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Town of Moraga

Available Roadway Capacity Study

Prepared for the
Town of Moraga
Prepared by
Robert L. Harrison Transportation Planning
January 1999

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January 11, 1999

Mr. Ross G. Hubbard, Town Manager
Town of Moraga
P. O. Box 188
Moraga, CA 94556

Dear Mr. Hubbard:

I am pleased to submit the January 1999 update of the *Town of Moraga -- Available Roadway Capacity Study*. The updated Study presents an analysis of both the existing and the future condition "mitigated" capacity available on the major arterial roadways that serve Moraga. The total existing available capacity on the three roadway corridors that serve Moraga is 150 morning peak hour vehicle trips and 310 afternoon peak hour vehicle trips. The future year three corridor total mitigated available capacity is projected to be 250 morning peak hour vehicle trips and 340 afternoon peak hour vehicle trips.

The changes from the previous version of the *Available Roadway Capacity Study* are based primarily on two modifications in the technical data or methods used to calculate available capacity. These are:

1 -- Use of October 1998 traffic counts wherever they are available. Several of these traffic counts resulted in lower existing traffic volumes and thus increased existing available capacity; and,

2 -- Use of the technical procedures developed for the Lafayette General Plan EIR Traffic Analysis. These procedures incorporate the sub-regional traffic forecasts from the CMP / Central County Computer Model maintained by the Contra Costa Transportation Authority.

The Study continues to include two recommendations with regard to the adoption of supplemental criteria on Level of Service (LOS) standards. It is recommended that the Town of Moraga, along with the Cities of Lafayette and Orinda, consider adoption of the following procedures as a supplement to the Measure C required LOS methods for the calculation of intersection LOS:

1. At signalized intersections: Supplement the CCTA required LOS calculation method with the method presented in the most recent Highway Capacity Manual (HCM). It has been found that the HCM method often times provides better estimates of the actual conditions found at Lamorinda intersections, particularly in the congested areas of central Lafayette and Orinda. The City of Lafayette has already adopted this procedure.

2. At stop sign controlled intersections: Establish LOS standards for stop sign controlled intersections. The analysis of the major travel Corridors found that available capacity is frequently limited by stop sign controlled intersections. In order to calculate available capacity, a standard that can be used to determine the potential total capacity of these intersections is needed. LOS standards for stop sign controlled intersections are proposed in the Available Capacity Study.

It is also recommended that standard trip generation procedures be adopted by all three Lamorinda cities. A set of trip generation procedures is described in the Study for consideration by all three cities.

I look forward to discussing the results of the updated Study with you and with the appropriate elected officials. Please call if you have any questions or comments.

Sincerely,

Robert L. Harrison

FORWARD

Following is a chronology of events leading to the production of the attached Town of Moraga Available Roadway Capacity Study prepared by Robert L. Harrison Transportation Planning. This information is provided as background to clarify the intent and purpose of the study.

In October 1997, discussions about traffic at the Lamorinda Project Management Committee (LPMC) raised the issue of the actual traffic capacity of various intersections and roadways in the Lamorinda area. The Moraga Town Council directed their staff to prepare a request for proposals (RFP) to conduct a study of the actual capacity of the area, while taking into account any roadway or traffic changes currently approved and funded by any of the Lamorinda communities. This was to be the first phase of a comprehensive traffic plan to identify the capacity of the major streets between Moraga and State Route 24 and to ultimately develop a method to allocate the available capacity units to the Lamorinda community.

In November 1997, the RFP was sent to approximately twenty traffic engineering firms with traffic study experience in Contra Costa County. Four proposals were received, and two firms were interviewed. The Moraga Town Council appropriated $15,000 towards this study and authorized the Town Manager to sign an agreement with Robert L. Harrison.

On January 29, 1998 Mr. Harrison made a presentation to the three Lamorinda Councils at the Lamorinda Leadership Forum held at Saint Mary's College. Mr. Harrison discussed the methodology and goals of his study and presented some preliminary findings.

In March 1998 the original Available Roadway Capacity Study report was distributed to each of the Lamorinda councils and the Lamorinda Project Management Committee for review and comments.

In May of 1998, the Moraga Council authorized an amendment to Mr. Harrison's scope of work to include analysis of the recently approved projects in Lafayette along the Mt. Diablo Boulevard and Moraga Road corridors on the capacity of the roadway system. The report was updated in May 1998 to reflect the projects approved in Lafayette, as well as the revised level of service standards adopted by the Lafayette City Council for the Moraga Road/Brook Street/School Street intersection.

Throughout this process, the Lamorinda Project Management Committee was kept up to date on the progress of the study, and each revised version of the study was distributed to each of the three councils. A letter from Mayor Grodin was received on June 9, 1998 commenting on the May 1998 version of the Available Roadway Capacity Study.

In September and October 1998, the Moraga Council continued to discuss traffic issues, including the Lamorinda Sub-regional mitigation fee program, and a Lamorinda Congestion Management Program Proposal developed by Moraga Councilmember Ron Enzweiler. During these discussions various questions and concerns were raised regarding Mr. Harrison's assumptions and methodologies. A meeting was held on November 20, 1998 to address these matters. Representatives from the cities of Lafayette, Orinda, and the development community were invited to attend this meeting to meet with Mr. Harrison to discuss any discrepancies with his study.

Since this meeting, Mr. Harrison has revised the report to reflect new information obtained since the May 1998 version. New information includes use of newer traffic counts wherever available, using technical procedures developed for the Lafayette General Plan, which includes updated information from the Central County Computer Model, and analysis of the future condition "mitigated" capacity available on the major arterial roadways that serve Moraga. This updated, and hopefully final, version of the Available Roadway Capacity Study is dated January 1999.

I hope this summary provides insight into the goal and purpose of this study. Any comments on this study should be directed to the Moraga Town Offices, P.O. Box 188, Moraga CA 94556.

Sincerely,

Ross G. Hubbard
Town Manager
Town of Moraga

January 25, 1999

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1. Introduction

This is an updated report on the capacity of the street system that serves the portion of the Lamorinda area south of State Route (SR) 24. The primary objective of this work is to reach agreement among the three Lamorinda cities, Lafayette, Orinda and Moraga, on the existing capacity of the arterial street system. If agreement can be reached on existing conditions, the next phase of the study may develop a basis for the allocation of trips generated by new development among the three Lamorinda cities. In this first phase of the work, the existing conditions and available capacity at the critical intersections are documented.

Also documented in this study is the condition known as "mitigated available capacity". The mitigated available capacity assumes a future condition when all of the currently approved new development projects in the Lamorinda area are fully built out and when all approved roadway improvements are constructed. The goal of this first phase of the study is to establish the existing and mitigated available capacities on the major streets that serve the southerly portion of the Lamorinda area.

The approach used in this study to determine the available capacity is to first calculate the existing Level of Service (LOS) at all important intersections. The capacity of an intersection is then estimated by calculating the maximum number of trips that could pass through the intersection without exceeding the established LOS standard. The available capacity is the difference between the potential maximum number of trips and the existing number of trips at each intersection.

It is the intent of this work to reach agreement among the three Lamorinda cities on the following technical data or procedures:

1 -- The existing traffic counts at all important intersections;

2 -- The method(s) to calculate the Level of Service (LOS) at critical intersections and the resultant LOS based on the preferred method;

3 -- The LOS standards to be adopted at all important intersections;

4 -- The trip generation procedures to be used to estimate the number of new trips that would be added by each new development proposal;

5 -- The existing and mitigated available capacity at all important intersections based on adopted LOS standards and on the existing LOS.

If agreement can be reached on each of the measures listed, a second phase of work may be undertaken to develop a system of allocating new development based on the available capacity of the arterial street system in the Lamorinda area.

The three major arterial route corridors that connect the southerly portion of the Lamorinda area with the SR 24 freeway and with the BART stations in Lafayette and Orinda are shown in Figure 1. If the second phase of this study is undertaken, it is the capacity of these corridors that would be used to estimate the maximum amount of new development that could be permitted in the Lamorinda area south of SR 24.

This report is organized as follows. A description of LOS and the methods available to calculate service levels is discussed in the next chapter of this report. A survey of the existing polices on LOS in each Lamorinda city is reported in the third chapter of the report. The fourth report section describes the existing LOS at each intersection studied.

An estimate of existing available capacity at critical intersections in each of the three major transportation corridors studied is described in chapter five. The sixth section of the report recommends a procedure to calculate trip generation for new development projects. The report concludes with an estimate of the mitigated available capacity for each transportation corridor.

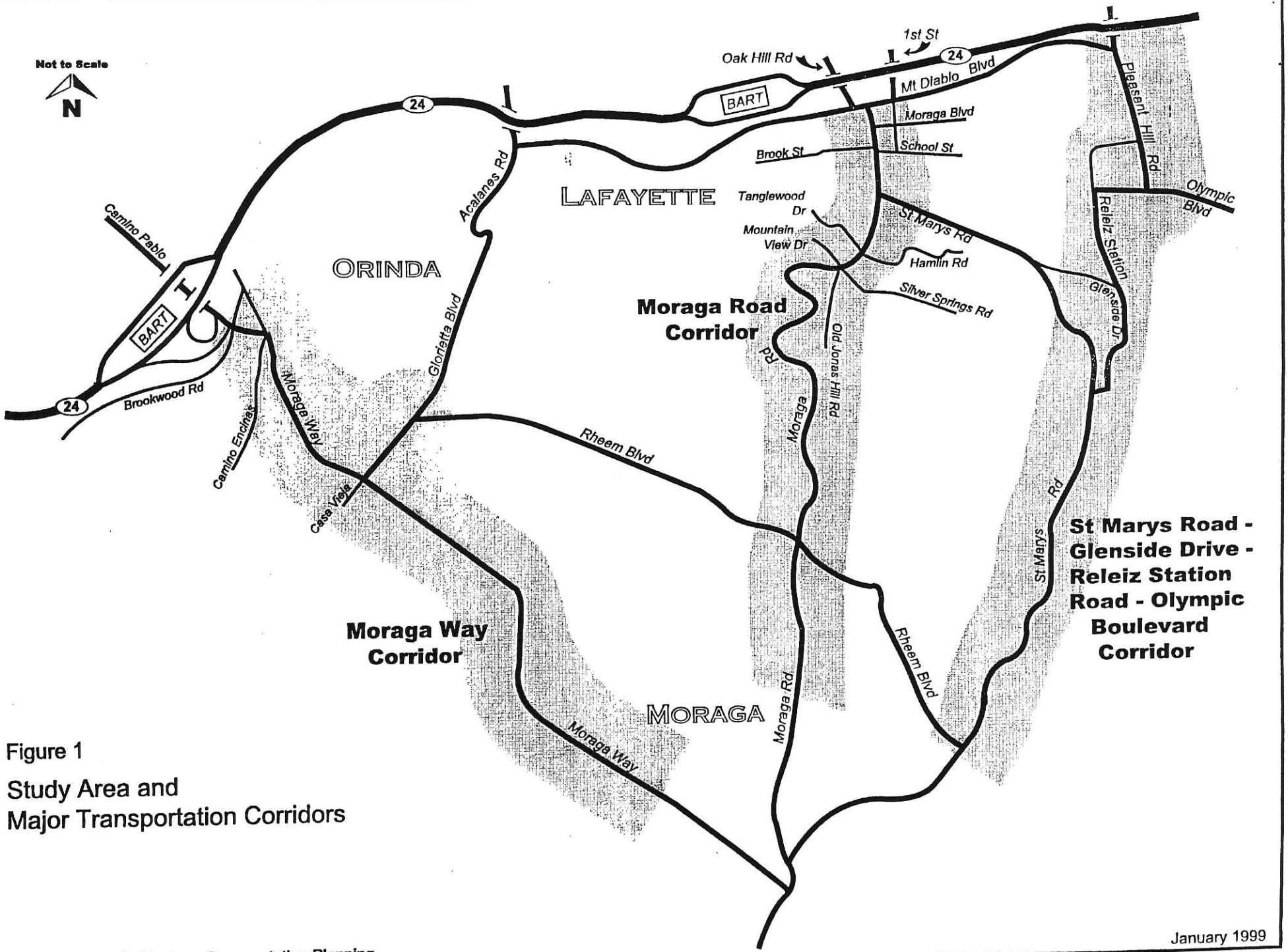

Figure 1

Study Area and
Major Transportation Corridors

January 1999

Source: Robert L. Harrison Transportation Planning

2. Description of Level of Service

The best method to estimate available capacity and to measure how well an urban street system is working is to determine the amount of congestion or delay experienced by motorists at important intersections. The quality of traffic movement is reported in terms of Level of Service (LOS) ranging from a letter grade of A to a grade of F. The three cities of the Lamorinda area have adopted LOS standards (see the next section of this report) and are, therefore, familiar with the concept of LOS. To ensure that all readers are familiar with LOS, a summary description of LOS is provided below for both signalized and stop sign controlled intersections.

Signalized Intersections

The two most commonly used methods to calculate LOS at signalized intersections are described below.

Highway Capacity Manual Method. LOS at signalized intersections is defined in terms of average stopped delay per vehicle proportioned over the whole intersection. Delay can be thought of a surrogate measure of driver discomfort and frustration, fuel consumption and excessive travel time. LOS criteria for signalized intersections are stated in terms of average stopped delay per vehicle for a 15 minute analysis period. The LOS delay criteria from the *1994 Highway Capacity Manual*[1] (HCM) are shown in Table 1.

Delay may be measured in the field but is usually estimated using procedures presented in the HCM. Delay is a complex measure and is dependent on a number of factors including the quality of progression, the cycle length, the green time ratio, and the volume to capacity ratio for the lane group or intersection approach being studied.[2] A detailed definition of each LOS letter grade from the HCM is provided in the Appendix to this report.

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1 Transportation Research Board, *Highway Capacity Manual - Special Report 209*, Third Edition, 1994.

2 Progression, cycle length and green time ratio are defined in the Appendix.

Table 1
Signalized Intersection Level of Service Description

Level of Service	Vehicle Delay in Seconds	Description	Delay
A	0 - 5.0	Free Flow	Insignificant
B	5.1 - 15.0	Sure Stable Operation	Minimal
C	15.1 - 25.0	Stable Operation	Acceptable
D	25.1 - 40.0	Approaching Unstable Operation	Tolerable
E	40.1 - 60.0	Unstable Operation	Significant
F	>60.0	Forced Flow	Excessive

Source: Transportation Research Board, *Highway Capacity Manual*, Third Edition 1994. Table 9-1.

Volume to Capacity (V/C) Ratio Method. Rather than using the HCM delay method to calculate LOS, the Contra Costa Transportation Authority (CCTA) requires the use of the Critical Movement Volume to Capacity Ratio (V/C ratio) method to determine LOS at signalized intersections. The CCTA allows the use of other LOS calculation methods to supplement to the required method. The required method relies on a comparison of the critical traffic turning movements in an intersection with the capacity of the intersection to serve these movements. The required method is similar to the *Circular 212*[3] Critical Movement Analysis Planning Method except that through movement capacity has been increased by the CCTA from 1,500 vehicles per hour to 1,800 vehicles per hour. The LOS letter grades are based on the V/C ratio that is found for the intersection under study. As shown in Table 2, the Contra Costa Transportation Improvement and Growth Management Program (Measure C) sets LOS letter grade standards for various land use types.

Table 2
Level of Service Standards for Signalized Intersections on Basic Routes

Land Use Type	Measure C GMP* LOS* Standard	CCTA* Volume to Capacity Ratio	Highway Capacity Manual (HCM) Stopped Delay Per Vehicle
Central Business District	Low E	0.90 to 0.94	40.1 to 50 Seconds
Urban Areas	High D	0.85 to 0.90	33.1 to 40 Seconds
Suburban Areas	Low D	0.80 to 0.84	25.1 to 33 Seconds
Semi - Rural	High C	0.75 to 0.79	20.1 to 25 Seconds
Rural	Low C	0.70 to 0.74	15.1 to 20 Seconds

* GMP = Contra Costa Transportation Improvement and Growth Management Plan; LOS = Level of Service; CCTA = Contra Costa Transportation Authority.

Sources: 1 – CCTA Technical Procedures, 1992. Table 7.
2 – Highway Capacity Manual. Transportation Research Board, 3rd Edition 1994. Table 9-1.

[3] Transportation Research Board, *Transportation Research Circular 212*, January 1980.

Both the CCTA required V/C ratio standards and the HCM seconds of delay standards are shown for each LOS letter grade in Table 2. The use of either method to calculate LOS should result in the same service level letter grade. However, when compared to actual conditions, the CCTA method tends to produce service levels that understate the level of congestion and delay found at some Lamorinda area intersections. The delay based HCM method often provides a better estimate of the actual conditions found at signalized intersections in the Lamorinda area.

As shown on Table 2, the CCTA defined service level letter grades are divided into high and low categories. A "High D", for example, means a higher V/C ratio than does a "Low D". This definition has caused some confusion because a "high" letter grade means a worse level of service than does a "low" grade of the same letter. To clarify the meaning of each divided letter grade, it is proposed that the LOS letter grades be defined as Good or Poor. The Good letter grade would be equivalent to the CCTA "low" category and a Poor letter grade would be equivalent to the CCTA "high" category. For example, a "Good D" is equivalent to the CCTA "Low D" and represents a better service level than a "Poor D", the grade that is equivalent to the CCTA "High D".

It is recommended that both the CCTA V/C ratio and the HCM delay method be used to calculate signalized intersection LOS in the Lamorinda area. This is because:

1 - The V/C ratio method is required by the CCTA; and,
2 - The HCM delay method produces more reliable results for most intersections in the Lamorinda area.

Stop Sign Controlled Intersections

The procedure to evaluate stop sign controlled intersections is also presented in the HCM. Two types of stop sign control are described: the all-way stop-controlled (AWSC) intersection and the two-way stop-controlled (TWSC) intersection.

The LOS letter grade criteria for stop sign controlled intersections are given in Table 3. As shown in Table 3, the criteria for stop sign controlled intersections are different from those for signalized intersections. The total delay threshold for any given level of service is less for a stop sign intersection than for a signalized intersection. The primary reason for this difference is that drivers expect different levels of performance from different kinds of transportation facilities. The expectation is that a signalized intersection is designed to carry higher traffic volumes than an unsignalized intersection. Thus, greater delay may be expected at signalized intersections than at stop sign controlled intersections.

Table 3
Stop Sign Controlled Intersection Level of Service Description

Level of Service	Vehicle Delay in Seconds	Description
A	0 - 5.0	Little or no delay
B	5.1 - 10.0	Short traffic delay
C	10.1 - 20.0	Average traffic delay
D	20.1 - 30.0	Long traffic delay
E	30.1 - 45.0	Very long delay
F	>45.0	Excessive delay

Source: Transportation Research Board, *Highway Capacity Manual*, Third Edition 1994. Table 10-3.

Delay at an AWSC intersection is calculated as total delay per vehicle approaching the intersection. Similar to signalized intersections, the delay and LOS is reported for the AWSC intersection as an average condition for the entire intersection.

Generally, the LOS and total delay at a TWSC intersection is reported only for those traffic movements that have to stop or wait for through traffic to clear. There is no delay for traffic that does not stop at TWSC intersections. This means the LOS is defined by the delay encountered by the side street traffic waiting to enter or to cross the traffic stream on the main road.

None of the Lamorinda cities nor the CCTA have adopted LOS standards for stop sign controlled intersections. The CCTA LOS standards shown in Table 2 "are intended for application at signalized intersections only."[4] It would be desirable for the cities of the Lamorinda area to adopt LOS standards for stop sign intersections. LOS standards for stop sign controlled intersections are discussed in the next section of this report.

4 CCTA Technical Procedures, 1992. Page 39.

3. Existing Policies and Standards

Each of the three Lamorinda cities has adopted a set of standards with regard to acceptable Level of Service (LOS) at signalized intersections. The requirements of Measure C included the adoption of a Growth Management Element in each city's General Plan. With the adoption of the Growth Management Element, each of the three Lamorinda cities established LOS standards for signalized intersections based on the CCTA required V/C ratios as shown in Table 2. The following discussion describes how each Lamorinda city has supplemented the CCTA required LOS standards.

City of Lafayette Level of Service Policies

In addition to adopting a Growth Management Element including the LOS standards as shown in Table 2, the Lafayette City Council has also adopted a Goals and Policies statement for the revised Draft General Plan. The Public Hearing Draft of the General Plan includes the following policies:[5]

T - 2.2 **Level of Service Standards:** Establish the following level of service (LOS) standards.

Signalized Intersections	LOS Standard	CCTA Standard V/C Ratio	HCM Standard Stopped Delay at Peak Hours
Downtown Core: Lafayette "Y"	Good E	0.90 to 0.94	40 to 50 Seconds
Other Downtown Intersections	Poor D	0.85 to 0.90	33 to 40 Seconds
Intersections Outside Downtown	Good D	0.80 to 0.84	25 to 33 Seconds

Unsignalized Intersections	LOS Standard	HCM Standard Total Stopped Delay at Peak Hours
All-Way Stop Control	Poor D	Not to exceed 30 seconds
One- or Two-Way Stop Control		
Overall Intersection	Poor C	Not to exceed 20 seconds
Side Street Traffic	Poor E	Not to exceed 45 seconds

5 City of Lafayette, *Draft General Plan - 2015*, Transportation Chapter. Page II - 17.

The City of Lafayette approach to calculating LOS at signalized intersections is to use both the CCTA required method and the HCM delay method. The LOS standards are the same letter grades under either calculation method. As shown later in this report, the use of the HCM method produces more reliable estimates of the actual operating conditions at intersections in central Lafayette.

As shown in the policies listed above, the City of Lafayette is also considering adoption of LOS standards for stop sign control intersections. Should they be adopted, these standards would be the first adopted for unsignalized intersections by any of the jurisdictions in the Lamorinda area.

City of Orinda Level of Service Policies

The City of Orinda General Plan includes the Measure C required Growth Management Element and signalized intersection LOS standards as shown in Table 2. In addition, ten intersections on basic routes are identified by land use category and LOS standard. Of the four Orinda intersections studied in this report, two are listed in the General Plan as follows:

"Table 5.1 **Minimum Traffic Level of Service for Basic Route Signalized Intersections**

	Basic Route Signalized Intersection	Land Use Category	Minimum Level of Service
7.	Moraga Way/ Camino Encinas/ Camino Pablo	Central Business District	Low [Good] E (V/C 0.90 to 0.94)
8.	Glorietta Boulevard/ Moraga Way	Suburban	Low [Good] D (V/C 0.80 to 0.84)"[6]

While not specifically listed in the General Plan, the third Orinda signalized intersection studied in this report, Camino Pablo with Brookwood Road and the SR 24 eastbound off-ramp, is also within the Central Business District. It is assumed that this intersection would be required to meet the minimum LOS standard for the Central Business District, Low [Good] E.

6 City of Orinda, General Plan, Table 5.1, page 83.

The fourth Orinda intersection studied, Glorietta Boulevard at Rheem Boulevard, is stop sign controlled and not subject to the LOS standards listed in the Growth Management Element.

In addition to the LOS standards of the Growth Management Element, the Orinda General Plan includes the following policy with regard to LOS:

"C. Strive to retain the existing peak hour level of service (LOS) of "C" or better at those intersections where it now prevails and improve the LOS at all other intersections."[7]

The above policy does not appear to be standard but rather a guiding principle for planning purposes.

Town of Moraga Level of Service Policies

The Town of Moraga has adopted the Measure C required Growth Management Element including LOS standards. LOS standards are shown as follows in TC Resolution 43-89.

"EXHIBIT 'A'
ATTACHMENT TO TC RESOLUTION 43-89

TOWN OF MORAGA
TRAFFIC LEVEL OF SERVICE STANDARDS*

RURAL -- LOS low [good] C (70 to 74) Volume to Capacity (V / C)
SEMI-RURAL -- LOS high [poor] C (75 to 79) (V / C)
SUBURBAN -- LOS low [good] D (80 to 84) (V / C)
URBAN -- LOS high [poor] D (85 to 89) (V / C)
CENTRAL BUSINESS DISTRICT -- LOS low [good] E (90 to 94) (V / C)

*As set forth in the Revised Contra Costa Transportation Improvement and Growth Management Program - Adopted August 3, 1988 (Page 10)"[8]

Exhibit "B" to Resolution 43-89 designates Moraga Way and Moraga Road as Urban streets establishing high, poor LOS D (V/C = 0.85 to V/C = 0.89) as the standard for these two streets. All other streets are designated as suburban meaning the service level standard is low, good LOS D (V/C = 0.80 to V/C = 0.84). Consistent with the standards adopted by the CCTA, all Town of Moraga LOS standards are meant to apply to signalized intersections only.

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7 Ibid. Page 21.
8 Town of Moraga, TC Resolution 43-89 adopted December 6, 1989. Exhibit "A"

- Level of Service Standards for Stop Sign Controlled Intersections

As discussed above, the City of Lafayette is considering adoption of LOS standards for unsignalized intersections. Neither the City of Orinda nor the Town of Moraga has adopted LOS standards for stop sign controlled intersections. As also indicated above, the CCTA does not require the calculation of LOS at, nor recommend a LOS standard for, stop sign controlled intersections.

The capacity of certain segments of the three transportation corridors studied in this report is controlled primarily by stop sign intersections. In order to determine the available capacity at these locations it is necessary to establish some measure of the maximum potential capacity of stop sign intersections.

It is recommended that each Lamorinda city consider adoption of a LOS standard for stop sign controlled intersections. The following standard will be used in this report.

Level of Service (LOS) Standards For Stop Sign Controlled Intersections

All-Way Stop Control (AWSC)

Land Use Type	LOS Standard	Total Delay at Peak Hours
All Land Use Types		
Overall Intersection	Poor - D	Not to Exceed 30 Seconds

One- or Two-Way Stop Control (TWSC)

Land Use Type	LOS Standard	Total Delay at Peak Hours
All Land Use Types		
Overall Intersection	Poor - C	Not to Exceed 20 Seconds
Side Street Traffic	Poor - E	Not to Exceed 45 Seconds
(Applies to minimum of 10 vehicles per hour)		

Similar to a signalized intersection, LOS for an AWSC intersection is reported as an average condition for the total intersection. A maximum total intersection delay of 30 seconds, poor LOS D, is the recommended standard for this type of intersection. This compares to the signalized intersection LOS standards as shown on Table 2 of 33 seconds per vehicle delay for suburban land use intersections and 40 seconds per vehicle delay for urban land use intersections.

A dual standard is recommended for TWSC intersections. Because through traffic does not stop at these intersections there is little or no delay for the majority of traffic. The overall delay standard can, therefore, be higher than established for the AWSC or signalized intersection. The overall AWSC intersection service level standard is recommended at a maximum of 20 seconds or poor LOS C.

The greatest delays found at TWSC intersections are experienced by the traffic on the side street that has to stop and wait for a gap in the major traffic flow. Because the volume of side street traffic is usually low, it is possible to establish a longer delay for this limited number of vehicles and still find the overall operation of the intersection is satisfactory. The side street traffic service level standard is recommended at a maximum delay of 45 seconds or poor LOS E. The side street LOS standard would apply only when the traffic count on the side street is at least ten vehicles per hour. It is not appropriate to set LOS standards for a traffic count of less than ten vehicles per hour.

4. Existing Level of Service

The existing LOS is calculated for 19 intersections in the Lamorinda area using both the HCM delay and V/C ratio methods. These intersections are located along the most important arterial street corridors that connect the southerly portion of the Lamorinda area with the SR 24 freeway and with the BART stations in Lafayette and Orinda. It is the capacity of the intersections on these major arterial corridors that determines the ability of the Lamorinda area street system to serve potential new development.

Major Corridors Studied

The major corridors studied in this report are shown in Figure 1. The corridors serve north-south traffic destined primarily between the southerly portion of the Lamorinda area and the central portions of Lafayette and Orinda. Because SR 24 and BART are located within or just north of the central business districts of both Orinda and Lafayette, through traffic from the south necessarily has to pass by way of these two downtowns. Through traffic combines with local trips to cause significant congestion in the central areas of both cities.

The major travel corridors shown on Figure 1 include the Moraga Way Corridor, the Moraga Road Corridor and the St. Marys Road -- Glenside Drive -- Reliez Station Road -- Olympic Boulevard Corridor. While each corridor serves a significant volume of traffic, each may be described as primarily residential or rural in character. Each is served by a two lane roadway, segments of which are of substandard width with minimal shoulders, relatively sharp curves, steep grades and inadequate pedestrian and bicycle routes. There are schools within all three corridors so issues of pedestrian access and safety are of concern. There are also commercial centers within the Moraga Way and Moraga Road Corridors.

The range of typical daily traffic volumes for each corridor is shown in Table 4. Traffic volumes are lowest at the south end of each corridor and grow to highest levels at the north end of each corridor.

Table 4
Daily Traffic Volumes for Each Major Travel Corridor

Corridor	Daily Traffic
Moraga Way	10,000 -- 21,000
Moraga Road	12,000 -- 26,000
St. Marys - Glenside - Reliez Station - Olympic	9,000 -- 18,000

Sources: Various intersection peak hour traffic counts extrapolated to daily volumes.

Intersection Level of Service

The LOS at intersections is studied for the times of highest traffic volumes, weekday morning and afternoon peak hours. These peak one hour periods occur within the 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. daily peak traffic periods. The exact peak one hour within the peak period varies by location. Significant traffic volumes are known to also occur on Saturday midday, particularly near commercial centers. However, the highest traffic volumes have been counted at the peak times noted above. It is these peak traffic times that are studied in this report.

This report includes the most recent traffic counts available at each intersection studied. Several intersections in Lafayette were counted in October 1998 and this most recent data is used to calculate LOS. The existing peak hour traffic counts for each intersection studied are shown in the Appendix to this report.

The existing LOS for the intersections studied in this report is shown in Table 5. Average delay and V/C ratio are not shown on Table 5 but are available in the LOS calculation sheets that are provided in the Appendix to this report. Existing LOS for each intersection studied is shown on Figure 2. Existing traffic operations for each corridor are described below.

Moraga Way Corridor

As shown on Table 5, existing traffic in the Moraga Way Corridor experiences significant congestion, LOS F, in downtown Orinda in the afternoon peak hour. LOS F congestion is also experienced at the Moraga Way at Glorietta Boulevard intersection in the morning peak hour. Both of these LOS F conditions are determined using the HCM method to calculate LOS. Using the CCTA recommended V/C ratio method would produce LOS D and LOS E in the downtown and Glorietta Boulevard intersections respectively. Based on observations taken in the field, the HCM result appears to better reflect actual existing conditions.

Table 5
Existing Intersection Level of Service (LOS)
Highway Capacity Manual (HCM) and CCTA (V/C ratio) Calculation Methods

Intersection	Jurisdiction	Morning Peak Hr HCM LOS	Morning Peak Hr CCTA LOS	Afternoon Pk Hr HCM LOS	Afternoon Pk Hr CCTA LOS
Moraga Way Corridor					
Signalized Intersections					
Camino Pablo at Brookwood Rd/ SR 24 Off-ramp	Orinda	D	A	F	D
Moraga Way at Camino Pablo/ Camino Encinas [Note 1]	Orinda	B	A	B	A
Moraga Way at Glorietta Blvd.	Orinda	F	E	C	A
Stop Sign Controlled Intersection [Note 2]					
Glorietta Blvd. at Rheem Blvd.	Orinda	E/C(3)	---	C/A(3)	---
Moraga Road Corridor					
Signalized Intersections					
Mt. Diablo Blvd. at Oak Hill Rd	Lafayette	C	A	D	B
Moraga Rd at Mt. Diablo Blvd.	Lafayette	D	B	E	C
Mt. Diablo Blvd. at First St.	Lafayette	C	B	C	B
Moraga Rd at School/Brook Sts.	Lafayette	D	D	C	B
Moraga Rd at St. Marys Rd (North)	Lafayette	B	C	B	B
Moraga Rd at Rheem Blvd.	Moraga	B	A	B	A
Moraga Rd at St. Marys Rd (South)	Moraga	B	A	B	A
Stop Sign Controlled Intersections [Note 2]					
Moraga Rd at Moraga Boulevard	Lafayette	F/C [3]	---	F/B [3]	---
Moraga Rd at Hamlin Rd/Tanglewood	Lafayette	D/B [3]	---	E/B [3]	---
Moraga Rd at Silver Springs/Mt View Drive/Old Jonas Hill Rd	Lafayette	C/B [3]	---	C/B [3]	---
St. Marys - Glenside - Reliez Station - Olympic Corridor					
Signalized Intersection					
Pleasant Hill Rd at Mt. Diablo Blvd.	Lafayette	B	A	C	A
Stop Sign Controlled Intersections [Note 2]					
Olympic Blvd. at Pleasant Hill Rd	Lafayette	C	---	C	---
Reliez Station Rd at Olympic Blvd.	Lafayette	C	---	C	---
Glenside Dr. at Reliez Station Rd	Lafayette	C	---	C	---
St. Marys Rd at Glenside Dr. (South)	Lafayette	C	---	C	---
St. Marys Rd at Rheem Blvd.	Moraga	C/A [3]	---	E/B [3]	---

Note 1: Southbound traffic queues back through this intersection due to the inadequate length of the merge lane provided. Actual LOS may be lower than as shown.

Note 2: Stop sign control LOS calculated using the HCM methods. The CCTA does not require nor recommend a method to calculate LOS at stop sign controlled intersections.

Note 3: LOS at two-way stop intersections shown for side street and total intersection, e.g. D/A.

Source: Robert L. Harrison Transportation Planning

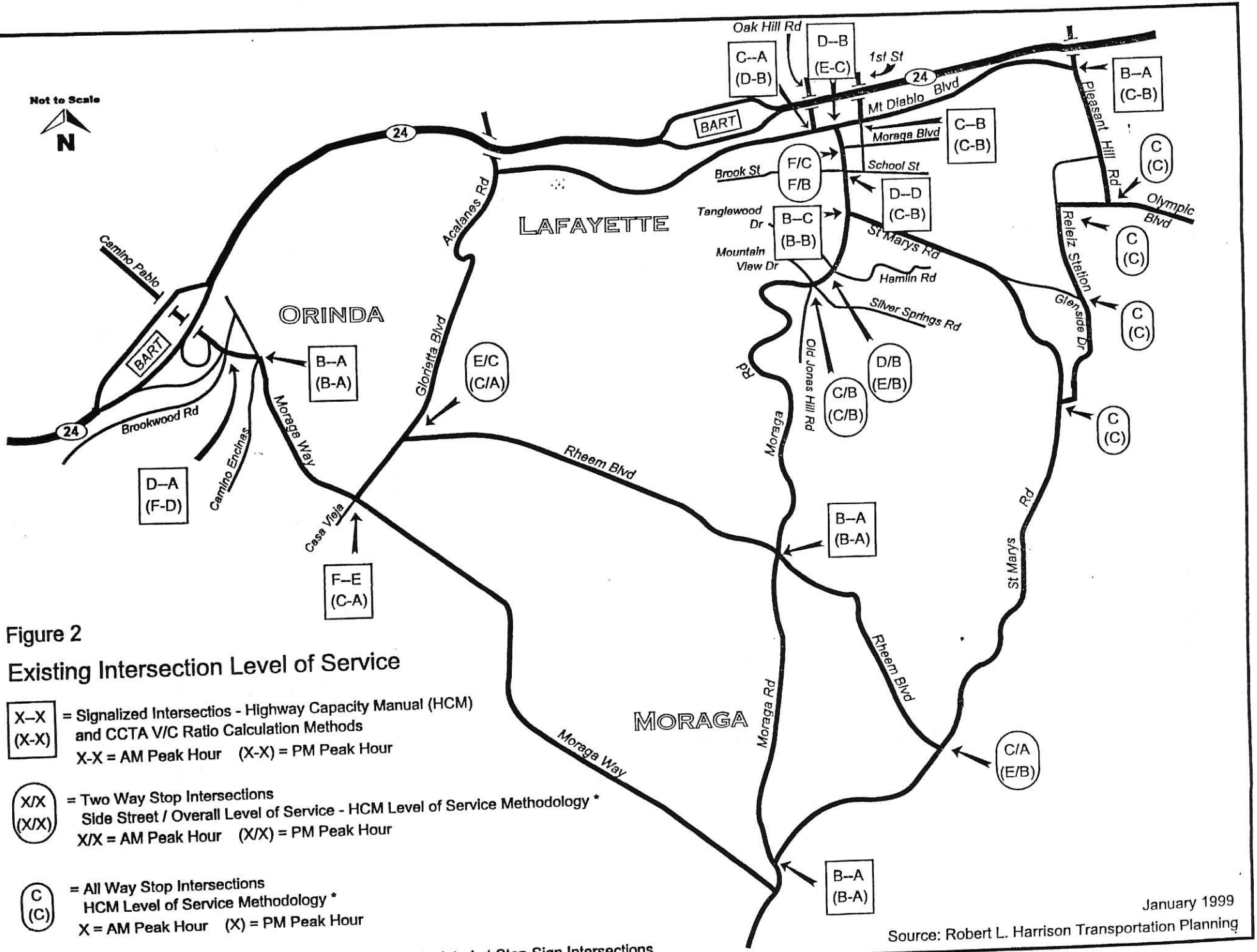

Figure 2

Existing Intersection Level of Service

X--X (X-X) = Signalized Intersectios - Highway Capacity Manual (HCM) and CCTA V/C Ratio Calculation Methods
X-X = AM Peak Hour (X-X) = PM Peak Hour

X/X (X/X) = Two Way Stop Intersections
Side Street / Overall Level of Service - HCM Level of Service Methodology *
X/X = AM Peak Hour (X/X) = PM Peak Hour

C (C) = All Way Stop Intersections
HCM Level of Service Methodology *
X = AM Peak Hour (X) = PM Peak Hour

CTA does not require Level of Service to be calculated at Stop Sign Intersections

January 1999

Source: Robert L. Harrison Transportation Planning

A third spot in the Moraga Way Corridor with significant delay is at the stop sign controlled intersection of Glorietta Boulevard at Rheem Boulevard. In the morning peak hour the left turn from Rheem to Glorietta operates at LOS E. Because this intersection is controlled by a one way stop sign much of the traffic passing through the intersection does not have to stop and experiences no delay. The overall delay experienced at the intersection, including both the traffic that stops and the traffic that does not stop, results in a LOS C. Both the traffic movement that experiences the greatest delay and the overall intersection LOS are shown on Table 5. For example:

Westbound left turn	=	LOS E;
Total overall delay	=	LOS C;
LOS as shown on Table 5	=	E/C.

The above approach, reporting two LOS results, is used for each one- or two-way stop sign controlled (TWSC) intersection studied in this report.

It should also be noted that for stop sign controlled intersections there is no LOS shown on Table 5 for the CCTA calculation method. This is because the CCTA does not require LOS to be calculated at stop sign controlled intersections. The methods used to calculate LOS at stop sign controlled intersections in this report are from the HCM.

Moraga Road Corridor

Significant congestion is experienced at the northerly end of the Moraga Road Corridor in downtown Lafayette. At the intersection of Moraga Road with Mt. Diablo Boulevard, the HCM LOS calculation method results in LOS D in the morning peak hour and LOS E in the afternoon peak hour

The service level derived for the intersection of Moraga Road and Mt. Diablo Boulevard using the CCTA V/C ratio method is LOS B in the morning peak hour and LOS C in the afternoon peak hour. Actual existing congestion and delay at this intersection appear to be greater than as estimated by the V/C ratio method to calculate LOS.

The side street traffic at the one-way stop sign controlled intersection of Moraga Road with Moraga Boulevard experiences significant delay at both morning and afternoon peak hours, LOS F.

At the time of peak morning traffic volumes, traffic may queue back from Mt. Diablo Boulevard to Brook Street. The intersection of Brook and School Streets with Moraga Road operates at LOS D over the morning peak hour.

For short periods within the morning peak hour when school drop-off traffic is greatest, congestion is greater than LOS D at the School Street intersection. Traffic may queue back through the St. Marys Road intersection for short time intervals at these peak traffic hours. Afternoon peak hour congestion is not as great as found at morning peak because school traffic is not present at this time of day.

The two-way stop sign controlled (TWSC) intersections of Moraga Road with Hamlin Road and Tanglewood Drive and with Silver Springs Road, Mt. View Drive and Old Jonas Hill Road experience delay for side street traffic. Occasionally, traffic backs up from the St. Marys Road intersection blocking access to Moraga Road from these side streets. More typically, the service level for the north-south through traffic is good, LOS A. The afternoon peak hour service level for the eastbound traffic on Hamlin Road is low, LOS E. However, just 11 peak hour vehicles on Hamlin Road experience this LOS E condition. All other traffic movements operate at LOS D or better at these intersections.

There is very little congestion at the southerly end of the Moraga Road Corridor. Both the intersections of Moraga Road with Rheem Boulevard and with St. Marys Road (South) operate at LOS B, thus exceeding the LOS standards of the Growth Management Element in the Town of Moraga General Plan.

The existing traffic operations in the Lafayette portion of Moraga Road Corridor meet the signalized intersection LOS standards adopted by the Lafayette City Council. Overall and side street service levels for the two-way stop controlled (TWSC) intersections in the corridor would meet the LOS standards proposed for unsignalized intersections in this report.

St. Marys Road - Glenside Drive - Reliez Station Road - Olympic Boulevard Corridor

This corridor is different from the two previous corridors in that the greatest level of existing congestion does not occur at its northerly limit but, rather, congestion is greatest in the central portion of the corridor. In this central segment of the corridor the primary roadway is just two lanes wide and most intersections are controlled by all-way stops (AWSC). All-way stops allow gaps in through traffic that permit local side street traffic to enter the major traffic stream with limited delay. However, in terms of capacity, the AWSC is the least efficient type of intersection.

Service levels are LOS C or better at all of the AWSC intersections in this corridor.

At the southerly end of the corridor the one way stop sign controlled intersection of St. Marys Road with Rheem Boulevard operates at LOS E in the afternoon peak hour for the left turn from Rheem onto St. Marys Road. Overall operation of the intersection is LOS B at this time of day.

At the northerly end of the corridor Pleasant Hill Road is four lanes wide and there is very little delay for traffic at its intersection with Mt. Diablo Boulevard. This intersection operates at LOS C or better.

The existing traffic operations in this corridor meet all adopted LOS standards in the City of Lafayette. Existing traffic conditions at all stop sign intersections in this corridor meet the stop sign control LOS standards recommended in this report.

5. Existing Available Capacity

The existing available capacity in each Lamorinda transportation corridor is determined by comparing the existing traffic counts and service levels with the potential maximum number of trips that could be served while not exceeding adopted LOS standards. The capacity that would be available assuming all approved new development projects were fully built and all approved roadway projects were constructed, known as the "mitigated available capacity", is described in Chapter 7 of this report.

In a developed area it is the capacity of important intersections that establishes the limitations on roadway capacity. The most congested intersections in each transportation corridor set the limits on the capacity of that corridor. Each of the most congested intersections is studied to determine how many additional trips could be served without exceeding the adopted service level standards.

It should be noted that the number of added trips that could be served at an intersection is greatly dependent on the direction of travel of the new trips. Certain turning movements are more critical than others in the determination of LOS. For example, there is typically more available capacity in each corridor for off-peak direction travel. In the morning peak hour, travel toward the south is usually faster than travel toward the north. In the afternoon peak hour, peak direction travel is reversed. The capacity of any intersection to serve additional trips is dependent on the direction of travel of the new trips.

For the purposes of quantifying an approximate available capacity in this report, it is assumed that new trips will increase proportionally by the same amount for all through traffic. That is, both peak direction and off-peak direction travel will increase by the same growth factor. This is believed to be a reasonable assumption because the number of potential added trips will not be large enough to radically change the existing patterns of trips at major intersections. Existing travel patterns are set by existing land use patterns. New development will not significantly alter the patterns of land use already established in the Lamorinda area.

Summary of Level of Service Standards

A summary of adopted and proposed LOS standards is shown in Table 6. As shown in Table 6, the City of Lafayette has adopted a service level standard based on average delay per vehicle as a supplement to the LOS calculation method required by the CCTA that is based on V/C ratio. The same service level letter grade should result from application of either method to calculate LOS. However, as discussed earlier in this report, experience in the Lamorinda area has shown that LOS calculated using the HCM delay method often times more closely replicates the actual levels of congestion observed in the field.

Table 6
Summary of Level of Service Standards

Type of Intersection	LOS Standard	Volume to Capacity Ratio	Stopped Delay Per Vehicle
Traffic Signal Control			
Standards Adopted by the City of Lafayette:			
Downtown Core: Lafayette "Y"	Good E	0.90 to 0.94	40 to 50 Seconds
Other Downtown Intersections	Poor D	0.85 to 0.90	33 to 40 Seconds
Intersections Outside Downtown	Good D	0.80 to 0.84	25 to 33 Seconds
Standards Adopted by the City of Orinda and the Town of Moraga:			
Central Business District	Good E	0.90 to 0.94	Not Applicable
Urban Areas	Poor D	0.85 to 0.90	Not Applicable
Suburban Areas	Good D	0.80 to 0.84	Not Applicable
Semi - Rural	Poor C	0.75 to 0.79	Not Applicable
Rural	Good C	0.70 to 0.74	Not Applicable
All-Way Stop Sign Control (AWSC)			
Standards have not been adopted by any city.			
All Land Use Types			
Overall Intersection	Poor D	Not Applicable	Not to exceed 30 Sec.
One- and Two-Way Stop Sign Control (TWSC)			
Standards have not been adopted by any city.			
All Land Use Types			
Overall Intersection	Poor C	Not Applicable	Not to Exceed 20 Sec.
Side Street Traffic	Poor E	Not Applicable	Not to Exceed 45 Sec.
(Applies to minimum of 10 vehicles per hour.)			

Source: Robert L. Harrison Transportation Planning

The available capacity at signalized intersections is calculated in this report using the HCM delay method. Should the CCTA V/C ratio method be used, the available capacity would be found to be significantly greater at most intersections. It is recommended that the Town of Moraga and the City of Orinda consider adoption of the HCM method to calculate LOS as a supplement to the CCTA required V/C ratio calculation method.

Also shown on Table 6 are proposed LOS standards for stop sign controlled intersections. For those areas where corridor capacity is set by stop sign controlled intersections, the LOS standards proposed in this report and as shown in Table 6 are used to determine the potential available capacity. It is recommended that all three Lamorinda cities consider adoption of service level standards for stop sign controlled intersections.

Existing Available Capacity for Each Transportation Corridor

The existing available capacity for each major transportation corridor is discussed below. The intersections that limit existing capacity and the maximum number of peak hour trips that each could accommodate are shown in Table 7 and on Figure 3.

Moraga Way Corridor

The three most congested intersections in the Moraga Way Corridor are studied to determine existing available capacity. This Corridor has virtually no capacity available assuming existing roadway geometrics. Because existing LOS is F, there is no capacity available in the afternoon peak hour at the intersection of Camino Pablo at Brookwood Road and the SR 24 off-ramp. Similarly, there is no capacity available in the morning peak hour at the intersection of Moraga Way at Glorietta Boulevard. As discussed in Chapter 7, the adopted roadway improvement projects proposed at each of these intersections would provide significant additional capacity.

The stop sign controlled intersection of Glorietta Boulevard with Rheem Boulevard has an available capacity of 50 additional morning peak hour and 280 additional afternoon peak hour trips. The capacity of stop sign controlled intersections normally can be increased by providing a traffic signal. There is no current plan to install a traffic signal at the intersection of Glorietta and Rheem Boulevards.

Moraga Road Corridor

The intersection of Moraga Road with Mt. Diablo Boulevard serves the greatest number of vehicles in the Moraga Road Corridor. However, using the LOS standards described in this report, this intersection is not the primary constraint to the capacity of the Moraga Road Corridor. Based on October 1998 traffic counts, the maximum number of trips that could be added to this intersection and still not exceed the Good E LOS standard that has been adopted for intersections at the Lafayette "Y" is 570 vehicles in the morning peak hour and 220 vehicles in the afternoon peak hour.

Table 7
Existing Available Capacity at the Most Congested Intersections

Intersection	Jurisdiction	LOS Standard	Available Capacity Vehicles per Peak Hour AM Pk Hr	PM Pk Hr
Moraga Way Corridor				
Camino Pablo at Brookwood Rd / SR 24 Off-ramp	Orinda	Good E	700	None
Moraga Way at Glorietta Blvd.	Orinda	Good D	None	650
Glorietta Blvd. at Rheem Blvd.	Orinda	Poor E / C [1]	50	280
Moraga Road Corridor				
Moraga Road at Mt. Diablo Blvd.	Lafayette	Good E	570	220
Moraga Road at Moraga Boulevard	Lafayette	Poor E / C [1]	None	None
Moraga Road at School / Brook Sts.	Lafayette	Poor D	90	630
Moraga Road at Hamlin Road / Tanglewood Drive	Lafayette	Poor E / C [1]	250	100
St. Marys - Glenside - Reliez Station - Olympic Corridor				
St. Marys Road at Glenside Drive	Lafayette	Poor D [2]	540	600
Glenside Drive at Reliez Station Road	Lafayette	Poor D [2]	150	310
Reliez Station Road at Olympic Blvd.	Lafayette	Poor D [2]	280	310
Olympic Blvd. at Pleasant Hill Road	Lafayette	Poor D [2]	520	490

Note 1: Two-way stop sign controlled (TWSC) intersection. No LOS standards adopted. Proposed standard for TWSC intersection = Poor LOS E for side street traffic and Poor LOS C for overall intersection.

Note 2: All-way stop sign controlled (AWSC) intersection. No LOS standards adopted. Proposed standard for AWSC intersection = Poor LOS D.

Source: Robert L. Harrison Transportation Planning

As shown on Table 7, the intersection that most severely limits the existing capacity of the Moraga Road Corridor is Moraga Road at Moraga Boulevard. Because the intersection operates at LOS F for side street traffic under existing traffic loads, there is no capacity available at this intersection assuming existing stop sign control is maintained. The City of Lafayette has recently adopted the *Downtown Traffic Plan* including roadway and pedestrian improvements for the section of Moraga Road from Mt. Diablo Boulevard to the southerly city limit. The Plan calls for the installation of a traffic signal at the intersection of Moraga Road with Moraga Boulevard. As discussed below under "Mitigated Available Capacity" in Chapter 7, the capacity of this intersection would be greatly increased when the approved traffic signal is installed.

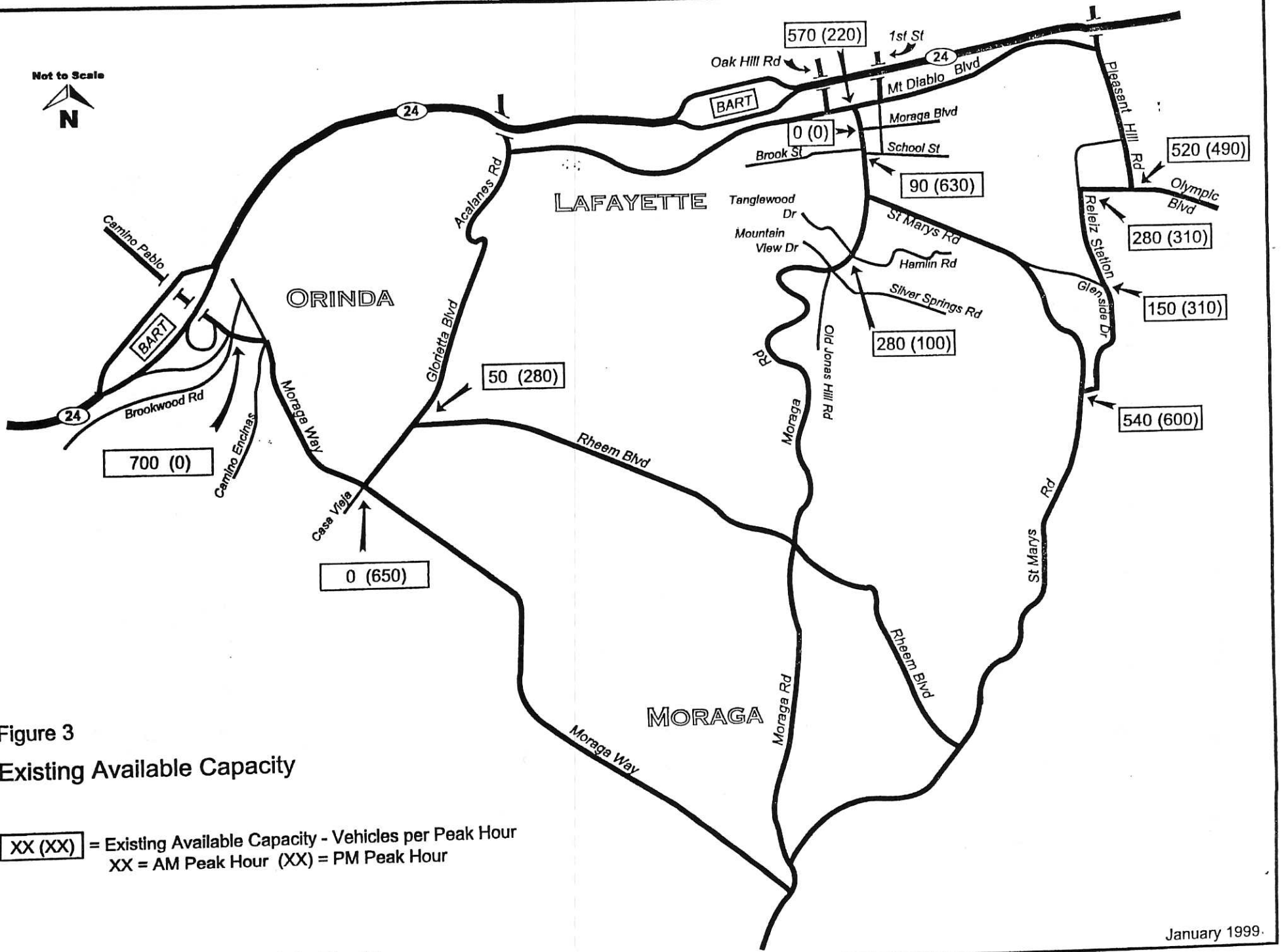

Figure 3

Existing Available Capacity

XX (XX) = Existing Available Capacity - Vehicles per Peak Hour
XX = AM Peak Hour (XX) = PM Peak Hour

January 1999

Source: Robert L. Harrison Transportation Planning

The intersection that is the second most capacity limiting in the Moraga Road Corridor is Moraga Road at School and Brook Streets. Using the HCM LOS calculation method, the LOS at this intersection in the morning peak hour is level D with about 35 seconds of average stopped delay for each vehicle entering the intersection.

For the purposes of this report, the intersection of Moraga Road with School and Brook Streets will be assigned the LOS standard that applies to "other downtown intersections" in Lafayette, Poor LOS D. Under this criteria, about 90 additional morning peak hour and 630 additional afternoon peak hour vehicle trips could be added to the intersection without exceeding the LOS standard.

A third point of capacity limitation in the Moraga Road Corridor is at the intersection of Moraga Road with Hamlin Road and Tanglewood Drive. The delay for some of the side street traffic at this two-way stop controlled (TWSC) intersection is long under existing peak hour traffic loads. A relatively low number of added through trips would cause the side street delay to grow to the maximum allowed by the proposed LOS standard for TWSC intersections.

The addition of about 100 afternoon peak hour through trips or 250 morning peak hour through trips at this intersection would cause the side street delay to grow to 45 seconds per vehicle, LOS E. In the past, the City of Lafayette has considered the installation of a traffic signal at this intersection. The existing conditions at this intersection do not satisfy any of the 11 warrants that would justify the installation of a traffic signal. There is no current plan to install a traffic signal at this intersection.

The intersection of Moraga Road with Silver Springs Road and Mt. View Drive and Old Jonas Hill Road also experiences significant delay for side street traffic. However, the greatest delay and lowest service level at this intersection is found for the very low traffic volumes on Mt. View Drive. (There were just eight morning peak hour vehicles and two afternoon peak hour vehicles counted on Mt. View Drive.) These traffic volumes are less than the proposed LOS side street minimum volume standard of ten vehicles per hour. This intersection is not, therefore, considered a primary constraint to the capacity of the Moraga Road Corridor.

- *St. Marys Road - Glenside Drive - Reliez Station Road - Olympic Boulevard Corridor*

The capacity of this corridor is controlled by a series of all-way stop sign controlled (AWSC) intersections. The AWSC intersection has lower capacity than a comparable TWSC or traffic signal controlled intersection. The AWSC intersection is particularly inefficient when side street traffic volumes are low compared to through traffic volumes. Because the side street traffic volume is low at most of the AWSC intersections in this corridor, none of the 11 warrants that are used to justify installation of a traffic signal are satisfied at any of the intersections studied.

The advantage of the AWSC intersection is that it allows side street traffic a favorable opportunity to enter the major through traffic stream. In the central segment of this corridor, it has been the policy of the City of Lafayette that side street traffic should not be severely disadvantaged by sizable through traffic volumes and thus AWSC has been installed at several intersections.

It should be noted again that there are no adopted LOS standards for stop sign controlled intersections. The following estimate of available capacity is based on the LOS standards for AWSC intersections developed in this report. It is recommended that all of the cities in the Lamorinda area consider the adoption of service level standards for stop sign intersections.

The intersection with the least existing available capacity in this corridor is Glenside Drive at Reliez Station Road. This intersection operates at LOS C under existing traffic loads. The addition of 150 morning peak hour trips or 310 afternoon peak hour trips would increase the total delay per vehicle at this intersection to 30 seconds, or Poor LOS D, the proposed LOS standard for the AWSC intersection. There are no roadway improvement projects now under consideration that would increase the capacity of this intersection.

Total Existing Available Corridor Capacity South of the SR 24 Freeway

The total existing available capacity of the three corridors studied in this report is most limited at morning peak hour. Existing available capacity at this time of day is 150 added peak hour trips. Existing available capacity is greater in the afternoon peak hour, about 310 total added trips.

This total "screen line" existing capacity for all three corridors is derived as shown in Table 8. Also shown on Table 8 are the intersections in each corridor that cause the greatest limit on existing available capacity for the morning peak and afternoon peak hours.

Table 8
Total Existing Available Corridor Capacity
Three Corridors South of SR 24

Corridor	Limiting Intersection	Existing Available Capacity Vehicles per Hour
Morning Peak Hour		
Moraga Way	Moraga Way at Glorietta Boulevard	None
Moraga Road	Moraga Road at Moraga Boulevard	None
St.Marys Road - Glenside Drive - Reliez Station Rd. - Olympic Blvd.	Glenside Drive at Reliez Station Road	150
Total Morning Peak Hour Existing Available Capacity		**150**
Afternoon Peak Hour		
Moraga Way	Camino Pablo at Brookwood Rd / SR 24 Off-ramp	None
Moraga Road	Moraga Road at Moraga Boulevard	None
St. Marys Road - Glenside Drive - Reliez Station Rd. - Olympic Blvd.	Glenside Drive at Reliez Station Road	310
Total Afternoon Peak Hour Existing Available Capacity		**310**

Source: Robert L. Harrison Transportation Planning

6. New Development Trip Generation Procedures

In order to review the traffic impacts of proposed new developments in an orderly manner, it is necessary to have agreement on each step in the technical analysis process. For example, a set of technical procedures to estimate intersection Level of Service is recommended for adoption by all Lamorinda cities in previous sections of this report.

The first step in assessing the impact of a new development project is to estimate the trips that the proposed project would generate. Trip generation is typically estimated using trip rates for each type of land use that have been developed from research studies of that particular land use category. The most used and most reliable research on trip generation is compiled by the Institute of Transportation Engineers (ITE) in the publication *Trip Generation*. The sixth edition of *Trip Generation* was published in November 1997.

Trip Generation is an informational report of the ITE. The report contains data compiled from the experiences of the transportation engineering profession. The data in *Trip Generation* are based on more than 3,750 studies conducted by public agencies, developers and consulting firms and reported to the ITE. The data were primarily collected at suburban locations with little or no transit service, limited pedestrian amenities, and no travel demand management programs.

Trip generation is related to an independent variable in the form of a trip rate. The trip rate maybe expressed in trips per: the number of dwelling units; the number of square feet of an office or retail development; or in terms of other factors such as the number of employees, number of theater seats, or number of hotel rooms.

The data provided in *Trip Generation* include trip generation rates and equations for average weekday, Saturday, Sunday; for the morning and afternoon peak hours of the generator; and for the weekday hour when the adjacent street traffic is at its peak in the morning and afternoon.

Trip Generation provides the user with three methods of estimating trips:

1. A plot of trip ends versus the size of the independent variable;
2. The weighted average trip generation rate per unit of the independent variable; and,
3. A regression equation relating trips ends to the size of the independent variable.

The most used method to estimate trip generation is to apply the weighted average trip rate to the proposed development project. This method is most useful when applied to standard developments such as single family homes. *Trip Generation* contains the result of over 300 studies at single family home developments.

A regression equation is provided for those trip generation relationships that are based on sufficient data (at least four studies) and that show at least 50% of the change in trip rate is accounted for by a change in the independent variable. *Trip Generation* provides both the regression equation and the coefficient of determination (R^2) where the R^2 is greater than or equal to 0.50. An R^2 of 0.90 indicates that 90% of the variance in the number of trips is accounted for by the variance in size of the independent variable. Use of the regression equation allows direct forecasting of trip ends based on the independent variable of the proposed development and, where the R^2 is high, provides a more reliable estimate of trip making than does use of an average trip rate.

A summary of the trip generation rates from *Trip Generation* for some of the most frequently occurring land uses in the Lamorinda area is provided in Table 9. The residential trip rates shown on Table 9 are average rates for each of several types of residential development. Single family developments are divided into categories based on the size of the proposed units. For example, smaller units under 2,500 square feet would, on average, generate trips at the weighted average rate found in *Trip Generation*, 9.57 trip ends per day. The trip rates for larger units are adjusted based on assumed larger family sizes and more vehicles owned per each of the larger units. Factors to adjust from the average trip rate in order to account for family size and vehicle ownership were presented in the 5th Edition of *Trip Generation*.

The rates shown on Table 9 for office buildings and shopping centers are based on a fitted curve developed from regression analysis. The regression equation has an R^2 of 0.88 for office buildings and 0.78 for shopping centers. The trip rates per square foot of these types of development vary significantly dependent on the size of the development considered. The specific trip rates shown on Table 9 assume a 100,000 square foot (sf) Gross Floor Area (GFA) development for the office building and shopping center uses .

Table 9
Trip Generation Rates

Land Use	Unit of Trip Rate	Daily Trip Rate	Peak Hour Trip Rates Morning	Afternoon
Single Family Residential				
1,500 to 2,500 sf	Dwelling Unit	9.57	0.75	1.01
2,500 to 3,500 sf	Dwelling Unit	10.67*	0.84	1.13
Over 3,500 sf	Dwelling Unit	12.47*	0.98	1.32
Other Residential				
Multi-Family	Dwelling Unit	7.73	0.59	0.72
Senior Assisted Care	Dwelling Unit	2.15	0.06	0.17
Office Building (100,000 sf)	1,000 sf GFA	13.27**	1.86	1.91
Shopping Center (100,000 sf)	1,000 sf GFA	68.17**	1.60	6.28
Restaurant (One hour sit down)	Seat	4.83	0.42	0.47

* Rates shown account for greater vehicle ownership and larger family size found in larger units.
** Trip rate based on fitted curve. Rates shown are per 1,000 square feet of Gross Floor Area (sf GFA) for a 100,000 gross square foot building.

Source: Institute of Transportation Engineers, Trip Generation, 6th Edition, 1997.

In summary, the trip generation rates shown in Table 9 and use of the ITE *Trip Generation* manual are recommended as the standards for estimating the trip generation of new developments in the Lamorinda area. Specific unique developments may require additional research to determine appropriate trip generation rates. These unusual projects should be required to conduct additional trip generation research as needed on a case by case basis.

7. Mitigated Available Capacity

Mitigated Available Capacity is a potential future condition based on the adopted policies of the three Lamorinda cities. It is defined as the roadway capacity that would be available assuming:

1 -- All adopted roadway improvement projects are constructed; and,

2 -- All approved new developments are fully built out.

The Mitigated Available Capacity condition may never be actualized but it is important to evaluate because it represents the current articulated policy of all three Lamorinda cities.

Summary of Roadway Improvement Projects

In the portion of the Lamorinda area studied in this report, there are adopted roadway improvement projects in both the Cities of Orinda and Lafayette.

City of Orinda Roadway Improvements

There are two roadway improvement projects adopted in the City of Orinda. These are:

1 -- Camino Pablo at Brookwood Road and SR 24 Off-ramp --
Provide added eastbound lane on the SR 24 Off-ramp; and,

2 -- Moraga Way at Glorietta Boulevard --
Provide separate westbound and northbound right turn lanes;
Provide pedestrian and bicycle improvements.

As shown on Table 10, with the proposed roadway improvements in place, all signalized intersections in the Moraga Way Corridor would meet the LOS standards shown in the City of Orinda General Plan for existing traffic volumes.

Table 10
Existing and Improved Roadway Intersection Level of Service (LOS)
At All Intersections Where Roadway Improvements[1] Have Been Adopted
Assumes Existing Traffic Counts

Intersection	Existing LOS	Existing Delay[2]	With Roadway Improvements Potential LOS	With Roadway Improvements Delay[2]
Moraga Way Corridor				
Camino Pablo at Brookwood Road / SR 24 Off-ramp				
Morning Peak Hour	D	26	C	21
Afternoon peak Hour	F	>60	D	27
Moraga Way at Glorietta Boulevard				
Morning Peak Hour	F	>60	C	19
Afternoon Peak Hour	C	16	B	12
Moraga Road Corridor				
Moraga Road at Mt. Diablo Boulevard				
Morning Peak Hour	D	33	C	20
Afternoon Peak Hour	E	42	C	23
Moraga Road at Moraga Boulevard				
Morning Peak Hour	F/D	>45/27	B	7
Afternoon Peak Hour	F/D	>45/22	B	6
Moraga Road at School / Brook Streets				
Phase I and II Improvements				
Morning Peak Hour	D	36	C	18
Afternoon Peak Hour	C	18	B	9
Phase III and IV Improvements				
Morning Peak Hour	D	36	C	19
Afternoon Peak Hour	C	18	B	15

Notes:
1 – Adopted roadway improvements as described in text.
2 – Seconds of average stopped delay per vehicle.

Source: Robert L. Harrison Transportation Planning

The stop sign controlled intersection of Glorietta Boulevard with Rheem Boulevard, not shown on Table 10, would meet the Orinda General Plan policy guideline of maintaining a LOS C at existing intersections.

City of Lafayette Roadway Improvements

The City of Lafayette has recently approved the *Downtown Traffic Plan*, a four phase $4.8 million program intended to improve traffic operations and pedestrian safety along Moraga Road from Mt. Diablo Boulevard to the southerly city limit. The improvements included in the Plan that would add capacity at important intersections are as follows.

1 -- Moraga Road at Mt. Diablo Boulevard:
Provide northbound right turn overlap signal phase;
Add eastbound through lane;
Add southbound separate left turn lane.

2 -- Moraga Road at Moraga Boulevard:
Provide traffic signal.

3 -- Moraga Road at School and Brook Streets:
Phases I and II -
Test and then construct closure of all left turns at Brook Street and consolidate all east-west pedestrian crossings south of School Street;
Phases III and IV -
Acquire right-of-way and realign Brook Street to provide a standard four leg intersection.

As shown on Table 10, the proposed roadway improvements would significantly improve service for existing traffic at the three intersections listed. At Mt. Diablo Boulevard the afternoon peak hour LOS would be improved by two service level letter grades, from E to C. At Moraga Boulevard, the existing stop sign control LOS F/D would be improved to LOS B with signalization of the intersection. At School and Brook Streets the LOS would be improved by one service level letter grade.

The above LOS results assume existing traffic volumes. Mitigated Available Capacity assumes existing volumes would be increased by the build out of all approved new developments in the Lamorinda area. The remainder of this chapter studies the impact that already approved but not yet constructed new development would have on capacity. The trips that could be generated by the approved new development would add to existing traffic counts and would reduce available capacity from the existing conditions.

Trips Generated by Approved Development Projects

The currently approved developments in each of the three Lamorinda area cities are listed in Table 11. Also shown on Table 11 are the trips that each project would generate. The estimate of trip generation for each project is calculated using the methods of the ITE *Trip Generation* manual. A spreadsheet showing the detailed trip generation calculation procedures is provided in the Appendix to this report.

As shown on Table 11, the three Lamorinda cities have approved projects that would generate 12,544 daily vehicle trips, 1,298 trips in the afternoon peak hour trips and 713 trips in the morning peak hour trips.

Table 11
Lamorinda Area Approved Projects Trip Generation

Project Name	Development Type (1)	Development Amount	Trip Generation Daily	AM Pk Hr	PM Pk Hr
Lafayette Projects					
Town Center	Office	26,000 sf	472	68	70
	Retail	25,000 sf	2,795	73	274
	MF Res	75 Units	580	40	49
La Fiesta	Retail		(See Note 2)		
Club Sport	Health Club	70,000 sf	2,800	112	301
Gousias	SF Res	4 Units	43	3	5
French	SF Res	3 Units	32	3	4
Bruzzone	SF Res	8 Units	85	7	9
Focus Realty	SF Res	9 Units	96	8	10
Hourany	SF Res	2 Units	21	2	2
De Silva	SF Res	4 Units	43	3	5
		Lafayette Subtotals	6,817	279	701
Orinda Projects					
Montanera in Gateway	SF Res	225 Units	2,401	189	254
Castlegate	SF Res	42 Units	448	35	47
Zuckerman	SF Res	4 Units	43	3	5
Urban	SF Res	2 Units	21	2	2
		Orinda Subtotals	2,913	229	308
Moraga Projects					
Mulholland Hill	SF Res	6 Units	64	5	7
Oakbay Kimberly Drive	SF Res	5 Units	62	5	7
Batavia / Longwood	SF Res	4 Units	50	4	5
Camino Moraga	SF Res	9 Units	96	8	10
Moraga Valley Lane	SF Res	25 Units	267	21	28
Country Club Vista	SF Res	16 Units	171	13	18
Moraga Country Club	SF Res	68 Units	725	57	77
Thoms	SF Res	2 Units	25	2	3
Oakmont Senior Assisted Care Facility		76 Rooms	163	5	13
Luxor Apartments	MF Res	25 Units	193	15	18
St. Mary's College Dormitories		80 Rooms	400	24	40
Rheem Theater	Movie Theater		(See Note 2)		
B of A Kiosk	Auto Teller		(See Note 2)		
Advanced Mobile Solutions Product Development Center	R + D	28,000 sf	429	45	46
Moraga Barn	Restaurant	35 Seats	169	2	16
		Moraga Subtotals	2,815	205	288
Lamorinda Approved Projects Totals			**12,544**	**713**	**1,298**

Note 1: MF Res = Multi-family residential; SF Res = Single family residential; R + D = Research and Development facility.

Note 2: Rehabilitation or conversion of existing use. Assumes no new trips generated.

Sources: Lafayette, Moraga and Orinda Community Development Departments; Robert L Harrison Transportation Planning.

The trips that would be generated by the construction of each approved development project are assigned to each of the three travel corridors studied in this report. Trip assignment is based on determination of the most logical access route to each project. The existing travel patterns as shown by traffic counts at major street intersections is used to distribute trips among the three travel corridors studied in this report.

It should be noted that not all trips generated would impact all segments of any one of the travel corridors. A portion of the trips generated within the Town of Moraga, for example, remain within Moraga and do not add to traffic in Lafayette or Orinda. Based on recently completed studies conducted for the Lafayette General Plan EIR Traffic Analysis, the proportion of trips generated in the Town of Moraga that remain within the Moraga is 35% of total trips. This means 65% of Moraga generated trips add to traffic in Lafayette and Orinda.

The assignment of approved projects trip generation by travel corridor and by city is shown in Table 12. Because, as explained above, not all trips generated are assigned to all segments of each corridor, the trips per city as shown in Table 12 do not add to the same trip generation totals as shown in Table 11.

Table 12
Approved Projects Trip Generation By Corridor and City

Corridor	Lafayette	Moraga	Orinda	Totals
Morning Peak Hour				
Moraga Way	6	41	78	125
Moraga Road	45	56	0	101
St. Marys Road - Glenside Dr. - Reliez Station Rd. - Olympic Blvd.	12	35	0	47
Totals	63	132	78	273
Afternoon Peak Hour				
Moraga Way	15	57	105	177
Moraga Road	102	76	0	178
St. Marys Road - Glenside Dr. - Reliez Station Rd. - Olympic Blvd.	16	54	0	70
Totals	133	187	105	425

Source: Robert L. Harrison Transportation Planning

- Mitigated Available Capacity for Each Transportation Corridor

The impact of both roadway improvement projects and of the full build out of all approved development projects on the capacity of each travel corridor is shown in Table 13. The intersections that limit either existing or mitigated capacity are shown on Table 13. Where roadway improvement projects would increase the existing available capacity, the improved roadway capacity is shown. Mitigated available capacity is also depicted on Figure 4.

For all intersections where roadway improvements are now planned, the improved roadway capacity would no longer be the limiting point in any of the Corridors studied. In other words, the planned roadway improvements will add sufficient capacity to existing conditions so that the mitigated available capacity will be determined by intersections where no improvements are now planned. Examples of the impact of the roadway improvements on existing capacity and the resultant impact on mitigated capacity is described for each Corridor below.

Moraga Way Corridor

Morning Peak Hour. Existing available capacity is limited by the intersection of Moraga Way at Glorietta Boulevard where capacity is zero. Improvements to this intersection will increase available capacity to 310 vehicles. With the increased capacity, this intersection would not be the limiting point for mitigated available capacity. The intersection of Glorietta Boulevard with Rheem Boulevard where no improvements are planned becomes the limiting point for mitigated available capacity. As shown on Table 13, approved development projects would generate 125 trips at this intersection. The added trips would exceed the existing capacity of 50 vehicles. The resultant mitigated available capacity would be zero.

Afternoon Peak Hour. Existing available capacity is limited by the intersection of Camino Pablo at Brookwood Road and the SR 24 Ramps where capacity is zero. Improvements to this intersection will increase available capacity to 820 vehicle trips. This intersection would not be the limiting point for mitigated available capacity. The intersection of Glorietta Boulevard with Rheem Boulevard where no improvements are planned becomes the limiting point for mitigated available capacity. As shown on Table 13, approved development projects would generate 177 trips at this intersection. The added trips subtract from the existing capacity of 280 vehicles. The resultant mitigated available capacity would be about 100 vehicle trips.

Also shown on Table 13 is the available capacity at the intersection of Glorietta and Rheem Boulevards if a traffic signal were installed. Corridor mitigated available capacity would be increased to about 185 morning peak hour

trips (limited by Moraga Way at Glorietta Boulevard) and 400 afternoon peak hour trips if this limiting intersection were signalized. There are no current plans to install a traffic signal at this intersection.

Table 13
Total Existing and Mitigated Available Capacity*

Corridor	Limiting Intersection	**Existing** Available Capacity	Improved Roadway Capacity	Approved Projects Trip Generation	**Mitigated** Available Capacity
Morning Peak Hour					
Moraga Way	Moraga Way at Glorietta Boulevard	None	310 = Not Limiting		N/A
Moraga Way	Glorietta Blvd. at Rheem Boulevard [If signalized]	50	N/A [800]	125	None
Moraga Road	Moraga Road at Moraga Boulevard	None	570 = Not Limiting		N/A
Moraga Road	Moraga Road at School / Brook Streets	90	400 = Not Limiting		N/A
Moraga Road	Moraga Rd at Hamlin Rd/Tanglewood Dr. [If signalized]	250	N/A [730]	101	150
St. Marys-Glenside Reliez Station Rd-Olympic Boulevard	Glenside Drive at Reliez Station Road	150	N/A	47	100
	Total Morning Peak Hour Mitigated Available Capacity				**250**
Afternoon Peak Hour					
Moraga Way	Camino Pablo at Brookwood Road / SR 24 Ramps	None	820 = Not Limiting		N/A
Moraga Way	Glorietta Blvd. at Rheem Blvd. [If signalized]	280	N/A [570]	177	100
Moraga Road	Moraga Road at Moraga Boulevard	None	850 = Not Limiting		N/A
Moraga Road	Moraga Road at Hamlin Rd/Tanglewood Dr. [If signalized]	100	N/A [850]	178	None
St. Marys-Glenside-Reliez Station Rd-Olympic Boulevard	Glenside Drive at Reliez Station Road	310	N/A	70	240
	Total Afternoon Peak Hour Mitigated Available Capacity				**340**

* Note: Data in this table is rounded for clarity of presentation.

Source: Robert L. Harrison Transportation Planning

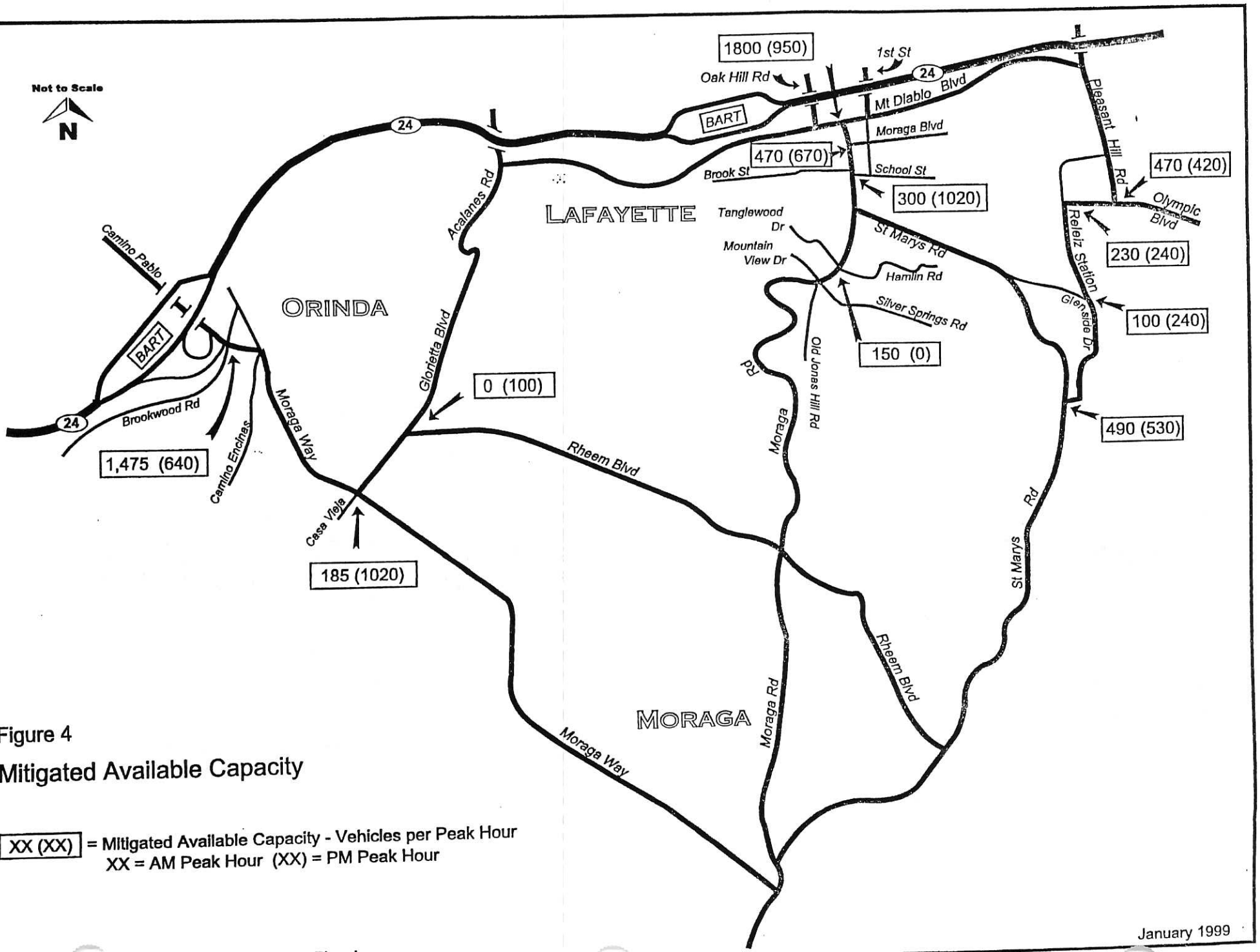

Figure 4

Mitigated Available Capacity

XX (XX) = Mitigated Available Capacity - Vehicles per Peak Hour
XX = AM Peak Hour (XX) = PM Peak Hour

January 1999

Source: Robert L. Harrison Transportation Planning

Moraga Road Corridor

Morning Peak Hour. Existing available capacity is limited by the intersection of Moraga Road at Moraga Boulevard where capacity is zero. Signalization of this intersection will increase available capacity to 570 vehicle trips. The intersection of Moraga Road at School and Brook Streets has an existing available capacity of 90 trips. Planned improvements will increase this capacity to 400 trips. Neither of the above intersections would limit mitigated available capacity.

The intersection of Moraga Road at Hamlin Road / Tanglewood Drive where no improvements are planned becomes the limiting point for mitigated available capacity. As shown on Table 13, approved development projects would generate 101 trips at this intersection. The added trips subtract from the existing capacity of 250 vehicles. The resultant mitigated available capacity would be about 150 vehicle trips.

Afternoon Peak Hour. Existing available capacity is also limited by the intersection of Moraga Road with Moraga Boulevard where capacity is zero. Signalization of this intersection will increase available capacity to 850 vehicle trips. This intersection would not limit mitigated available capacity. The intersection of Moraga Road at Hamlin Road / Tanglewood Drive where no improvements are planned would again be the limiting point for mitigated available capacity. As shown on Table 13, approved development projects would generate 178 trips at this intersection. The added trips would exceed the existing capacity of 100 vehicles. The resultant mitigated available capacity would be zero.

Also shown on Table 13 is the available capacity at the intersection of Moraga Road with Hamlin Road / Tanglewood Drive if a traffic signal were installed. Corridor mitigated available capacity would be increased to about 300 morning peak hour (limited by Moraga Road at School / Brook Streets) and 670 afternoon peak hour trips if this limiting intersection were signalized. There are no current plans to install a traffic signal at this intersection.

St. Marys Road - Glenside Drive - Reliez Station Road - Olympic Boulevard Corridor

Morning Peak Hour. Existing available capacity is limited by the intersection of Glenside Drive at Reliez Station Road where capacity is 150 vehicle trips. There are no roadway improvements planned for this Corridor so mitigated available capacity is based on the existing 150 available vehicle trips. The approved development projects would generate 47 trips. The resultant mitigated available capacity is about 100 vehicle trips.

Afternoon Peak Hour. Existing available capacity is again limited by the intersection of Glenside Drive at Reliez Station Road where capacity is 310 vehicle trips. Again, there are no roadway improvements planned for this Corridor so mitigated available capacity is based on the existing 310 available vehicle trips. The approved development projects would generate 70 trips. The resultant mitigated available capacity is about 240 vehicle trips.

Total Mitigated Available Corridor Capacity

In summary, total mitigated available capacity for all three travel corridors is approximately 250 trips in the morning peak hour and 340 trips in the afternoon peak hour. If those stop sign controlled intersections that limit mitigated available capacity were signalized, the mitigated capacity would be increased.

Appendix

Definition of Signalized Intersection Level of Service

The Highway Capacity Manual defines signalized intersection service levels as follows:[9]

Level of Service A describes operations with very limited delay, less than five seconds per vehicle. This occurs when progression is extremely favorable and when most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level of Service B describes operations with delay greater than five and up to 15 seconds per vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS A, causing higher levels of average delay.

Level of Service C describes operations with delay greater than 15 and up to 25 seconds per vehicle. These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.

Level of Service D describes operations with delay greater than 25 seconds and up to 40 seconds per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

Level of Service E describes operations with delay greater than 40 seconds and up to 60 seconds per vehicle. This limit is considered by many agencies to be the limit of acceptable delay. These very high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.

Level of Service F describes operations with delay in excess of 60 seconds per vehicle. This level, considered to be unacceptable to most drivers, often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

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9 Transportation Research Board, *Highway Capacity Manual - Special Report 209*, Third Edition, 1994.

Definition of Technical Terms

In order to clarify the meaning of certain terms that are unique to traffic engineering the following definitions of technical terms are provided.

Annual Average Daily Traffic (AADT) is the typical number of vehicles that pass a particular point on the street system averaged over a year. Vehicle counts will likely be higher than the AADT for certain seasons of the year and lower at other times.

Level of Service (LOS) is the system used to evaluate the operation of the street and freeway system. LOS is expressed in terms similar to a school report card with letter grades from A to F. At levels A and B there would be little congestion or delay for motorists. Levels E and F indicate significant congestion and long delays for motorists.

Delay for motorists is estimated to determine how well the street system is working. At traffic signals delay is expressed as the time an average vehicle is stopped and has to wait for the light to change from red to green. Delay at stop signs and roundabouts is the total time from when a motorist first arrives at the intersection until there is a gap in the opposing traffic stream and the driver is able to proceed.

Progression describes the kind of traffic arrival type experienced at a particular signalized intersection. For example, if vehicles arrive in dense platoons at the start of the red phase of the signal the quality of progression is very poor. On the other hand, if traffic arrives in dense platoons at the beginning of each green phase of the traffic signal the quality of progression is highly favorable.

Cycle length is the length of time it takes for all phases of a traffic signal to be consecutively displayed.

Green time ratio is the comparison of the length of time the green phase is displayed as compared to the total cycle length of a traffic signal.

Volume to capacity ratio (V/C ratio) is the comparison of the traffic volume using a facility to the theoretical capacity of the same facility.

Approved Projects Trip Assignment and Trip Generation Calculation Spreadsheets

Approved Projects' Trips Assigned by Travel Corridor

	Travel Corridors					
	Moraga Way		Moraga Road		Reliez Station Etc.	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Total Approved Projects' Trips	**125**	**178**	**102**	**178**	**48**	**70**

Approved Projects' Trips by City

	Trip Generation		Travel Corridors								
			Moraga Way			Moraga Road			Reliez Station Etc.		
	AM Peak	PM Peak	% of	Trips		% of	Trips		% of	Trips	
Project Name	Hour	Hour	Total	AM Peak	PM Peak	Total	AM Peak	PM Peak	Total	AM Peak	PM Peak
Lafayette Projects											
Town Center	68	70									
	73	274									
	40	49									
Less:	-39	-27									
Totals*	142	366	0%	0	0	15%	21	55	0%	0	0
La Fiesta	0	0	100%	0	0	0%	0	0	0%	0	0
Club Sport**	112	301	5%	6	15	10%	11	30	0%	0	0
Gousias	3	5	0%	0	0	100%	3	5	0%	0	0
French	3	3	0%	0	0	100%	3	3	0%	0	0
Bruzzone	7	9	0%	0	0	80%	5	7	20%	1	2
Focus Realty	8	10	0%	0	0	0%	0	0	100%	8	10
Hourany	2	2	0%	0	0	100%	2	2	0%	0	0
De Silva	3	5	0%	0	0	0%	0	0	100%	3	5
Lafayette Totals	279	701		6	15		45	102		12	16

*Project totals at Mt.Diablo/Moraga Road Intersection

Trips on Mt. Diablo Blvd.	40%	57	146
Total at Mt. Diablo/Moraga Rd Intersection		78	201

**Project totals at Mt.Diablo/Moraga Road Intersection

Trips on Mt. Diablo Blvd.	20%	22	60
Total at Mt. Diablo/Moraga Rd Intersection		34	90

Orinda Projects											
Montanera	189	254	20%	38	51	0%	0	0	0%	0	0
Castlegate	35	47	100%	35	47	0%	0	0	0%	0	0
Zuckerman	3	5	100%	3	5	0%	0	0	0%	0	0
Urban	2	2	100%	2	2	0%	0	0	0%	0	0
Orinda Totals	229	308		78	105		0	0		0	0

Approved Projects' Trips Assigned by Travel Corridor

	Trip Generation		Travel Corridors								
			Moraga Way			Moraga Road			Reliez Station Etc.		
	AM Peak	PM Peak	% of	Trips		% of	Trips		% of	Trips	
Project Name	Hour	Hour	Total	AM Peak	PM Peak	Total	AM Peak	PM Peak	Total	AM Peak	PM Peak
Moraga Projects											
Mulholland Hill	5	7	25%	1	2	65%	3	4	10%	1	1
Oakbay KimberlyDr	5	7	75%	4	5	20%	1	1	5%	0	0
Batavia/Longwood	4	5	25%	1	1	65%	3	3	10%	0	1
Camino Moraga	8	10	30%	2	3	42%	3	4	28%	2	3
Moraga Valley Lane	21	28	40%	8	11	36%	8	10	24%	5	7
Country Club Vista	13	18	40%	5	7	36%	5	7	24%	3	4
MoragaCountryClul	19	26	40%	8	10	36%	7	9	24%	5	6
MoragaCountryClul	38	51	40%	15	20	36%	14	18	24%	9	12
MS602-91 Thoms	2	3	75%	1	2	20%	0	1	5%	0	0
OakmontSeniorCar	5	13	40%	2	5	36%	2	5	24%	1	3
Luxor Apartments	15	18	25%	4	5	65%	10	12	10%	1	2
St. Mary's Dorms	24	40	0%	0	0	20%	5	8	80%	19	32
Rheem Theatre	0	0	25%	0	0	65%	0	0	10%	0	0
BofA ATM Kiosk	0	0	25%	0	0	65%	0	0	10%	0	0
Adv.MobileSolution Product Dev. Ctr	45	46	25%	11	12	60%	27	28	15%	7	7
Moraga Barn	2	16	30%	1	5	40%	1	7	30%	1	5
Moraga Totals	205	288		63	88		87	117		54	83
Moraga Regional Trips	65%	of Total				(Adds to Traffic in Orinda and Lafayette)					
	133	187		41	57		56	76		35	54
Moraga Local Trips	35%	of Total									
	72	101		22	31		30	41		19	29

Approved Projects Trip Generation

	Daily	AM Peak Hour	PM Peak Hour
Total Lamorinda Approved Projects' Trip Generation	**12,544**	**713**	**1,298**

Approved Projects' Trip Generation by City

Project Name	Land Use Type	Amount	Units	Trip Generation Rate	Daily Trips	AM Peak Hour Rate	AM Peak Hour Trips	PM Peak Hour Rate	PM Peak Hour Trips
Lafayette Projects									
Town Center	Office	26	GFA 000's	18	472	Note 1	68	Note 1	70
	Retail	25	GFA 000's	112	2,795	Note 1	73	Note 1	274
	MF Residentia	75	D.U.s	7.73	580	Note 1	40	Note 1	49
Less:	Existing Trips		(Parking Lot)		(150)		(39)		(27)
Town CenterTotals					3,697		142		366
	Retail (Existing Rehabilitation)				0		0		0
La Fiesta	Health Club	70	GFA 000's	40	2,800	1.6	112	4.3	301
Club Sport	SF Residential	4	D.U.s	10.67	43	0.84	3	1.13	5
Gousias	SF Residential	3	D.U.s	10.67	32	0.84	3	1.13	3
French	SF Residential	8	D.U.s	10.67	85	0.84	7	1.13	9
Bruzzone	SF Residential	9	D.U.s	10.67	96	0.84	8	1.13	10
Focus Realty	SF Residential	2	D.U.s	10.67	21	0.84	2	1.13	2
Hourany	SF Residential	4	D.U.s	10.67	43	0.84	3	1.13	5
De Silva									
Lafayette Totals					6,817		279		701

Note 1: Trips from the "Updated Lafayette Town Center Traffic Impact Study", Korve Engineering. March 6, 1997.

Orinda Projects									
Montanera in Gateway Valley	SF Residential	225	D.U.s	10.67	2401	0.84	189	1.13	254
Castlegate	SF Residential	42	D.U.s	10.67	448	0.84	35	1.13	47
Zuckerman	SF Residential	4	D.U.s	10.67	43	0.84	3	1.13	5
Urban	SF Residential	2	D.U.s	10.67	21	0.84	2	1.13	2
Orinda Totals					2,913		229		308

Approved Projects Trip Generation

Project Name	Land Use Type	Land Use Amount	Land Use Units	Trip Generation Daily Rate	Daily Trips	AM Peak Hour Rate	AM Peak Hour Trips	PM Peak Hour Rate	PM Peak Hour Trips
Moraga Projects									
LL01 Mulholland Hill	SF Residential	6	D.U.s	10.67	64	0.84	5	1.13	7
UP-08-97 Oakbay Kimberly Dr.	SF Residential	5	D.U.s	12.47	62	0.98	5	1.32	7
UP-01-97 Batavia / Longwood	SF Residential	4	D.U.s	12.47	50	0.98	4	1.32	5
Sub8067 Camino Moraga	SF Residential	9	D.U.s	10.67	96	0.84	8	1.13	10
Sub7301 Moraga Valley Lane	SF Residential	25	D.U.s	10.67	267	0.84	21	1.13	28
Sub7764 Country Club Vista	SF Residential	16	D.U.s	10.67	171	0.84	13	1.13	18
Sub7351 Moraga Country Club	SF Residential	23	D.U.s	10.67	245	0.84	19	1.13	26
Sub7747 Moraga Country Club	SF Residential	45	D.U.s	10.67	480	0.84	38	1.13	51
MS602-91 Thoms	SF Residential	2	D.U.s	12.47	25	0.98	2	1.32	3
UP-10-96 Oakmont Senior Ass. Care Facility		76	Rooms	2.15	163	0.06	5	0.17	13
UP-03-95 Luxor Apartments	MF Residentia	25	D.U.s	7.73	193	0.59	15	0.72	18
UP-05-97 St. Mary's College Dormitories		80	Rooms	5	400	0.3	24	0.5	40
UP-12-97 Rheem Theatre	Movie Theatre	-499	Seats		0		0		0
UP-11-97 BofA ATM Kiosk	Auto Teller	(Exist.Conversion)			0		0		0
UP-06-97 Advanced Mobile Solutions Product Development Cente	R + D	28	GFA 000's	15.31	429	1.59	45	1.65	46
UP-03-97 Moraga Barn	Restaurant	35	Seats	4.83	169	0.01	2	0.47	16
Moraga Totals					2,815		205		288

Existing Traffic Counts

Existing Traffic Counts (Page 1 of 4)

Updated With October 1998 Data Where Available

MORAGA WAY CORRIDOR

Intersection Turning Movements	Camino Pablo at Brookwood Rd./ SR 24 Off-ramp	Moraga Way at Camino Pablo/ Camino Encinas	Moraga Way at Glorietta Blvd./ Casa Vieja	Glorietta Blvd. at Rheem Blvd.
Morning Peak Hour				
NB Left	8	8	1	0
NB Thru	1191	1132	914	190
NB Right	9	294	91	62
South Leg Approach	*1208*	*1434*	*1006*	*252*
South Leg Departure	*798*	*839*	*796*	*499*
WB Left	8	80	172	373
WB Thru	2	5	3	0
WB Right	338	39	342	102
East Leg Approach	*348*	*124*	*517*	*475*
East Leg Departure	*324*	*383*	*204*	*103*
SB Left	206	44	109	41
SB Thru	549	751	622	126
SB Right	13	1	1	0
North Leg Approach	*768*	*796*	*732*	*167*
North Leg Departure	*1774*	*1228*	*1260*	*292*
EB Left	245	57	4	0
EB Thru	109	45	4	0
EB Right	241	8	2	0
West Leg Approach	*595*	*110*	*10*	*0*
West Leg Departure	*23*	*14*	*5*	*0*
Total Approach Vol.	*2919*	*2464*	*2265*	*894*
Afternoon Peak Hour				
NB Left	15	2	3	0
NB Thru	567	529	454	132
NB Right	20	213	79	344
South Leg Approach	*602*	*744*	*536*	*476*
South Leg Departure	*1228*	*1403*	*866*	*291*
WB Left	29	140	88	136
WB Thru	5	4	3	0
WB Right	262	45	137	46
East Leg Approach	*296*	*189*	*228*	*182*
East Leg Departure	*499*	*300*	*371*	*429*
SB Left	299	41	291	85
SB Thru	647	1239	777	155
SB Right	49	1	1	0
North Leg Approach	*995*	*1281*	*1069*	*240*
North Leg Departure	*1695*	*607*	*594*	*178*
EB Left	866	33	3	0
EB Thru	180	46	1	0
EB Right	552	24	1	0
West Leg Approach	*1598*	*103*	*5*	*0*
West Leg Departure	*69*	*7*	*7*	*0*
Total Approach Vol.	*3491*	*2317*	*1838*	*898*

Existing Traffic Counts (Page 2 of 4)

Updated With October 1998 Data Where Available

MORAGA ROAD CORRIDOR

Intersection Turning Movements	Moraga Rd.at Mt.Diablo Blvd. (10/98)	Oak Hill Rd. at Mt.Diablo Blvd. (10/98)	First St. at Mt.Diablo Blvd. (10/98)	Moraga Rd. at School/Brook St	Moraga Rd. at St. Marys Rd.
Morning Peak Hour					
NB Left	397	50	14	7	0
NB Thru	131	56	39	1188	801
NB Right	683	51	15	17	36
South Leg Approach	*1211*	*157*	*68*	*1212*	*837*
South Leg Departure	*859*	*133*	*124*	*914*	*591*
WB Left	535	61	9	36	76
WB Thru	329	523	452	0	0
WB Right	38	188	158	339	464
East Leg Approach	*902*	*772*	*619*	*375*	*540*
East Leg Departure	*1180*	*739*	*544*	*114*	*230*
SB Left	48	266	92	96	194
SB Thru	73	60	103	864	515
SB Right	31	150	483	8	0
North Leg Approach	*152*	*476*	*678*	*968*	*709*
North Leg Departure	*227*	*308*	*913*	*1577*	*1265*
EB Left	58	64	716	50	0
EB Thru	449	422	437	1	0
EB Right	251	12	12	14	0
West Leg Approach	*758*	*498*	*1165*	*65*	*0*
West Leg Departure	*757*	*723*	*949*	*15*	*0*
Total Approach Vol.	*3023*	*1903*	*2530*	*2620*	*2086*
Afternoon Peak Hour					
NB Left	312	38	29	50	0
NB Thru	102	75	36	739	509
NB Right	579	100	29	17	24
South Leg Approach	*993*	*213*	*94*	*806*	*533*
South Leg Departure	*1051*	*167*	*213*	*1232*	*943*
WB Left	579	43	17	42	23
WB Thru	456	682	521	0	0
WB Right	43	99	122	63	215
East Leg Approach	*1078*	*824*	*660*	*105*	*238*
East Leg Departure	*1421*	*1137*	*933*	*37*	*412*
SB Left	106	314	165	19	388
SB Thru	139	94	174	1072	920
SB Right	51	206	567	30	0
North Leg Approach	*296*	*614*	*906*	*1121*	*1308*
North Leg Departure	*219*	*340*	*807*	*837*	*724*
EB Left	74	166	649	35	0
EB Thru	736	723	739	1	0
EB Right	333	30	22	118	0
West Leg Approach	*1143*	*919*	*1410*	*154*	*0*
West Leg Departure	*819*	*926*	*1117*	*80*	*0*
Total Approach Vol.	*3510*	*2570*	*3070*	*2186*	*2079*

Existing Traffic Counts (Page 3 of 4)

Updated With October 1998 Data Where Available

MORAGA ROAD CORRIDOR

Intersection Turning Movements	Moraga Rd. at Hamlin Rd. / Tanglewood Dr.	Moraga Rd. at Silver Springs Rd./ Old Jonas Hill Rd.	Moraga Road at Rheem Blvd.	Moraga Road at St.Marys Rd.(South)
Morning Peak Hour				
NB Left	5	0	147	0
NB Thru	780	715	661	442
NB Right	10	6	19	232
South Leg Approach	*795*	*721*	*827*	*674*
South Leg Departure	*470*	*459*	*509*	*552*
WB Left	10	9	25	212
WB Thru	0	0	76	0
WB Right	35	77	83	25
East Leg Approach	*45*	*86*	*184*	*237*
East Leg Departure	*30*	*36*	*169*	*285*
SB Left	20	30	110	53
SB Thru	455	450	414	340
SB Right	10	4	1	0
North Leg Approach	*485*	*484*	*525*	*393*
North Leg Departure	*835*	*800*	*838*	*467*
EB Left	20	8	94	0
EB Thru	0	0	40	0
EB Right	5	0	70	0
West Leg Approach	*25*	*8*	*204*	*0*
West Leg Departure	*15*	*4*	*224*	*0*
Total Approach Vol.	*1350*	*1299*	*1740*	*1304*
Afternoon Peak Hour				
NB Left	3	0	131	0
NB Thru	640	607	372	494
NB Right	2	6	62	399
South Leg Approach	*645*	*613*	*565*	*893*
South Leg Departure	*943*	*902*	*729*	*872*
WB Left	6	5	61	356
WB Thru	0	0	49	0
WB Right	10	41	59	53
East Leg Approach	*16*	*46*	*169*	*409*
East Leg Departure	*36*	*64*	*255*	*436*
SB Left	34	58	81	37
SB Thru	936	897	459	516
SB Right	15	3	1	0
North Leg Approach	*985*	*958*	*541*	*553*
North Leg Departure	*660*	*650*	*604*	*547*
EB Left	10	2	173	0
EB Thru	0	0	112	0
EB Right	1	0	209	0
West Leg Approach	*11*	*2*	*494*	*0*
West Leg Departure	*18*	*3*	*181*	*0*
Total Approach Vol.	*1657*	*1619*	*1769*	*1855*

Existing Traffic Counts (Page 4 of 4)

Updated With October 1998 Data Where Available

ST.MARYS RD.- GLENSIDE DR.- RELIEZ STATION RD.- OLYMPIC BLVD. CORRIDOR

Intersection	St.Marys Rd.	St.Marys Rd.	Glenside Dr.	ReliezStation R.	Olympic Blvd.	Pleasant Hill Rd.
Turning	at	at	at	at	at	at
Movements	Rheem Blvd.	Glenside Dr.	ReliezStation R.	Olympic Blvd.	Pleasant Hill Rd.	Mt.Diablo Blvd.
		(10/98)			(10/98)	(10/98)
Morning Peak Hour						
NB Left	**29**	**7**	**19**	**0**	**0**	**238**
NB Thru	**246**	**121**	**585**	**15**	**4**	**682**
NB Right	**0**	**345**	**0**	**620**	**0**	**361**
South Leg Approach	*275*	*473*	*604*	*635*	*4*	*1281*
South Leg Departure	*307*	*251*	*323*	*425*	*5*	*648*
WB Left	**0**	**186**	**0**	**400**	**0**	**0**
WB Thru	**0**	**19**	**0**	**0**	**223**	**0**
WB Right	**0**	**78**	**0**	**15**	**466**	**0**
East Leg Approach	*0*	*283*	*0*	*415*	*689*	*0*
East Leg Departure	*0*	*442*	*0*	*625*	*586*	*704*
SB Left	**0**	**40**	**0**	**5**	**330**	**0**
SB Thru	**258**	**54**	**309**	**25**	**5**	**463**
SB Right	**120**	**6**	**28**	**0**	**226**	**374**
North Leg Approach	*378*	*100*	*337*	*30*	*561*	*837*
North Leg Departure	*335*	*241*	*664*	*30*	*847*	*763*
EB Left	**89**	**42**	**79**	**0**	**377**	**81**
B Thru	**0**	**57**	**0**	**0**	**256**	**343**
EB Right	**49**	**11**	**14**	**0**	**0**	**185**
West Leg Approach	*138*	*110*	*93*	*0*	*633*	*609*
West Leg Departure	*149*	*32*	*47*	*0*	*449*	*612*
Total Approach Vol.	*791*	*966*	*1034*	*1080*	*1887*	*2727*
Afternoon Peak Hour						
NB Left	**117**	**19**	**9**	**0**	**0**	**203**
NB Thru	**321**	**74**	**409**	**5**	**5**	**560**
NB Right	**0**	**300**	**0**	**420**	**0**	**166**
South Leg Approach	*438*	*393*	*418*	*425*	*5*	*929*
South Leg Departure	*407*	*495*	*554*	*640*	*8*	*940*
WB Left	**0**	**320**	**0**	**625**	**2**	**0**
WB Thru	**0**	**41**	**0**	**0**	**289**	**0**
WB Right	**0**	**53**	**0**	**15**	**517**	**0**
East Leg Approach	*0*	*414*	*0*	*640*	*808*	*0*
East Leg Departure	*0*	*423*	*0*	*422*	*765*	*702*
SB Left	**0**	**98**	**0**	**2**	**513**	**0**
SB Thru	**329**	**158**	**521**	**15**	**6**	**735**
SB Right	**98**	**37**	**73**	**0**	**362**	**422**
North Leg Approach	*427*	*293*	*594*	*17*	*881*	*1157*
North Leg Departure	*465*	*158*	*456*	*20*	*810*	*809*
EB Left	**144**	**31**	**47**	**0**	**288**	**249**
EB Thru	**0**	**25**	**0**	**0**	**252**	**536**
EB Right	**78**	**17**	**33**	**0**	**0**	**205**
West Leg Approach	*222*	*73*	*80*	*0*	*540*	*990*
West Leg Departure	*215*	*97*	*82*	*0*	*651*	*625*
Total Approach Vol.	*1087*	*1173*	*1092*	*1082*	*2234*	*3076*

Calculation of Intersection Level of Service

(Available under separate cover)