110	\$186,128	\$397,232

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: \$2,388
Annually: \$597,003



Mountain View Ave (I-10 WB Ramps to Barton Rd)**"Before and After" Study Results**

Jurisdiction: Loma Linda

Length (mile): 1.15

Number of Signals: 8

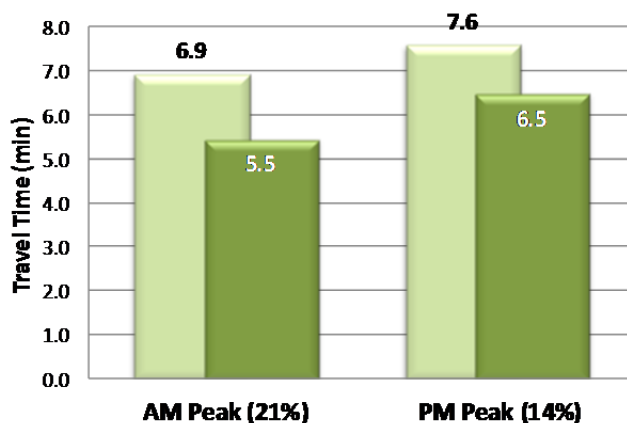
1. Measures of Effectiveness (MOE) Summary

AM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		3.9	3.0	6.9	2.1	1.2	3.3	2.6	1.4	4.0	18.0	25.4	20.7
AFTER		2.9	2.6	5.5	1.1	0.8	1.9	2.4	1.5	3.8	25.0	27.1	25.7
% Improvement		27%	13%	21%	50%	34%	44%	9%	-4%	5%	39%	7%	24%

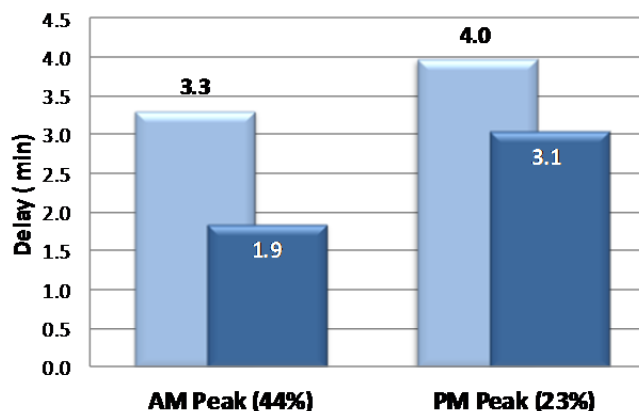
PM		Travel Time (min)			Delay (min)			Number of Stops			Average Speed (mph)		
Direction		NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	R/T Avg.
BEFORE		4.2	3.4	7.6	2.4	1.6	4.0	3.7	2.4	6.1	18.7	21.9	19.3
AFTER		3.8	2.7	6.5	2.1	0.9	3.1	3.3	1.6	4.9	19.6	27.8	22.0
Improvement		9%	22%	14%	12%	41%	23%	12%	33%	20%	5%	27%	14%

Travel Time

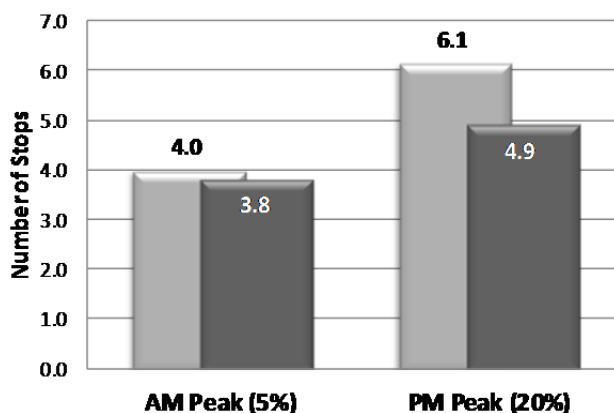
■ Before ■ After

**Delay**

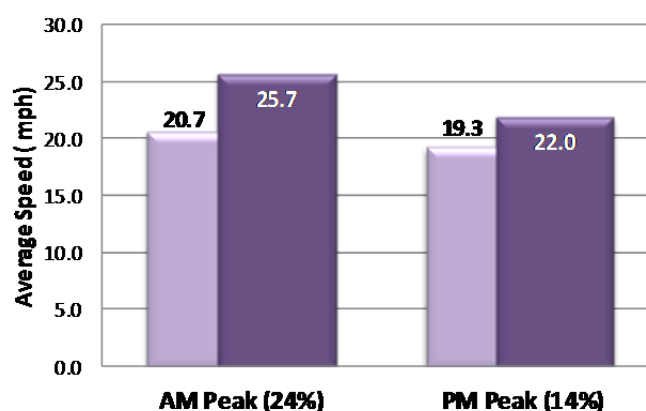
■ Before ■ After

**Number of Stops**

■ Before ■ After

**Average Speed**

■ Before ■ After



Mountain View Ave (I-10 WB Ramps to Barton Rd)**"Before and After" Study Results**

Jurisdiction: Loma Linda

Length (mile): 1.15

Number of Signals: 8

2. Emissions, Fuel and Travel Time (VHT)

AM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	2390	3559	5950	1311	2007	3318	248	327	575	955	1057	2012	59	65	124	43	45	88
AFTER	2347	3553	5900	1243	1991	3234	206	306	512	977	1026	2003	56	61	118	31	40	71
% Reduction	2%	0%	1%	5%	1%	3%	17%	6%	11%	-2%	3%	0%	6%	5%	5%	28%	10%	19%

PM	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)		
Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
BEFORE	3808	2813	6621	2075	1590	3665	373.1	271.8	645	1759	1087	2846	102	65	166	60	41	101
AFTER	3958	2606	6564	2180	1525	3705	350.7	240.7	591	1484	863	2347	87	51	139	55	33	88
% Reduction	-4%	7%	1%	-5%	4%	-1%	6%	11%	8%	16%	21%	18%	14%	20%	17%	9%	19%	13%

Reduction Rate	CO (g/hr)			NOx (g/hr)			CO2 (kg/hr)			VOC(g/hr)			Fuel (gal/hr)			VHT (veh-hr /hr)			
	Direction	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
AM		43.2	6.4	49.6	68.0	16.0	84.0	41.7	20.6	62.3	-22.2	31.2	9.0	3.4	3.3	6.7	12.3	4.4	16.7
PM		-150.0	207.2	57.2	-105.0	65.0	-40.0	22.4	31.1	53.5	274.3	224.2	498.5	14.3	13.2	27.5	5.2	7.6	12.8

Emission, Fuel and Travel Time Savings

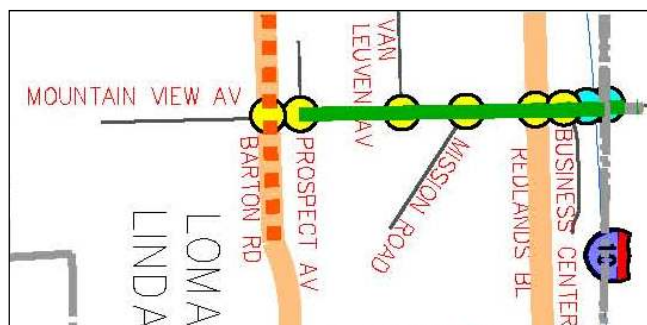
Corridor	CO (lb)	NOx (lb)	CO2 (lb)	VOC (lb)	Fuel (gal)	VHT (veh-hr)
Daily	0.7	0.2	756.2	3.9	112.9	86.6
Annually	179	39	189,047	974	28,219	21,638

Emission, Fuel and Travel Time Monetary Savings

Corridor	CO	NOx	CO2	VOC	Fuel	VHT
Daily (\$)	\$0.03	\$1.39	\$8.70	\$2.45	\$440.21	\$1,024.75
Annually (\$)	\$7	\$347	\$2,174	\$613	\$110,053	\$256,188

Emissions, Fuel and Travel Time Monetary Savings Summary

Daily: **\$1,478**
 Annually: **\$369,382**



6.2 Overall Project Benefits

ADVANTEC has successfully achieved improvements on travel performance from the synchronization of Tier 3 & 4 corridors. As a result, drivers in the San Bernardino Valley area have experienced reduced travel time, stops and delays, as well as significant fuel savings, and the resulting reduction in emissions of air pollutants.

In the first year of implementation, this project resulted in a total of **6,949 tons** of emissions reduced, **2.5 Million gallons** of fuel saved, and **1.3 Million vehicle-hours** in travel time saved. Table 5.2 summarizes the project savings in Fuel, Emissions and Vehicle Travel Time.

Table 5.2 Quantification of Project Benefits

Tier 3 & 4 Project Annual Savings					
Emissions (lb)				Fuel (gal)	VHT (veh-hr)
CO	NOx	CO2	VOC		
93,657	52,832	13,656,678	93,995	2,467,157	1,271,060
Total:	6,949 tons				

Project monetary benefits were estimated to be a total of **\$25.4 Million** in savings for the first year of implementation. Specifically, benefits from Vehicle Travel Time reduction represent about \$15 Million, while benefits from Fuel savings and Emissions reduction are \$9.6 Million and \$0.7 Million. With the total cost of coordination of \$1,589,237, the Benefit/Cost ratio for this project is calculated to be **16:1** or the *first year* of implementation. Table 5.3 summarizes the monetary benefits resulting from each parameter calculated.

Table 5.3 Summary of Project Monetary Benefits

Tier 3 & 4 Project Annual Monetary Savings					
Emissions				Fuel	VHT
CO	NOx	CO2	VOC		
\$3,763	\$479,197	\$164,618	\$58,558	\$9,666,247	\$15,069,232
\$700,812					
\$25,441,645					

It should be noted that all the monetary estimations above are expected to be under-estimated because of two main factors.

- 1) Traffic demand data used in calculations were collected between 2008 and 2010 when traffic demand was generally lower than that in 2014, since San Bernardino County was experiencing an economic recession with high unemployment. In other words, the cumulative savings are calculated based on 2008-2010 traffic demand, and is therefore, under-estimated.
- 2) The 'After' studies were performed recently in late 2013/early 2014, while 'Before' Studies were performed back in 2011, when traffic demand was lower due to economic downturn. If 'Before' study was done recently, reflecting new economic conditions and traffic conditions, the performance would likely produce worse results than in 2011. As a result, a higher percentage of improvements and savings would be expected.

Please note the results presented in this report are only for the 40 corridors that 'Before' and 'After' Studies were performed. There are some corridors that ADVANTEC had implemented coordination plans but were not part of 'After' Study because of field construction or some other unforeseen circumstances.



7. Future Recommendations

Since 1999, SANBAG has developed the San Bernardino Valley Coordinated Traffic Signal System Plan. This strategic plan was developed to synchronize key arterials in four tiers, called Tier 1, 2, 3 and 4. With the completion of Tier 3 and 4 in June 2012, all the key arterials in San Bernardino Valley have been equipped with communications equipment and synchronized. SANBAG has spent a total of about \$15 million in costs for this effort, and this has resulted in significant benefits to the travelers in terms of reduction in delay, travel time, stops, fuel consumption and pollutant emissions.

However, the equipment needs to be maintained, signal timing needs to be updated and the signal systems need operational attention from time to time. Traffic pattern changes over time with new developments, new signals, and new roadways. It is important for the cities to upkeep the hardware and provide constant attention to the traffic operational needs. However, not all the cities have staffing resources to handle the demanding operational and maintenance needs, especially since many cities have experienced staff reduction or furlough or both in recent years.

With the completion of SANBAG's original vision of implementing Tier 1, 2, 3 and 4, it is important to continue this effort and not let the good results deteriorate over time due to lack of staffing or funding. As evidenced in the Hardware Status Report (under separate cover), from the 10 months of June 2012 to April 2013, more than two-thirds (2/3) of the intersections went offline. ADVANTEC has worked with the cities and SANBAG to bring as much of the remaining intersections online by the end of February 2014. However, SANBAG and the cities would need to continue to upkeep the equipment and attend to the operational needs. Not all cities currently have the staffing or capabilities to do this.

In order not to lose the benefits of signal synchronization at the end of this project, it is imperative that efforts be made to continue on the way forward. Staffing and financial constraints are the key reasons hampering the cities' ability to operate and maintain the signal synchronization hardware and timing needs. Some of the equipment furnished in Tier 3 and 4 utilize Ethernet communications equipment that is very different from the serial communications equipment that city maintenance staff are used to maintaining. Signal timing needs to be reviewed and updated from time to time to respond to changes in travel patterns. Some cities (typically the larger cities) may have more operations and maintenance staffing resources that can handle the technical needs. Other smaller cities will experience staffing resource problems and may not be able to do so. The Federal Highways Administration recommends a staffing level of 75-100 signals per traffic operations engineer and 30-40 traffic signals per maintenance technician¹. This means that some of the smaller cities (with less than 100 signals) would still need 'fractions' of a traffic operations engineer, and this cannot be achieved unless through some staff sharing arrangement.

1. Source: "Traffic Signal Operations and Maintenance Staffing Guidelines", FHWA, March 2009.

<http://ops.fhwa.dot.gov/publications/fhwahop09006/fhwahop09006.pdf>

One way to ensure that the benefits of Tier 1, 2, 3 and 4 is not lost can be achieved through sharing of staffing resources among cities. One basic premise behind traffic signal synchronization is to allow seamless traffic progression through the key arterials without regard to jurisdictional boundaries, and this has become a founding objective of Tier 1, 2, 3 and 4 - to synchronize traffic signals through inter-agency cooperation. To continue along this philosophy, the cities can group together and share the operations and maintenance responsibilities. This can be achieved through a number of different inter-agency cooperation mechanisms. It has been done in many metropolitan cities in the USA, and they can range from very formal legal structures to simple agreements among cities, examples as follows:-

1. In Las Vegas, since the 1980s, the three cities of Las Vegas, North Las Vegas, Henderson, and Clark County has formed a Joint Powers Authority (JPA) to operate and maintain all the traffic signals in Las Vegas Valley. It developed a traffic signal system called Las Vegas Area Computer Traffic System (LVACTS) in a Regional TMC that operates and maintains all the traffic signals in the region, with funding provided from each agency through a cost sharing mechanism based on the number of signalized intersections. The JPA assumes all the operations and maintenance responsibilities. Since 2001, the LVACTS system has also expanded to include the freeway operations by NDOT and has become the Freeway and Arterial System of Transportation (FAST) Project.
2. In Los Angeles County, through METRO funding initiatives, the County is in the process of setting up Regional TMCs, each with participation by several adjacent cities. For example, the Pomona Valley will operate with a Regional TMC located in Diamond Bar that also allows 7 adjacent cities to share video streaming and real-time traffic information.
3. In south Orange County, through an OCTA led traffic signal synchronization program, several cities recently joined together to share a common traffic signal system. The cities include:- Laguna Hills, Laguna Niguel, Aliso Viejo, Laguna Woods and Lake Forest. Laguna Hills currently operates a Centracs system that the adjacent cities also connect into, and each city has VPN access into the server. In this manner, each city is responsible for its operations and maintenance through use of a common signal system.

The manner in which the cities can cooperatively handle traffic signal operations and maintenance shall be established through discussions among them. Conceivably, the San Bernardino Valley can be divided into three sub-regions. The 3 sub-regions maybe:-

1. From county line to I-15 - this include cities of Chino Hills, Chino, Ontario, Montclair, Upland, Rancho Cucamonga.
2. From I-15 to SR-215 - this include cities of Fontana, Rialto and Colton.
3. East of SR-215 - this include cities of San Bernardino, Grand Terrace, Loma Linda, Redlands, and Highland.

Each of the sub-regions may have one or more Regional Traffic Management Centers (TMC) that operates (and potentially maintains) the traffic signals. Costs may be shared among the cities prorated by the number of intersections. 801