McCORRISTON MILLER MUKAI MacKINNON LLP

RANDALL F. SAKUMOTO 4848
Five Waterfront Tower, Suite 400
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Attorney for Petitioners
Makena Hotel, LLC, Makena
Golf, LLC and Keaka LLC

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of MAKENA RESORT CORP. To Amend the Land Use District Boundary of Certain Land Situated at Makena, Island of Maui, State of Hawaii, consisting of approximately 146.209 acres from the Agricultural to the urban District.	DOCKET NO. A97-721 PETITIONERS MAKENA HOTEL, LLC MAKENA GOLF, LLC, AND KEAKA LLC'S MOTION FOR FOURTH AMENDMENT TO THE FINDINGS OF FACT, CONCLUSIONS OF LAW AND DECISION AND ORDER, FILED ON FEBRUARY 19, 1998; AFFIDAVIT OF ROY FIGUEIROA, AFFIDAVIT OF RANDALL F. SAKUMOTO; CERTIFICATE OF SERVICE

PETITIONERS MAKENA HOTEL, LLC, MAKENA GOLF, LLC AND KEAKA LLC'S MOTION FOR FOURTH AMENDMENT TO THE FINDINGS OF FACT, CONCLUSIONS OF LAW AND DECISION AND ORDER, FILED ON FEBRUARY 19, 1998

COME NOW, Petitioners Makena Hotel, LLC, Makena Golf, LLC and Keaka LLC (collectively, "Petitioners"), by and through their attorneys, McCorriston Miller Mukai MacKinnon LLP, and respectfully submit this Motion for Fourth Amendment to the Findings of Fact, Conclusions of Law and Decision and Order, filed in these proceedings on February 19, 1998 (the "Decision and Order"). This Motion is made pursuant to Hawaii Administrative Rules

("HAR") §15-15-70 and §15-15-94, and is further supported by the attached affidavits, and records and files contained herein.

Condition No. 12 of the Decision and Order, as amended by Order Granting In Part and Denying In Part Petitioner's Motion for First Amendment to the Findings of Fact, Conclusions of Law and Decision and Order, Filed February 19, 1998 (the "Amended Decision and Order"), originally read as follows:

> "12. Petitioner shall participate in the pro rata funding and construction of local and regional transportation improvements and programs, including dedication of rights of way as determined by the State Department of Transportation (DOT) and the County of Maui. Agreement between Petitioner and DOT as to the level of funding and participation shall be obtained within two (2) years from June 1, 2000."

On May 25, 2004, Makena Resort Corp., filed a Motion for Third Amendment to the Findings of Fact, Conclusions of Law, and Decision and Order, Filed on February 19, 1998, pursuant to HAR §15-15-70 and HAR §15-15-94. Makena Resort Corp. requested that the Land Use Commission further amend Condition No. 12 to read as follows:

> "12. Petitioner shall participate in the pro rata funding and construction of local and regional transportation improvements and programs, including dedication of rights of way as determined by the State Department of Transportation ("DOT") and the County of Maui. Agreement between Petitioner and DOT as to the level of funding and participation shall be obtained within two (2) years from June 1, 2004."

The Land Use Commission duly considered Makena Resort Corp's Motion, the supporting affidavit, the oral and written arguments presented by the parties, and further representations made by Petitioner during the hearing, and a motion having been made at a hearing on June 4, 2004, in Honolulu, Hawaii, and the motion having received the affirmative

votes required by HAR §15-15-13, and there being good cause for the motion, the Land Use Commission ordered that Condition No. 12 of the Amended Decision and Order dated February 19, 1998, be amended to read as follows:

> "12. Petitioner shall participate in the pro rata funding and construction of local and regional transportation improvements and programs, including dedication of rights of way as determined by the State Department of Transportation ("DOT") and the County of Maui. Agreement between Petitioner and DOT as to the level of funding and participation shall be obtained within eight (8) years from June 1, 2000."

On April 27, 2005, Petitioner Keaka LLC acquired certain lands within the original Petition Area. On June 26, 2007, Petitioners Makena Hotel, LLC and Makena Golf, LLC, acquired the properties which collectively comprise the Makena Resort, including the Maui Prince Hotel, the Makena Golf Course – South and the Makena Golf Course – North, and certain undeveloped lands. Affiliates of Makena Hotel, LLC and Makena Golf, LLC also later acquired all of the stock in Makena Wastewater Corp., the owner of the Makena wastewater treatment facility. The portions of the Makena Resort acquired by the Petitioners Makena Hotel, LLC and Makena Golf, LLC include land within the original Petition Area.

Following the above-referenced acquisitions, Petitioners continued the efforts of their predecessors, to satisfy the conditions of the Amended Decision and Order, including, but not limited to Condition No. 12 thereof. On August 10, 2007, Petitioners, through their traffic engineer, Phillip Rowell and Associates, submitted the Makena Resort Master Plan Traffic Study dated July 19, 2007, to the State Department of Transportation (the "DOT"). The traffic study was being prepared both in connection with Condition No. 12 of the Amended Decision and Order, and in support of the zone change being requested from the County of Maui. Based on its review of that traffic study, the DOT concluded in September 2007 that Piilani Highway will

need two additional lanes from Kilohana Drive to Wailea Ike Drive if a zone change were to be approved for the Makena Resort, the Honua'ula project, or both. Petitioners have since met with the DOT and have indicated their willingness to participate on a pro rata basis in the funding and construction of such improvements to Piilani Highway. Petitioners have also met with the developers of the Honua'ula and A&B Wailea projects to negotiate an agreement to share in the cost of such improvements, and such meetings are ongoing.

While Petitioners have made meaningful progress toward reaching an agreement with the DOT on its pro rata share of funding and construction of transportation improvements, additional time is required to properly address all issues related to this complex matter. Petitioners reasonably believe that such an agreement can be reached within the next twenty-four months, and therefore request that Condition No. 12 of the Amended Decision and Order be further amended to read as follows:

> "12. Petitioner shall participate in the pro rata funding and construction of local and regional transportation improvements and programs, including dedication of rights of way as determined by the State Department of Transportation ("DOT") and the County of Maui. Agreement between Petitioner and DOT as to the level of funding and participation shall be obtained within ten (10) years from June 1, 2000."

Based upon the foregoing, Petitioners herein respectfully request a hearing on this Motion, and that the Land Use Commission grant this Motion and amend Condition No. 12 of the Amended Decision and Order accordingly.

DATED: Honolulu, Hawaii, May 23, 2008.

RANDALL F. SAKUMOTO
Attorney for Petitioners
Makena Hotel, LLC, Makena Golf, LLC
and Keaka LLC

AFFIDAVIT OF ROY FIGUEIROA

STATE OF HAWAII)
) SS.
COUNTY OF MAUI)

ROY FIGUEIROA ("Affiant"), being duly sworn on oath, does hereby state as follows:

1. Affiant is the former Vice President of Makena Resort Corp., an affiliate of the prior owner of the property that is the subject of State Land Use Commission docket proceeding number A97-721. In that capacity, I was responsible for monitoring Makena Resort Corp.'s compliance with the Findings of Fact, Conclusions of Law, and Decision and Order, Filed on February 19, 1998 therein, as amended by orders filed on June 20, 2000, May 7, 2002 and May 25, 2004 therein (the "Amended Decision and Order").

2. After the Makena Resort was acquired by Makena Hotel, LLC, Makena Golf, LLC (collectively, Petitioners) and their affiliated entities in June 2007, I was hired to serve as the project manager of the Petitioners herein. In that capacity, I am responsible for monitoring Petitioners' compliance with the Amended Decision and Order, and am familiar with matters relating to this Motion for Fourth Amendment to the Decision and Order and the real property that is the subject of the same.

3. Pursuant to Condition No. 12 of the Amended Decision and Order, Petitioners have continued the efforts of their predecessor in interest, Makena Resort Corp., to satisfy the conditions of the Amended Decision and Order, including, but not limited to Condition No. 12 thereof.

4. Based upon discussions that Petitioners have had with representatives of the State Department of Transportation (the "DOT"), and based upon communications between the DOT and the County of Maui concerning the proposed zone changes for the Makena Resort, Petitioners understand that, in connection with the rezoning of the Makena Resort and the Honua'ula projects, and development of other adjacent lands, the DOT has concluded that Piilani Highway will need two additional lanes from Kilohana Drive to Wailea Ike Drive. Petitioners have expressed their willingness to participate on a pro rata basis in the funding and construction of such improvements to Piilani Highway. Petitioners have also met with the developers of the Honua'ula and A&B Wailea projects to negotiate an agreement to share in the cost of such improvements, and such meetings are ongoing.

[THE REMAINDER OF THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.]

FURTHER, AFFIANT SAYETH NAUGHT.

ROY FIGUEIROA

Subscribed and sworn to before me
this 23rd day of May, 2008.

Name of Notary: Tammie Ann Matsuura
Notary Public, State of Hawaii

My commission expires: April 9, 2012

TAMMIE ANN MATSUURA
NOTARY PUBLIC
STATE OF HAWAII

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of	)	DOCKET NO. A97-721
	)	
MAKENA RESORT CORP.	)	AFFIDAVIT OF RANDALL F. SAKUMOTO
	)	
To Amend the Land Use District Boundary of Certain Land Situated at Makena, Island of Maui, State of Hawaii, consisting of approximately 146.209 acres from the Agricultural to the urban District.	)	

AFFIDAVIT OF RANDALL F. SAKUMOTO

STATE OF HAWAII	)	
	)	SS:
CITY & COUNTY OF HONOLULU	)	

RANDALL F. SAKUMOTO, ("Affiant") being first duly sworn on oath, does hereby state as follows:

1. I am an attorney licensed to practice in all courts in the State of Hawaii and am one of the attorneys of record for Makena Hotel, LLC, Makena Golf, LLC and Keaka LLC (collectively, "Petitioners").

2. Attached hereto as **Exhibit "A"** is a true and correct copy of letter dated August 10, 2007 from Philip Rowell and Associates, to the Department of Transportation, transmitting as enclosure the Makena Resort Master Plan Traffic Study dated July 19, 2007 prepared for R. M. Towill Corporation.

3. Attached hereto as **Exhibit "B"** are true and correct copies of (i) a letter dated January 25, 2007 from the Department of Transportation to the Land Use Committee, County Council, and (ii) a letter dated September 12, 2007 from the Department of Transportation to the Land Use Committee, County Council.

4. On June 26, 2007, Petitioners, along with certain affiliates of Petitioners, collectively acquired the properties which collectively comprise the Makena Resort, including the Maui Prince Hotel, the Makena Golf Course – South and the Makena Golf Course – North, and certain undeveloped lands. Affiliates of Petitioners also later acquired all of the stock in Makena Wastewater Corp., the owner of the Makena wastewater treatment facility. The portions of the Makena Resort acquired by the Petitioners include land within the original Petition Area.

5. Makena Hotel, LLC acquired its interest in a portion of the Petition Area pursuant to that certain Limited Warranty Deed dated June 26, 2007, recorded in the Bureau of Conveyances of the State of Hawaii on June 26, 2007 as Document No. 2007-114461.

6. Makena Golf, LLC acquired its interest in a portion of the Petition Area pursuant to that certain Limited Warranty Deed dated June 26, 2007, recorded in said Bureau of Conveyances on June 26, 2007 as Document No. 2007-114462.

7. Keaka LLC acquired its interest in a portion of the Petition Area pursuant to that certain Limited Warranty Deed dated April 27, 2005, recorded in said Bureau of

Conveyances on April 27, 2005 as Document No. 2005-083571.

FURTHER, AFFIANT SAYETH NAUGHT.

RANDALL F. SAKUMOTO

Subscribed and sworn to before me
this 23rd day of May, 2008.

Name of Notary: KAREN R. YAMASATO
Notary Public, State of Hawaii
My commission expires: April 14, 2010

DIR 1237

Phillip Rowell and Associates
47-273 'D' Hui Iwa Street Kaneohe, Hawaii 96744 Phone: (808) 239-8206 FAX: (808) 239-4175 mail:prowell@hawaiiantel.net

August 10, 2007

DEPT OF TRANSPORTATION
2007 AUG 10 A 10:54
HIGHWAYS DIVISION

DIRECTOR'S OFFICE
DEPT OF
TRANSPORTATION
2007 AUG 10 A 10:24

Mr. Barry Fukunaga, Director
State of Hawaii Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813-5097

Re: Makena Resort Traffic Study

Dear Mr. Fukunaga:

Enclosed are six (6) copies of the Makena Resort Traffic Study dated July 19, 2007. I am also sending one (1) paper copy of the report to Freddie Cajigal of the Maui District office in order to hopefully expedite the review process.

The report has been prepared to support the zone change proposed by Makena Resort. We are requesting that State of Hawaii Department of Transportation review this report and provide comments in time for us to respond prior to the scheduled hearing before the Maui County Council. The proposed zone change hearing before the Maui County Council is scheduled for September 19, 2007.

During review of the report, consider the following:

1. This traffic report is not the coordinated traffic study of the South Maui development projects that has been discussed previously. It is our understanding that each of the three South Maui Developers (Makena Resort, Wailea Resort and Wailea 670, aka Honua'ula) will coordinate their studies and submit a consolidated traffic study that will address the future widening of Piilani Highway between Wailea Ike Drive and Kilohana Drive at a later date.

2. As part of the coordination of the three studies and in response to comments from SDOT, a trip generation study of resort residential units was undertaken. Trip generation rates estimated from this trip generation study were used in this updated traffic study for Makena Resort. Therefore, our trip generation calculations should be consistent with those of the other projects.

3. For Makena Resort, we have used a build-out year of 2017. This is the same build-out year indicated for Wailea Resort in the TIAR for Wailea Resort. The build-out year for Wailea 670 indicated in that project's TIAR is 2012. We took the traffic projections for each of these two projects directly from the respective traffic study and used them to develop 2017 traffic projections along Piilani Highway.

EXHIBIT "A"

Please address the Department's correspondence to Mr. Don Fujimoto of Dowling Company, Inc., with copies of Mr. Bert Toba, R.M. Towill Corporation. I have attached addresses and phone numbers of these contacts. During the Department's review, please contact me directly if there are any questions or additional information is needed. I can be reached at 808-239-8206 or 808-387-8206.

Very truly yours,
PHILLIP ROWELL AND ASSOCIATES

Phillip J. Rowell, P.E.
Principal

cc: Mr. Don Fujimoto
Dowling Company, Inc.
2005 Main Street
Wailuku, Maui, Hawaii 96793
(808) 270-0526

Mr. Bert Toba
R.M. Towill Corporation
420 Waiakamil Road, Suite 411
Honolulu, Hawaii 96817
(808) 842-1133

MAKENA RESORT MASTER PLAN
TRAFFIC STUDY

IN MAKENA, MAUI, HAWAII

Prepared For

R. M. TOWILL CORPORATION
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Phillip Rowell and Associates
47-273 'D' Hui Iwa Street
Kaneohe, Hawai'i 96744
Tel: 808-239-8206 Fax: 808-239-4175
Email: prowell@gte.net

July 19, 2007

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1. INTRODUCTION

Phillip Rowell and Associates has been retained by R. M. Towill Corporation to prepare the following traffic impact study for Makena Resort in Makena, Maui, Hawaii. This study has been prepared for a zone change application. A separate report has been prepared as a basis of design for the proposed roadways and intersections within the Makena Resort boundary.

This introductory chapter discusses the location of the project, the proposed development plan, and the study methodology.

Purpose and Objectives

1. Quantify the traffic characteristics of the proposed development plan.

2. Quantify the traffic impacts of the project on roadways providing access to and egress from the resort.

3. Identify locations where project generated traffic significantly impacts traffic levels-of-service.

4. As needed, formulate recommendations for roadway improvements to mitigate the significant traffic impacts of the project.

Study Area

During meetings with State of Hawaii Department of Transportation, it was agreed that the study area for the three development projects in South Maui (Makena Resort, Wailea Resort and Wailea 670) would restrict their studies areas to the area south of and including Kilohana Drive. The study intersections are shown in Figure 1. There are six (6) study intersections within this study area. These intersections are:

1. Piilani Highway at Kilohana Drive and Mapu Place
2. Piilani Highway at Okolani Drive and Mikioi Street
3. Piilani Highway at Wailea Ike Drive
4. Wailea Alanui Road at Wailea Ike Drive
5. Wailea Alanui Road at Kaukahi Street
6. South Kihei Road at Kilohana Drive

The intersections within the Makena Resort boundary have been analyzed separately and the analysis presented in a separate report.

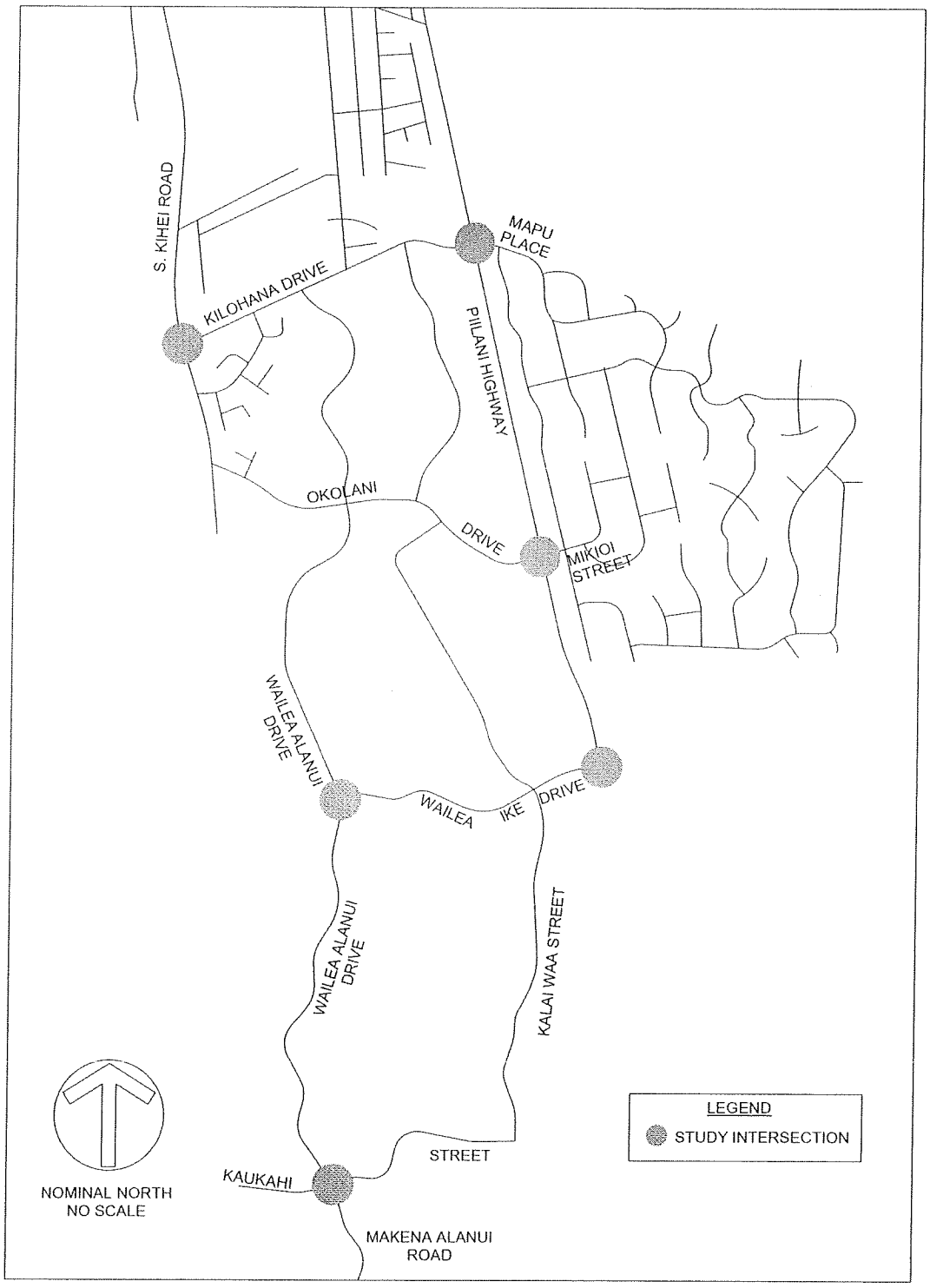

Figure 1
STUDY INTERSECTIONS

Project Location and Description

1. The proposed project is located south of Wailea and Kihei on the Island of Maui.

2. The total area of Makena Resort is approximately 1860 acres. A breakdown of the uses in this area by proposed use is summarized in Table 1.

Table 1 Description of Development Plan

Use	Existing	Future Development		Comment
		Current Plan[1]	Proposed Plan	
Hotel Use	310 Rooms[2]	545 Units	200 Rooms	345 less
Business/Retail		200,000 GSF[3]	140,000 GSF	60,000 GSF less
Multi-Family		924 Units	1,072 Units	148 more units
Single-Family		176 Units	53 Units	123 less units
Golf Course	431 Acres			
Parks		35.3 Acres	35.3 Acres	No Change
Public/Quasi Public		16.4 Acres	16.4 Acres	No Change

Notes:
(1) Source: The Traffic Management Consultant, Traffic Impact Analysis Report for the Proposed Makena Resort Master Plan, May 2000, page 12.
(2) This is the Maui Prince Hotel. The number of rooms was obtained from the hotel's web site.
(3) GSF denotes gross square feet of floor area.

3. Existing development within the study area includes the Maui Prince Hotel, golf course and tennis courts.

Study Methodology and Order of Presentation

The first tasks was to define the study area and collect exiting traffic volumes. Where possible, existing traffic volumes were obtained from recent traffic studies for various projects in Kihei, Wailea and Makena. If no counts were available or if the counts were more than two years old, new traffic counts were performed. Intersection configurations and traffic control information were also collected in the field at the time of the traffic counts. Other data collected included speed limits and right-of-way controls.

Using the data collected, existing traffic operating conditions in the study area were determined. The methodology for signalized and unsignalized intersections described in the 2000 *Highway Capacity Manual* (HCM) [1] was used to determine the level-of-service (LOS) at the study intersections.

Background traffic conditions are defined as future traffic conditions without the proposed project during the design year. The year 2017 was used as the design year because this is the anticipated build-out year for Makena Resort and Wailea Resort.

[1] *Highway Capacity Manual*, Institute of Transportation Engineers, Washington, D.C., 1997

The next step in the traffic analysis was to estimate the peak-hour traffic that would be generated by the proposed development plan. This was done using standard trip generation procedures outlined in the *Trip Generation Handbook*[2]. In general, the amount of traffic generated by each parcel of the proposed plan was estimated. These trips were distributed based on the available approach and departure routes and surrounding land uses, both existing and proposed. The project-related traffic was then superimposed on 2020 cumulative traffic volumes at the study intersections.

The operations methodology described in the *Highway Capacity Manual* was used to conduct a LOS analysis for background plus project conditions. The results of this analysis were compared to 2020 background conditions to determine the incremental impacts of this project.

Order of Presentation

Chapter 2 describes existing traffic conditions, the Level-of-Service (LOS) concept and the results of the Level-of-Service analysis of existing conditions.

Chapter 3 describes the process used to estimate 2017 background traffic volumes and the resulting background traffic projections. Background conditions are defined as future background traffic conditions without traffic generation by the study project.

Chapter 4 describes the methodology used to estimate the traffic characteristics of the proposed project, including 2017 background plus project traffic projections.

Chapter 5 discusses the results of the traffic impact analysis and identifies potential mitigation measures.

[2] *Trip Generation Handbook*, Institute of Transportation Engineers, Washington, D.C., October 1998

2. EXISTING CONDITIONS

This chapter presents the existing traffic conditions on the roadways adjacent to the proposed project. The level-of-service (LOS) concept and the results of the LOS analysis for existing conditions are also presented. The purpose of this analysis is to establish the base conditions for the determination of the impacts of the project which are described in a subsequent chapter.

Existing Major Streets and Roadways

Makena Alanui Road

The major roadway within Makena Resort is Makena Alanui Road. This roadway generally runs north-south through the resort. The roadway is a two-lane, two way roadway with bike lanes along both sides. There is a sidewalk along the makai side of the road. Intersections are STOP sign controlled.

Wailea Alanui Drive

Wailea Alanui Drive is the continuation of Makena Alanui Road north from Makena resort through Wailea Resort. This road basically connects Makena Resort with South Kihei. Wailea Alanui is a four-lane divided roadway. Major intersections are STOP sign controlled except for the intersection of Wailea Alanui Road at Wailea Ike Drive, which is signalized.

South Kihei Road

South Kihei Road begins at the northern boundary of Wailea and then runs north through Kihei to Mokulele Highway to the north. The basic cross-section is a two-lane roadway with short sections that have been widened to provide separate left or right turn lanes. The base speed limit along South Kihei Road is 25 miles per hour (mph).

Piilani Highway

Piilani Highway is a major State highway that runs north-south from Wailea Resort to Mokulele Highway through Kihei. South of Kilohana Drive, the highway was a two-lane, two-way roadway. Since then, an additional northbound and southbound through lane has been constructed. North of Kilohana Drive, Piilani Highway is a four-lanes wide. Major intersections are signalized and separate left and right turn lanes are provided. The posted speed limit is 40 mph.

Figure 2 is a schematic diagram of the above roadways indicating the lane configurations and right-or-way controls.

Existing Traffic Volumes

Existing peak hour traffic volumes within the study area were obtained from recent studies along Piilani Highway and traffic counts within and adjacent to Makena Resort. Traffic volumes along Piilani Highway south of Kulanihakoi Road were obtained from the traffic study for Wailea 670[3], which were performed during December 2000. It was determined that the traffic volumes used in the Environmental Assessment for the Piilani Highway Interim Widening Project[4] used these same traffic volumes.

For the remaining intersections, the traffic volumes were obtained from various traffic studies performed during 2002.

The morning peak hour traffic volumes are shown on Figure 3 and the afternoon peak hour traffic volumes are shown in Figure 4.

[3]BPQD, *Traffic Study for Wailea 670 Development*, May 2001

[4]Julian Ng, Inc., *Traffic Assessment Report for Piilani Highway Interim Widening*, January 2002

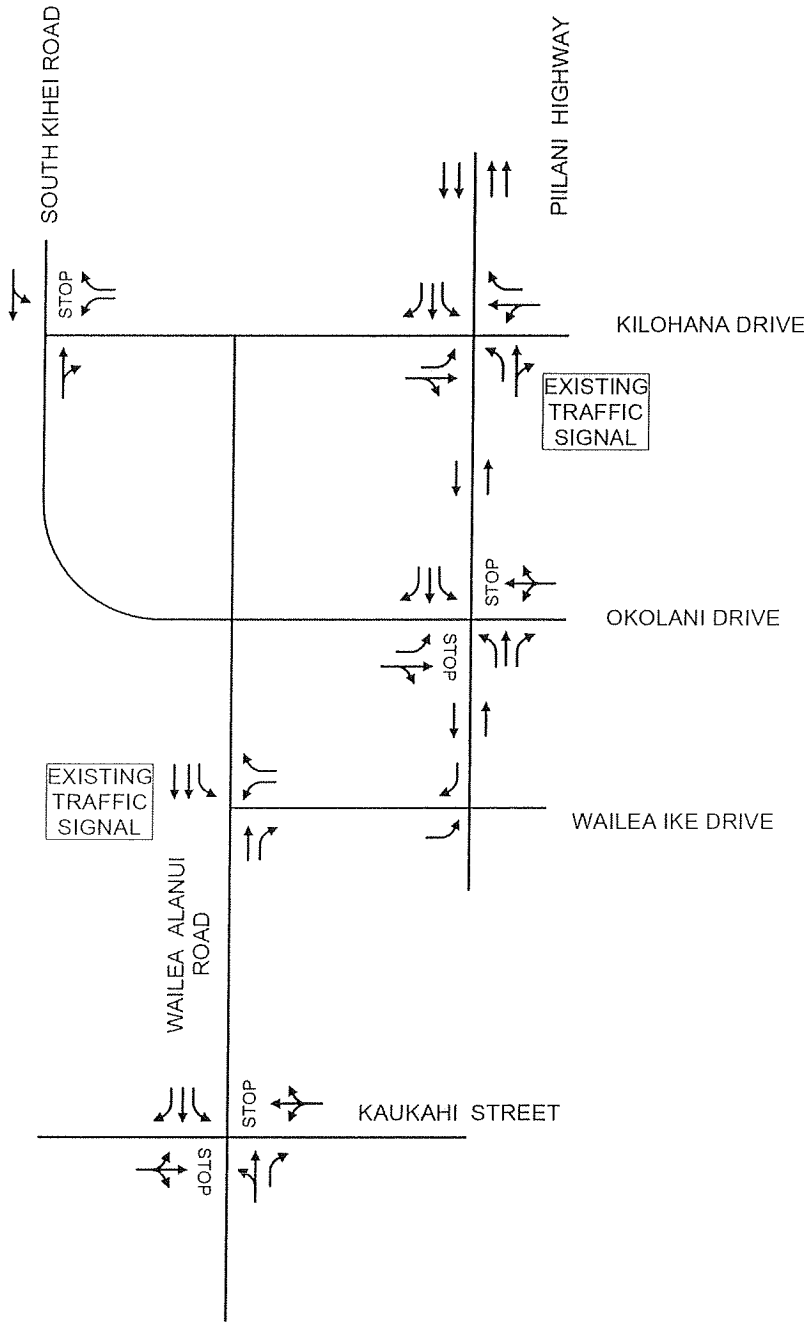

Figure 2
EXISTING LANE CONFIGURATIONS AND RIGHT-OF-WAY CONTROLS

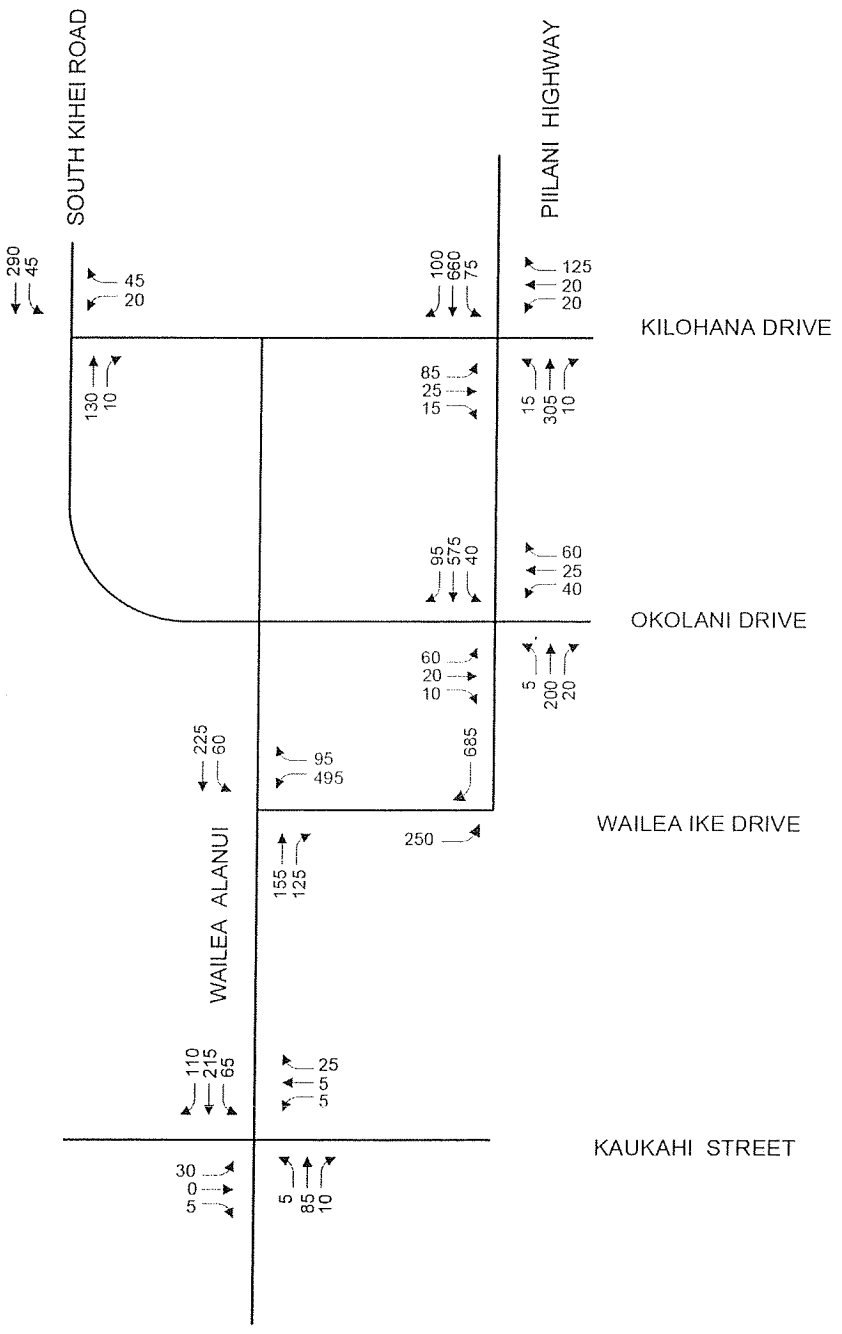

Figure 3
EXISTING AM PEAK HOUR TRAFFIC VOLUMES

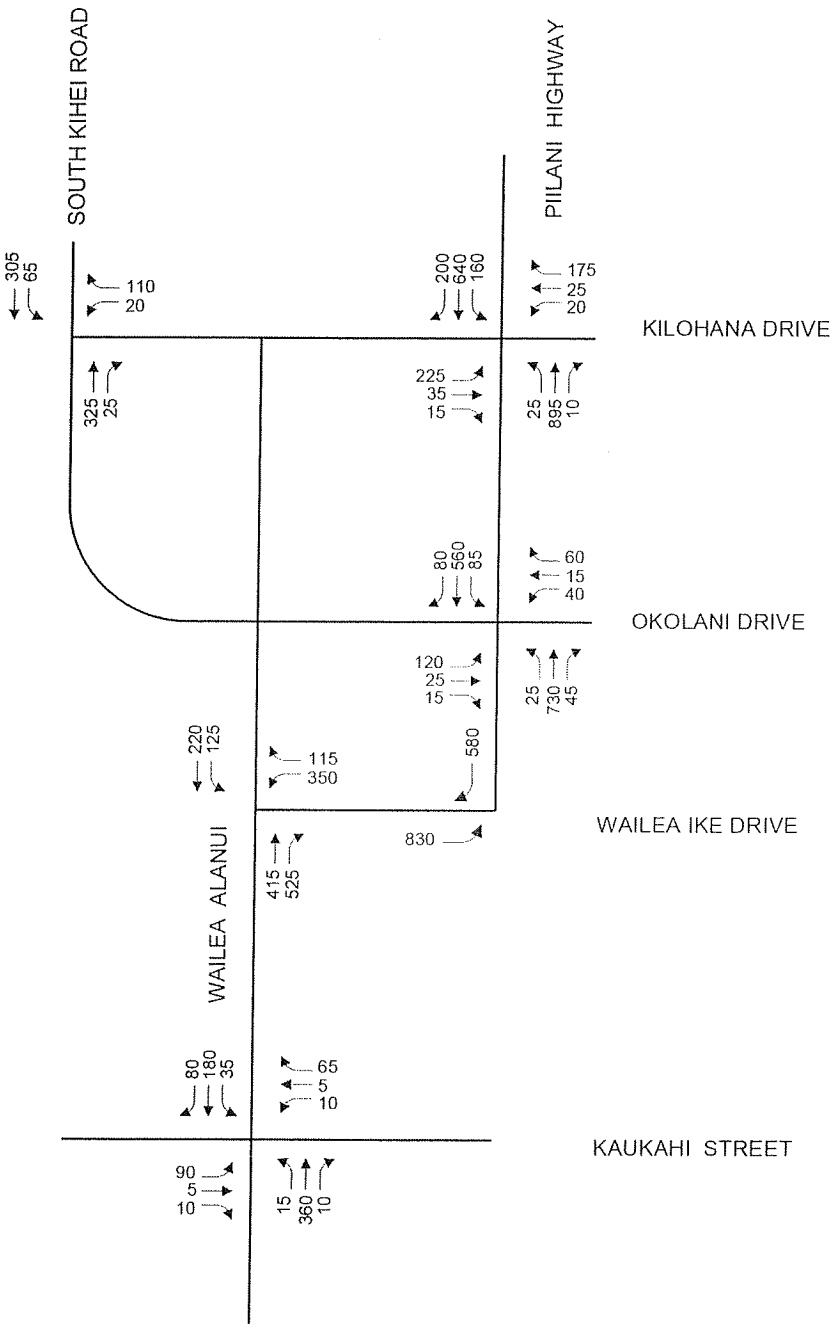

Figure 4
EXISTING PM PEAK HOUR TRAFFIC VOLUMES

Level-of-Service Concept

Signalized Intersections

The operations method described in the *2000 Highway Capacity Manual* (HCM) was used to analyze the operating efficiency of the signalized intersections adjacent to the study site. This method involves the calculation of a volume-to-capacity (V/C) ratio and average vehicle delay which is related to a level-of-service.

"Level-of-Service" is a term which denotes any of an infinite number of combinations of traffic operating conditions that may occur on a given lane or roadway when it is subjected to various traffic volumes. Level-of-service (LOS) is a qualitative measure of the effect of a number of factors which include space, speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience.

There are six levels-of-service, A through F, which relate to the driving conditions from best to worst, respectively. The characteristics of traffic operations for each level-of-service are summarized in Table 2. In general, LOS A represents free-flow conditions with no congestion. LOS F, on the other hand, represents severe congestion with stop-and-go conditions. ***Level-of-service D is typically considered acceptable for peak hour conditions in urban areas.***

Corresponding to each level-of-service shown in the table is a volume/capacity ratio. This is the ratio of either existing or projected traffic volumes to the capacity of the intersection. Capacity is defined as the maximum number of vehicles that can be accommodated by the roadway during a specified period of time. The capacity of a particular roadway is dependent upon its physical characteristics such as the number of lanes, the operational characteristics of the roadway (one-way, two-way, turn prohibitions, bus stops, etc.), the type of traffic using the roadway (trucks, buses, etc.) and turning movements.

Table 2 Level-of-Service Definitions for Signalized Intersections[1]

Level of Service	Interpretation	Volume-to-Capacity Ratio[2]	Stopped Delay (Seconds)
A, B	Uncongested operations; all vehicles clear in a single cycle.	0.000-0.700	<10.0
C	Light congestion; occasional backups on critical approaches	0.701-0.800	10.1-20.0
D	Congestion on critical approaches but intersection functional. Vehicles must wait through more than one cycle during short periods. No long standing lines formed.	0.801-0.900	20.1-35.0
E	Severe congestion with some standing lines on critical approaches. Blockage of intersection may occur if signal does not provide protected turning movements.	0.901-1.000	35.1-80.0
F	Total breakdown with stop-and-go operation	>1.001	>80.0

Notes:
(1) Source: *Highway Capacity Manual*, 2000.
(2) This is the ratio of the calculated critical volume to Level-of-Service E Capacity.

Unsignalized Intersections

Like signalized intersections, the operating conditions of intersections controlled by stop signs can be classified by a level-of-service from A to F. However, the method for determining level-of-service for unsignalized intersections is based on the use of gaps in traffic on the major street by vehicles crossing or turning through that stream. Specifically, the capacity of the controlled legs of an intersection is based on two factors: 1) the distribution of gaps in the major street traffic stream, and 2) driver judgement in selecting gaps through which to execute a desired maneuver. The criteria for level-of-service at an unsignalized intersection is therefore based on delay of each turning movement. Table 3 summarizes the definitions for level-of-service and the corresponding delay.

Table 3 Level-of-Service Definitions for Unsignalized Intersections[1]

Level-of-Service	Expected Delay to Minor Street Traffic	Delay (Seconds)
A	Little or no delay	>10
B	Short traffic delays	10.1 to 15.0
C	Average traffic delays	15.1 to 25.0
D	Long traffic delays	25.1 to 35.0
E	Very long traffic delays	35.1 to 50.0
F	See note (2) below	>50.1

Notes:
(1) Source: *Highway Capacity Manual*, 2000.
(2) When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvement of the intersection.

Level-of-Service Analysis of Existing Conditions

The results of the Level-of-Service analysis for the signalized intersections are summarized in Table 4. Shown in the table are the volume-to-capacity ratios, average vehicle delays and levels-of-service for all lane groups. The following is a summary of existing operating conditions of the study intersections.

1. The intersection of Piilani Highway at Kilohana Drive also operates at Level-of-Service B during the morning and Level-of-Service D during the afternoon peak hour.

2. The intersection of Wailea Alanui at Wailea Ike operates at Level-of-Service B during the morning and afternoon peak hours. All movements operate at Level-of-Service C or better.

The results of the Level-of-Service analysis of the unsignalized intersections is summarized in Table 5. Shown are the average vehicle delays and the levels-of-service.

1. All movements at the intersection of Wailea Alanui Drive at Kaukahi Street will operate at Level-of-Service C, or better, during both peak periods.

2. At the intersection of Piilani Highway at Okolani Drive, the eastbound approach will operate at Level-of-Service E during the morning peak hour and all other movements will operate at Level-of-Service C, or better. During the afternoon peak hour, the eastbound and westbound approaches will operate at Level-of-Service F. The remaining controlled movements, the northbound left and southbound left, will operate at Level-of-Service A.

3. At the intersection of South Kihei Road at Kilohana Drive, all movements operate at Level-of-Service C, or better.

4. The intersection of Piilani Highway at Wailea Ike Drive is not included in the level-of-service analysis because there are only two allowed movements and these movements are uncontrolled. Therefore, there is no level-of-service to calculate.

Table 4 Level-of-Service Analysis For Signalized Intersections

Intersection and Movement	AM Peak Hour V/C[1]	AM Peak Hour Delay[2]	AM Peak Hour LOS[3]	PM Peak Hour V/C	PM Peak Hour Delay	PM Peak Hour LOS
Piilani Highway at Kilohana Drive	***0.67***	***18.8***	***B***	***0.89***	***37.7***	***D***
Eastbound Left	0.51	36.6	D	0.88	70.8	E
Eastbound Thru & Right	0.16	33.3	C	0.11	38.7	D
Westbound Left & Thru	0.35	36.3	D	0.14	39.0	D
Westbound Right	0.09	34.2	C	0.12	38.8	D
Northbound Left	0.48	63.9	E	0.49	59.9	E
Northbound Thru	0.37	13.5	B	0.91	46.0	D
Northbound Right	0.01	10.3	B	0.01	14.2	B
Southbound Left	0.35	32.5	C	0.85	78.4	E
Southbound Thru	0.64	13.4	B	0.56	12.8	B
Southbound Right	0.07	6.9	A	0.14	7.8	A
Wailea Alanui Drive at Wailea Ike Drive	***0.52***	***19.8***	***B***	***0.60***	***23.2***	***C***
Westbound Left	0.84	30.0	C	0.84	53.7	D
Westbound Right	0.07	0.0	A	0.08	32.9	C
Northbound Thru	0.23	14.9	B	0.47	19.2	B
Northbound Right	0.09	13.6	B	0.39	3.3	A
Southbound Left	0.49	33.6	C	0.64	54.8	D
Southbound Thru	0.13	8.6	A	0.10	6.6	A

NOTES:
1. V/C denotes ratio of volume to capacity.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay. See Tables 2 for definitions.

Table 5 Level-of-Service Analysis For Unsignalized Intersections

Intersection and Movement	AM Peak Hour Delay[1]	AM Peak Hour LOS[2]	PM Peak Hour Delay	PM Peak Hour LOS
Wailea Alanui Road at Kaukahi Street				
Northbound Left & Thru	8.0	A	7.8	A
Southbound Left	7.5	A	8.2	A
Westbound Left, Thru & Right	10.4	B	12.9	B
Eastbound Left, Thru & right	13.3	B	24.5	C
Piilani Highway at Okulani Drive				
Northbound Left	8.4	A	8.9	A
Southbound Left	7.8	A	10.0	A
Westbound Left, Thru & Right	23.4	C	174.0	F
Eastbound Left, Thru & Right	35.3	E	937.1	F
South Kihei Road at Kilohana Drive				
Southbound Left & Thru	7.6	A	8.2	A
Westbound Left	12.9	B	17.1	C
Westbound Right	9.2	A	11.4	B

NOTES:
1. Delay is in seconds per vehicle.
2. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay. See Tables 3 for definitions.

3. PROJECT CUMULATIVE TRAFFIC CONDITIONS

The purpose of this chapter is to discuss the assumptions and data used to estimate 2017 cumulative traffic conditions. Cumulative traffic conditions are defined as future traffic volumes without the proposed project.

Future traffic growth consists of two components. The first is ambient background growth that is a result of regional growth and cannot be attributed to a specific project. The second component is estimated traffic that will be generated by other development projects in the vicinity of the proposed project.

Design Year

The design year, or horizon year, is the year for which the traffic impact of the project is analyzed. Selection of the proper design year "reflects the applicant's responsibility for only that traffic superimposed on the conditions that will exist at the time of the opening of the development."[5] The Institute of Transportation Engineers suggests that the design year for large, multi-phase projects should be one of the following:

1. The anticipated opening year of each phase,
2. The anticipated year of complete build-out or occupancy,
3. The adopted transportation plan horizon year, or
4. Additional years when a major area transportation improvement is completed.[6]

[5] Institute of Transportation Engineers, *Transportation and Land Development*, Washington, D.C., 2002, p. 3-13

[6] Ibid, p 3-13

Anticipated build-out of the study project is approximately 2017. This is also the planning horizon year of the Wailea Resort Revised Master Plan[7]. Therefore, the year 2017 was selected as the appropriate design year for the project.

Background Traffic Growth

The *Maui Long Range Transportation Plan*[8] does not provide future traffic projections for all the roadways in the study area. However, this study concluded that traffic in Maui would increase an average of 1.6% per year from 1990 to 2017. This growth rate was used to estimate the background growth between 2007, the year that the traffic counts were performed, and 2017, the design year for this project. The growth factor was calculated to be 1.172 using the following formula:

$$F = (1 + i)^n$$

where F = Growth Factor
i = Average annual growth rate, or 0.016
n = Growth period, or 10 years

This growth factor was applied to the estimated through traffic.

Related Projects

The second component in estimating background traffic volumes is traffic resulting from other proposed projects in the vicinity. Related projects are defined as those projects that are under construction or have been approved for construction and would significantly impact traffic in the study area. Related projects may be development projects or roadway improvements.

It was determined that the traffic from future development of Wailea Resort and Wailea 670 would have a direct impact on traffic projections at the study intersections. The traffic impact studies for Wailea Resort[9] and Wailea 670 [10] provided the most current data on future development between Kihei and Wailea. The build-out traffic projections at the study intersections generated by these projects are presented as Appendix A.

2017 Background Traffic Projections

2017 background traffic projections were calculated by expanding estimate through traffic volumes by the appropriate growth rate and then superimposing traffic generated by Wailea Resort and Wailea 670. The resulting 2017 morning background peak hour traffic projections are shown in Figure 5 and the 2017 afternoon peak hour traffic projections are shown on Figure 6.

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[7] Austin, Tsutsumi & Associates, *Traffic Impact Analysis Report Wailea Resort Revised Master Plan - 2005*, May 2005

[8] Kaku Associates, October 1996

[9] Austin, Tsutsumi & Associates, *Traffic Impact Analysis Report Wailea Resort Revised Master Plan - 2005*, May 2005

[10] Parsons Brinckerhoff Quade & Douglas, *Traffic Study Honulua'ula/Wailea 670, Wailea Resort & Makena Resort*, September 2006

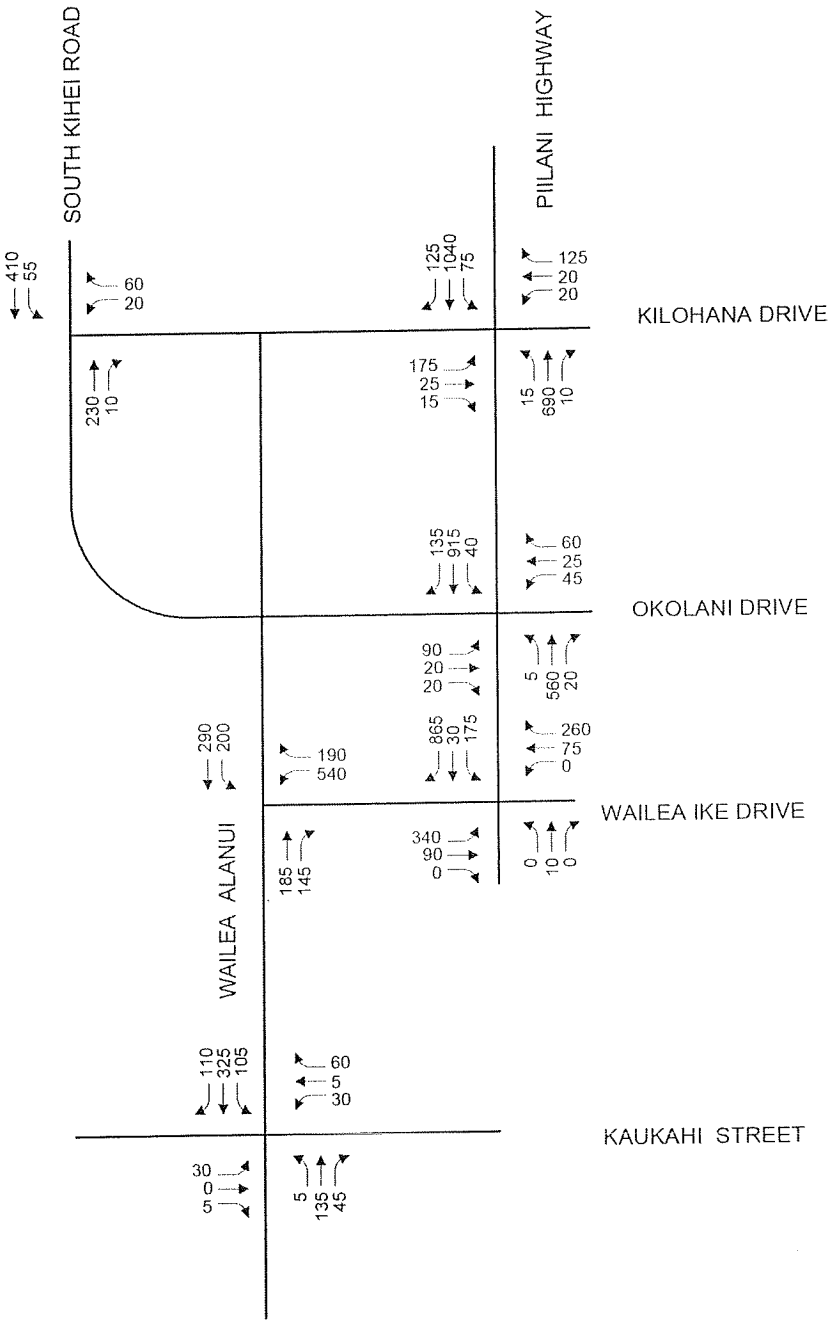

Figure 5
2017 BACKGROUND AM PEAK HOUR TRAFFIC PROJECTIONS

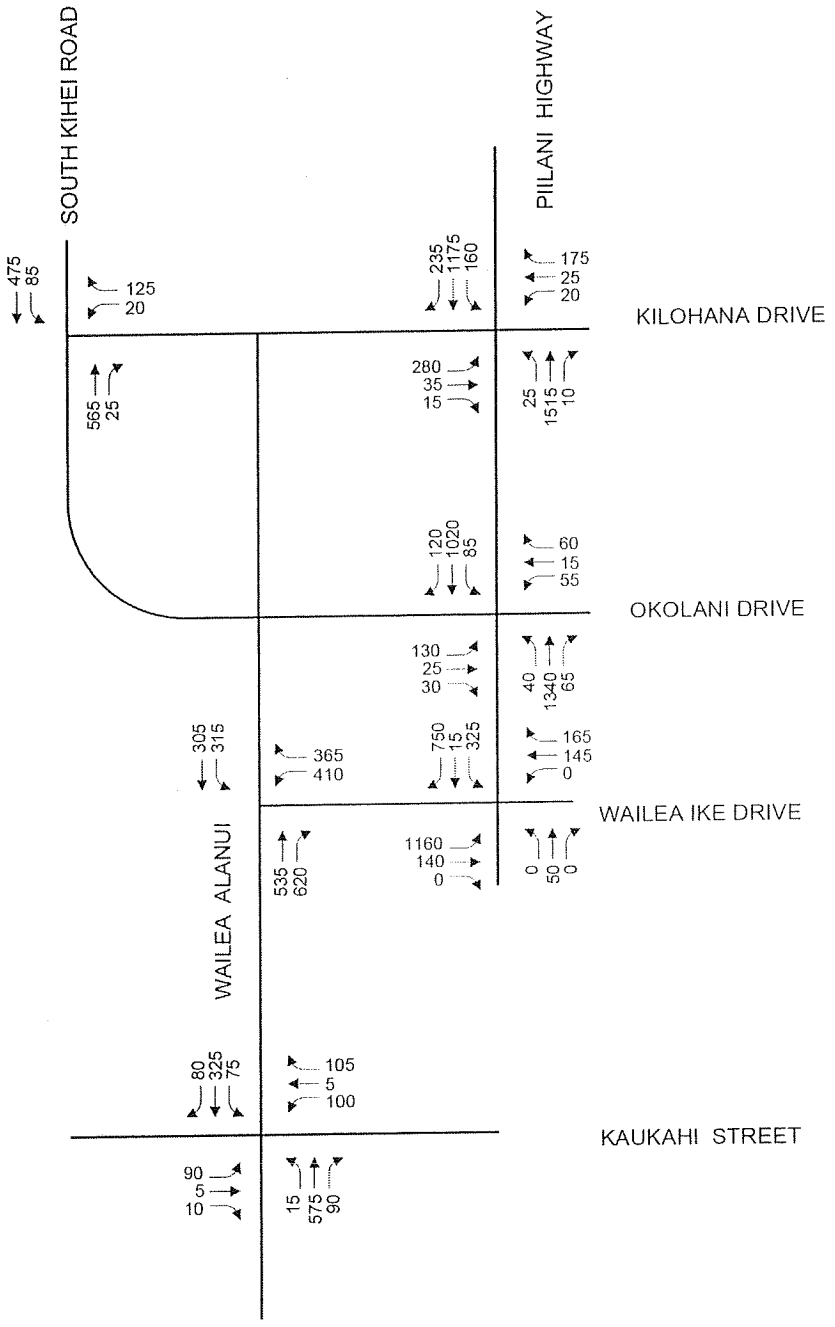

Figure 6
2017 BACKGROUND PM PEAK HOUR TRAFFIC PROJECTIONS

4. PROJECT-RELATED TRAFFIC CHARACTERISTICS

This chapter discusses the development of future traffic projections as a result of the proposed project. Generally, the process involves the determination of weekday peak-hour trips that would be generated by the proposed project, distribution and assignment of these trips on the approach and departure routes, and finally, determination of the levels-of-service at affected intersections and driveways subsequent to implementation of the project.

This chapter presents the generation, distribution and assignment of project generated traffic. The resulting traffic projections, which are future background plus project generated traffic volume estimates, and the internal roadway needs, are presented.

Methodology

1. Estimate the traffic generation parameters, which are the number of dwelling units, hotel rooms and square feet of retail floor area.

2. Estimate the peak hour traffic generated by the resort.

3. Distribute the estimated traffic along existing and planned roadways, both within and outside the resort.

4. Assign the traffic to the roadway network within the study area.

5. Estimate 2017 background plus project traffic volumes by adding the project generated traffic volumes generated to and from the site and the 2017 background traffic volumes discussed in the previous chapter.

Estimate Trip Generation Parameters

The trip generation parameters were estimated from the areas shown in the Makena Resort Master Plan.[11] This document indicated the proposed uses within the resort and the acreage for each of the uses. This map is shown as Figure 6 and the areas in acres are summarized in Table 7.

Table 6 Land Use Acres

LAND USE	PARCEL	AREA IN ACRES
Hotel		
	H-1	38.493
	H-2	27.928
	Subtotal	66.421
Business		
	B-1	3.800
	B-2	9.525
	B-3	8.900
	Subtotal	22.225
Multi-Family		
	M-1	22.100
	M-2	21.532
	M-3	15.900
	M-4	18.100
	M-5	22.108
	M-6	13.530
	M-7	25.944
	M-8	10.939
	M-9	21.218
	M-10	23.000
	M-11	13.800
	M-12	17.500
	Subtotal	225.671
Single Family		
	S-1	92.897
	S-2	7.263
	S-3	105.813
	S-4	40.257
	S-5	0.420
	S-6	98.750
	S-7	3.910
	Subtotal	349.31
	Subtotal	663.627
	TOTAL =	1860.028

LAND USE	PARCEL	AREA IN ACRES
Golf Course		
	G-1	97.600
	G-2	49.337
	G-3	50.144
	G-4	146.860
	G-5	67.900
	G-6	10.426
	G-7	9.153
	Subtotal	431.42
Park		
	P-1	25.200
	P-2	2.021
	P-3	0.427
	P-4	0.965
	P-5	4.400
	P-6	2.300
	Subtotal	35.313
Public/ Quasi Public Facility		
	F-1	4.500
	F-2	11.862
	Subtotal	16.362
Future Expansion		
	U-1	626.362
Roads		
	Piilani Hwy Ext	45.495
	Roads	41.449
	Subtotal	86.944
	Subtotal	1196.401

Source: R.M. Towill Corporation

[11] R.M. Towell Corporation, *Makena Resort Master Plan*, January 6, 2000

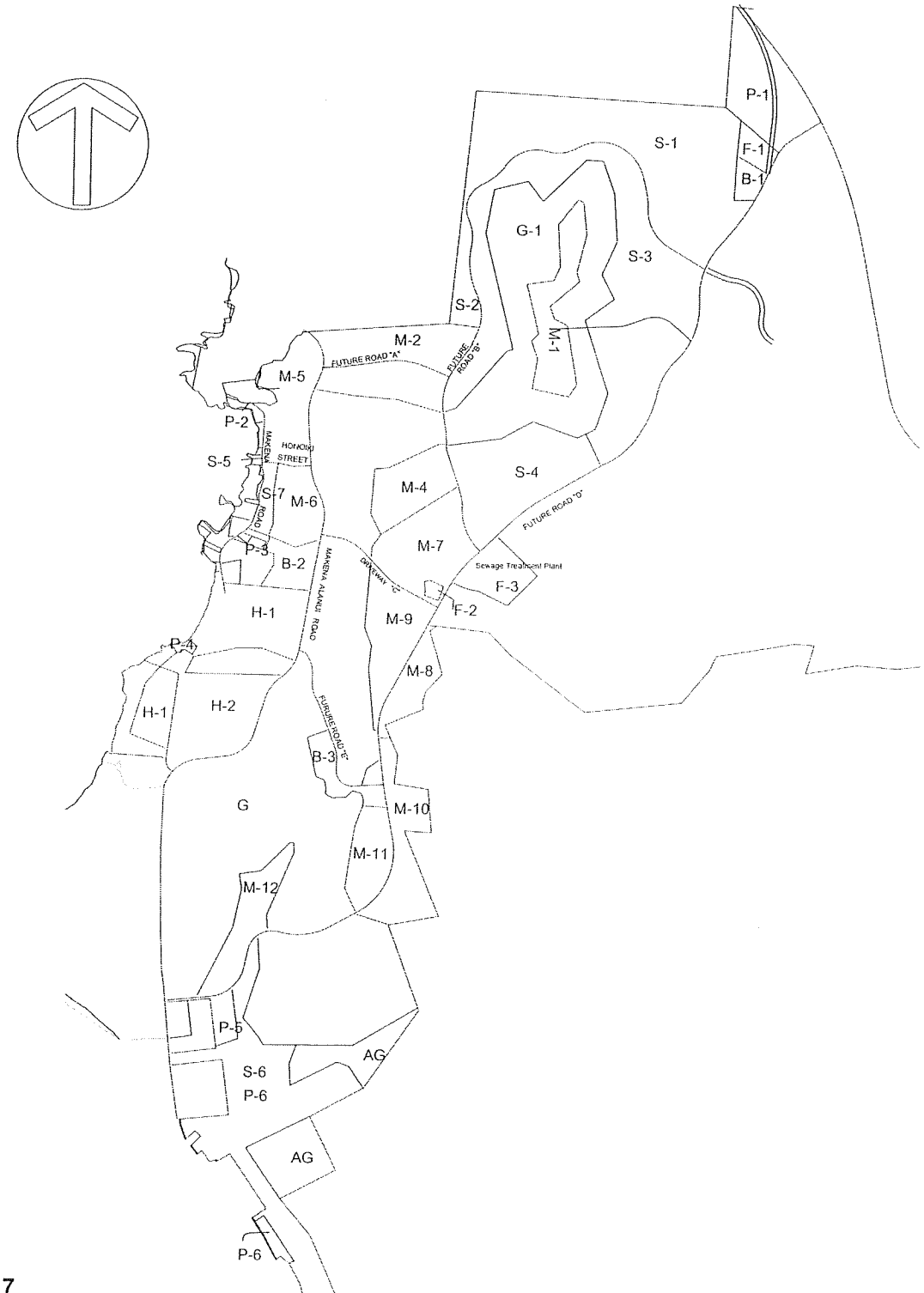

Figure 7
PLANNING ZONES WITHIN MAKENA RESORT

There are different trip generation parameters for the land uses shown. The parameters for the uses shown in the plan are summarized in Table 7.

Table 7 Trip Generation Parameters

Proposed Land Use	Trip Generation Parameter
Hotel	Rooms
Business/Retail	1,000 Square Feet Gross Leasable Area
Multifamily Residential	Dwelling Units
Single-Family Residential	Dwelling Units
Golf Course	Acres
Parks	Acres
Public/Quasi Public	See Note (1)

Notes:
(1) These facilities are water treatment facilities and other public utilities. These types of uses generate minimal or no peak hour traffic

The assumptions used to estimate the trip generation parameters for each of the uses are as follows:

Hotel

1. Zone H-1 is the Maui Prince Hotel. The number of hotel rooms was determined to be 310. This number was used rather than making assumptions for the number of rooms per acre.

2. Zone H-2 is the area south of the Keaka project. The traffic study for the proposed development of this project was obtained and the number of units in the development proposal was used. It should be noted that the actual number of units proposed for this parcel is less than 100, which is significantly less than the 500 rooms previously discussed.

Multi-Family Residential

1. The total number of proposed multi-family residential units proposed in the development plan is 1072.

2. The total number of multi-family units was distributed among the multi-family zones proportional to the acreage in each zone.

3. 30% of the multifamily residential units will be owner-occupied and thus have traffic characteristics comparable to residential townhouses and condominiums. The remainder will be seasonal or second homes and will thus have traffic characteristics based on a trip generation study of comparable housing in Wailea Resort.

Single-Family Residential

1. The total number of proposed single-family residential units proposed in the development plan is 106.

2. The total number of single-family units was distributed among the single-family designated zones proportional to the acreage in each zone.

3. Single-family housing units will have traffic characteristics comparable to single-family, detached housing as defined by the Institute of Transportation Engineers.

Golf Courses

100% of the acreage shown on the Master Plan was used directly.

Parks

100% of the acreage shown on the Master Plan was used directly.

Using the number of units and assumptions listed above the number of respective hotel rooms and dwelling units were calculated for the hotel and residential uses. The results are shown in Table 8. Also shown are the land areas used for the golf course and park trip generation calculations.

Table 8 Land Use Calculations

Zone	Gross Area (Acres)	Units	Number of Units Phase 1	Phase 2	Total
H-1 (Maui Prince Hotel)	38.493	Rooms	310		310
H-2 (Four Seasons)	27.928	Rooms	100		100
Subtotal	**66.421**		**410**	**0**	**410**
B-1	3.800	TGSF		40.00	40.00
B-2	9.525	TGSF	100.00		100.00
B-2	8.900	TGSF	0.00		0.00
Subtotal	**22.225**		**100.00**	**40.00**	**140.00**
M-1	22.100	du		105	105
M-2	21.532	du	102		102
M-3	15.900	du	76		76
M-4	18.100	du	86		86
M-5	22.108	du	105		105
M-6	13.530	du	64		64
M-7	25.944	du	123		123
M-8	10.939	du	52		52
M-9	21.218	du	101		101
M-10	23.000	du	109		109
M-11	13.800	du	66		66
M-12	17.500	du	83		83
Subtotal	**225.671**		**967**	**105**	**1072**
S-1	92.897	du		28	28
S-2	7.263	du		2	2
S-3	105.813	du		32	32
S-4	40.257	du		12	12
S-5	0.420	du	1	1	1
S-6	98.750	du	30		30
S-7	3.910	du	1		1
Subtotal	**349.310**		**16**	**37**	**106**
G-1	97.600	Acres	97.600		97.600
G-2	49.337	Acres	49.337		49.337
G-3	50.144	Acres	50.144		50.144
G-4	146.860	Acres	146.860		146.860
G-5	67.900	Acres	67.900		67.900
G-6	10.426	Acres	10.426		10.426
G-7	9.153	Acres	9.153		9.153
Subtotal	**431.420**		**431.420**	**0.000**	**431.420**
P-1	25.200	Acres		25.200	25.200
P-2	2.021	Acres	2.021		2.021
P-3	0.427	Acres	0.427		0.427
P-4	0.965	Acres	0.965		0.965
P-5	4.400	Acres	4.400		4.400
P-6	2.300	Acres		2.300	2.300
Subtotal	**35.313**		**7.813**	**27.550**	**35.313**

Project Trip Generation

Future traffic volumes generated by a project are estimated using the procedures described in the *Trip Generation Handbook,*[12] published by the Institute of Transportation Engineers. Typically, this method uses trip generation rates and equations to estimate the number of trips that a proposed project will generate during the peak hours. *Trip Generation*[13] is the standard reference for trip generation rates in lieu of site specific trip generation rates or local trip generation rates defined by the reviewing agencies.

The trip generation analysis calculations are attached as Appendix B. Table 9 is a summary of the trip generation estimates of future development at Makena Resort. Trips generated by the Maui Prince Hotel, the golf course, parks and public facilities are not shown as these already exist and traffic associated with these projects is included in the traffic counts. Also, not shown are the pass-by trips associated with the retail development, which are approximately 39% of the total retail trips. Pass-by trips will be discussed in the section on trip table development.

Table 9 Trip Generation Summary of Future Projects at Makena Resort

	AM Peak Hour			PM Peak Hour		
Project	Total	Inbound	Outbound	Total	Inbound	Outbound
Hotel	82	45	37	122	61	61
Retail	253	155	98	971	466	505
Multi-Family	438	146	292	429	239	190
Single-Family	83	21	62	109	71	38
TOTALS	856	367	489	1,631	837	794

Trip Distribution and Assignments

The project generated trips were distributed and assigned based on data provided in the *Maui Long-Range Land Transportation Plan*. The morning and afternoon peak hour trip assignments for the total project are shown in Figures 8 and 9.

2017 Background Plus Project Projections

Background plus project traffic conditions are defined as 2017 background traffic conditions plus project related traffic. 2017 background plus project traffic volumes with the project were estimated by superimposing the peak hourly traffic generated by the proposed project on the 2017 background peak hour traffic volumes presented in Chapter 3. The 2017 background plus project traffic projections are shown on Figures 10 and 11.

[12] Institute of Transportation Engineers, *Trip Generation Handbook*, Washington, D.C., 1998, p. 7-12

[13] Institute of Transportation Engineers, *Trip Generation, An Informational Guide*, Sixth Edition, Washington, D.C., 1997

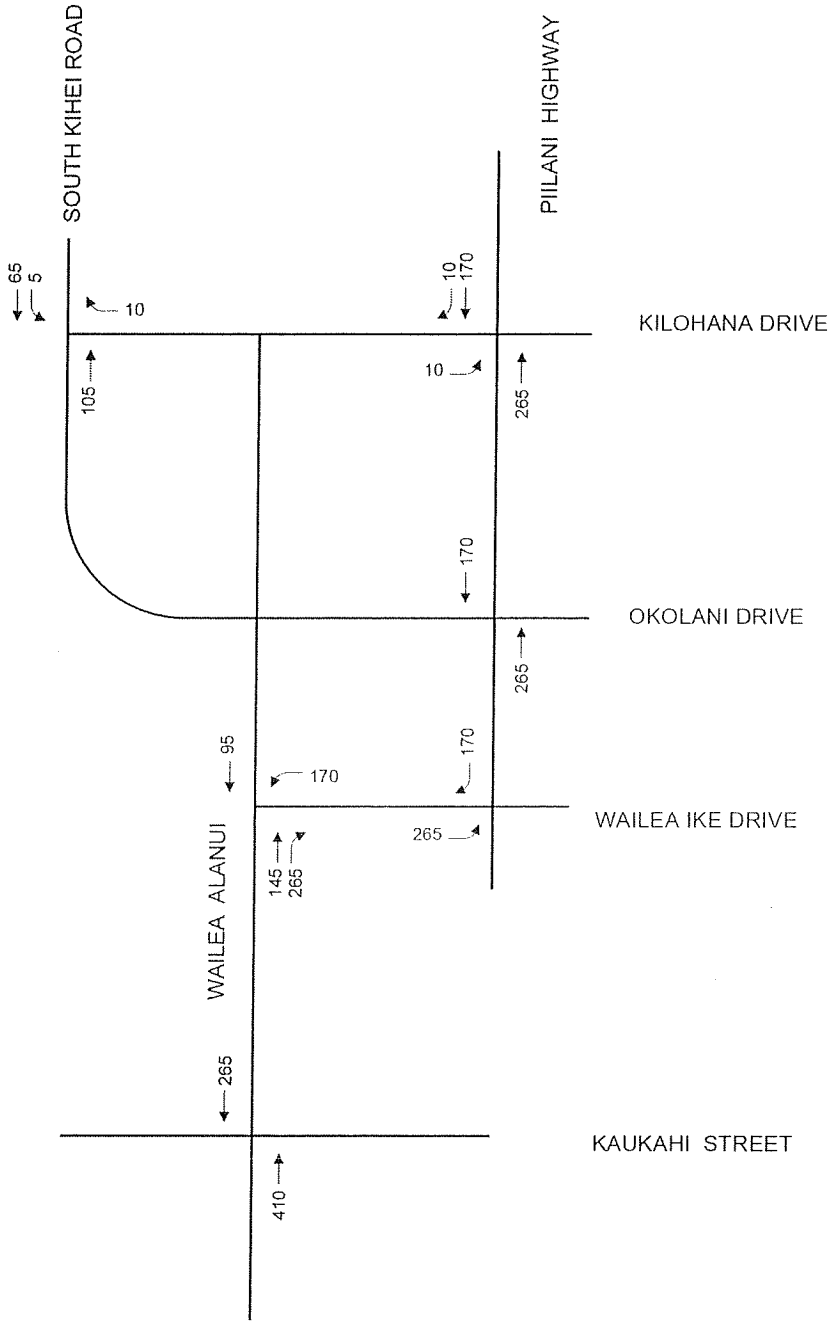

Figure 8
AM PEAK HOUR PROJECT TRIP ASSIGNMENTS

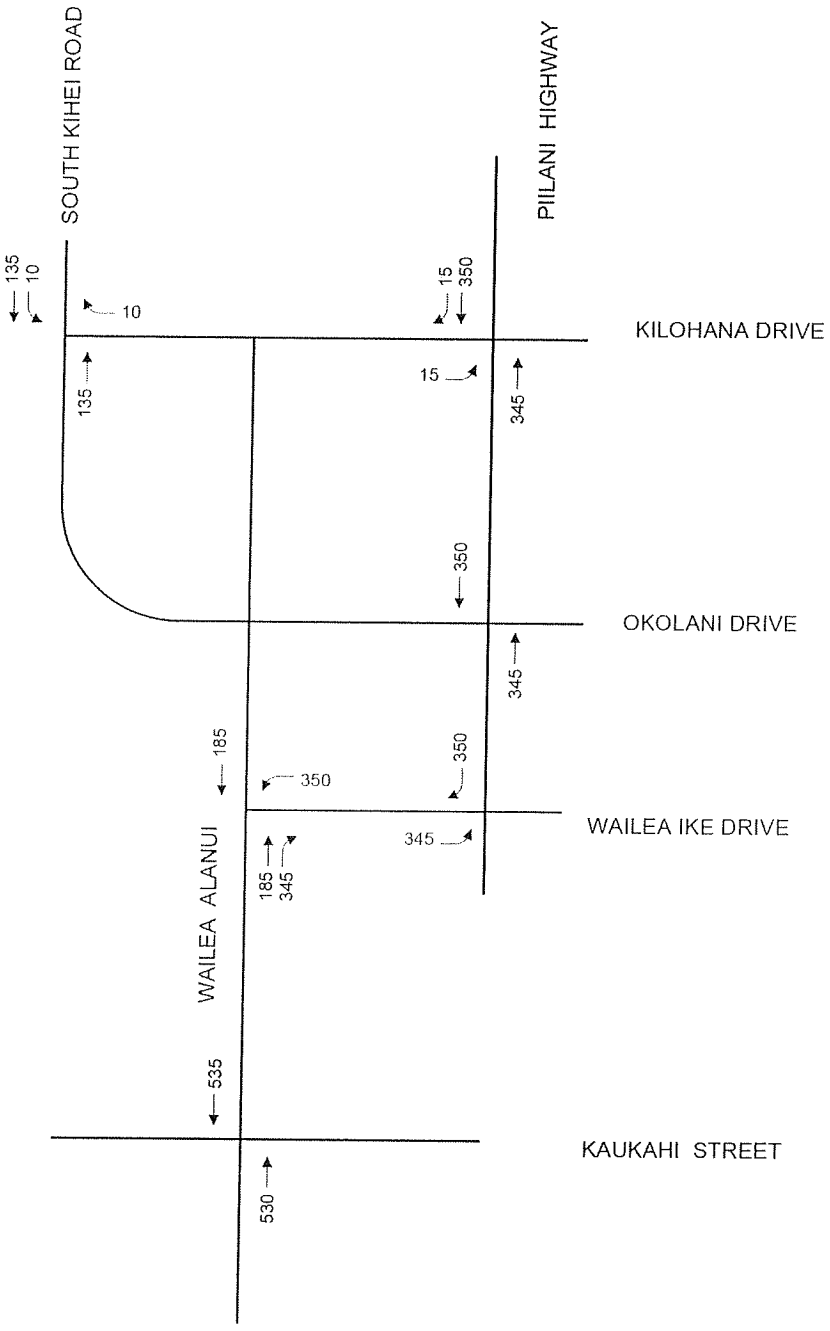

Figure 9
PM PEAK HOUR PROJECT TRIP ASSIGNMENTS

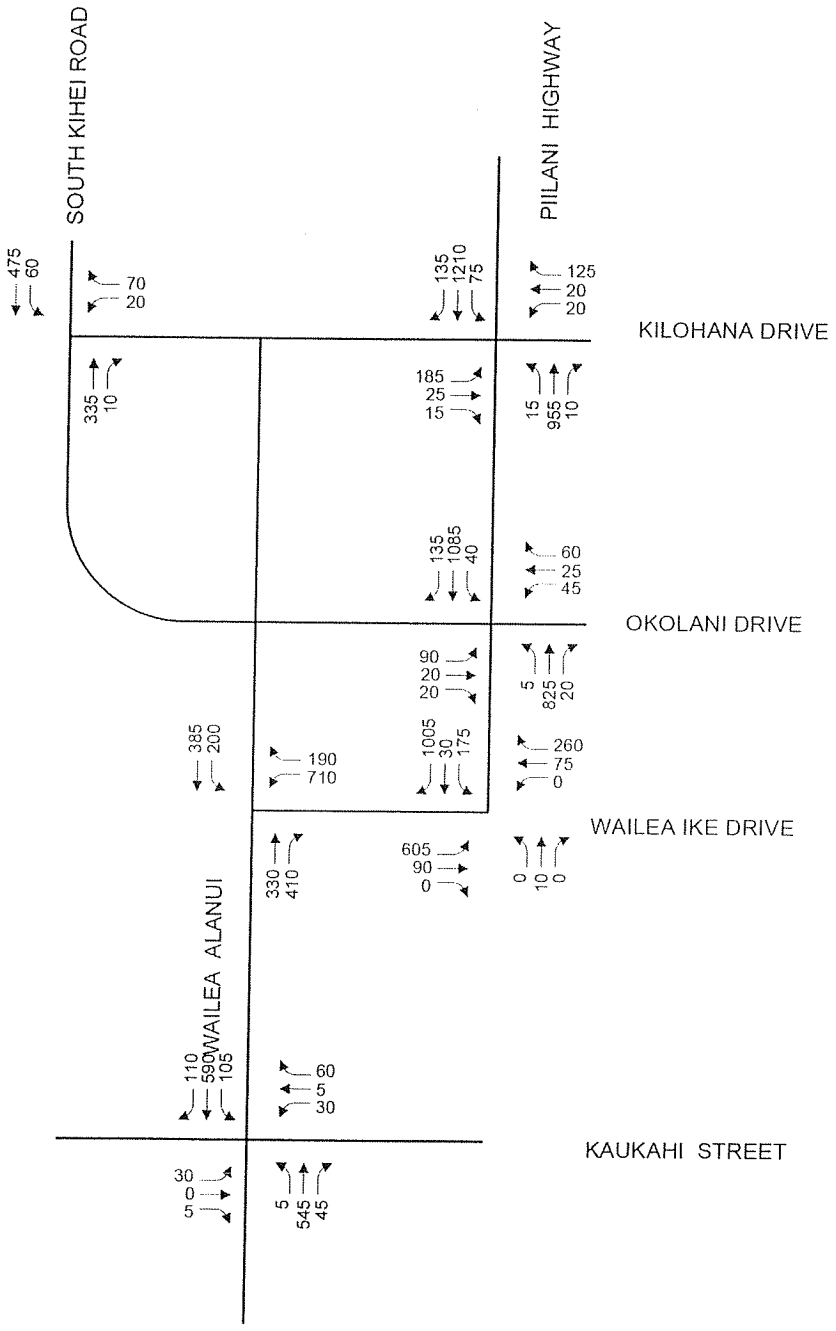

Figure 10
2017 BACKGROUND PLUS PROJECT AM PEAK HOUR TRAFFIC PROJECTIONS

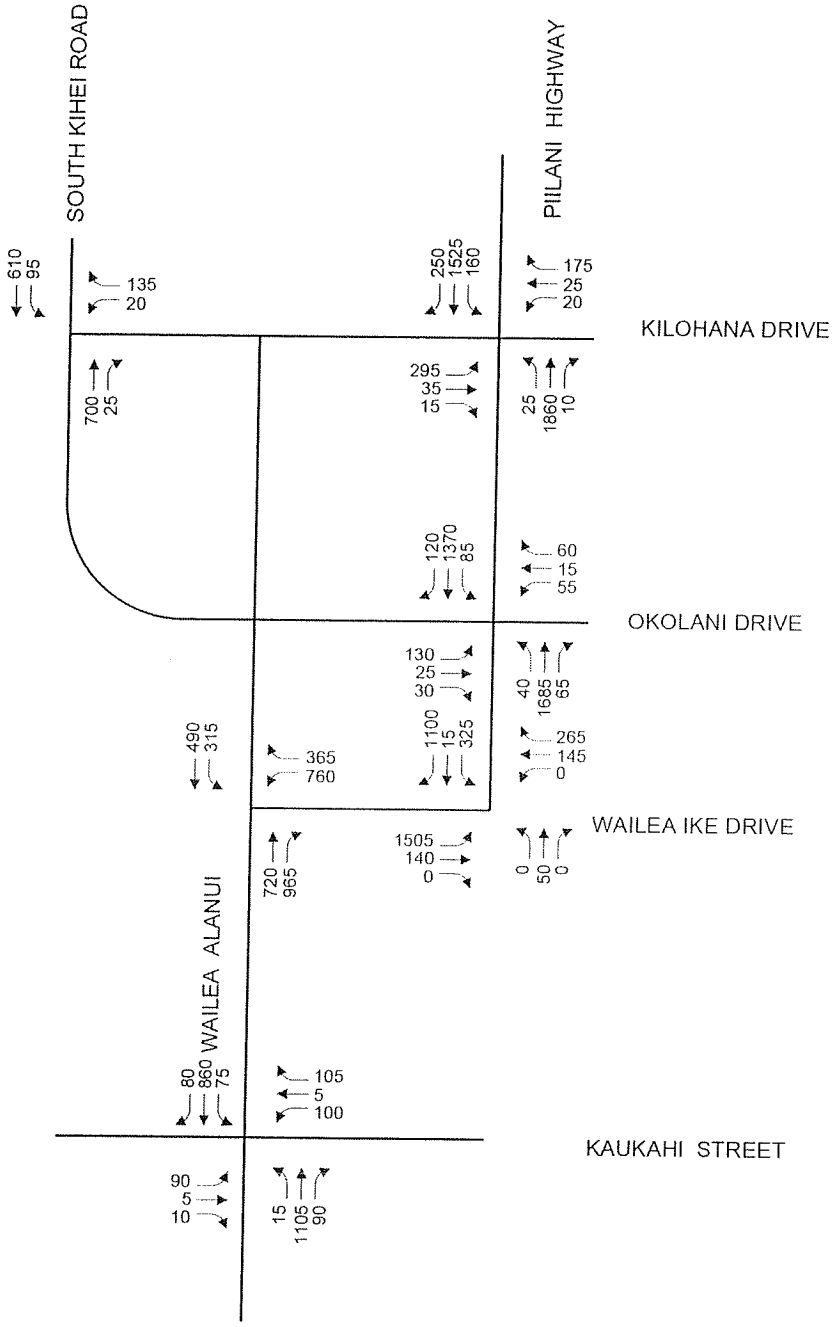

Figure 11
2017 BACKGROUND PLUS PROJECT AM PEAK HOUR TRAFFIC PROJECTIONS

5. TRAFFIC IMPACT ANALYSIS

The purpose of this chapter is to summarize the results of the level-of-service analysis, which identifies the project-related impacts. In addition, any mitigation measures necessary and feasible are identified and other access, egress and circulation issues are discussed.

The impact of the project was assessed by analyzing the changes in traffic volumes and levels-of-service at the study intersections. Mitigation measures are described in the following chapter.

Changes in Total Intersection Volumes

An analysis of the project's share of 2017 background plus project intersection approach volumes at the study intersections is summarized in Table 10. The table summarizes the project's share of total 2017 peak hour approach volumes at each intersection. Also shown are the percentage of 2017 background plus project traffic that is the result of background growth and traffic generated by related projects.

An analysis of the project's pro rata share of the increase of traffic volumes between 2005 and 2017 summarized in Table 11. This table summarizes the growth between 2005 and 2017 and indicates the percentage of growth resulting from background growth and related projects and the percentage growth resulting from project generated traffic.

Table 10 Analysis of Project's Share of Total Intersection Approach Volumes [1]

Intersection	Period	Existing	2017 Background	2017 Background Plus Project	Background Growth		Project Traffic	
					Trips	Percent of Total Traffic [2]	Trips	Percent of Total Traffic [3]
Piilani Hwy at Kilohana Dr	AM	1455	2335	2790	880	31.5%	455	16.3%
	PM	2425	3670	4395	1245	28.3%	725	16.5%
Piilani Hwy at Okolani Dr	AM	1150	1935	2370	785	33.1%	435	18.4%
	PM	1770	2985	3680	1215	33.0%	695	18.9%
Piilani Hwy at Wailea Ike Dr	AM	935	1815	2250	880	39.1%	435	19.3%
	PM	1410	2850	3545	1440	40.6%	695	19.6%
Wailea Alanui Dr at Wailea Ike Dr	AM	1155	1550	2225	395	17.8%	675	30.3%
	PM	1750	2550	3615	800	22.1%	1065	29.5%
Wailea Alanui Dr at Kaukahi St	AM	560	855	1530	295	19.3%	675	44.1%
	PM	865	1475	2540	610	24.0%	1065	41.9%
S. Kihei Rd at Kilohana Dr	AM	540	785	970	245	25.3%	185	19.1%
	PM	850	1295	1585	445	28.1%	290	18.3%

Notes:
(1) Volumes shown are total intersection approach volumes or projections.
(2) Percentage of total 2017 background plus project traffic.

Table 11 Analysis of Project's Pro Rata Share of Intersection Traffic Growth [1]

Intersection	Period	Existing	2017 Background	Background Plus Project	Background Growth [2]		Project Trips [3]	
					Volume	% of 2005 to 2017 Growth	Volume [4]	% of 2005 to 2017 Growth
Piilani Hwy at Kilohana Dr	AM	1455	2335	2790	880	65.9%	455	34.1%
	PM	2425	3670	4395	1245	63.2%	725	36.8%
Piilani Hwy at Okolani Dr	AM	1150	1935	2370	785	64.3%	435	35.7%
	PM	1770	2985	3680	1215	63.6%	695	36.4%
Piilani Hwy at Wailea Ike Dr	AM	935	1815	2250	880	66.9%	435	33.1%
	PM	1410	2850	3545	1440	67.4%	695	32.6%
Wailea Alanui Dr at Wailea Ike Dr	AM	1155	1550	2225	395	36.9%	675	63.1%
	PM	1750	2550	3615	800	42.9%	1065	57.1%
Wailea Alanui Dr at Kaukahi St	AM	560	855	1530	295	30.4%	675	69.6%
	PM	865	1475	2540	610	36.4%	1065	63.6%
S. Kihei Rd at Kilohana Dr	AM	540	785	970	245	57.0%	185	43.0%
	PM	850	1295	1585	445	60.5%	290	39.5%

Notes:
(1) Volumes shown are total intersection approach volumes or projections.
(2) Background versus existing.
(3) Background plus project versus background.
(4) Project generated traffic

Methodology for Level-of-Service Analysis

1. Synchro 6 was used to analyze the signalized intersections. The Highway Capacity Software was used to analyze the unsignalized intersections. Both software packages are based on the *Highway Capacity Manual*.

2. Neither Synchro nor the Highway Capacity Software results report a volume-to-capacity ratio for unsignalized intersections or results for the overall unsignalized intersection.

3. We have used the Institute of Transportation Engineers standard that a Level-of-Service D is the minimum acceptable level-of-service and that the criteria is applicable to the overall intersection and the major movements on the major roadways. If project generated traffic causes the level-of-service to drop below Level-of-Service D, then mitigation should be provided to improve the level-of-service to Level-of-Service D or better. Minor movements, such a left turns and side street approaches may operate at Level-of-Service E for short periods. "Although this level is generally considered undesirable for a signalized intersection, Level-of-Service E is sometimes tolerated for minor movements such as left turns when there are no feasible mitigating measures or if it helps maintain the main through movements at acceptable levels-of-service."[14]

4. To be consistent with the *Highway Capacity Manual*, level-of-service is defined by delay, rather than the volume-to-capacity ratio.

Results of Level-of-Service Analysis

The level-of-service analysis for 2017 conditions was performed using the following assumptions:

Since the traffic generated by Wailea Resort and Wailea 670 are included in the 2017 background without project traffic projections, the improvements recommended in the TIAR's for these projects are assumed to be in place for background without and with project calculations. This roadway improvements are summarized on Figure 12.

1. Piilani Highway between Kilohana Drive and Wailea Ike Drive has been widened from two to four lanes. The anticipated completion date for this widening is the subject of a joint traffic study for Makena Resort, Wailea Resort and Wailea 670. It has generally been concluded that this widening should be in place by 2012. The owners of the three projects have agreed to construct the project, but the pro rata share of each is yet to be determined.

2. The intersection of Wailea Ike Drive at Piilani Highway has been improved to provide a northbound, a westbound approach and traffic signals. The northbound approach is part of the Wailea Resort Master Plan and is to be constructed between 2012 and 2017. The westbound approach is to provide access to Wailea 670 and should be constructed before 2012. The traffic signals are also one of the improvements to be provided by Wailea 670.

3. The intersection of Piilani Highway at Okolani Drive is signalized. The signalization is recommended in the Wailea Resort Master Plan TIAR.

4. The intersection of South Kihei Road is modified to provide a separate southbound to eastbound left turn lane and a northbound to eastbound right turn lane. These improvements are recommended by the Wailea Resort Master Plan TIAR.

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[14] M&E Pacific, Inc. *Traffic Impact Analysis Report for Lihue Civic Center Master Plan*, October 2005, p. 25

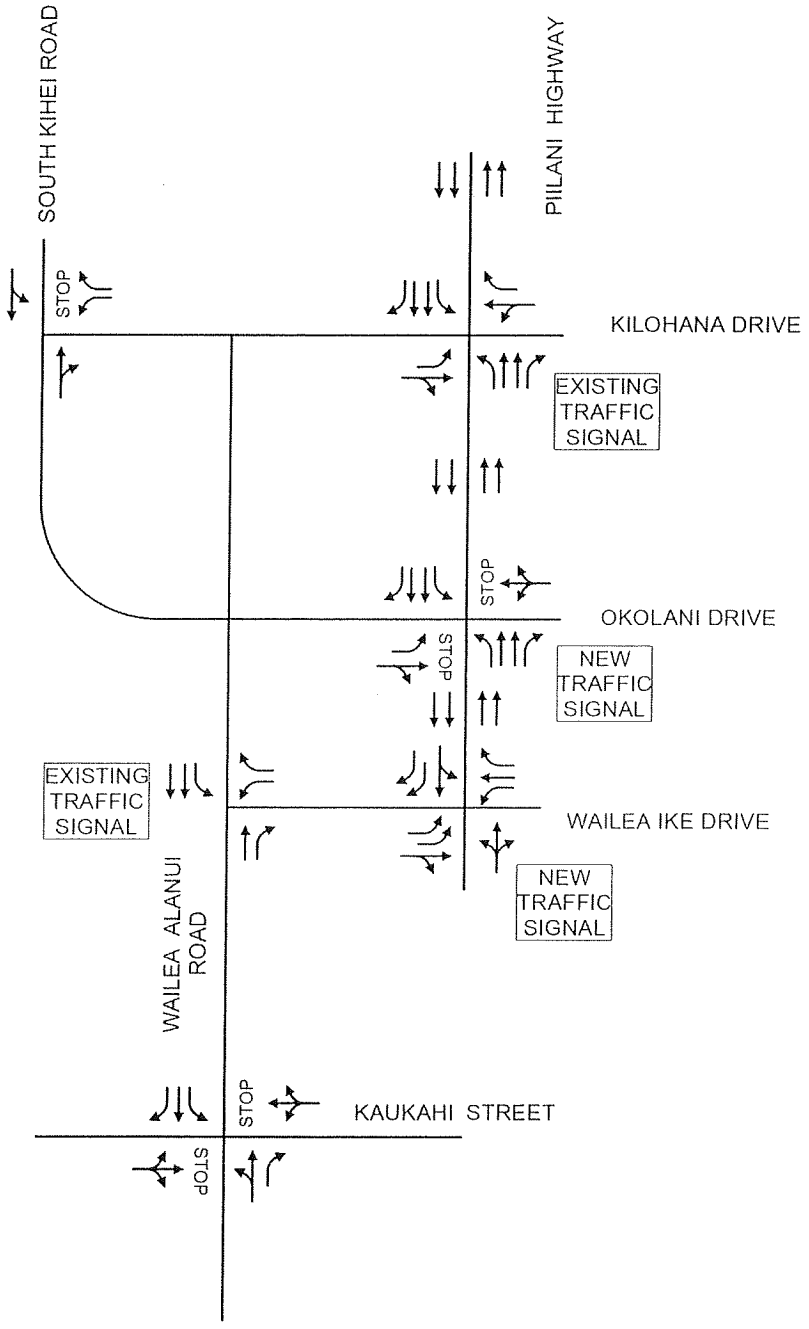


Figure 12
2017 LANE CONFIGURATIONS AND RIGHT-OF-WAY CONTROLS

Piilani Highway at Kilohana Drive & Mapu Drive

The results of the level-of-service analysis for the intersection of Piilani Highway at Kilohana Drive and Mapu Drive are summarized in Table 12. Shown in the table are volume-to-capacity ratio, control delay per vehicle and Levels-of-Service for each lane group and the overall intersection.

During the morning peak hour, the overall intersection will operate at Level-of-Service B, without and with the project. The northbound left-turn will operate at Level-of-Service E, without and with the project. This is the only movement that will operate below Level-of-Service D during the morning peak hour. The Makena Resort project adds no traffic to this movement. The volume-to-capacity ratio of this movement implies Level-of-Service B. This implies that the low level-of-service is a function of the traffic signal timing rather than the intersection configuration. The remaining movements will operate at Level-of-Service D, or better.

During the afternoon peak hour, the overall intersection will operate at Level-of-Service D, without and with the project. The northbound left-turn will operate at Level-of-Service E during both peak periods without and with project generated traffic. The volume-to-capacity ratio implies a higher level-of-service which implies the long delay, and therefore the low level-of-service, is a function of traffic signal timing. The eastbound left-turn and the southbound left turn will also operate at Level-of-Service F, without and with the project. These are considered minor movements.

Because the overall intersection and the major northbound and southbound through movements operate at Level-of-Service D, or better, without and with project generated traffic, no mitigation is required.

Table 12 2017 Levels-of-Service - Piilani Highway at Kilohana Drive & Mapu Drive

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Approach and Movement	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Intersection Totals	***0.66***	***18.2***	***B***	***0.73***	***18.7***	***B***	***0.88***	***36.5***	***D***	***1.01***	***45.3***	***D***
Eastbound Left	0.66	36.8	D	0.68	37.8	D	0.97	86.5	F	1.02	101.7	F
Eastbound Thru & Right	0.10	28.7	C	0.10	28.4	C	0.10	36.2	D	0.10	36.2	D
Westbound Left & Thru	0.35	36.3	D	0.35	36.3	D	0.13	36.5	D	0.13	36.5	D
Westbound Right	0.09	34.2	C	0.09	34.2	C	0.24	37.7	D	0.26	37.9	D
Northbound Left	0.48	62.0	E	0.48	63.9	E	0.51	57.7	E	0.51	63.1	E
Northbound Thru	0.49	14.5	B	0.69	14.6	B	0.82	40.5	D	1.01	59.0	E
Northbound Right	0.01	7.1	A	0.01	3.8	A	0.01	18.8	B	0.01	13.5	B
Southbound Left	0.37	33.3	C	0.37	33.3	C	0.98	116.2	F	0.98	116.2	F
Southbound Thru	0.60	14.0	B	0.70	16.2	B	0.57	13.4	B	0.74	17.1	B
Southbound Right	0.09	9.2	A	0.09	9.5	A	0.16	9.2	A	0.16	9.2	A

NOTES:.
1. V/C denotes ratio of volume to capacity.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

Piilani Highway at Okolani Drive

The results of the level-of-service analysis for the intersection of Piilani Highway at Okolani Drive and Mikioi Street are summarized in Table 13. Shown in the table are volume-to-capacity ratio, control delay per vehicle and Levels-of-Service for each lane group and the overall intersection.

During the morning peak hour, the overall intersection will operate at Level-of-Service A, without and with project generated traffic. The eastbound left and through movement and the northbound left-turn will operate at Level-of-Service E, without and with project generated traffic. The volume-to-capacity ratios imply Levels-of-Service D and A, respectively.

During the afternoon peak hour, the overall intersection will operate at Level-of-Service C, without and with the project. The eastbound left and through movement and the northbound left-turn will operate at Level-of-Service E, without and with project generated traffic. The volume-to-capacity ratios of these movements imply Levels- of-Service D and A, respectively.

Since the overall intersection will operate at Level-of-Service A and C during the morning and afternoon peak hours, respectively, and the major movements along Piilani Highway will operate a Level-of-Service D, or better, no mitigation is recommended.

Table 13 2017 Levels-of-Service - Piilani Highway at Okolani Drive & Mikioi Street

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Approach and Movement	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Intersection Totals	***0.48***	***8.4***	***A***	***0.52***	***6.2***	***A***	***0.70***	***28.3***	***C***	***0.82***	***29.3***	***C***
Eastbound Left & Thru	0.81	61.0	E	0.81	61.0	E	0.85	76.1	E	0.85	76.1	E
Eastbound Right	0.01	30.0	C	0.01	31.7	C	0.02	40.9	D	0.02	40.9	D
Westbound Left, Thru & Right	0.51	34.5	C	0.57	38.5	D	0.58	49.8	D	0.58	49.8	D
Northbound Left	0.17	55.8	E	0.17	55.8	E	0.49	64.6	E	0.49	66.1	E
Northbound Thru	0.26	2.1	A	0.38	1.5	A	0.64	20.4	C	0.81	23.0	C
Northbound Right	0.01	0.0	A	0.01	0.0	A	0.04	13.7	B	0.05	9.1	A
Southbound Left	0.39	57.1	E	0.38	53.5	D	0.63	48.5	D	0.63	48.4	D
Southbound Thru	0.40	0.7	A	0.46	1.0	A	0.46	24.0	C	0.62	27.6	C
Southbound Right	0.09	0.1	A	0.09	0.1	A	0.08	46.9	D	0.08	36.8	D

NOTES:
1. V/C denotes ratio of volume to capacity.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

Piilani Highway at Wailea Ike Drive

The results of the level-of-service analysis for the intersection of Piilani Highway at Okolani Drive and Mikioi Street are summarized in Table 14.

During the morning peak hour the overall intersection will operate at Level-of-Service C without project generated traffic and Level-of-Service D with project generated traffic. All movements will operate at Level-of-Service D, or better.

During the afternoon peak hour, the overall intersection will operate at Level-of-Service C without project generated traffic and Level-of-Service D with project generated traffic. The westbound through movement will operate at Level-of-Service E and the southbound left and through movement will operate at Level-of-Service F. The volume-to-capacity ratios of these movements imply Levels-of-Service C and E, respectively. Both are also considered minor movements. Also, the Makena resort project adds no traffic to these movements.

Since the overall intersection will operate at Level-of-Service D during both peak periods and the major movements will operate a Level-of-Service D, or better, no mitigation is recommended.

Table 14 2017 Levels-of-Service - Piilani Highway at Wailea Ike Drive

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Approach and Movement	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Intersection Totals	***0.62***	***33.5***	***C***	***0.79***	***37.9***	***D***	***0.93***	***30.9***	***C***	***1.05***	***38.6***	***D***
Eastbound Left	0.57	30.6	C	0.81	34.7	C	0.85	35.3	D	1.00	54.5	D
Eastbound Thru & Right	0.15	17.7	B	0.13	15.2	B	0.14	11.4	B	0.13	9.2	A
Westbound Left	0.00	0.0	A	0.00	0.0	A	0.00	0.0	A	0.00	0.0	A
Westbound Thru	0.39	34.0	C	0.39	34.0	C	0.73	62.7	E	0.73	62.7	E
Westbound Right	0.18	32.5	C	0.18	32.5	C	0.18	48.3	D	0.18	48.3	D
Northbound Left, Thru & Right	0.01	8.3	A	0.01	10.1	B	0.08	26.3	C	0.09	29.9	C
Southbound Left & Thru	0.29	10.0	A	0.32	12.2	B	0.81	65.6	E	0.92	80.5	F
Southbound Right	0.34	42.5	D	0.39	49.0	D	0.33	0.1	A	0.49	2.7	A

NOTES:
1. V/C denotes ratio of volume to capacity.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

Wailea Alanui Drive at Wailea Ike Drive

The results of the level-of-service analysis for the intersection of Wailea Alanui Drive at Wailea Ike Drive are summarized in Table 15.

During the morning peak hour, the overall intersection will operate at Level-of-Service C and all movements will operate at Level-of-Service D, or better.

During the afternoon peaj hour, the overall intersection will operate at Level-of-Service D without the project and Level-of-Service F with the project. The westbound left, northbound through and the southbound left-turn movement will operate at Level-of-Service F and the volume-to-capacity ratios exceed 1.0, which is implies long delays, low level-of-service and lane deficiency. Mitigation is required.

Table 15 2017 Levels-of-Service - Wailea Alanui Drive at Wailea Ike Drive

	AM Peak Hour						PM Peak Hour					
	Without Project			With Project			Without Project			With Project		
Approach and Movement	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Intersection Totals	***0.68***	***21.3***	***C***	***0.99***	***31.0***	***C***	***0.84***	***38.5***	***D***	***1.18***	***81.5***	***F***
Westbound Left	0.85	29.2	C	0.95	39.8	D	0.85	52.7	D	1.21	150.6	F
Westbound Right	0.13	0.2	A	0.13	0.2	A	0.25	33.1	C	0.43	32.1	C
Northbound Thru	0.40	23.2	C	0.84	46.3	D	0.73	35.5	D	1.13	120.5	F
Northbound Right	0.10	19.5	B	0.28	26.7	C	0.55	6.9	A	0.83	14.2	B
Southbound Left	0.73	36.0	D	0.78	45.1	D	1.08	122.5	F	1.23	190.0	F
Southbound Thru	0.18	10.0	A	0.27	14.4	B	0.15	9.1	A	0.27	16.5	B

NOTES:
1. V/C denotes ratio of volume to capacity.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

Wailea Alanui Drive at Kaukahi Street

The results of the level-of-service analysis of the intersection of Wailea Alanui Drive at Kaukahi Street are summarized in Table 16. Shown are the delays and levels-of-service of the controlled lane groups. The northbound and southbound approaches will operate at Levels-of-Service A and B. However, the side street approaches will operate at Level-of-Service F during both peak periods. Mitigation is required.

Table 16 2017 Levels-of-Service - Wailea Alanui Drive at Kaukahi Street

	AM Peak Hour				PM Peak Hour			
	Without Project		With Project		Without Project		With Project	
Approach and Movement [1]	Delay[2]	LOS[3]	Delay	LOS	Delay	LOS	Delay	LOS
Northbound Left & Thru	8.3	A	9.3	A	8.3	A	8.3	A
Southbound Left	7.8	A	9.4	A	9.5	A	13.1	B
Westbound Left, Thru & Right	14.3	B	51.9	F	145.0	F	1023.0	F
Eastbound Left, Thru & Right	20.0	C	88.8	F	204.4	F	2159.0	F

NOTES:
1. Overall intersection delays and levels-of-service are not calculated for unsignalized intersections.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

South Kihei Road at Kilohana Drive

The results of the level-of-service analysis of the intersection of Wailea Alanui Drive at Kaukahi Street are summarized in Table 17. Shown are the delays and levels-of-service of the controlled lane groups.

All movements will operate t Level-of-Service C, or better, except the westbound left turn lane which will operate at Level-of-Service F during the afternoon peak hour. Mitigation is required.

Table 17 2017 Levels-of-Service - South Kihei Road at Kilohana Drive

Approach and Movement [1]	AM Peak Hour				PM Peak Hour			
	Without Project		With Project		Without Project		With Project	
	Delay[2]	LOS[3]	Delay	LOS	Delay	LOS	Delay	LOS
Southbound Left	7.9	A	8.2	A	9.2	A	9.9	A
Westbound Left	16.5	C	20.5	C	32.2	D	50.9	F
Westbound Right	9.9	A	10.9	B	15.3	C	18.6	C

NOTES:.
1. Overall intersection delays and levels-of-service are not calculated for unsignalized intersections.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

Mitigation

Wailea Alanui Road at Wailea Ike Drive

Table 18 2017 Levels-of-Service - Wailea Alanui Drive at Wailea Ike Drive

Approach and Movement	AM Peak Hour						PM Peak Hour					
	Without Mitigation			With Mitigation[4]			Without Mitigation			With Mitigation		
	V/C[1]	Delay[2]	LOS[3]	V/C	Delay	LOS	V/C	Delay	LOS	V/C	Delay	LOS
Intersection Totals	***0.99***	***31.0***	***C***	***0.96***	***24.1***	***C***	***1.18***	***81.5***	***F***	***0.94***	***28.5***	***C***
Westbound Left	0.95	39.8	D	0.94	35.1	D	1.21	150.6	F	0.98	47.2	D
Westbound Right	0.13	0.2	A	0.14	0.2	A	0.43	32.1	C	0.31	13.1	B
Northbound Thru	0.84	46.3	D	0.38	20.0	C	1.13	120.5	F	0.84	37.1	D
Northbound Right	0.28	26.7	C	0.28	20.0	B	0.83	14.2	B	0.84	10.4	B
Southbound Left	0.78	45.1	D	0.80	44.5	D	1.23	190.0	F	0.89	55.8	E
Southbound Thru	0.27	14.4	B	0.29	13.0	B	0.27	16.5	B	0.35	16.2	B

NOTES:.
1. V/C denotes ratio of volume to capacity.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.
4. Mitigation is an additional northbound through lane, a second southbound to eastbound left turn lane and a second westbound to southbound left turn lane.

Wailea Alanui Road at Kakahi Street

Table 19 Mitigation Analysis - Wailea Alanui Drive at Kaukahi Street

	AM Peak Hour								PM Peak Hour							
	Without Mitigation		4-Way Stop		Roundabout		Signals		Without Mitigation		With Mitigation		4-Way Stop		Roundabout	
Approach [1]	Delay[2]	LOS[3]	Delay	LOS	V/C	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Northbound	9.3	A	11.3	B	0.07	A	5.2	A	7.4	A	14.5	B	0.28	A	26.5	C
Southbound	9.4	A	11.6	B	0.16	A	3.9	A	13.1	B	17.3	C	0.66	B	11.0	B
Westbound	51.9	F	58.1	F	0.65	B	26.5	C	487.8	F	625.4	F	1.36	F	56.3	E
Eastbound	88.8	F	120.8	F	0.80	D	26.3	C	1001.0	F	455.0	F	1.09	F	49.5	D

NOTES:.
1. Overall intersection delays and levels-of-service are not calculated for unsignalized intersections.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.

South Kihei Road at Kilohana Drive

Table 20 Mitigation Analysis - South Kihei Road at Kilohana Drive

	AM Peak Hour				PM Peak Hour			
	Without Mitigation		With Mitigation[4]		Without Mitigation		With Mitigation	
Approach and Movement [1]	Delay[2]	LOS[3]	Delay	LOS	Delay	LOS	Delay	LOS
Southbound Left	8.2	A	8.2	A	9.9	A	9.9	A
Westbound Left	20.5	C	15.1	C	50.9	F	22.2	C
Westbound Right	10.9	B	10.9	B	18.6	C	18.6	C

NOTES:.
1. Overall intersection delays and levels-of-service are not calculated for unsignalized intersections.
2. Delay is in seconds per vehicle.
3. LOS denotes Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. LOS is based on delay.
4. Mitigation is a left turn refuge lane for westbound to southbound left turns.

Internal Roadway Needs

The results are summarized as follows:

1. A two lane roadway configuration along the roadways will accommodate traffic generated by the project. Widening the approaches of these side streets to provide separate turn lanes results in a higher level-of-service and should be assessed when development of the adjacent parcel is being planned as the final development plan may no have the same number and type of units used in the traffic study.

2. Traffic signals at intersections within the resort should be avoided. Alternatives should be assessed and traffic signals installed as a last resort. Alternatives include left-turn refuge lanes, all-way stops and roundabouts.

3. Roadway cross-sections should provide for bicycle and pedestrian uses.

Design Standards

The Maui Police Department and the public has indicated that speed along Makena Alanui is an issue that should be addressed. This issue has been raised on several projects over the last two years.

The Institute of Transportation Engineers has developed a "toolbox" of traffic calming measure. However, the measures are not intended for use along major roadways such as Makena Alanui. They are more applicable to the other minor roadways within the project and should be considered in the design.

In addition, design standards to control speeds were recently summarized by the Institute of Transportation Engineers in the *Traffic Engineering*, the journal of the Institute of Transportation Engineers. A copy of this article is attached as Appendix E. These standards provide maximum roadway tangent lengths and minimum radii to limit the speed. It is recommended that these standards be incorporated into future minor roadway alignments within the project.

Recommendations

1. The intersection of Wailea Alanui Drive at Wailea Ike Drive should be improved to provide a second northbound through lane, a second southbound left-turn lane and a second westbound left turn lane.

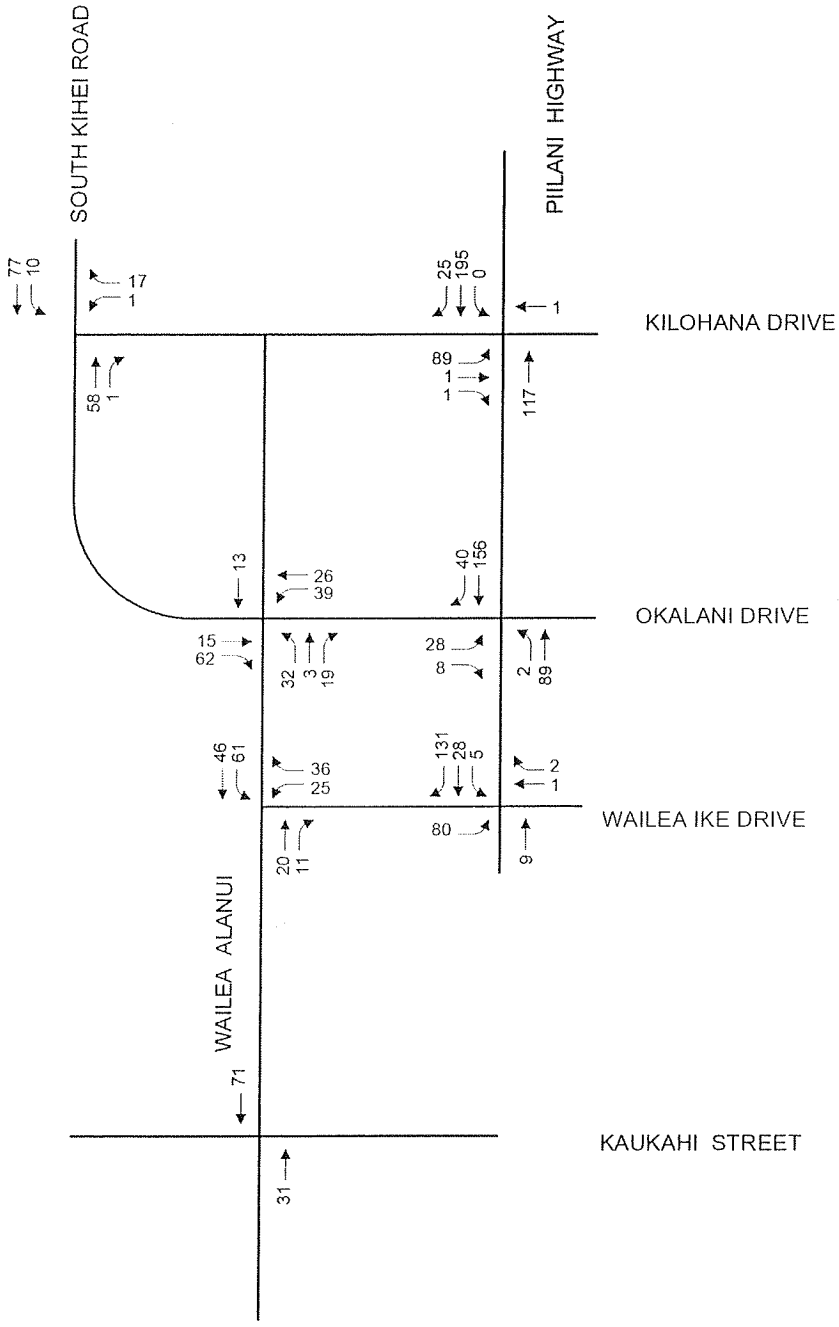
2. The intersection of Wailea Alanui Drive at Kaukahi Street should be improved.

3. The intersection of South Kihei Road at Kilohana Drive should be improved to provide a left-turn refuge lane for left turns from westbound Kilohana Drive to southbound South Kihei Road.

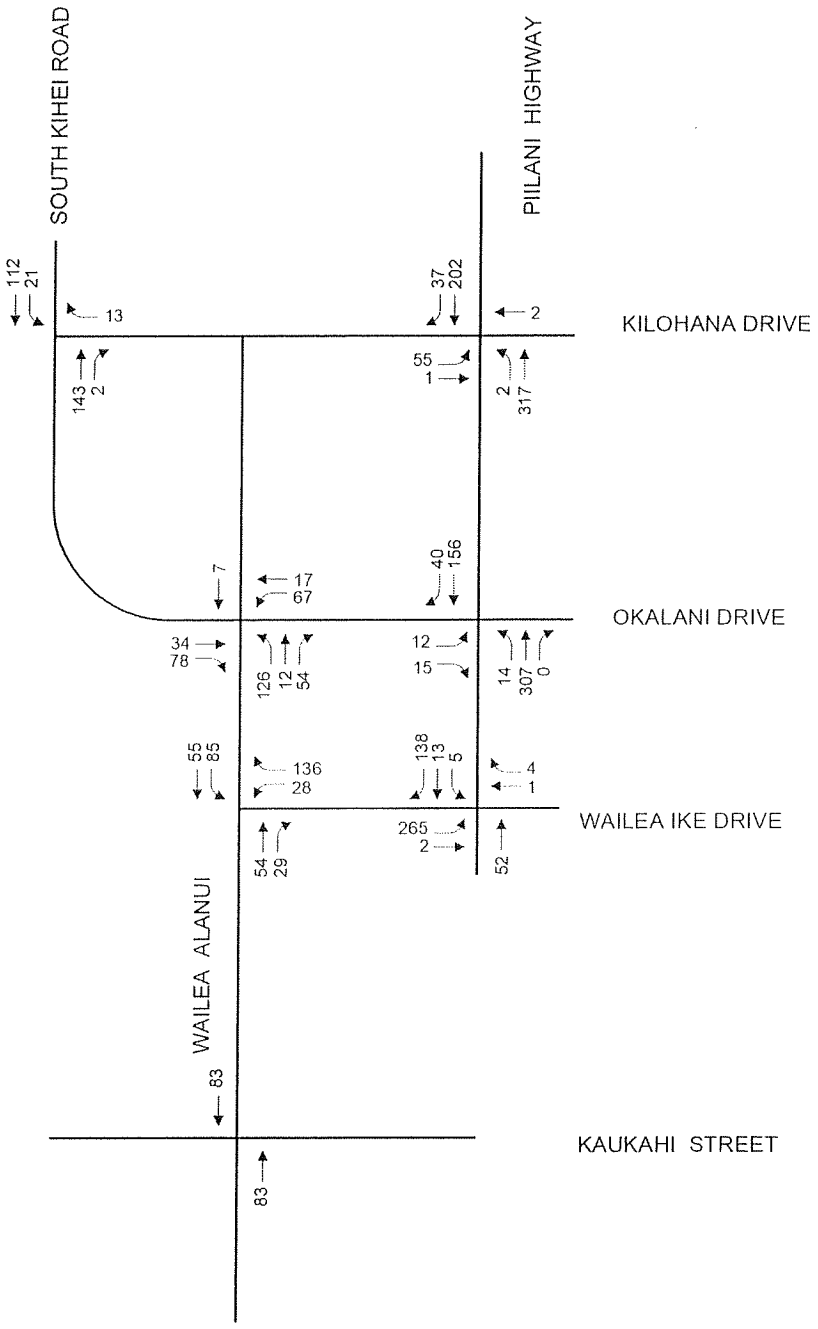
4. Separate traffic impact assessments should be prepared for each parcel upon development. The traffic assessment would update traffic volumes and insure that development of the parcel under study does not exceed the traffic forecasts used in the traffic study for the master plan.

5. Roadways within the resort should be limited to two lanes (one lane in each direction). Intersections should be controlled by STOP signs where feasible. Traffic signals should be installed as a last resort. Alternatives should be assessed. Alternatives include all-way stops and roundabounts.

APPENDIX A
PROJECT TRIP ASSIGNMENTS FOR WAILEA RESORT AND WAILEA 670



WAILEA RESORT
2017 AM TRIP ASSIGNMENTS



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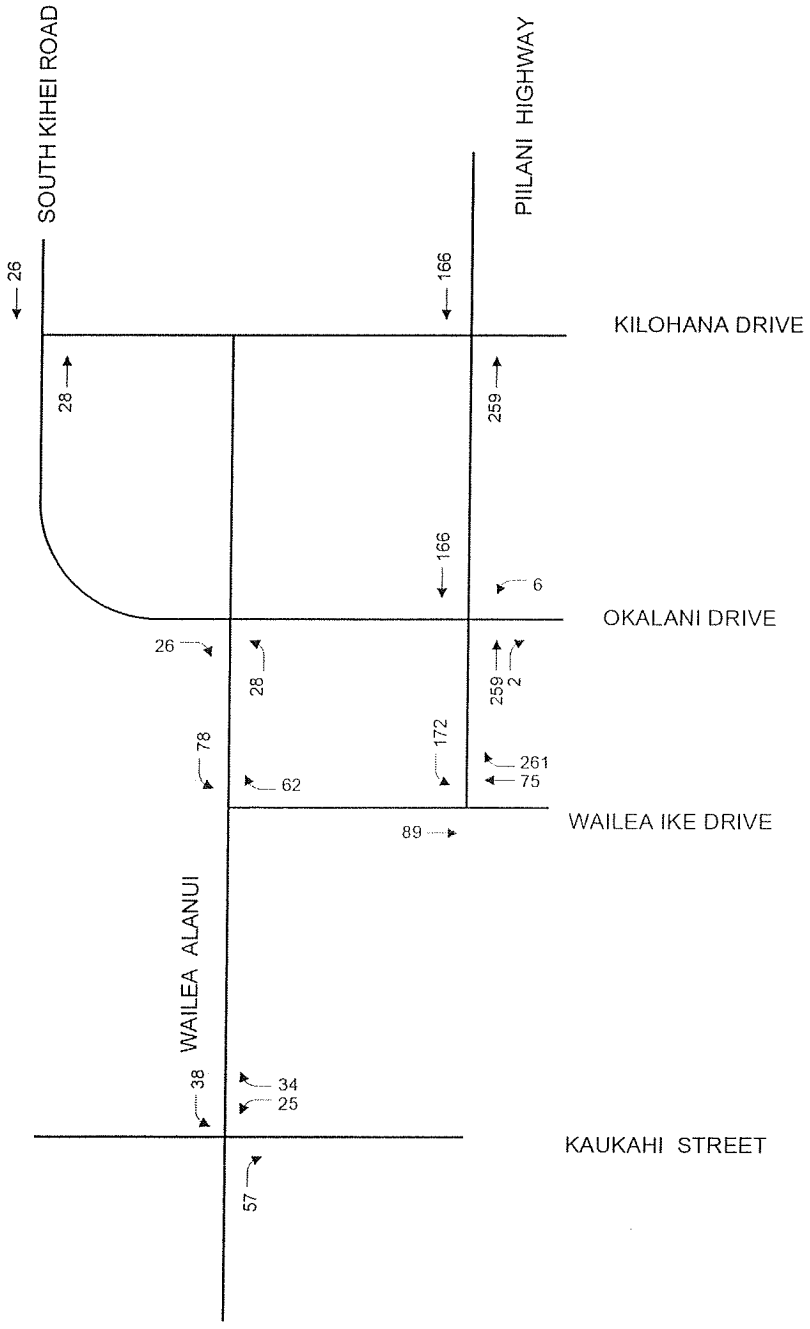
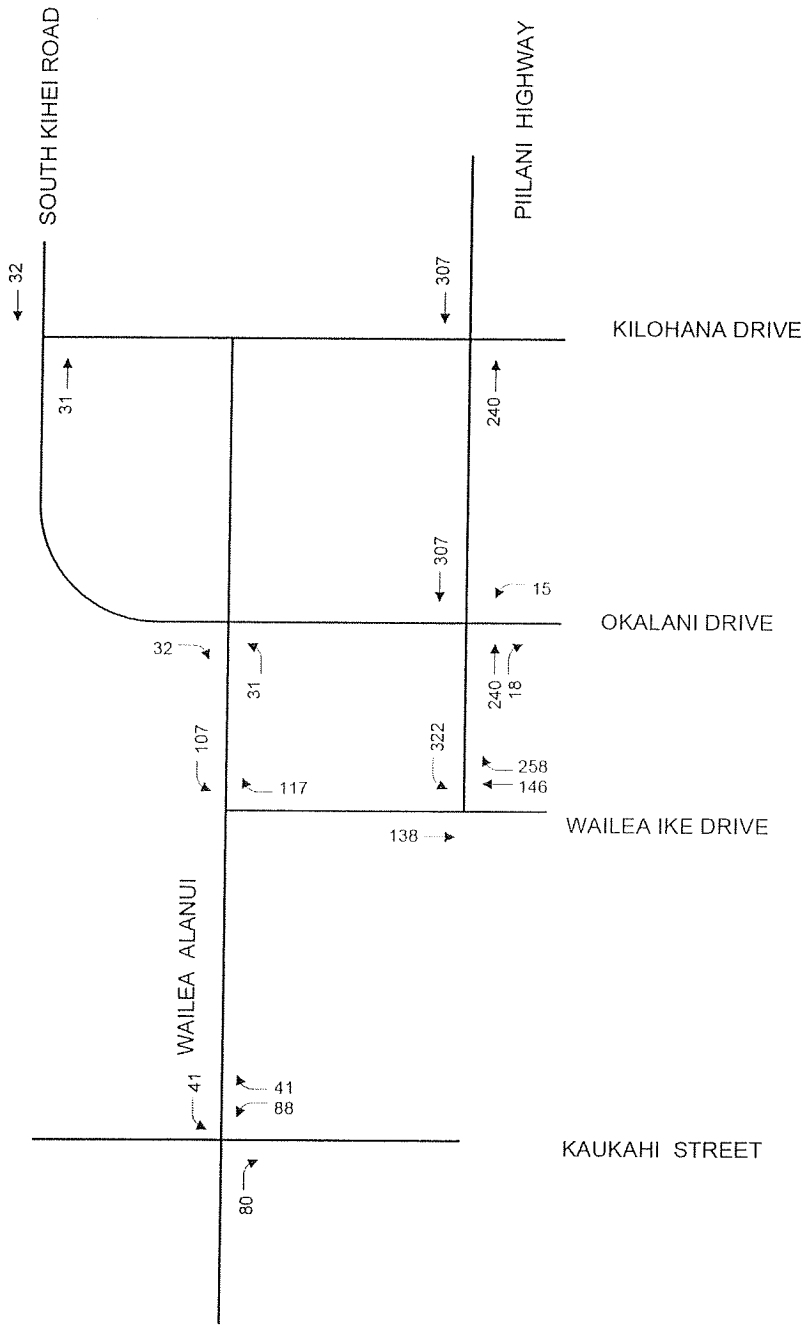


WAILEA 670
2012 AM TRIP ASSIGNMENTS



WAILEA 670
2012 PM TRIP ASSIGNMENTS

APPENDIX B
MAKENA RESORT TRIP GENERATION CALCULATIONS AND TRIP TABLES

Part 1

Land Use Calculations

Makena Resort Master Plan

July 2007

Zone	Area (Acres)	Percent Useable	Useable Acres	Units	Units per Acre	#Units
H-1 (Maui Prince)	38.493	100%	38.493	Rooms		250
H-2 Four Seasons)	27.928	100%	27.928	Rooms		200
Subtotal	**66.421**					**450**
B-1 SC 1	3.800					40
B-2 SC 2	9.525					100
B-3 Golf Club)	8.900	0%	0.000	TGSF	39.6	0
Subtotal	**22.225**					**140**
M-1	22.100	95%	20.995	D. U.	5.0	105
M-2	21.532	95%	20.455	D. U.	5.0	102
M-3	15.900	95%	15.105	D. U.	5.0	76
M-4	18.100	95%	17.195	D. U.	5.0	86
M-5	22.108	95%	21.003	D. U.	5.0	105
M-6	13.530	95%	12.854	D. U.	5.0	64
M-7	25.944	95%	24.647	D. U.	5.0	123
M-8	10.939	95%	10.392	D. U.	5.0	52
M-9	21.218	95%	20.157	D. U.	5.0	101
M-10	23.000	95%	21.850	D. U.	5.0	109
M-11	13.800	95%	13.110	D. U.	5.0	66
M-12	17.500	95%	16.625	D. U.	5.0	83
Subtotal	**225.671**		**214.387**	**D. U.**		**1072**
S-1	92.897	15%	13.935	D. U.	1.0	28
S-2	7.263	15%	1.089	D. U.	1.0	2
S-3	105.813	15%	15.872	D. U.	1.0	32
S-4	40.257	15%	6.039	D. U.	1.0	12
S-5	0.420	15%	0.063	D. U.	1.0	1
S-6	98.750	15%	14.813	D. U.	1.0	30
S-7	3.910	15%	0.587	D. U.	1.0	1
Subtotal	**349.310**	**100%**	**52.397**	**D. U.**		**106**
G-1	97.600	100%	97.600	Acres		97.6
G-2	49.337	100%	49.337	Acres		49.3
G-3	50.144	100%	50.144	Acres		50.1
G-4	146.860	100%	146.860	Acres		146.9
G-5	67.900	100%	67.900	Acres		67.9
G-6	10.426	100%	10.426	Acres		10.4
G-7	9.153	100%	9.153	Acres		9.2
Subtotal	**431.420**		**431.420**	**Acres**		**431.4**
P-1	25.200	100%	25.200	Acres		0.0
P-2	2.021	100%	2.021	Acres		2.0
P-3	0.427	100%	0.427	Acres		0.4
P-4	0.965	100%	0.965	Acres		1.0
P-5	4.400	100%	4.400	Acres		4.4
P-6	2.300	100%	2.300	Acres		2.3
Subtotal	**35.313**		**35.313**	**Acres**		**10.1**
F-1	4.500	100%	4.500	Acres		4.5
F-3	11.862	100%	11.862	Acres		11.9
Subtotal	**16.362**		**16.362**	**Acres**		**16.4**
U-1	626.491	100%	626.491			
Subtotal	**626.491**		**626.491**			
Piilani Hwy Ext	45.495	100%	45.495			
Roads	41.449	100%	41.449			
Subtotal	**86.944**		**86.944**			
Total	**1860.157**		**1463.314**			

Residential Unit Occupancy Analysis

Owner Occupied		Recreational Units	
%	No	%	No
30%	32	70%	73
30%	31	70%	71
30%	23	70%	53
30%	26	70%	60
30%	32	70%	73
30%	19	70%	45
30%	37	70%	86
30%	16	70%	36
30%	30	70%	71
30%	33	70%	76
30%	20	70%	46
30%	25	70%	58
	324		**748**
100%	28	0%	0
100%	2	0%	0
100%	32	0%	0
100%	12	0%	0
100%	1	0%	0
100%	30	0%	0
100%	1	0%	0
	106		**0**

Part 2

Trip Generation Rates and Equations

Makena Resort Master Plan
July 2007

Land Use	Sub-Category	LU Code	Unit	AM Peak Rate	AM Peak % In	AM Peak % Out	PM Peak Rate	PM Peak % In	PM Peak % Out
Resort Hotel		330	Occ. Rms.	0.41	63%	37%	0.61	50%	50%
Business		820	tgsf	Ln(T)=0.596LN(A)+2.329)	61%	39%	Ln(T)=0.660Ln(A)+3.403	48%	52%
Multi-Family	Owner Occupied	230	D. U.	0.44	18%	82%	0.54	65%	35%
	Recreational	260	D. U.	0.22	40%	60%	0.34	49%	51%
Single Family	Owner Occupied	210	D. U.	0.77	25%	75%	1.02	64%	36%
	Recreational	260	D. U.	0.46	58%	42%	0.46	50%	50%
Golf Course			Acres	0.33	47%	53%	0.39	43%	57%
Park			Acres	0.52	71%	29%	0.59	35%	65%

Part 3

Trip Generation Calculations

Makena Resort Master Plan

July 2007

Zone	Unit	No. of Units	Total Trips Generated AM Peak Total	AM Peak In	AM Peak Out	PM Peak Total	PM Peak In	PM Peak Out
H-1	Rooms	250	103	57	46	153	77	76
H-2	Rooms	200	82	45	37	122	61	61
Subtotal	Rooms	450	185	102	83	275	138	137
B-1	TGSF	40	93	57	36	343	165	178
B-2	TGSF	100	160	98	62	628	301	327
B-3	TGSF	0	0	0	0	0	0	0
Subtotal	TGSF	140.001	253	155	98	971	466	505
M-1	D.U.	105	43	15	28	42	23	19
M-2	D.U.	102	42	14	28	41	23	18
M-3	D.U.	76	31	10	21	30	17	13
M-4	D.U.	86	35	12	23	34	19	15
M-5	D.U.	105	43	15	28	42	23	19
M-6	D.U.	64	26	8	18	25	14	11
M-7	D.U.	123	50	17	33	49	27	22
M-8	D.U.	52	21	7	14	21	12	9
M-9	D.U.	101	41	13	28	40	22	18
M-10	D.U.	109	45	15	30	44	25	19
M-11	D.U.	66	27	9	18	27	15	12
M-12	D.U.	83	34	11	23	34	19	15
Subtotal	D.U.	1072	438	146	292	429	239	190
S-1	D.U.	28	22	6	16	29	19	10
S-2	D.U.	2	2	1	1	2	1	1
S-3	D.U.	32	25	6	19	33	21	12
S-4	D.U.	12	9	2	7	12	8	4
S-5	D.U.	1	1	0	1	1	1	0
S-6	D.U.	30	23	6	17	31	20	11
S-7	D.U.	1	1	0	1	1	1	0
Subtotal	D.U.	106	83	21	62	109	71	38
Golf	Acres	431.42	142	67	75	168	72	96
Subtotal	Acres	431.4	142	67	75	168	72	96
P-1	Acres	0.0	0	0	0	0	0	0
P-2	Acres	2.0	1	1	0	1	0	1
P-3	Acres	0.4	0	0	0	0	0	0
P-4	Acres	1.0	1	1	0	1	0	1
P-5	Acres	4.4	2	1	1	3	1	2
P-6	Acres	2.3	1	1	0	1	0	1
Subtotal	Acres	10.1	5	4	1	6	1	5
F-1	Acres	4.5	0	0	0	0	0	0
F-3	Acres	11.9	0	0	0	0	0	0
Subtotal		16.4	0	0	0	0	0	0

U-1
Subtotal
Piilani Hwy ext
Roads
Subtotal
Total
Part 4

Trip Generation Summary

Makena Resort Master Plan
July 2007

	Trips Generated						Percentages					
		AM Peak			PM Peak			AM Peak			PM Peak	
Zone	Total	In	Out	Total	In	Out	Total	In	Out	Total	In	Out
H-1	103	57	46	153	77	76	56%	56%	55%	56%	56%	55%
H-2	82	45	37	122	61	61	44%	44%	45%	44%	44%	45%
Subtotal	185	102	83	275	138	137						
B-1	93	57	36	343	165	178	37%	37%	37%	35%	35%	35%
B-2	160	98	62	628	301	327	63%	63%	63%	65%	65%	65%
B-3	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%
Subtotal	253	155	98	971	466	505						
M-1	43	15	28	42	23	19	10%	10%	10%	10%	10%	10%
M-2	42	14	28	41	23	18	10%	10%	10%	10%	10%	9%
M-3	31	10	21	30	17	13	7%	7%	7%	7%	7%	7%
M-4	35	12	23	34	19	15	8%	8%	8%	8%	8%	8%
M-5	43	15	28	42	23	19	10%	10%	10%	10%	10%	10%
M-6	26	8	18	25	14	11	6%	5%	6%	6%	6%	6%
M-7	50	17	33	49	27	22	11%	12%	11%	11%	11%	12%
M-8	21	7	14	21	12	9	5%	5%	5%	5%	5%	5%
M-9	41	13	28	40	22	18	9%	9%	10%	9%	9%	9%
M-10	45	15	30	44	25	19	10%	10%	10%	10%	10%	10%
M-11	27	9	18	27	15	12	6%	6%	6%	6%	6%	6%
M-12	34	11	23	34	19	15	8%	8%	8%	8%	8%	8%
Subtotal	438	146	292	429	239	190						
S-1	22	6	16	29	19	10	27%	29%	26%	27%	27%	26%
S-2	2	1	1	2	1	1	2%	5%	2%	2%	1%	3%
S-3	25	6	19	33	21	12	30%	29%	31%	30%	30%	32%
S-4	9	2	7	12	8	4	11%	10%	11%	11%	11%	11%
S-5	1	0	1	1	1	0	1%	0%	2%	1%	1%	0%
S-6	23	6	17	31	20	11	28%	29%	27%	28%	28%	29%
S-7	1	0	1	1	1	0	1%	0%	2%	1%	1%	0%
Subtotal	83	21	62	109	71	38	100%	100%	100%	100%	100%	100%
G	142	67	75	168	72	96	100%	100%	100%	100%	100%	100%
Subtotal	142	67	75	168	72	96						
P-1	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%
P-2	1	1	0	1	0	1	20%	25%	0%	17%	0%	20%
P-3	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%
P-4	1	1	0	1	0	1	20%	25%	0%	17%	0%	20%
P-5	2	1	1	3	1	2	40%	25%	100%	50%	100%	40%
P-6	1	1	0	1	0	1	20%	25%	0%	17%	0%	20%
Subtotal	5	4	1	6	1	5						
F-1	0	0	0	0	0	0						
F-3	0	0	0	0	0	0						
Subtotal	0	0	0	0	0	0						
Total	1,106	495	611	1,958	987	971						

Part 5
AM Trip Distribution Calculations
Makena Resort Master Plan
October 2002

Preliminary Distribution By Land Use Category

Origin Use	Destination Use: Hotel	Bus	MF	SF	Golf	Park	Totals: % Int	% Ext	Total Trips: In	Out	Int-Int: In	Out	Int-Ext: In	Out
Hotel	0%	20%	0%	0%	15%	5%	40%	60%	102	83	41	41	61	42
Bus	5%	0%	2%	3%	0%	0%	10%	90%	155	98	16	16	139	82
MF	2%	15%	0%	0%	10%	0%	27%	73%	146	292	39	39	107	253
SF	2%	15%	0%	0%	10%	0%	27%	73%	21	62	6	6	15	56
Golf	15%	15%	10%	10%	0%	0%	50%	50%	67	75	34	34	33	41
Park	5%	0%	0%	0%	0%	0%	5%	95%	4	1	0	0	4	1
									495	611	136	136	359	475

Distribution By Zone

Origin Zone	Destination Zones: H-1	H-2	B-1	B-2	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	S-1	S-2	S-3	S-4	S-5	S-6	S-7	G	P-1	P-2	P-3	P-4	P-5
	0.56	0.44	0.37	0.63	0.10	0.10	0.07	0.08	0.10	0.05	0.12	0.05	0.09	0.10	0.06	0.08	0.29	0.05	0.29	0.10	0.00	0.00	0.00	1.00	0.00	0.25	0.00	0.25	0.25
H-1			0.07	0.13																				0.15	0.00	0.03	0.00	0.03	0.03
H-2			0.07	0.13																				0.15	0.00	0.03	0.00	0.03	0.03
B-1	0.03	0.02			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00						
B-2	0.03	0.02			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00						
M-1	0.01	0.01	0.06	0.10																				0.10					
M-2	0.01	0.01	0.06	0.10																				0.10					
M-3	0.01	0.01	0.06	0.10																				0.10					
M-4	0.01	0.01	0.06	0.10																				0.10					
M-5	0.01	0.01	0.06	0.10																				0.10					
M-6	0.01	0.01	0.06	0.10																				0.10					
M-7	0.01	0.01	0.06	0.10																				0.10					
M-8	0.01	0.01	0.06	0.10																				0.10					
M-9	0.01	0.01	0.06	0.10																				0.10					
M-10	0.01	0.01	0.06	0.10																				0.10					
M-11	0.01	0.01	0.06	0.10																				0.10					
M-12	0.01	0.01	0.06	0.10																				0.10					
S-1	0.01	0.01	0.06	0.10																				0.10					
S-2	0.01	0.01	0.06	0.10																				0.10					
S-3	0.01	0.01	0.06	0.10																				0.10					
S-4	0.01	0.01	0.06	0.10																				0.10					
S-5	0.01	0.01	0.06	0.10																				0.10					
S-6	0.01	0.01	0.06	0.10																				0.10					
S-7	0.01	0.01	0.06	0.10																				0.10					
G	0.08	0.07	0.06	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.03	0.01	0.00	0.00	0.00	0.10					
P-1	0.03	0.02																											
P-2	0.03	0.02																											
P-3	0.03	0.02																											
P-4	0.03	0.02																											
P-5	0.03	0.02																											
P-6	0.03	0.02																											
X-1	0.56	0.44	0.37	0.63	0.10	0.10	0.07	0.08	0.10	0.05	0.12	0.05	0.09	0.10	0.06	0.08	0.29	0.05	0.29	0.10	0.00	0.00	0.00	1.00	0.00	0.25	0.00	0.25	0.25
X-2	0.56	0.44	0.37	0.63	0.10	0.10	0.07	0.08	0.10	0.05	0.12	0.05	0.09	0.10	0.06	0.08	0.29	0.05	0.29	0.10	0.00	0.00	0.00	1.00	0.00	0.25	0.00	0.25	0.25
X-3	0.56	0.44	0.37	0.63	0.10	0.10	0.07	0.08	0.10	0.05	0.12	0.05	0.09	0.10	0.06	0.08	0.29	0.05	0.29	0.10	0.00	0.00	0.00	1.00	0.00	0.25	0.00	0.25	0.25
X-4	0.56	0.44	0.37	0.63	0.10	0.10	0.07	0.08	0.10	0.05	0.12	0.05	0.09	0.10	0.06	0.08	0.29	0.05	0.29	0.10	0.00	0.00	0.00	1.00	0.00	0.25	0.00	0.25	0.25

Part 6

AM Trip Table

Makena Resort Master Plan
October 2002

AM Peak Hour Assignments

Origin Zone	Trips Produced	Destiination Zones H-1	H-2	B-1	B-2	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	S-1	S-2	S-3	S-4	S-5	S-6	S-7	G	P-1	P-2	P-3	P-4	P-5	P-6	Sub
H-1	46		0	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	1	0	1	1	1	20
H-2	37	0		3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	1	0	1	1	1	18
B-1	36	1	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
B-2	62	2	1	0		0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	5
M-1	28	0	0	2	3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-2	28	0	0	2	3	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-3	21	0	0	1	2	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-4	23	0	0	1	2	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5
M-5	28	0	0	2	3	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5
M-6	18	0	0	1	2	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-7	33	0	0	2	3	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	5
M-8	14	0	0	1	1	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-9	28	0	0	2	3	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
M-10	30	0	0	2	3	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-11	18	0	0	1	2	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8
M-12	23	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	2	0	0	0	0	0	0	5
S-1	16	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	2	0	0	0	0	0	0	5
S-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	2	0	0	0	0	0	0	5
S-3	16	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0
S-4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	2	0	0	0	0	0	0	5
S-5	19	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
S-6	7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	2	0	0	0	0	0	0	5
S-7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		1	0	0	0	0	0	0	2
G	75	6	5	4	7	1	1	1	1	0	1	0	1	1	0	1	2	0	0	2	1	0	0	0		0	0	0	0	0	0	0
P-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	36
P-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
P-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
P-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
P-5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
P-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
		9	7	31	54	1	1	1	1	1	0	1	0	1	1	0	1	3	0	3	1	0	0	0	49	0	2	0	2	2	2	
Ext to		48	38	26	44	14	13	9	11	14	8	16	7	12	14	9	10	3	1	3	1	0	6	0	18	0	-1	0	-1	-1	-1	
	%																															
X-1	30%	14	11	8	13	4	4	3	3	4	2	5	2	4	4	3	3	1	0	1	0	0	2	0	5	0	0	0	0	0	0	0
X-2	5%	2	2	1	2	1	1	0	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
X-3	60%	29	23	16	26	8	8	5	7	8	5	10	4	7	8	5	6	2	1	2	1	0	4	0	11	0	-1	0	-1	-1	-1	0
X-4	5%	2	2	1	2	1	1	0	1	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
		47	38	26	43	14	14	8	12	14	7	17	6	13	14	8	11	3	1	3	1	0	6	0	18	0	-1	0	-1	-1	-1	0
		56	45	57	97	15	15	9	13	15	7	18	6	14	15	8	12	6	1	6	2	0	6	0	67	0	1	0	1	1	1	

Part 7

PM Trip Distribution Calculations

Makena Resort Master Plan
October 2002

Preliminary Distribution By Land Use Category

Origin Use	Destination Use						Totals	Ext	Total Trips		Int-Int	Int-Int	Ext-Int	Int-Ext
Use	Hotel	Bus	MF	SF	Golf	Park	% Int	% Ext	In	Out	In	Out	In	Out
Hotel	0%	25%	0%	0%	10%	5%	40%	60%	138	137	55	55	83	82
Bus	10%	0%	5%	5%	0%	0%	20%	80%	466	505	93	93	373	412
MF	15%	15%	0%	0%	3%	0%	33%	67%	239	190	79	79	160	111
SF	15%	15%	0%	0%	3%	0%	33%	67%	71	38	23	23	48	15
Golf	15%	15%	3%	3%	0%	0%	36%	64%	72	96	26	26	46	70
Park	5%	0%	0%	0%	0%	0%	5%	95%	1	5	0	0	1	5
									987	971	276	276	711	695

Distribution By Zone

Origin Zone	Destination Zones																												
	H-1	H-2	B-1	B-2	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	S-1	S-2	S-3	S-4	S-5	S-6	S-7	G	P-1	P-2	P-3	P-4	P-5	P-
	0.56	0.44	0.35	0.65	0.10	0.10	0.07	0.08	0.10	0.06	0.11	0.05	0.09	0.10	0.06	0.08	0.27	0.01	0.30	0.11	0.01	0.28	0.01	1.00	0.00	0.00	0.00	0.00	1.00	0.0
H-1			0.09	0.16																				0.10	0.00	0.00	0.00	0.00	0.03	0.0
H-2			0.09	0.16																				0.10	0.00	0.00	0.00	0.00	0.03	0.0
B-1	0.06	0.04			0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.02	0.01	0.00	0.01	0.00							
B-2	0.06	0.04			0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.02	0.01	0.00	0.01	0.00							
M-1	0.08	0.07	0.05	0.10																				0.03						
M-2	0.08	0.07	0.05	0.10																				0.03						
M-3	0.08	0.07	0.05	0.10																				0.03						
M-4	0.08	0.07	0.05	0.10																				0.03						
M-5	0.08	0.07	0.05	0.10																				0.03						
M-6	0.08	0.07	0.05	0.10																				0.03						
M-7	0.08	0.07	0.05	0.10																				0.03						
M-8	0.08	0.07	0.05	0.10																				0.03						
M-9	0.08	0.07	0.05	0.10																				0.03						
M-10	0.08	0.07	0.05	0.10																				0.03						
M-11	0.08	0.07	0.05	0.10																				0.03						
M-12	0.08	0.07	0.05	0.10																				0.03						
S-1	0.08	0.07	0.05	0.10																				0.03						
S-2	0.08	0.07	0.05	0.10																				0.03						
S-3	0.08	0.07	0.05	0.10																				0.03						
S-4	0.08	0.07	0.05	0.10																				0.03						
S-5	0.08	0.07	0.05	0.10																				0.03						
S-6	0.08	0.07	0.05	0.10																				0.03						
S-7	0.08	0.07	0.05	0.10																				0.03						
G	0.08	0.07	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.03						
P-1	0.03	0.02																												
P-2	0.03	0.02																												
P-3	0.03	0.02																												
P-4	0.03	0.02																												
P-5	0.03	0.02																												
P-6	0.03	0.02																												
X-1	0.56	0.44	0.35	0.65	0.10	0.10	0.07	0.08	0.10	0.06	0.11	0.05	0.09	0.10	0.06	0.08	0.27	0.01	0.30	0.11	0.01	0.28	0.01	1.00	0.00	0.00	0.00	0.00	1.00	0.0
X-2	0.56	0.44	0.35	0.65	0.10	0.10	0.07	0.08	0.10	0.06	0.11	0.05	0.09	0.10	0.06	0.08	0.27	0.01	0.30	0.11	0.01	0.28	0.01	1.00	0.00	0.00	0.00	0.00	1.00	0.0
X-3	0.56	0.44	0.35	0.65	0.10	0.10	0.07	0.08	0.10	0.06	0.11	0.05	0.09	0.10	0.06	0.08	0.27	0.01	0.30	0.11	0.01	0.28	0.01	1.00	0.00	0.00	0.00	0.00	1.00	0.0
X-4	0.56	0.44	0.35	0.65	0.10	0.10	0.07	0.08	0.10	0.06	0.11	0.05	0.09	0.10	0.06	0.08	0.27	0.01	0.30	0.11	0.01	0.28	0.01	1.00	0.00	0.00	0.00	0.00	1.00	0.0

Part 8

PM Trip Table

Makena Resort Master Plan
October 2002

AM Peak Hour Assignments

Origin Zone	Trips Produced	Destination Zones H-1	H-2	B-1	B-2	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	S-1	S-2	S-3	S-4	S-5	S-6	S-7	G	P-1
H-1	76		0	7	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0
H-2	61	0		5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
B-1	178	10	8		0	1	1	1	1	1	1	1	1	1	1	1	1	2	0	3	1	0	2	0	0	0
B-2	327	18	14	0		2	2	1	1	2	1	2	1	2	2	1	1	5	0	5	2	0	5	0	0	0
M-1	19	2	1	1	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
M-2	18	2	1	1	2	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
M-3	13	1	1	1	1	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-4	15	1	1	1	1	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-5	19	2	1	1	2	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-6	11	1	1	1	1	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
M-7	22	2	1	1	2	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-8	9	1	1	0	1	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	1	0
M-9	18	2	1	1	2	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0
M-10	19	2	1	1	2	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	1	0
M-11	12	1	1	1	1	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	1	0
M-12	15	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
S-1	10	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
S-2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
S-3	12	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
S-4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
S-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
S-6	11	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
S-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0
G	96	8	6	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
P-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	
P-2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
P-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X-1	30%	6	5	40	75	6	6	5	5	6	4	7	3	6	7	4	5	3	0	4	2	0	4	0	16	0
X-2	5%	1	1	7	12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	0	3	0
X-3	60%	12	11	80	149	12	12	9	10	12	7	14	6	11	13	8	10	7	1	7	3	1	7	1	31	0
X-4	5%	1	1	7	12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	0	3	0
		77	61	165	300	23	23	18	19	23	15	26	13	22	25	16	19	20	1	22	8	1	21	1	73	0

X-3	X-4	Total
27	2	74
22	2	60
85	7	180
157	13	328
8	1	21
7	1	20
5	0	12
6	1	15
8	1	21
4	0	10
9	1	22
4	0	9
7	1	20
8	1	21
5	0	11
6	1	15
4	0	10
0	0	0
5	0	11
2	0	3
0	0	0
4	0	10
0	0	0
37	3	92
0	0	0
1	0	1
0	0	0
1	0	1
1	0	2
1	0	2
50	50	480
120	50	570
	200	550
200		700
794	335	

APPENDIX C
DESIGN STANDARDS FOR TRAFFIC CALMING

Traffic Calming Design Standards for New Residential Streets: A Proactive Approach

ONE U.S. COUNTY HAS DEVELOPED A PROACTIVE APPROACH TO ACHIEVE TRAFFIC CALMING IN NEW SUBDIVISIONS THAT HAVE NOT YET BEEN BUILT. DEVELOPERS WILL BE REQUIRED TO INCLUDE IN THEIR PLANS DESIGN FEATURES TO ENSURE REASONABLE SPEEDS ON NEIGHBORHOOD STREETS, SUCH AS SPECIFICATIONS FOR TANGENT LENGTHS AND CURVES OR DEVICES SUCH AS TRAFFIC CIRCLES OR SPEED HUMPS.

BY JOSEPH E. WOMBLE, P.E. AND W. MARTIN BRETHERTON JR., P.E.

PROBLEMS ASSOCIATED WITH residential speeding, both real and perceived, require an inordinate amount of traffic engineers' time and effort in local jurisdictions. Gwinnett County, GA, USA, located in the metropolitan Atlanta area, certainly is no exception. As the population of the county has grown—from 166,808 in 1980 to 352,910 in 1990 to 588,448 in 2000—so has the number of residential speed complaints.

EARLY TRAFFIC CALMING EFFORTS

Since 1985, Gwinnett County has had an aggressive program of residential speed control. The first effort consisted of selective closures of streets that carried large volumes of traffic taking shortcuts through residential neighborhoods. However, it did not take long to discover that street closures can be quite controversial and that, therefore, the approach should be considered for only the most egregious cases of "cut-through" traffic.

The next effort was a program known as Neighborhood Speed Watch, which sought compliance with residential speed limits through behavior modification brought about by peer pressure, increased awareness and a greater sense of responsibility.[1] It was designed specifically for self-contained residential areas, where such an approach is most successful.

Neighborhood Speed Watch worked well for Gwinnett County. Neighborhoods that were in the program for two to three years realized 85th-percentile speed reductions in the range of 11 to 13 miles per hour (mph), which corresponded closely with the results obtained through speed humps. The program did have a serious drawback: To function adequately, it required considerable support from Gwinnett County staff. Neighborhood Speed Watch was eliminated in 1992 during a budget crunch. However, it is interesting to note that speeds in subdivisions that were in the program for two to three years have not returned to their pre-program levels, indicating a lasting modification in behavior.

Following the release of the Institute of Transportation Engineers' first draft on speed hump guidelines, Gwinnett County began an extensive program of retrofitting speed humps on existing streets. Speed humps are installed on a petition basis and capital costs are funded by a special purpose local option sales tax, levied by Gwinnett County to fund transportation and other capital improvements. On a street with 85th-percentile speeds in excess of 35 mph, the approval of 70 percent of the property owners is required. On a street with 85th-percentile speeds less than 35 mph, 90 percent of the residents must approve. In addition, each property owner on a street with speed humps must pay a special tax assessment of $12 per year in perpetuity for the maintenance of the humps.

Gwinnett County's speed hump program has proven quite popular. Since the inception of the program, 797 humps have been installed in 126 subdivisions.

RESIDENTIAL STREET DESIGN STANDARDS

Throughout this period, the Gwinnett County Department of Transportation (DOT) has sought to reduce future residential speed problems by taking a proactive role in the development review and rezoning process and by promoting street design layouts that discourage higher speeds. Only limited success in this endeavor has been achieved, as evidenced by the number of speed hump petitions that continues to be received from new subdivisions. One aspect of the problem is the relatively low operating speed required for strong complaints to be voiced. For example, 18 percent of

the speed hump petitions received in past months have involved 85th-percentile speeds in the 30–35 mph range, which require approval by 90 percent of area residents.

Residential street design standards typically specify minimum values for geometric design features such as horizontal curves but do not specify maximum values. Gwinnett County design standards are no exception.[2] By specifying both maximum and minimum design standards, streets can be designed to operate at speeds that are acceptable in a residential area.

A PROACTIVE APPROACH TO ACHIEVE TRAFFIC CALMING

Gwinnett County's population now is increasing by more than 20,000 people per year. Therefore, it has been important to take a proactive approach to modify the elements of street layout and design that lead to excessive speed. This has been accomplished only by developing specific design standards and incorporating them into the county's development regulations. In developing these low-speed design standards, the following factors were considered:

- Once implemented, the standards should result in 85th-percentile speeds in the 25–30 mph range.
- The standards should be easy to understand.
- The standards should offer maximum flexibility to subdivision designers and developers.

The design elements considered in developing low-speed design criteria include tangent lengths and various types of speed control points, such as horizontal curves, breaks in continuity and different types of traffic calming devices.

Tangent Lengths

While numerous studies have been conducted to determine the effect of tangent lengths on operating speeds, additional studies were conducted to determine this relationship based on Gwinnett County's subdivision development standards (such as street widths, setbacks and parking conditions).

Accordingly, speed studies were completed on eight residential streets with 24 tangent sections. The studies were conducted over 24-hour periods with electronic tube counters. The accuracy of the counters was checked by radar. Tangent lengths ranged from 300 to 2,510 feet (ft.) and operating speeds (85th percentile) ranged from 25.5 to 41.2 mph. The studies were conducted at the midpoints of the tangents. Figure 1 shows a scatter diagram of the 24 studied road segments.

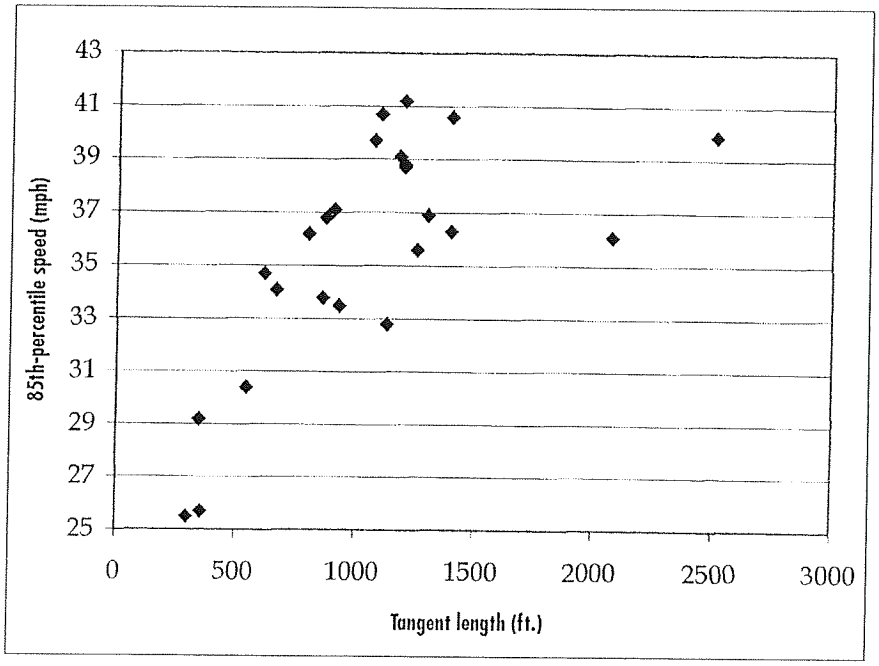


Figure 1. Scatter diagram of the 24 studied road segments on eight residential streets.

A regression analysis was conducted to determine the relationship between operating speeds and the length of tangent segments on residential streets. The model found the following relationship:

$$V = 16.6 + 0.03484\,L - 0.0000138\,L^2$$

V = 85th-percentile speed (mph)

L = length of straight residential street (ft.)

The results of the application of this model, based on Gwinnett County's subdivision street standards, are presented in Table 1. Other results include the following findings:

- The model fits the data well with an R-squared value of 0.83. All residuals are within 1.5 standard error from the expected value.
- The model applies only to straight segments between 300 and 1,400 ft.
- The model found the 85th-percentile speed maximum value (38.6 mph) when the straight segment length is 1,260 ft. To be consistent with the theory that longer segment length generates higher speed, it was decided that the model would use a maximum value of 38.6 mph for segments longer than 1,260 ft.

Table 1. Relationship between tangent length and operating speed on residential streets.

Tangent length (ft.)	Expected operating speed (mph)
300	25.8
400	28.3
500	30.6
600	32.5
700	34.2
800	35.6
900	36.8
1,000	37.6
1,100	38.2
1,200	38.5
1,300	38.6
1,400	38.6

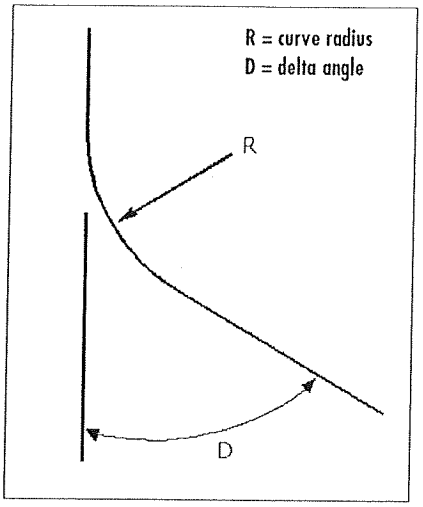


Figure 2. Curve radius and delta angle.

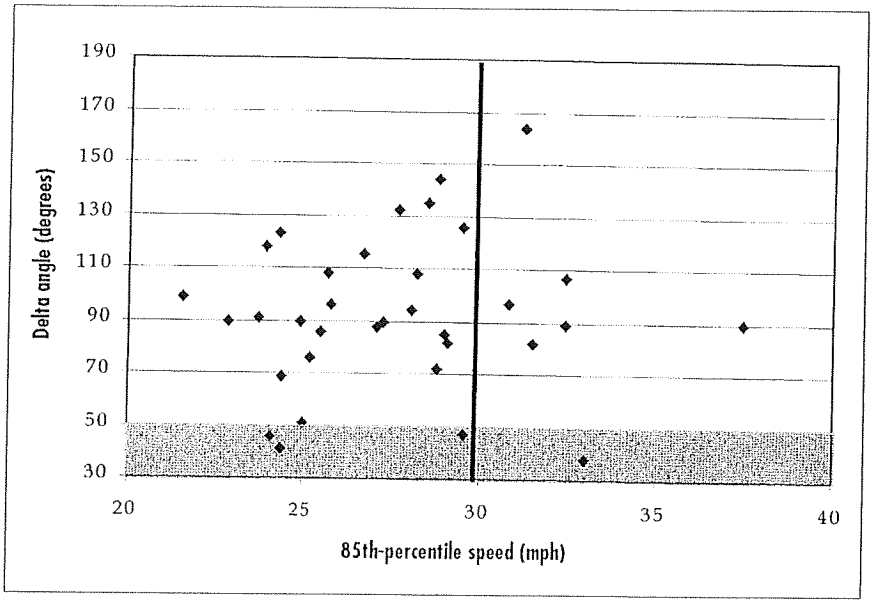


Figure 3. Scatter diagram of the 35 studied curves on eight residential streets.

Speed Control Points

Speed control points are defined as the design elements at the end of tangent sections that can be negotiated safely only at operating speeds of 25–30 mph or less. These include horizontal curves, breaks in continuity and traffic calming devices.

Horizontal Curves. As shown in Figure 2, the two most important curve characteristics influencing operating speed are delta angle and radius. (This assumes super-elevation rate e = 0, which is the standard for Gwinnett County's residential streets.)

To determine the effect of horizontal curves on operating speed, a statistical analysis was performed on data collected on eight residential streets. The data included operating speed, delta angle and radius for 35 horizontal curves. The curve data were obtained from final subdivision development plats. Operating speeds in the study ranged from 21.5 to 37.4 mph and were measured at the point of curvature or point of tangency to determine the effect of the curve on speed. In addition, data were collected using automatic 24-hour traffic counters with rubber tubes. Vehicles needed to hit the tubes perpendicularly to obtain accurate readings. The delta angles ranged from 37 to 164 degrees and the curve radii ranged from 51 to 426 ft.

Figure 3 shows a scatter diagram of the 35 studied curves. Most of the data points are left of the 30-mph marker, showing possible curve designs of less than 30 mph using different delta angles. There is a very strong correlation between delta angle and curve length (correlation coefficient equals 0.94), because the radius (or curve length) usually is not chosen independently once the delta angle is determined; it often is determined on the basis of design criteria. Due to the strong correlation between delta angle and curve length, the speed prediction model based on the regression analysis would have only one of the two as an independent variable.

Both analysis of variance and regression analysis were conducted to determine the relationship between operating speed and horizontal curve design on residential streets. No model could be found because all relationships were statistically insignificant (best R-squared equals 0.66). The study plotted all data points on a graph and drew a line at 30 mph, as shown in Figure 3. The reasonable grouping of data points was used. Based on this study, Table 2 shows curve values required to maintain operating speeds in the 25–30 mph range.

Table 2. Curve values required to maintain 25–30 mph operating speeds.

Delta angle (must be greater than 30 degrees)	Radius
30 degrees – 40 degrees	100 ft.
41 degrees – 50 degrees	120 ft. (minimum) – 130 ft. (maximum)
Greater than 51 degrees	120 ft. (minimum) – 150 ft. (maximum)

Breaks in Continuity. Conditions that require a motorist to come to a complete stop include a T intersection or a stop-controlled intersection between a residential street and a collector or arterial road. These conditions do not include unwarranted multi-way stop control at an intersection between local subdivision streets. (Section 2B.05 of the *Manual on Uniform Traffic Control Devices* states that, "Stop signs should not be used for speed control." Experience has shown this to be a sound policy, which the Gwinnett County DOT supports).[3]

Traffic Calming Devices. While there are various traffic calming devices available, those now considered for use in Gwinnett County are limited to speed humps, traffic circles, median islands and roundabouts.[4] Design details for these devices will be presented in the "Traffic Calming Guide for the Approved Design and Spacing of Traffic Calming Devices," currently under development. Design guidelines for roundabouts are contained in the Federal Highway Administration guidelines.[5]

TRAFFIC CALMING CRITERIA FOR NEW RESIDENTIAL STREETS

With this research to serve as background, very simply stated criteria have been developed to govern low-speed design of residential streets in new developments. As such, subdivision streets should be designed to encourage and maintain 85th-percentile speeds in the 25–30 mph range. To achieve this objective, the maximum length of a roadway section between speed control points should be 500 ft. A speed control point is defined as any one of the following:

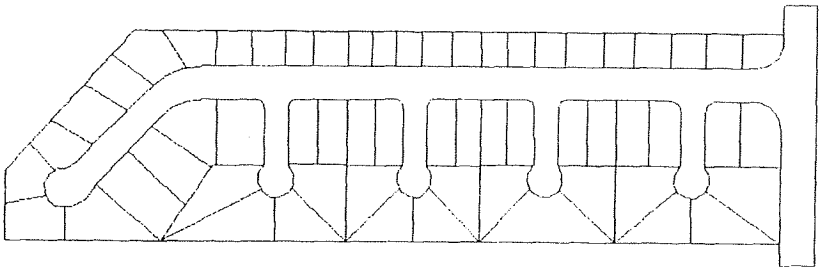
- Any design condition that requires a complete stop, such as the intersection of a local residential street with a collector or arterial road or a T intersection between local streets. (Unwarranted stop-sign control at an intersection between local streets does not qualify.)
- A horizontal curve with the design features shown in Table 2.
- A traffic calming device of which the design is subject to review and approval by the Department of Transportation. (See the "Traffic Calming Guide for the Approved Design and Spacing of Traffic Calming Devices," currently under development.)

APPLICATION OF TRAFFIC CALMING CRITERIA

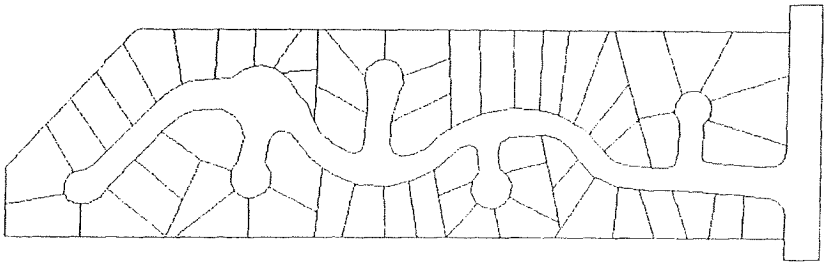
Figure 4 shows how traffic calming criteria might be applied to a new residential subdivision. Figure 4a illustrates a subdivision that was submitted for development review. Although it was a small subdivision, the straight tangent length of its principal street (greater than 1400 ft.) was certain to generate operating speeds in excess of 30 mph—beyond the threshold at which residents express concerns about residential speeding.

Figure 4b illustrates a conceptual redesign of the subdivision utilizing short tangent lengths and curves to ensure operating speeds less than 30 mph. Figure 4c illustrates how the same objective can be achieved by retaining the original street layout but adding strategically placed traffic calming devices such as traffic circles.

4a. Traditional subdivision street layout.



4b. Traffic calming achieved through curvilinear design involving application of short tangent lengths and low-speed curves.



4c. Traffic calming achieved by inclusion of traffic calming devices in design. In this case, landscaped traffic circles were used.

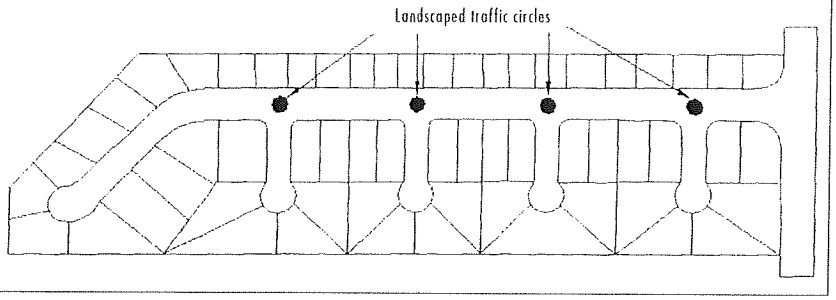


Figure 4. Application of traffic calming design standards to a new residential subdivision.

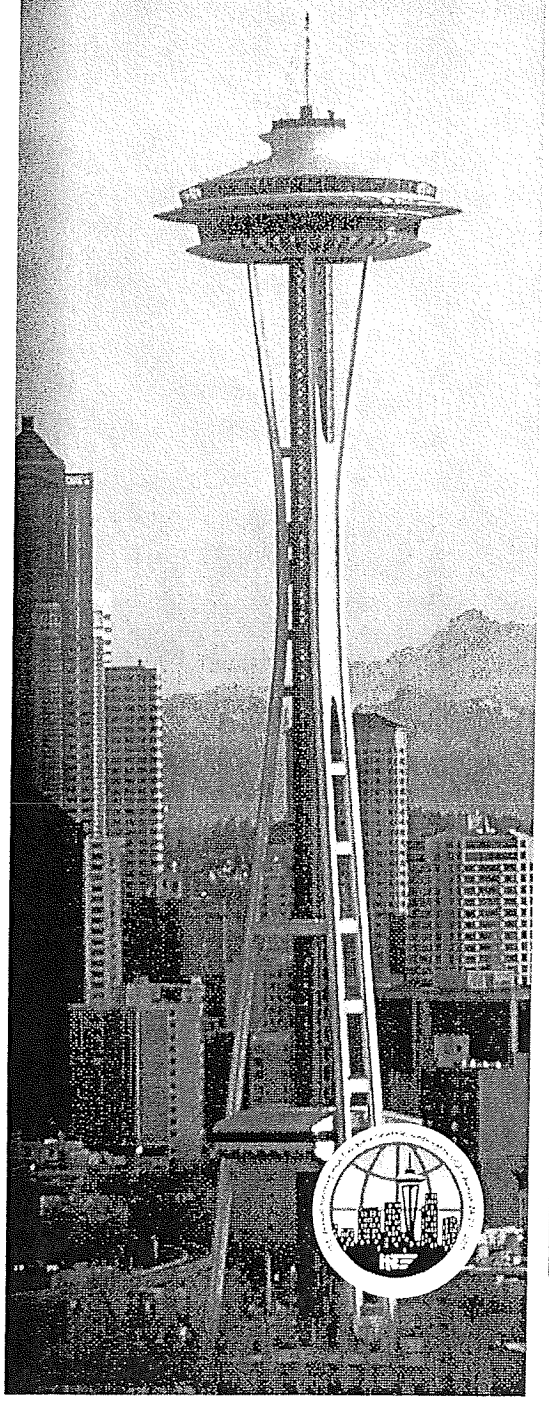
Another solution might be a combination of curvilinear design and traffic calming devices. This offers developers maximum flexibility and ensures that traffic calming measures can be accommodated with little or no loss in lot yield.

The preferred solution is a curvilinear design that encourages a constant and reasonable speed; this design does not require vehicles to accelerate and decelerate frequently, which results in wasted fuel and increased noise and air pollution. In addition, a curvilinear design eliminates the maintenance requirements associated with traffic calming devices. This not only ensures acceptable operating speeds but also improves the aesthetics of the area, contributing to a better quality of life for residents.

SUMMARY

There are various proven and well documented ways to implement traffic calming measures in existing residential areas. However, for new residential developments, it is far preferable to design streets to maintain acceptably low operating speeds rather than to face the need to retrofit traffic calming devices, with all the attendant disruption and controversy it often entails. To achieve wide acceptability, traffic calming, or low-speed design, should satisfy the following criteria:

- When applied, the standards should result in 85th-percentile speeds in the 25–30 mph range.
- The standards should be specific, yet simple and easy to understand and apply.



- The standards should offer maximum flexibility and choice to subdivision designers and developers. ■

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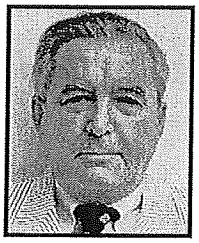

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HUGH W. MCGEE, *Ph.D., P.E., is chairman of the board of BMI in Vienna, VA, USA. He has more than 30 years of experience in traffic engineering, operations and safety, providing studies and designs for state and local governments and conducting research at the federal and national level. He holds degrees in civil engineering from Pennsylvania State University. McGee is a fellow of ITE and the American Society of Civil Engineers.*

KIMBERLY A. ECCLES, *E.I.T., is a senior engineer at BMI in Vienna, VA. She has a bachelor's of science degree in civil engineering from Michigan State University and a master's degree in civil engineering from North Carolina State University. Eccles is a member of ITE.*

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

HWY-PS
2.3496

JAN 25 2007

Mr. Michael J. Molina
Land Use Committee
County Council
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Mr. Molina:

Subject: Change in Zoning and Project District Phase I Approval for Honua'ula / Wailea 670 Residential Development (LU-38)

Thank you for your January 12, 2007 letter and for allowing HDOT to share our perspective on the Honua'ula traffic study.

As stated in their September 29, 2006 and January 22, 2007 letters to your Committee, the Honua'ula developer (WCPT/GW Land Associates, LLC) has offered to design, acquire necessary right-of-way, obtain necessary permits, and construct two additional lanes and intersection improvements to Piilani Highway from Kilohana Drive to Wailea Ike Drive at no cost to the State or County. We would have no objection to approval of the Honua'ula zone change and project district applications provided this offer were imposed as a condition of approval. In simple terms, such a zoning/permit condition would relieve us of the burden of negotiating a cost-sharing agreement between South Maui developers to ensure that required highway improvements would be provided when needed.

We do not believe that a revised Piilani Highway traffic study, which reflects updated plans of all major South Maui developers, is necessary for the Maui Council to require the Honua'ula developer to widen and improve Piilani Highway as a zoning/permit condition. Such a traffic study will be provided at a later date as part of the design process for highway improvements. We assume that an updated traffic study would also help in the negotiation of cost-sharing arrangements between South Maui developers.

EXHIBIT " B "

If there are any questions, please contact Ronald Tsuzuki, Head Planning Engineer, Highways Division at 587-1830.

Very truly yours,

BRENNON T. MORIOKA, Ph.D., P.E.
Deputy Director - Highways

DM:dn

c: Charles Jencks

LINDA LINGLE
GOVERNOR

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STATE OF HAWAII
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IN REPLY REFER TO:
HWY-PS
2.5613

SEP 12 2007

The Honorable Michael J. Molina, Chair
Land Use Committee
County Council
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96793

Dear Councilmember Molina:

Subject: Change in Zoning for Various Parcels of Land in the Makena Resort Area, Makena, Maui, Hawaii (LU-37); Change in Zoning and Project District Phase I approval for Honua'ula/Wailea 670 Residential Development (LU-38)

This supplements our attached HWY-PS 2.3496 letter dated January 25, 2007.

Based on a July 2007 traffic study for the Makena Resort, we believe that Piilani Highway will need two additional lanes from Kilohana Drive to Wailea Ike Drive if a zone change is approved for the Makena Resort, Honua'ula, or both. We would have no objection to approval of the Makena Resort zone change, the Honua'ula zone change, or both, provided that zoning conditions require one or both developers to design, acquire right-of-way, obtain permits, and construct two additional lanes and intersection improvements on Piilani Highway from Kilohana Drive to Wailea Ike Drive at no cost to the State or County.

Our understanding is that the developers of the Makena Resort, Honua'ula, and A&B Wailea are willing to negotiate a cost-sharing agreement and privately construct needed improvements of Piilani Highway if both zone changes are approved. Although not required, if the proposed cost-sharing agreement includes private extension of Piilani Highway as a County road south of Wailea Ike Drive, we will support the extension and allow use of existing unimproved State highway right-of-way.

If there are any questions, please contact Ronald Tsuzuki, Head Planning Engineer, Highways Division at (808) 587-1830.

Very truly yours,

BRENNON T. MORIOKA, Ph.D., P.E.
Deputy Director – Highways

Attachment: HWY-PS 2.3496

c: Jeff Hunt
Don Fujimoto
Charles Jencks
Clyde Murashige

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of	)	DOCKET NO. A97-721
	)	
MAKENA RESORT CORP.	)	CERTIFICATE OF SERVICE
	)	
To Amend the Land Use District Boundary of Certain Land Situated at Makena, Island of Maui, State of Hawaii, consisting of approximately 146.209 acres from the Agricultural to the urban District.	)	

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing document was duly served upon counsel by depositing the same with the United States Postal Service or hand delivery on May 23, 2008 addressed to:

	Hand Delivery	Mail
Office of Planning State Office Tower, 6th Floor 235 South Beretania Street P. O. Box 2359 Honolulu, Hawaii 96804		X
Abe Mitsuda, Administrator Office of Planning Land Use Division State Office Tower, 6th Floor 235 South Beretania Street P. O. Box 2359 Honolulu, Hawaii 96804		X

	Hand Delivery	Mail
Jeffrey S. Hunt, Director Planning Department County of Maui 250 South High Street Wailuku, Maui, Hawaii 96793		X
Maui Planning Commission County of Maui 250 South High Street Wailuku, Maui, Hawaii 96793		X
Maui Electric Company, Ltd. P. O. Box 398 Kahului, Maui, Hawaii 96732-0398		X
Verizon Hawaii Inc. 60 S. Church Street Wailuku, Maui, Hawaii 96793		X
Ulupalakua Ranch P. O. Box 901 Ulupalakua, Maui, Hawaii 96790		X
Jeffrey Eng, Director Department of Water Supply County of Maui 200 South High Street Wailuku, Maui, Hawaii 96793-2155		X

DATED: Honolulu, Hawaii, May 23, 2008.

RANDALL F. SAKUMOTO
Attorney for Petitioners
Makena Hotel, LLC, Makena Golf, LLC
and Keaka LLC