

CONTRA COSTA

2013 Multi-Modal Traffic Service Objective

Monitoring Program Final Monitoring Report March, 2014



MULTI-MODAL TRAFFIC SERVICE OBJECTIVE MONITORING REPORT

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1.0 EXECUTIVE SUMMARY

This report summarizes the results of the 2013 monitoring of multi-modal traffic service objectives (MTSOs) adopted in the various sub-county Action Plans for routes of Regional Significance. These MTSOs were most recently incorporated into the 2009 Countywide Transportation Plan (CTP) and Action Plan updates. The majority of the MTSOs applied to the Routes of Regional Significance in Contra Costa use intersection level of service (LOS), roadway segment LOS, travel delay or average speed, and vehicle occupancy rates (VORs) as the measure of effectiveness. A summary of the results of the 2013 MTSO analysis for the five sub-areas within Contra Costa County is shown in Table 1.

Table 1: Summary of Monitoring Results

Traffic Service Objective	Locations	AM Peak Hour				PM Peak Hour			
		Achieving MTSOs		Not Achieving MTSOs		Achieving MTSOs		Not Achieving MTSOs	
		No.	%	No.	%	No.	%	No.	%
Intersection Level of Service	198	193	97.4%	5	2.6%	194	98%	4	2%
Roadway Segment	19	19	100%	0	0%	19	100%	0	0%
Vehicle Occupancy	6	5	83%	1	17%	5	83%	1	17%
Transit Ridership	5	4	80%	1	20%	5	4	80%	1
Side Street wait time	38	37	97.4%	1	2.6%	35	92%	3	8%

Intersection Level of Service: A total of 198 intersection locations were monitored during the AM and the PM peak hour. 98 percent of the locations achieve the MTSO in the AM and PM peak hours. Five locations in the AM peak hour and four locations in the PM peak hour do not meet the MTSO.

Roadway Segment Level of Service: A total of 19 freeway segment locations were monitored during the AM and the PM peak hour. All locations met the MTSO Standards during the AM and the PM peak hours.

Vehicle Occupancy: A total of six study locations were monitored during the AM and the PM peak hour. All locations except Vasco Road met the MTSO Standards during the AM and the PM peak hours. Vehicle Occupancy Rates on Vasco Road were approximately 1.12 passengers per vehicle which was lower the MTSO standard of 1.2 occupants per vehicle.

Transit Ridership: A total of three study locations were monitored during the AM and the PM peak hour. All locations except transit ridership along San Pablo Dam Road met MTSO standards. The West County Action Plan specifies an increase in daily bus ridership on San Pablo Dam Road by to 3,000 average weekday daily riders. Bus ridership along San Pablo Dam Road was approximately 2,250 passengers per day which was lower than the MTSO standard.

Side Street Wait Times: The Action Plan for Lamorinda and West County sub areas includes a MTSO specifying that the maximum wait time for vehicles cannot exceed a specified number of cycles. A total of 38 locations were monitored for side-street delays out of which three intersections did not meet the established MTSO standards.

2.0 INTRODUCTION

The following report documents the results of the 2013 data collection monitoring and results for the multi-modal traffic service objectives (MTSOs) adopted in the various sub-county Action Plans for routes of Regional Significance. These MTSOs were incorporated into the Countywide Transportation Plan (CTP) and Action Plan updates in 2009. Data collection performed for this MTSO Monitoring Report was conducted according to the MTSO Monitoring Plan approved by the Contra Costa Transportation Authority (CCTA) in December 2012. This MTSO Monitoring Report includes:

- An introduction and background information relevant to this MTSO Monitoring Report;
- The methodology applied to the findings documented in this MTSO Monitoring Report;
- The status of MTSOs; and
- Conclusions regarding the achievement of the MTSOs.

2.1 Background

The 2013 MTSO Monitoring Report was prepared to carry out the requirements of Measure C, which was passed by the voters of Contra Costa County in 1988. The following is a description of Measure C and requirements set forth in the Measure that affects this MTSO Monitoring Report.

2.1.1 MEASURE C

Measure C established a sales tax to be used to fund transportation improvements in Contra Costa. The Measure includes an innovative growth management program and requires CCTA to develop a comprehensive transportation plan and update it every other year. The first Plan was adopted in 1995. For the 1997 update, CCTA reaffirmed the policies and proposed actions contained in the 1995 Plan instead of preparing a full update. CCTA completed the first major update in 2000 and the second in 2004. This report documents results to be included in the major update for the year 2014.

Regional Routes: To receive a share of the sales tax generated by Measure C, local jurisdictions must adhere to the level of service (LOS) standards that Measure C applies to local streets and roads. These standards, which are keyed to characteristics of adjoining land uses, are applied to those streets and roads for which the jurisdictions are responsible. Each jurisdiction must take appropriate action to ensure that those LOS standards are met.

The Measure C Growth Management Program (GMP), however, recognizes that because the majority of congestion occurs on the most regionally significant roadways, those roadways should be subject to a more flexible standard that would be established and maintained cooperatively by the jurisdictions those roadways serve. For each of these designated Routes of Regional Significance, the Regional Transportation Planning Committees (RTPCs, refer to Figure 1), which are comprised of all the jurisdictions within the different sub-county regions in Contra Costa County, must prepare an Action Plan. Each jurisdiction must participate in their RTPC and work to implement the Action Plans to continue receiving return-to-source funds from

Measure C.

Designated Regional Routes include all the freeways and state highways, and the most significant arterials in Contra Costa. Some of these Regional Routes were established directly by Measure C while others were designated later by the Authority and the RTPCs. Each of these Regional Routes:

- Connects two or more of the sub-county regions; or
- Carries a significant amount of through traffic not tied to one jurisdiction; or
- Provides access to a regional highway or transit facility; or
- Enters or exits the county.

For each Regional Route, the RTPCs have adopted MTSOs and actions for achieving them in a regular update of the RTPC Action Plan documents. In its Implementation Documents, the Authority established the following requirements for each RTPC Action Plan:

- Long-range assumptions on future land use;
- Adopted MTSOs that use a quantifiable measure of effectiveness and include a target date for attaining the objective;
- Specific actions to be implemented by each participating jurisdiction;
- Requirements for consultation on environmental documents;
- A procedure for review of impacts resulting from General Plan amendments; and
- A schedule for reviewing progress in attaining the MTSOs and revising the Action Plans as needed.

CCTA has incorporated the MTSOs identified in each Action Plan into the Countywide Comprehensive Transportation Plan. Table 2 to Table 6 list the adopted MTSOs by Regional Route and by RTPC boundary region. Each MTSO uses one of following measures of effectiveness:

- Intersection LOS;
- Roadway segment LOS;
- Delay index;
- Peak period congestion;
- Average speed;
- Vehicle occupancy;
- Transit ridership; and
- Maximum wait time.

2.2 Changes to Transportation System

In the four years since the previous MTSO monitoring report, a number of changes were made to the transportation system within Contra Costa. Some of the more significant of these changes include:

- Widening of SR 4 East, adding mixed flow lanes from Loveridge Road to SR-160
- Construction of the fourth bore of the Caldecott Tunnel¹

¹ The completion of the fourth bore occurred after the monitoring reported on in this report was done.

Figure 1: Regional Transportation Planning Committee (RTPC) Boundaries

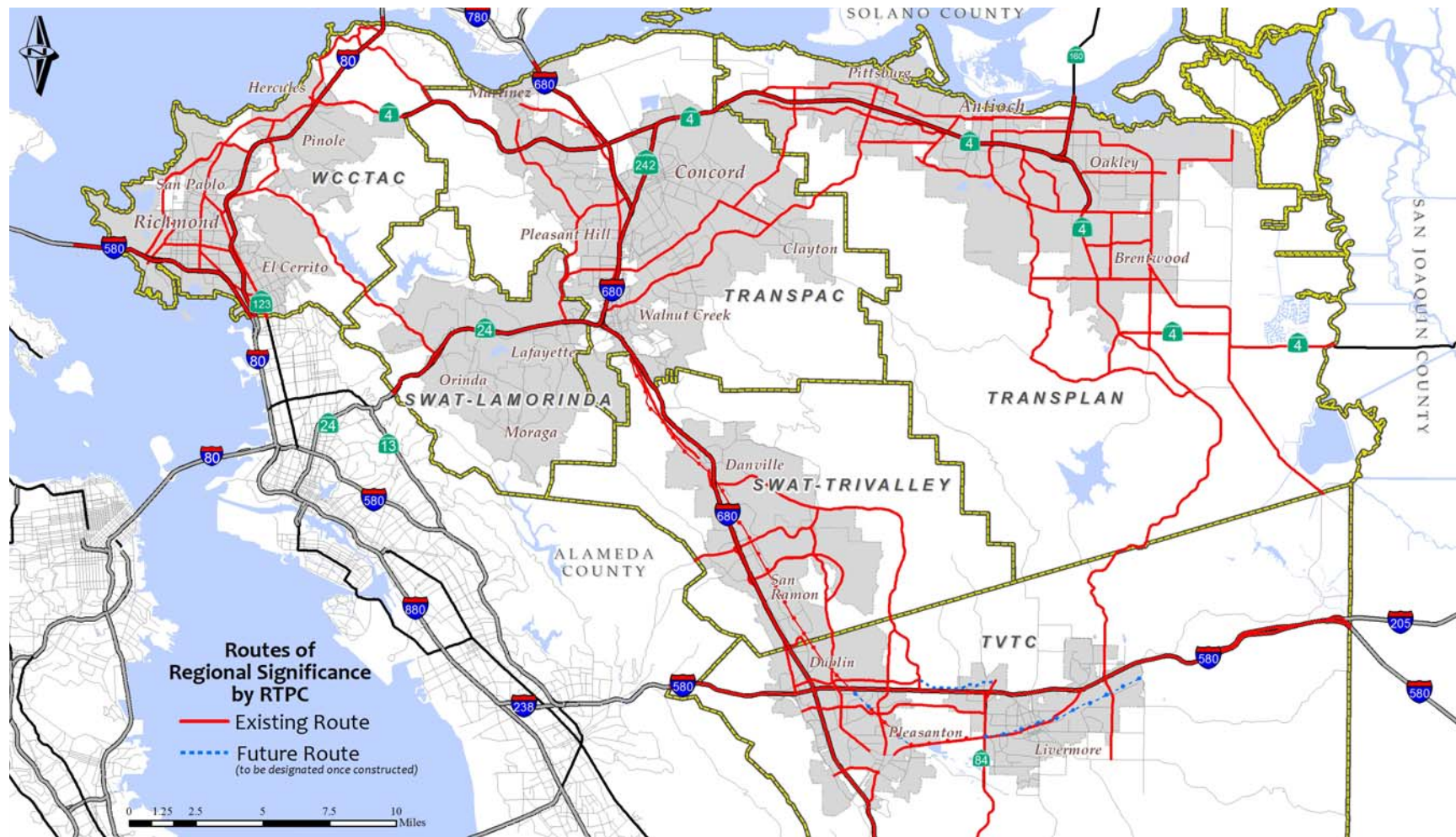


Table 2: Routes of Regional Significance and MTSOs for the LaMorinda RTPC Sub-Area

Lamorinda Facilities	Traffic Service Objectives
SR 24 (<i>Alameda Co. [Caldecott Tunnel] to I-680</i>)	<p>Maintain a Delay Index (DI) of 2.0 or lower on the SR 24 corridor between I-680 and the Caldecott Tunnel during peak periods in the peak commute direction</p> <p>Maintain a Delay Index (DI) of 1.5 or less for all but the six most congested hours of the day</p> <p>For BART -Maintain an hourly average loading factor (ratio of passengers to seats) of 1.5 or less approaching Lafayette Station westbound and Orinda Station eastbound during each and every hour of service</p>
San Pablo Dam Road (<i>I-80 to SR 24</i>)	<p>Delay index no greater than 2.0</p> <p>The maximum wait time for drivers on side streets wishing to access San Pablo Dam Road should be no greater than one signal cycle length</p>
Pleasant Hill Road	<p>Maintain a maximum wait time for drivers on side streets wishing to access Pleasant Hill Road or Taylor Boulevard of one signal cycle or less.</p> <p>Maintain peak hour peak direction delay index of 2.0 or lower.</p>

Table 3: Routes of Regional Significance and MTSOs for the Tri-Valley RTPC Sub-Area

Tri-Valley Facilities	Traffic Service Objectives
Interstate-680 <i>TRANSPAC/Tri-Valley boundary [between Rudgear Rd & Livorna Rd] to SR-84.</i>	Maintain a minimum average speed of 30 mph and a delay index of 2.0
Interstate-580 <i>I-680 to Vasco Road</i>	Maintain a minimum average speed of 30 mph and a delay index of 2.0
SR-84 <i>I-680 to I-580</i>	Delay Index of 3.0 on freeway segments
Danville Boulevard <i>TRANSPAC/Tri-Valley boundary [between Rudgear Rd & Livorna Rd] to La Gonda Way</i>	V/C < 0.91
Hartz Avenue / San Ramon Valley Boulevard <i>La Gonda Way to Railroad Ave [south] to Alameda Co. (7)</i>	V/C < 0.91
Camino Tassajara / Tassajara Road <i>Sycamore Valley Rd to Alameda Co.</i>	V/C < 0.91
Sycamore Valley Road <i>San Ramon Valley Blvd to Camino Tassajara</i>	V/C < 0.91
Alcosta Boulevard <i>San Ramon Valley Blvd to Village Parkway</i>	V/C < 0.91
Bollinger Canyon Road <i>San Ramon Valley Blvd to Alcosta Blvd [being extended east to Dougherty Road]</i>	V/C < 0.91
Crow Canyon Road <i>Alameda Co. to Camino Tassajara</i>	V/C < 0.91

Dougherty Road <i>Crow Canyon Rd to Alameda Co.</i>	V/C < 0.91
First Street (Livermore):	V/C < 0.91
Hacienda Drive	V/C < 0.91
Hopyard Road	V/C < 0.91
Isabel Extension	V/C < 0.91
Jack London Boulevard	V/C < 0.91
North Canyons Parkway:	V/C < 0.91
North Livermore Avenue:	V/C < 0.91
San Ramon Road:	V/C < 0.91
San Ramon Valley Boulevard:	V/C < 0.91
Santa Rita Road:	V/C < 0.91
Stanley Boulevard:	V/C < 0.91
Stoneridge Drive	V/C < 0.91
Sunol Boulevard	V/C < 0.91
Sycamore Valley Road:	V/C < 0.91
Tassajara Road	V/C < 0.91
Vasco Road	V/C < 0.91
West Las Positas Boulevard	V/C < 0.91

Table 4: Routes of Regional Significance and MTSOs for the WCCTAC RTPC Sub-Area

West County (WCCTAC) Facilities	Traffic Service Objectives
Interstate 80 <i>Solano County to Alameda County</i>	Maintain a minimum average speed of 30 mph and a delay index of 2.0 Increase HOV lane usage by 10% between year 2007 and 2012
State Route 4 (John Muir Parkway) <i>I-80 to TRANSPAC/WCCTAC boundary [at Cummings Skyway])</i>	Maintain a minimum average speed of 30 mph and a delay index of 2.0
Interstate 580 <i>Marin Co. to I-80</i>	Maintain a minimum average speed of 30 mph and a delay index of 2.0
23rd Street <i>San Pablo Ave/Road 20 to I-580</i>	Maintain LOS "D" or better at all signalized intersections
Appian Way <i>San Pablo Ave to San Pablo Dam Rd</i>	Maintain LOS "D" or better at all signalized intersections
Carlson Boulevard <i>23rd St to San Pablo Ave</i>	Maintain LOS "D" or better at all signalized intersections
Richmond Parkway	Maintain LOS "D" or better at all signalized intersections
San Pablo Avenue	Maintain LOS E or better at all signalized intersections
San Pablo Dam Road	Maintain LOS E or better at all signalized intersections

	Maintain transit ridership of 3,000 passengers per weekday by year 2012
Carlson Boulevard	Maintain LOS "D" or better at all signalized intersections
Central Avenue	Maintain LOS "D" or better at all signalized intersections
Cummings Skyway	Maintain LOS "D" or better at all signalized intersections
Cutting Boulevard	Maintain LOS "D" or better at all signalized intersections
El Portal Drive	Maintain LOS "D" or better at all signalized intersections
Willow Avenue	Maintain LOS "D" or better at all signalized intersections
Macondald Avenue	Maintain LOS "D" or better at all signalized intersections

Table 5: Routes of Regional Significance and MTSOs for the TRANSPAC RTPC Sub-Area

Central County (TRANSPAC) Facilities	Traffic Service Objectives
I-680 Solano Co. to Tri-Valley/TRANSPAC boundary [between Rudgear Rd & Livorna Rd interchanges]	Delay Index = 4.0
SR 242 I-680 to SR 4	Delay Index = 3.0
SR 4 (WCCTAC/TRANSPAC boundary [at Cummings Skyway] to TRANSPLAN/TRANSPAC boundary [at Willow Pass Grade])	Delay Index = 5.0
Alhambra Avenue + northern portion of Pleasant Hill Road(4) Alhambra Avenue - (Arch Street to Martinez/Pleasant Hill city limit) Pleasant Hill Road (northern portion)(4) -(Martinez/Pleasant Hill city limit to Taylor Blvd[north])	Delay Index = 2.0 / min pk hr avg speed = 15 mph Pk hr
Clayton Road Treat Blvd to Ygnacio Valley Rd-Kirker Pass Rd	Delay Index = 2.0 / min pk hr avg speed = 15 mph Pk hr Average stopped delay of 3 cycles at Kirker Pass Rd/Ygnacio Valley Rd and Treat Blvd/Denkinger Rd.
Contra Costa Boulevard Center Ave to Boyd Rd	AM Peak Hour speed = 15 mph for NB and 12 mph for SB PM Peak Hour avg. speed=10 mph
Geary Road Pleasant Hill Rd to I-680	LOS F at intersection with North Main Street
North Main Street	LOS F at intersection with Geary Road/Treat Boulevard
North Main Street Boyd Rd to I-680 interchange [n/o downtown Walnut Creek]	Delay Index = 2.0 / min pk hr avg speed = 15 mph Pk hr
Pacheco Boulevard Marina Vista to Center Ave	Delay Index = 2.0 / min pk hr avg speed = 15 mph Pk hr v/c of 1.5 for all signalized intersections
Pleasant Hill Road (central portion) (Geary Rd to Taylor Blvd)	Delay Index = 2.0 / min pk hr avg speed = 15 mph Pk hr v/c of 1.5 for all intersections
Taylor Boulevard	Within Pleasant Hill: 15 MPH Average Speed in both directions in the AM and PM peak hours V/C ratio of 1.5 for all intersections
Treat Boulevard	Within Concord: Average Stopped Delays (signal cycles)

	<p>to clear) at the following intersections: Clayton Road/Denkinger Road: 3 Cowell Road: 5 Oak Grove Road: 5</p> <p>Within Walnut Creek: LOS F at Bancroft Road intersection</p> <p>Within Contra Costa County: 1.5 V/C for all intersections</p>
Kirker Pass Road <i>Clayton Rd to TRANSPLAN/ TRANSPAC boundary</i>	<p>Within Concord: Average Stopped Delays as follows: Clayton Road/Kirker Pass Road: 3 Alberta Way/Pine Hollow Drive: 4 Cowell Road: 4</p> <p>Within Walnut Creek: LOS F at both Bancroft Road and Civic Drive intersections</p> <p>Within Contra Costa County: 1.5 V/C for all intersections</p>

Table 6: Routes of Regional Significance and MTSOs for the TRANSPLAN RTPC Sub-Area

East County (TRANSPLAN)Facilities	Traffic Service Objectives
SR 4 (freeway) <i>(TRANSPLAN/TRANSPAC boundary [at Willow Pass Grade] to Main St-SR 160)</i>	<p>Delay Index should not exceed 2.5 during the AM or PM Peak Period</p> <p>The HOV lane utilization should exceed 600 vehicles per lane in the peak direction during the peak hour.</p>
Unsignalized Suburban Arterials	<p>LOS D or better for the following routes:</p> <ul style="list-style-type: none"> • Byron Highway • Marsh Creek Road • Camino Diablo • Deer Valley Road • Walnut Boulevard (south of the City of Brentwood) • Cypress Road/Bethel Island Road • Deer Valley Road (unimproved portion) • Sellers Avenue • State Route 160 • SR-4 Non-Freeway: Balfour Road to San Joaquin County Line • Vasco Road

3.0 METHODOLOGY

This section describes both the methodology for collecting data and the methodology for calculating the intersection and freeway level of service MTSO measures. The descriptions of methodologies are grouped by the measures of effectiveness used in the MTSOs. For each measure of effectiveness, the applicable intersections, roadways, or other facilities are listed in the following sections.

For the most part, the MTSOs were adopted and their applications were unambiguous. Where the MTSO or its application was ambiguous, effort was made to reflect the intentions of the RTPCs and the CCTA.

3.1 Intersection Level of Service

Level of service is a traditional measure of transportation system performance. It is a quantitative stratification of performance measure that represents the quality of service. It rates the traffic conditions as perceived by the driver by assigning a letter value A through F, with an “A” corresponding to excellent conditions and “F” corresponding to poor traffic conditions.

3.1.1 Intersection Level Of Service

Intersection LOS was established using the methodologies described in the *Highway Capacity Manual, 2000* (HCM) published by the *Transportation Research Board*. SYNCHRO software was used to conduct the analysis. Signal timing in conjunction with traffic volume and intersection geometry data was used as the primary inputs for these calculations. **Table 7** describes the relationship between the volume capacity (V/C) ratio and LOS for signalized intersections.

3.1.2 Data Gathered And Method Used To Collect Data

Turning movement counts are needed as input to the analysis software (SYNCHRO). Turning movement counts were conducted by counting the number of vehicles making each of the three possible movements (i.e., left turn, through, and right turn) on each of the intersection approaches. The counts were conducted for a two-hour period during the AM and PM peak periods. The counts were recorded in 15-minute intervals and the one-hour period with the highest traffic volumes was used to calculate the LOS. Intersection lane geometrics and traffic signal phasing information were also used in calculating LOS, and were typically recorded at the same time that the turning movement counts were collected. Counts were conducted on a Tuesday, Wednesday, or Thursday outside of school and general holidays to represent “typical” traffic conditions. All turning movement counts are included in the appendix.

3.1.3 Monitored Intersections

Many MTSOs that apply intersection LOS specify a certain LOS at “all signalized intersections.” Intersections included as a part of this study was vetted with the Authority. The intersections chosen included:

- CMP intersections,
- Intersections identified in tables and figures in the Action Plans, and
- Signalized intersections where Routes of Regional Significance meet.

Table 8 through Table 11 list the intersections that were monitored, as well as the MTSOs and calculated levels of service for each intersection.

Table 7: Level of Service for Signalized Intersections

Level of Service	Type of Flow	Delay	Maneuverability	Delay in secs/veh
A	Stable Flow	Very slight or no delay. If signalized, conditions are such that no approach phase is fully utilized by traffic and no vehicle waits longer than one red indication.	Turning Movements are easily made, and nearly all drivers find freedom of operation.	≤10
B	Stable Flow	Slight delay. If signalized, an occasional approach phase is fully utilized.	Vehicle platoons are formed. Many drivers begin to feel somewhat restricted within groups of vehicles.	>10-20
C	Stable Flow	Acceptable delay. If signalized, a few drivers arriving at the end of a queue may occasionally have to wait through one signal cycle.	Back-ups may develop behind turning vehicles. Most drivers feel somewhat restricted.	>20-35
D	Approaching Unstable Flow	Tolerable delay. Delays may be substantial during short periods, but excessive back-ups do not occur.	Maneuverability is severely limited during short periods due to temporary back-ups.	>35-55
E	Unstable Flow	Intolerable delay. Delay may be great – up to several signal cycles.	There are typically long queues of vehicles waiting upstream of the intersection.	>55-80
F	Forced Flow	Excessive delay.	Jammed conditions. Back-ups from other locations restrict or prevent movement. Volumes may vary widely, depending principally on the downstream back-up conditions.	>80

3.2 Freeway and Roadway Segment Analysis

3.2.1 Data Collection

The project team's sub-consultants Quality Counts, NDS, TDS, and Wiltec collected various types of traffic data for the analysis segments. Filed observed data was further supplemented by traffic data archived through the PeMS database which is maintained by Caltrans. The following protocol was observed while collecting the various types of data.

Floating Car Runs:

- Travel time runs were conducted with a probe vehicle headway of 20 minutes or less such that at least 3 runs (preferably 5 runs) would be conducted during the peak hour per direction
- The travel time runs were GPS based runs

PeMS Database:

- Data was collected from detectors on study segments for year 2012.

Daily Segment Counts:

- Segment counts were conducted for a 2-day period and for 24 hours each day starting at midnight of the first day.
- Segment counts were conducted separately for each direction of travel on a roadway. Segment counts were collected using pneumatic tubes, video cameras or radar equipment.

3.2.2 Delay Index

The delay index measures travel congestion and is expressed as the ratio of the time required to travel between two points during the peak hour (the congested travel time) and the time required during un-congested off-peak times. A delay index of 2.0 means that congested travel time is twice as long as during an off-peak travel time. The following shows the formula for calculating delay indices:

$$\text{Delay Index} = \text{Free Flow Travel Time} / \text{Measured Peak Hour Travel Time}$$

The denominator of the delay index formula, measured peak hour travel time, was measured by conducting speed runs along Regional Routes with delay index MTSOs.

The numerator of the delay index formula, the free flow travel time is defined as "the time it takes to traverse a roadway segment at the speed limit including the average uncongested delay experienced at traffic signals." It is important to note that achievement of the MTSO delay index

and average speed is measured over entire length of the regional routes, even though it will be monitored by segment.

3.3 Vehicle Occupancy

3.3.1 Description And Method Of Calculation

The West County Action Plan includes MTSOs for vehicle occupancy rates (VORs). Measurements of VORs identify the average number of occupants per vehicle passing a given point on a route during peak traffic periods. The objective of many travel demand management (TDM) programs and air quality improvement programs is to increase VORs.

Vehicle occupancy rates are calculated by determining the number of people and the number of vehicles passing a certain point on a route, and dividing the number of people by the number of vehicles. Because it was not feasible to monitor every vehicle, this report relies on a statistical sample of the vehicles that passed the observation point.

3.3.2 Data Gathered And Method Used To Collect Data

Vehicle occupancy rates were determined manually by observers at a safe location away from the travel way, typically from overpasses or an elevated point above the roadway out of the view of the drivers. HOV lane use was determined by counting the number of vehicles using the HOV and non-HOV lane at predetermined locations on the freeway.

3.4 Transit Ridership

3.4.1 Description

The Lamorinda Action Plan contains a MTSO for the SR 24 corridor that specifies a maximum passenger-to-seats ratio of 1.5 at the Lafayette and Orinda stations in the eastbound and westbound directions. In addition, the Lamorinda Action Plan also contains an MTSO that specifies a target ridership of 3,000 daily passengers for transit facilities along San Pablo Dam Road.

3.4.2 Data Gathered And Method Used To Collect Data

Transit ridership data was obtained from BART and AC Transit for the transit facilities associated with the MTSOs. Passenger to seat ratio and daily ridership numbers were then derived from the transit information and compared against MTSO standards to determine compliance.

3.5 Maximum Side Street Wait Time

3.5.1 Description And Method Of Calculation

The West County, Lamorinda and Tri-Valley Action Plans contains a MTSO that establishes a maximum wait time for drivers on side streets wishing to access routes of regional significance. This MTSO is measured with direct observation of wait times for vehicles on the side streets.

3.5.2 Data Gathered And Method Used To Collect Data

Maximum wait time observations are recorded during the AM and PM peak hours for a minimum of 60 minutes at each intersection. During each cycle, the vehicle in the back of queue is recorded and observed to see if it passes through the intersection in one cycle. If the target vehicle does not pass through the intersection, the intersection does not achieve the MTSO for that cycle.

4.0 MONITORING RESULTS

The results of the monitoring of MTSOs are grouped by the measures of effectiveness used in the TSOs. All the data used to calculate these MTSOs were collected in conformance with the Authority's *Technical Procedures*.

4.1 Intersection Level of Service

Intersection LOS was monitored at 198 locations: 39 locations in the Tri-Valley sub area, 63 locations in the West County, 56 locations in the Central County area and 40 locations in the East County. Overall, 193 of the 198 intersections operate at an LOS equal to or better than the MTSO, either in the AM or PM peak hour (or more often both).

In Tri-Valley, the following three locations operate at a lower LOS than the MTSO:

- Bollinger Canyon Road and Camino Ramon
- Bollinger Canyon Road and Alcosta Boulevard
- Murrieta Boulevard and Stanley Street

In West County, two locations operate at a lower LOS than the MTSO:

- Richmond Parkway and Pittsburgh Avenue
- Richmond Parkway and Parr Boulevard

In East County, three locations operate at a lower LOS than the MTSO:

- Railroad Avenue and Leland Road

The results for the West County, East County, and the Tri-Valley Area are summarized in Table 8 through Table 11.

Table 8: Intersection Level of Service – Tri Valley Sub Area

No.	Primary Street	Secondary (Cross) Street	LOS Standard	AM Peak		PM Peak	
				LOS	Avg.Delay (secs/veh)	LOS	Avg.Delay (Secs/veh)
T 1	Sycamore Valley Road	SB I-680 on-off ramps	D	B	10.2	B	10.9
T 2	Sycamore Valley Road	NB I-680 off ramp	D	B	13.7	B	16.9
T 3	Sycamore Valley Road	Brookside Drive	D	B	18.8	B	18.1
T 4	Sycamore Valley Road	Camino Tassajara	D	C	23.9	B	18.8
T 5	Camino Tassajara	Sherburne Hills Road	D	B	20.1	C	27.6

No.	Primary Street	Secondary (Cross) Street	LOS Standard	AM Peak		PM Peak	
				LOS	Avg.Delay (secs/veh)	LOS	Avg.Delay (Secs/veh)
T 6	Camino Tassajara	Crow Canyon Road-	D	D	45.2	D	54.8
T 7	Crow Canyon Road	Bollinger Canyon Road	D	C	29.5	D	35.1
T 8	Crow Canyon Road	SB I-680 off ramp	D	B	17.1	C	22.6
T 9	Crow Canyon Road	NB I-680 off ramp	D	B	15.1	C	21.8
T 10	Crow Canyon Road	Crow Canyon Place	D	C	27.0	D	38.7
T 11	Crow Canyon Road	Camino Ramon	D	C	32.4	D	52.0
T 12	Crow Canyon Road	Alcosta Boulevard	D	B	13.9	C	27.6
T 13	Crow Canyon Road	Dougherty Road	D	B	19.4	C	29.5
T 14	Bollinger Canyon Road	SB I-680 off ramp	D	C	28.7	D	36.4
T 15	Bollinger Canyon Road	NB I-680 off ramp	D	B	19.2	C	24.7
T 16	Bollinger Canyon Road	Sunset Drive-	D	D	38.3	D	45.4
T 17	Bollinger Canyon Road	Camino Ramon	D	F	103.2	F	136.1
T 18	Bollinger Canyon Road	Alcosta Boulevard	D	D	46.1	F	90.8
T 19	Alcosta Boulevard	SB I-680 off ramp	D	D	53.0	D	49.2
T 20	Alcosta Boulevard	NB I-680 off ramp	D	C	31.6	D	36.6
T 21	Alcosta Boulevard	Village Parkway	D	B	13.9	B	15.9
T 22	Tassajara Road	Fallon Road	D	C	30.6	D	38.7
T 23	Dublin Boulevard	Fallon Road	D	C	32.6	C	33.9
T 24	Amador Valley Road	San Ramon Road	D	C	30.9	C	30.3
T 25	Fallon Road	Gleason Drive	D	C	24.9	B	19.4
T 26	Murrieta Boulevard	Holmes Street	D	C	31.3	C	31.2
T 27	Concannon Boulevard	Holmes Street	D	D	37.7	C	34.7
T 28	Murrieta Boulevard	Stanley Street	D	E	78.2	D	41.3
T 29	SR-84	Vallecito Road	D	D	53.7	B	13.1
T 30	SR-84	Vineyard Avenue	D	C	24	C	26.9
T 31	SR-84	Concannon Road	D	B	16.1	B	13.6
T 32	SR-84	Stanley Boulevard	D	B	19.2	C	25.4
T 33	SR-84	Discovery Lane	D	A	4.5	B	11.1
T 34	SR-84	Jack London Boulevard	D	D	31.6	C	28.4
T 35	SR-84	Airway Boulevard	D	C	31	C	31
T 36	SR-84	Kittyhawk Road	D	B	15	B	14.5
T 37	SR-84	EB I-580 Ramps	D	B	13.4	B	10.6
T 38	SR-84	WB I-580 Ramps	D	A	9.7	A	8.9
T 39	SR-84	Portola Avenue	D	D	45.1	D	36

Table 9: Intersection Level of Service – West County Sub Area

No.	Primary Street	Secondary (Cross) Street	LOS Standard	AM Peak		PM Peak	
				LOS	Avg.Delay (secs/veh)	LOS	Avg.Delay (Secs/veh)
W 1	Richmond Parkway	Blume Road	D	C	30.1	C	34.4
W 2	Richmond Parkway	Gertrude Avenue	D	C	32.6	D	38.6
W 3	Richmond Parkway	Pittsburgh Avenue	D	F	144.3	F	217
W 4	Richmond Parkway	Parr Boulevard	D	F	85.2	C	23.7
W 5	Richmond Parkway	Hensley Street	D	C	33.8	C	26.6
W 6	Richmond Parkway	Barrett Street	D	B	17.2	C	27.8
W 7	Richmond Parkway	McDonald Avenue	D	C	33.7	C	28.6
W 8	Richmond Parkway	I-580 EB Ramps	D	C	11.9	B	14.3
W 9	Richmond Parkway	I-580 WB Ramps	D	B	14.2	B	17.2
W 10	23rd Street	Rheem Avenue	D	C	24.1	C	31.1
W 11	23rd Street	Barrett Avenue	D	B	16.1	B	17.5
W 12	23rd Street	McDonald Avenue	D	A	9.3	A	10.0
W 13	23rd Street	Cutting Boulevard	D	B	17.9	C	33.6
W 14	Appian Way	Manor Road	D	B	14.1	B	14.2
W 15	Appian Way	Allview Avenue	D	B	18.0	B	16.8
W 16	Appian Way	Fitzgerald Drive	D	C	25.1	D	39.0
W 17	Appian Way	I-80 EB Ramps	D	A	8.5	B	18.5
W 18	Appian Way	I-80 WB Ramps	D	D	44.5	D	41.4
W 19	Appian Way	Tara Hills Drive	D	C	25.6	C	21.6
W 20	Appian Way	Mann Drive	D	A	3.5	A	3.8
W 21	Carlson Boulevard	Central Avenue	D	B	16.7	B	17.2
W 22	Carlson Boulevard	Huntington Avenue	D	A	2.0	A	2.0
W 23	Carlson Boulevard	I-80 NB Ramps	D	D	44.8	C	33.7
W 24	Carlson Boulevard	I-80 SB Ramps	D	A	6.4	C	31.1
W 25	Carlson Boulevard	S.55th Street	D	A	9.2	A	9.2
W 26	Carlson Boulevard	Bayview Avenue	D	D	42.1	C	34.8
W 27	Carlson Boulevard	S.37th Street	D	A	4.5	A	9.1
W 28	Carlson Boulevard	23rd Street	D	A	8.5	A	8.5
W 29	Central Avenue	Pierce Avenue	D	B	16.2	B	11.4
W 30	Central Avenue	I-80 EB Ramps	D	B	16.0	C	32.1
W 31	Central Avenue	I-80 WB Ramps	D	B	19.6	C	34.9
W 32	Central Avenue	I-580 Ramp	D	A	5.0	C	32.0
W 33	San Pablo Avenue	John Muir Parkway	E	D	37.5	E	63.8
W 34	San Pablo Avenue	Sycamore Avenue	E	C	31.2	C	30.3

No.	Primary Street	Secondary (Cross) Street	LOS Standard	AM Peak		PM Peak	
				LOS	Avg.Delay (secs/veh)	LOS	Avg.Delay (Secs/veh)
W 35	San Pablo Avenue	Pinole Valley Road	E	B	16.7	B	19.3
W 36	San Pablo Avenue	Tennant Avenue	E	B	10.3	A	8.7
W 37	San Pablo Avenue	Appian Way-Pinnon Avenue	E	C	35.1	D	40.7
W 38	San Pablo Avenue	Richmond Parkway	E	C	33.1	C	29.3
W 39	San Pablo Avenue	Hilltop Drive	E	C	27.3	E	71.9
W 40	San Pablo Avenue	Robert H Miller Drive	E	B	14.2	B	15.5
W 41	San Pablo Avenue	Rumrill Avenue-College Lane	E	C	26.6	D	39.1
W 42	San Pablo Avenue	El Portal Drive-Broadway Avenue	E	C	26.1	C	26.0
W 43	San Pablo Avenue	23rd Street-Road 20	E	D	49.4	D	42.2
W 44	San Pablo Avenue	Church Lane	E	B	19.7	C	29.1
W 45	San Pablo Avenue	San Pablo Dam Road	E	C	31.2	D	46.9
W 46	San Pablo Avenue	McBryde Road	E	C	20.7	C	28.8
W 47	San Pablo Avenue	WB I-80 off ramp	E	B	16.8	D	39.2
W 48	San Pablo Avenue	EB I-80 on-off ramps	E	C	33.5	D	35.3
W 49	San Pablo Avenue	Barrett Avenue	E	C	25.9	C	30.9
W 50	San Pablo Avenue	Cutting Boulevard	E	C	29.5	C	30.1
W 51	San Pablo Avenue	Portrero Avenue	E	C	34.5	B	18.9
W 52	San Pablo Avenue	Schmidt Lane	E	B	14.9	B	18.0
W 53	San Pablo Avenue	Central Avenue	E	C	30.5	C	33.6
W 54	San Pablo Avenue	Carlson Boulevard	E	C	34.1	C	34.6
W 55	San Pablo Dam Road	WB I-80 on-off ramps	E	C	26.2	C	24.1
W 56	San Pablo Dam Road	EB I-80 on-off ramps-Amador St	E	C	22.4	E	64.4
W 57	San Pablo Dam Road	El Portal Drive	E	D	35.3	D	36.7
W 58	San Pablo Dam Road	Appian Way-La Colina Road	E	C	33.8	D	44.3
W 59	San Pablo Dam Road	Castro Ranch Road	E	C	21.4	C	33.4
W 60	El Portal Avenue	Road 20	D	B	14.1	B	12.1
W 61	El Portal Avenue	WB I-80 on ramp	D	B	12.1	B	11.9
W 62	El Portal Avenue	WB I-80 off ramp	D	C	27.6	C	34.9
W 63	El Portal Avenue	EB I-80 on-off ramps	D	C	32.3	C	33.6

Table 10: Intersection Level of Service – Central County Sub Area

No.	Primary Street	Secondary (Cross) Street	v/c Standard	AM	PM
				v/c or Delay	v/c or Delay
C 1	Pacheco Boulevard	Shell Avenue	1.5	0.65	0.43
C 2	Pacheco Boulevard	Howe Road	1.5	0.47	0.53
C 3	Pacheco Boulevard	Morello Avenue	1.5	0.75	0.8
C 4	Pacheco Boulevard	Arthur Road	1.5	0.59	0.65
C 5	Pacheco Boulevard	Blum Road	1.5	0.65	0.85
C 6	Pacheco Boulevard	Joh Muir Road	1.5	0.34	0.5
C 7	Pacheco Boulevard	Center Avenue	1.5	0.56	0.82
C 8	Taylor Boulevard	Ruth Drive	1.5	0.62	0.47
C 9	Taylor Boulevard	Norse Drive	1.5	0.91	0.54
C 10	Taylor Boulevard	Morello Avenue	1.5	0.67	0.55
C 11	Taylor Boulevard	Apollo Way	1.5	0.41	0.68
C 12	Taylor Boulevard	Pleasant Hill Road	1.5	0.85	0.69
C 13	Taylor Boulevard	Grayson Road	1.5	0.85	0.71
C 14	Pleasant Hill Road	Paso Nogal Road	1.5	0.77	0.63
C 15	Pleasant Hill Road	Devon Avenue	1.5	0.73	0.62
C 16	Pleasant Hill Road	Westover Drive	1.5	0.48	0.33
C 17	Pleasant Hill Road	Grayson Road	1.5	1.05	0.91
C 18	Treat Boulevard	North Main Street	1.5	0.92	1.07
C 19	Treat Boulevard	Buskirk Avenue	1.5	0.99	0.91
C 20	Treat Boulevard	Oak Road	1.5	1.03	0.8
C 21	Treat Boulevard	Jones Road	1.5	0.78	0.99
C 22	Treat Boulevard	Cherry Lane	1.5	1.02	0.75
C 23	Treat Boulevard	Bancroft Road	1.5	1.13	1.17
C 24	Treat Boulevard	Carriage Drive	1.5	1.1	0.64
C 25	Treat Boulevard	Winton Drive	1.5	0.91	0.77
C 26	Treat Boulevard	Oak Grove Plaza	1.5	0.6	0.64
C 27	Treat Boulevard	Oak Grove Road	1.5	0.93	0.98
C 28	Treat Boulevard	San Simeon Drive	1.5	0.83	0.56
C 29	Treat Boulevard	Navarone Way	1.5	0.96	0.72
C 30	Treat Boulevard	Cowell Road	1.5	1.08	0.97
C 31	Treat Boulevard	Turtle Creek Road	1.5	0.59	0.54
C 32	Treat Boulevard	Bel Air Drive	1.5	0.7	0.67
C 33	Treat Boulevard	Clayton Road	1.5	0.87	0.9
C 34	Ygnacio Valley Road	Oakland Boulevard	1.5	0.89	1
C 35	Ygnacio Valley Road	N. California Boulevard	1.5	0.83	0.87

No.	Primary Street	Secondary (Cross) Street	v/c Standard	AM	PM
				v/c or Delay	v/c or Delay
C 36	Ygnacio Valley Road	N.Main Street	1.5	0.72	0.95
C 37	Ygnacio Valley Road	N.Broadway	1.5	0.79	1.01
C 38	Ygnacio Valley Road	Civic Drive	1.5	0.96	1.22
C 39	Ygnacio Valley Road	Walnut Boulevard	1.5	1.04	0.98
C 40	Ygnacio Valley Road	Homestead Avenue	1.5	0.93	1.09
C 41	Ygnacio Valley Road	Tampico Drive	1.5	0.82	0.92
C 42	Ygnacio Valley Road	La Casa Via	1.5	0.79	0.99
C 43	Ygnacio Valley Road	San Carlos Drive	1.5	0.99	0.9
C 44	Ygnacio Valley Road	Bancroft Road	1.5	1.08	1.18
C 45	Ygnacio Valley Road	Wiget Lane	1.5	0.84	1.04
C 46	Ygnacio Valley Road	Via Monte	1.5	0.61	0.72
C 47	Ygnacio Valley Road	Oak Grove Road	1.5	0.98	1.00
C 48	Ygnacio Valley Road	Montecito Drive	1.5	1.02	1.05
C 49	Ygnacio Valley Road	Crystyl Ranch Road	1.5	0.92	0.85
C 50	Ygnacio Valley Road	Ayers Road	1.5	1.01	0.9
C 51	Ygnacio Valley Road	Alberta Way	1.5	0.98	0.88
C 52	Ygnacio Valley Road	Michigan Boulevard	1.5	0.57	0.72
C 53	Ygnacio Valley Road	Park Highlands Boulevard	1.5	0.66	0.53
C 54	Ygnacio Valley Road	Clayton Road	1.5	0.91	0.78
C 55	Bailey Road	Concord Boulevard	LOS D	0.92 (48.7, D)	0.81 (36.8, D)
C 56	Bailey Road	Clayton Road	LOS D	0.67 (33.7, C)	0.58 (30.4, C)

Table 11: Intersection Level of Service – East County Sub Area

No.	Primary Street	Secondary (Cross) Street	LOS Standard	AM Peak		PM Peak	
				LOS	Delay Sec/veh	LOS	Delay Sec/veh
E 1	18th Street-Main Street (SR-4)	SB SR-160 on-off ramps	D	B	15.3	B	17.0
E 2	Main Street (SR-4)	NB SR-160 on-off ramps	D	B	14.2	B	16.9
E 3	Main Street (SR-4)	Nelroy Rd-Bridgehead Rd	D	C	23.4	C	29.5
E 4	Main Street (SR-4)	Big Break Road	D	C	24.5	D	37.3
E 5	Main Street (SR-4)	Empire Rd-Charles Way	D	C	24.1	B	23.2
E 6	Main Street (SR-4)	Cypress Road	D	C	36.0	C	22.6
E 7	Brentwood Blvd (SR-4)	Lone Tree Way	D	C	25.3	C	31.6
E 8	Brentwood Blvd (SR-4)	Sand Creek Rd	D	C	29.7	C	28.6
E 9	Brentwood Blvd (SR-4)	Central Blvd-Sycamore Road	D	B	17.6	B	19.9

No.	Primary Street	Secondary (Cross) Street	LOS Standard	AM Peak		PM Peak	
				LOS	Delay Sec/veh	LOS	Delay Sec/veh
E 10	Brentwood Blvd (SR-4)	Oak Street	D	C	27.7	C	26.3
E 11	Brentwood Blvd (SR-4)	Balfour Road	D	D	54.7	D	54.3
E 12	Walnut Boulevard	Oak Street	D	B	18.8	B	14.8
E 13	Walnut Boulevard	Balfour Road	D	D	41.0	C	35.3
E 14	Walnut Boulevard	Marsh Creek Road	D	C	29.3	D	47.6
E 15	Bailey Road	Willow Pass Road	D	C	24.0	C	21.8
E 16	Bailey Road	WB SR-4 on-off ramps	D	C	21.6	B	13.6
E 17	Bailey Road	EB SR-4 on-off ramps	D	C	21.6	C	27.6
E 18	Bailey Road	Leland Road	D	D	39.1	C	39.0
E 19	Railroad Avenue	WB SR-4 on ramp	D	D	38.1	C	21.2
E 20	Railroad Avenue	EB SR-4 on-off ramps	D	D	36.2	D	34.9
E 21	Railroad Avenue	Leland Road	D	E	59.0	F	81.9
E 22	Railroad Avenue	Buchanan Road	D	C	34.2	C	22.8
E 23	Somersville Road	WB SR-4 on-off ramps	D	C	21.4	C	25.6
E 24	Somersville Road	EB SR-4 on-off ramps	D	B	10.9	B	10.3
E 25	Somersville Road	Delta Fair Boulevard	D	C	31.1	D	36.5
E 26	Somersville Road	Buchanan Road	D	D	47.1	D	39.9
E 27	Lone Tree Way-A Street	WB SR-4 on-off ramps	D	C	20.4	C	34.3
E 28	Lone Tree Way	EB SR-4 on-off ramps	D	C	29.5	C	29.7
E 29	Lone Tree Way	W. Tregallas Road	D	B	16.0	C	20.2
E 30	Lone Tree Way	James Donlon Boulevard	D	D	47.7	D	36.9
E 31	Lone Tree Way	Deer Valley Road	D	D	41.1	D	43.6
E 32	Lone Tree Way	Hillcrest Avenue	D	C	33.9	C	34.7
E 33	Lone Tree Way	Empire Avenue	D	D	38.3	D	36.9
E 34	Lone Tree Way	Fairview Avenue	D	D	48.6	D	46.9
E 35	Lone Tree Way	O'Hara Avenue	E	D	38.1	D	37.9
E 36	Hillcrest Avenue	WB SR-4 on-off ramps	D	C	26.4	C	27.6
E 37	Hillcrest Avenue	EB SR-4 on-off ramps	D	C	23.2	C	27.5
E 38	Hillcrest Avenue	Deer Valley Road	D	C	29.9	C	30.8
E 39	Leland Road	Loveridge Road	D	D	48.2	C	38.2
E 40	Buchanan Road	Loveridge Road	D	C	34.5	C	20.4

4.2 Freeway and Roadway Segment Analysis

4.2.1 Delay Index And Average Speed

The monitoring of delay index and average speed involved similar monitoring activities, measurements, and calculations. The results are summarized in Table 12 and Table 13. Table 12 shows the results of AM peak period hour monitoring while Table 13 shows the results of PM peak hour monitoring. Both tables present monitored delay index and average speed for entire routes. Altogether, 19 routes are monitored in this report. Overall, all routes measured meet the average speed and delay index MTSOs.

Table 12: Roadway Segment Analysis – AM Peak Hour

Primary Street	Average Speed			Delay Index		
	MTSO	NB or EB	SB or WB	MTSO	NB or EB	SB or WB
Lamorinda Sub-Area						
SR-24	30	67.7	36.9	2.0	1.0	1.7
San Pablo Dam Road	20	32.4	34.2	2	1.2	1.2
Pleasant Hill Road	17.5	32.3	32.5	2	1.2	1.2
Tri Valley (TVTC) Sub-Area						
I-680	30	58	51.2	2	1.1	1.2
I-580	30	62.6	36.2	2	1.0	1.7
SR-84	20	34.3	29.3	3	1.5	1.7
West County (WCCTAC) Sub Area						
I-580	20	55	58	3	1.2	1.1
I-80	20	67	35	3	1	1.9
SR-4	20	61	60	3	1.1	1.1
Central County (TRANSPAC) Sub Area						
I-680	16	46	40	4	1.4	1.6
SR-4	13	62	52	5	1.0	1.2
SR-242	22	50	48	3	1.3	1.4
Alhambra Avenue	15	28	27	-	-	-
Clayton Road	15	33	28	-	-	-
Contra Costa Boulevard	15	23	20	-	-	-
Pacheco Boulevard	15	32	25	-	-	-
Pleasant Hill Road	15	30	30	-	-	-
Taylor Boulevard	15	33	28	-	-	-
East County (TRANSPAN) Sub-Area						
SR-4	26	61	49	2.5	1.1	1.4

Table 13: Roadway Segment Analysis – PM Peak Hour

Primary Street	Average Speed			Delay Index		
	MTSO	NB or EB	SB or WB	MTSO	NB or EB	SB or WB
Lamorinda Sub-Area						
SR-24	30	46	44	2.0	1.4	1.5
San Pablo Dam Road	20	33.2	33.8	2	1.2	1.2
Pleasant Hill Road	17.5	28.2	29.4	2	1.4	1.3
Tri Valley (TVTC) Sub-Area						
I-680	30	37.5	42	2	1.59	1.42
I-580	30	46.8	59.2	2	1.28	1.01
SR-84	20	34.2	35.5	3	1.49	1.44
West County (WCCTAC) Sub Area						
I-580	20	51	58	3	1.3	1.1
I-80	20	23	64	3	2.9	1.0
SR-4	20	60	60	3	1.1	1.1
Central County (TRANSPAC) Sub Area						
I-680	16	44	56	4	1.5	1.2
SR-4	13	46	65	5	1.4	1.0
SR-242	22	53	49	3	1.3	1.3
Alhambra Avenue	15	28.9	29.5	-	-	-
Clayton Road	15	27.2	27.6	-	-	-
Contra Costa Boulevard	15	20	18	-	-	-
Pacheco Boulevard	15	21	25	-	-	-
Pleasant Hill Road	15	26	27.3	-	-	-
Taylor Boulevard	15	25.6	27.4	-	-	-
East County (TRANSPLAN) Sub-Area						
SR-4	26	46	51	2.5	1.4	1.3

Unsignalized roadway segments in the East County sub area were analyzed using the HCM 2000 methodologies. All of the study roadways have a 2-lane cross-section and the results of the analysis indicate that all study roadways function without exceeding the MTSO standards at LOS D or better as shown in Table 14.

Table 14: Roadway Segment Analysis – Unsignalized Roadways

Roadway Segment	MTSO	Peak Direction Volume (vph)	v/c Ratio
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	(v/c)	EB/NB	WB/SB	EB/NB	WB/SB
Tri Valley (TVTC) Sub Area					
Alcosta Boulevard	0.91	1060	1100	0.59	0.61
Bernal Avenue	0.91	1023	1600	0.57	0.91
Bollinger Canyon Road	0.91	1871	1288	0.35	0.24
Camino Tassajara	0.91	1294	869	0.72	0.48
Crow Canyon Road	0.91	1530	1600	0.43	0.44
Danville Boulevard	0.91	962	1191	0.53	0.66
Dougherty Road	0.91	1920	1865	0.53	0.52
Dublin Boulevard	0.91	1430	1550	0.4	0.43
Fallon Road	0.91	550	970	0.31	0.54
First Street (Livermore)	0.91	1650	1480	0.46	0.41
Hacienda Drive	0.91	1880	1290	0.52	0.36
Hopyard Road	0.91	2022	3296	0.45	0.73
Isabel Extension	0.91	1803	1791	0.5	0.5
Jack London Boulevard	0.91	120	560	0.07	0.31
North Canyons Parkway	0.91	408	634	0.23	0.35
North Livermore Avenue	0.91	120	600	0.07	0.33
San Ramon Road	0.91	866	738	0.48	0.41
San Ramon Valley Boulevard	0.91	1151	632	0.64	0.35
Santa Rita Road	0.91	1838	1435	0.51	0.4
Stanley Boulevard	0.91	1803	1791	0.5	0.5
Stoneridge Drive	0.91	1700	1664	0.47	0.46
Sunol Boulevard	0.91	1081	1270	0.6	0.71
Sycamore Valley Road	0.91	1461	1645	0.41	0.46
Tassajara Road	0.91	1583	1519	0.59	0.56
West Las Positas Boulevard	0.91	527	635	0.29	0.35
Roadway Segment	MTSO	AM		PM	
	(LOS)	Speed (mph)	LOS	Speed (mph)	LOS
East County (TRANSPLAN) Sub Area					
Byron Highway	D	42.8	D	43.1	D
Marsh Creek Road	D	45.5	C	45.7	C
Camino Diablo	D	49.1	C	48.6	C
Deer Valley Road	D	42.7	D	44.1	D
Walnut Boulevard	D	40.7	D	40.5	D
Cypress Road	D	41.2	D	41.9	D
Deer Valley Road (unimproved section)	D	41	D	41	D
Sellers Avenue	D	47.9	C	47.1	C
State Route 160	D	41.3	D	40.3	D
SR-4/ Balfour Road	D	46.4	D	47	C
Vasco Road	D	47.8	C	47.8	C

Analysis of off-peak traffic was performed for SR-24 in the Lamorinda sub area. The MTSO for the off-peak hour analysis stipulates that the average speed not be less than 45 mph for any analysis hour and that the delay index be lower than 1.5. Results of the analysis indicate that the corridor meets the criteria for all analysis hours during the off-peak period as shown in Table 15.

Table 15: Roadway Segment Analysis – Off-Peak Hour

Start Time	Average Speed			Delay Index		
	MTSO	EB	WB	MTSO	EB	WB
SR-24 - Lamorinda Sub-Area						
12:00:00 AM	45	69.8	64.2	1.5	0.93	1.01
1:00:00 AM	45	69.1	62.8	1.5	0.94	1.03
2:00:00 AM	45	68.6	62.3	1.5	0.95	1.04
3:00:00 AM	45	68.2	62.3	1.5	0.95	1.04
4:00:00 AM	45	67.5	64.2	1.5	0.96	1.01
5:00:00 AM	45	68.6	63.3	1.5	0.95	1.03
6:00:00 AM	45	68.2	58.1	1.5	0.95	1.12
9:00:00 AM	45	67.2	51.6	1.5	0.97	1.26
10:00:00 AM	45	67.0	62.0	1.5	0.97	1.05
11:00:00 AM	45	67.2	62.5	1.5	0.97	1.04
12:00:00 PM	45	67.2	62.6	1.5	0.97	1.04
1:00:00 PM	45	66.8	62.0	1.5	0.97	1.05
2:00:00 PM	45	65.5	62.0	1.5	0.99	1.05
7:00:00 PM	45	65.0	62.6	1.5	1.00	1.04
8:00:00 PM	45	68.4	63.8	1.5	0.95	1.02
9:00:00 PM	45	70.1	64.6	1.5	0.93	1.01
10:00:00 PM	45	70.7	65.0	1.5	0.92	1.00
11:00:00 PM	45	70.5	64.2	1.5	0.92	1.01

Analysis of daily traffic congestion trends along I-680 in the Tri-Valley sub area indicates that the corridor experiences congested conditions for four hours in the NB and three hours in southbound directions during a typical day. Roadway segments operating at an average speed of less than 35 mph are defined as being congested. The MTSO for this study area stipulates that the corridor not experience more than five hours of congestion during a typical weekday. The study corridor functions without exceeding this MTSO standard as shown in Table 16.

Table 16: Roadway Segment Analysis – All-Day Traffic

Direction	MTSO	Observed		
		Congested	Non-Congested	
	(Congested hrs.)	<35 mph	<45 mph	<60 mph
Tri-Valley Sub Area – I-680				
NB	5	4	5	20
SB	5	3	4	18

4.3 Vehicle Occupancy

The Action Plans established MTSOs using three measures related to vehicle occupancy: vehicle occupancy ratio, measured as persons per vehicle during the peak hour; the percent of single-occupant vehicles; and HOV lane usage.

As shown in Table 17, peak hour VOR was monitored at 3 locations in the Tri-Valley sub area. The monitoring of VOR was conducted in the peak direction during both AM and PM peak hours. Of the 3 locations, one location did not meet the VOR value set in the MTSO. The 1.2 persons per vehicle MTSO is being achieved at two of the three locations

Table 17: Vehicle Occupancy

Vehicle Occupancy Rates (VOR)-Tri-Valley Sub Area			
Roadway	MTSO (VOR)	Observed (VOR)	
		AM	PM
I-680	1.2	1.3	1.31
I-580	1.2	1.3	1.3
Vasco Road	1.2	1.11	1.12
HOV Ridership – West County Sub Area			
Roadway	MTSO (increase in ridership)	Observed	
		2012/2007 ridership	% change
I-80	10%	19%/13%	43%
HOV Utilization – East County Sub Area			
Roadway	MTSO (vph)	Observed (vph)	
		AM	PM
SR-4 Eastbound	600	-	1029
SR-4 Westbound	600	826	-

4.4 Transit Ridership

Table 18 through Table 20 show the results of monitoring three transit-related MTSOs in the Lamorinda, Tri-Valley and West County areas.

The Lamorinda MTSO specifies a maximum “passenger-to-seat” ratio of 1.5 (50% more passengers than seats) for all BART trains at the Lafayette and Orinda stations along SR-24 throughout the day. Analysis of ridership data obtained from BART indicates that the BART trains operate well below this threshold as shown in Table 18.

The Tri-Valley Action Plan has stated increasing transit mode split as a goal. However, no specific target value has ever been set. Mode split is the percentage of peak period travelers that use transit as the mode of travel. Mode split is generally measured through extensive home

interview and work place surveys. These data are available every decade from the U.S. Census and periodically from MTC. Since household survey data was not available, transit ridership was monitored as a surrogate for mode split. Ridership data obtained from BART indicates a noticeable rise in transit ridership as shown in Table 19.

The West County Action Plan contains a MTSO that specifies an increase in daily bus ridership on San Pablo Dam Road by to 3,000 average weekday daily riders. As shown in Table 20, bus ridership along San Pablo Dam Road was approximately 2,250 passengers per day which falls short of the MTSO for this corridor.

Table 18: BART Ridership along SR-24

Start Time	MTSO	Observed	
	Ridership - PAX/Seats	Eastbound - Orinda	Westbound - Lafayette
4:00	1.5	0.06	0.66
5:00	1.5	0.33	0.94
6:00	1.5	0.24	1.12
7:00	1.5	0.28	1.26
8:00	1.5	0.19	1.21
9:00	1.5	0.15	0.69
10:00	1.5	0.16	0.61
11:00	1.5	0.25	0.53
12:00	1.5	0.56	0.34
13:00	1.5	0.75	0.25
14:00	1.5	0.88	0.32
15:00	1.5	1.47	0.44
16:00	1.5	1.18	0.33
17:00	1.5	1.11	0.24
18:00	1.5	0.95	0.15
19:00	1.5	0.64	0.12
20:00	1.5	0.56	0.22
21:00	1.5	0.49	0.11
22:00	1.5	0.44	0.04

Table 19: Transit Ridership As a Surrogate Measure of Travel Mode

Analysis Area	MTSO (Qualitative)	Daily Ridership			%Change	
		2008	2011	2012	'08 to '12	'11 to '12
Tri-Valley (Dublin and Pleasanton BART)	Increase transit ridership	7,858	8,133	9,239	+17.5%	+12%

Table 20: Transit Ridership along San Pablo Dam Road

Transit Line	MTSO – Daily Ridership	Observed Ridership
70	-	1,076
74	-	1,179
Total	3,000	2,255

4.5 Maximum Side Street Wait Time

The Action Plan for Lamorinda and West County sub areas includes a MTSO specifying that the maximum wait time for vehicles cannot exceed a specified number of cycles. Table 21 shows the results of a survey of 32 key signalized intersections in the Lamorinda sub area and six intersections in the West County sub area. Most study intersections presently meet the MTSO except for three intersections along Pleasant Hill Road. Side street approaches for the Mount Diablo Boulevard, Quandt Road and Green Valley Road intersections with Pleasant Hill Road require two signal cycles during the peak hour to clear the intersection.

Table 21: Maximum Wait Times for Side-Streets

No.	Primary Street	Secondary (Cross) Street	MTSO (Max. Wait time in cycles)	Observed	
				AM	PM
Lamorinda Sub Area					
1	Pleasant Hill Road	Condit Road	1	1	1
2	Pleasant Hill Road	Old Tunnel Road	1	1	1
3	Pleasant Hill Road	Mount Diablo Blvd	1	1	2
4	Pleasant Hill Road	Stanley Boulevard	1	1	1
5	Pleasant Hill Road	Quandt Road	1	2	2
6	Pleasant Hill Road	Reliez Valley Road	1	1	1
7	Pleasant Hill Road	Green Valley Road	1	1	2
8	Pleasant Hill Road	Rancho View	1	1	1
9	Pleasant Hill Road	Geary Road	1	1	1
10	Taylor Boulevard	Green Hill Drive	1	1	1
11	Taylor Boulevard	Withers Avenue	1	1	1
12	Taylor Boulevard	Grayson Road	1	1	1
13	Taylor Boulevard	Apollo Way	1	1	1
14	Taylor Boulevard	Morello Avenue	1	1	1
15	Taylor Boulevard	Lucille Lane	1	1	1
16	Taylor Boulevard	Ruth Drive	1	1	1
17	San Pablo Road	Brookwood Road	1	1	1
18	San Pablo Road	Santa Maria Way	1	1	1
19	San Pablo Road	Orinda Way	1	1	1
20	San Pablo Road	Miner Road	1	1	1
21	San Pablo Road	Camino Pablo	1	1	1
22	San Pablo Road	Claremont Avenue	1	1	1
23	San Pablo Road	Los Amigos Drive	1	1	1
24	San Pablo Road	Monte Verde Road	1	1	1
25	San Pablo Road	Wildcat Canyon Road	1	1	1
26	San Pablo Road	Castro Ranch Road	1	1	1
27	San Pablo Road	Valley View Road	1	1	1
28	San Pablo Road	May Road	1	1	1
29	San Pablo Road	Clark Road	1	1	1
30	San Pablo Road	Milton Drive	1	1	1
31	San Pablo Road	Appian Way	1	1	1
32	San Pablo Road	Hillcrest Road	1	1	1

No.	Primary Street	Secondary (Cross) Street	MTSO (Max. Wait time in cycles)	Observed	
				AM	PM
West County Sub Area					
1	Treat Boulevard	Clayton Road	3	2	2
2	Treat Boulevard	Cowell Road	5	2	3
3	Treat Boulevard	Oak Grove Road	5	2	3
4	Ygnacio Valley Road	Clayton Road	3	2	2
5	Ygnacio Valley Road	Alberta Way	4	3	3
6	Ygnacio Valley Road	Cowell Road	4	2	2

5.0 APPENDICES

Appendix A: Intersection Volume Count Data

Appendix B: Analysis output and Worksheets

Appendix C: Travel time and segment counts