South Kauai Community Traffic Impact Study Draft Report

Prepared for:
PBR
County of Kauai

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1.0 EXECUTIVE SUMMARY

1.1 Project Description

The South Kauai Community Plan is a multi-modal land use and transportation plan for the communities of Koloa, Poipu, Kalaheo, Omao, and Lawai on the island of Kauai. Key elements of the plan include:

- Identifying future development opportunity areas within the Community Plan area
- Estimating growth to accommodate future development
- Preparing a ***Regulatory Plan*** which outlines future land use changes
- Recommendations to improve roadway, transit, and bicycle/pedestrian networks to support the anticipated level of new development
- Preparing a ***Multi-Modal Transportation Plan*** reflecting these recommended improvements

The land use program and roadway network were developed through an extensive consultation process involving Agency Staff, Community Members, business owners, and other stakeholders.

The purpose of this study is threefold:

- Present background information regarding the transportation system within the Community Plan area
- Discuss the operations of the transportation system prior to the implementation of the South Kauai Community Plan
- Address the operations of the transportation system with the implementation of the South Kauai Community Plan

1.2 Transportation Analysis

This study addresses several specific questions related to the future performance of the transportation system:

- How does the roadway network perform prior to the buildout of the Regulatory Plan?
- How does the roadway network perform after the buildout of the Regulatory Plan?
- Does the implementation of the Regulatory Plan cause any element of the roadway network to fail that would otherwise operate at an acceptable level?

- How would the non-vehicular transportation system operate after the implementation of the Regulatory Plan and the Multi-Modal Transportation Plan?
- If there are roadway segments which operate in a deficient fashion after the implementation of the Regulatory Plan, what policy options or physical improvements might be available to reduce vehicular demand?
- Can several site specific improvements be implemented within the constraints of the overall transportation syste?

The primary analytical tool employed in this analysis is the Island of Kauai Travel Demand Forecasting Model (TDFM) which was prepared by the Hawaii Department of Transportation with the assistance of CH2MHill. This model was originally developed as part of the Long Range Land Transportation Plan for Kauai and is a key planning tool for forecasting future vehicular demand on the island. Land use changes were input into the Kauai TDFM and any resulting changes in roadway performance were noted.

1.3 Findings

The analysis concluded that there are several segments of Kaumuali`i Highway, which would operate at LOS F prior to and after the implementation of the Regulatory Plan associated with the South Kauai Community Plan. While the typical approach would be to recommend widening the roadway to accommodate additional projected demand, we instead concluded that the presence of the following elements in the Multi-Modal Transportation Plan could limit the need to widen the roadway in the future:

- Separate turn lanes at two locations on Kaumuali`i Highway (Papalina Road and Koloa Road) which represent key constraint points of highway capacity
- A continuous series of bicycle facilities proposed on Kaumuali`i Highway that would include an on-street bicycle lane (Class II) from Papalina Road to Koloa Road. East and west of this section, a bicycle route (Class III) would be implemented
- Pedestrian pathways and other improvements recommended for Kalaheo, to limit the need to use Kaumuali`i Highway for short-distance (i.e., intra-community) travel

The provision of a robust multi-modal transportation network as outlined in the SKCP has the potential to minimize increases in vehicular traffic on Kaumuali`i Highway, which may limit future congestion in the Study Area. However; this approach would also require modifications and enhancements to existing transit operations to ensure that sufficient capacity exists on bus routes to accommodate future growth.

Providing convenient and attractive travel options will allow residents, employees and visitors the opportunity to forgo the use of personal vehicles to meet the overall mobility goals within the Community Plan area.

2.0 ANALYSIS PARAMETERS

This chapter outlines the geographic scope of the traffic impact analysis, including the study intersections and roadways, and the analysis methodologies and significance criteria employed in this study.

2.1 Project Study Area

The study area for the SKCP is generally bound by the following facilities including:

- Kaumuali`i Highway to the north
- Maluhia Road and Alakinoiki Road to the east
- Papalina Road and Koloa Road to the west
- Poipu Road to the south

2.2 Analysis Scenarios

This report presents data for three scenarios including:

- Existing- This scenario reports existing traffic counts and transit data based on data collected from 2012 and earlier, as documented in the *Kauai Transportation Data Book for the Kauai Multimodal Land Transportation Plan* (May 2012).
- 2035 No Regulatory Plan- This scenario evaluates conditions prior to the implementation of the Regulatory Plan in 2035, which is the build out scenario for the Kauai TDFM. This scenario includes programmed roadway improvements and anticipated growth on Kauai, as identified during the development of the Kauai TDFM.
- 2035 With Regulatory Plan- This scenario analyzes transportation conditions once the Regulatory Plan has been implemented. Outside of the geographic areas addressed by the Regulatory Plan, this scenario relies on land use and transportation data within the Kauai TDFM.

2.3 Analysis Methodologies

This analysis primarily focuses on daily roadway segment operations. Capacity for each roadway segment is taken from the Kauai TDFM. These capacities reflect the effects of terrain, roadway width, and other factors identified during the model development process. Capacities as described within the model are shown in Table 2-1.

Table 2-1

Existing Year Roadway Capacities

Roadway	Location	Capacity
Kaumuali`i Highway	West of Paplina Road	19,800
Kaumuali`i Highway	Between Paplina Road and Koloa Road	19,900
Kaumuali`i Highway	Between Koloa Road and Omao Road	19,800
Kaumuali`i Highway	West of Omao Road	24,800
Maluhia Road	North of Alakinoiki Road	24,800
Alakinoiki Road	East of Maluhia Road	16,800
Alakinoiki Road	North of Poipu Road	16,200
Papalina Road	South of Kaumuali`i Highway	15,800
Koloa Road	South of Kaumuali`i Highway	19,000
Koloa Road	North of Poipu Road	22,200
Poipu Road	South of Koloa Road	19,000
Poipu Road	West of Alakinoiki Road	15,800

Source: Kauai TDFM

One method commonly used to assess the operations of a roadway is through the use of level of service (LOS). LOS is a quantitative approach to that defines how a facility operates by comparing observed or forecasted conditions against various types of performance metrics. Potential performance metrics include seconds of delay or capacity.

For purposes of this analysis, the observed and projected traffic volumes on a segment basis are compared against the capacity to determine the volume to capacity ratio (V/C ratio). Typically, LOS A indicates free-flowing conditions, LOS C is indicative of a moderate level of congestion, and LOS F indicates significant levels of congestion. For purposes of this analysis, a V/C ratio in excess of 1.0 is classified as LOS F as shown in the table below.

Table 2-2

Roadway Volume to Capacity Ratios

V/C Ratio	Level of Service
0.00 to 0.60	A
0.61 to 0.70	B
0.71 to 0.80	C
0.81 to 0.90	D
0.91 to 1.00	E
>1.00	F

Source: Fehr & Peers, 2014

The use of a daily V/C ratio for this study is appropriate in that it is used to evaluate the overall operation of a roadway for long-range planning purposes. However; it is generally not suitable for an evaluation of specific intersection designs which require the use of detailed modeling for peak hour operations.

3.0 EXISTING CONDITIONS

This chapter discusses the existing transportation conditions in the South Kauai Community Plan Study Area including the roadway, transit, and bicycle/pedestrian networks.

3.1 EXISTING ROADWAY FACILITIES

This section describes the existing roadways within the Study Area, primarily focusing on regional roadways. Major roadways within the study area include:

Kaumuali`i Highway, also known as Route 50, is one of the primary roadways on the island and general travels from east to west through the central portion of the island. This roadway is one of the backbone infrastructure elements on Kauai and serves a critical role in the movement of traffic on a regional basis. This roadway current has one travel lane in each direction.

Maluhia Road**,** which is also County Road 520 (CR 520) , is a north/south roadway which extends from Poipu Road in Koloa north to connect with Route 50 north of the study area. This roadway also has one travel lane in each direction.

Alakinoiki Road is another north/south roadway which connects Koloa down south to Poipu, intersecting with **Poipu** Road. Like the other roadways in the study area, this facility also has one travel lane in each direction.

Papalina Road is a north/south roadway which connects to Route 50 in Kalaheo. This roadway also has two lanes with one travel lane in each direction.

Koloa Road or County Road 530 extends from Route 50 in Lawai south to connect with Maluhia Road and Poipu Road in Koloa. In Koloa, these three roadways intersect in a series of off-set intersections. This roadway has two travel lanes, one in each direction.

Poipu Road provides connectivity from Koloa to Poipu. South of Koloa, Poipu extends in a southerly direction but then turns to the east to connect to Poipu. As with all other roadways, this roadway currently has one travel lane in each direction.

3.2 EXISTING TRANSIT FACILITIES

The County of Kauai operates a fixed route bus fleet throughout the island. Service is provided on several routes throughout the study area including:

Kekaha-Lihue Mainline (Route 100 and 150) travels through the study area with stops in Kalaheo. Service along this route is provided from approximately 5:30 AM to 9:30 PM Monday through Friday. Weekend and holiday service is offered from 7:30 AM to 4:30 PM. In Kalaheo, a bus travels through the community approximately every 30 to 60 minutes. This line is also operated as an express bus service with limited stops during the morning commute times.

Koloa Shuttle (Route 30) operates on a circular route, travel from the Kalaheo Neighborhood Center to Koloa. The shuttle then travels to Poipu before returning to Koloa and Kalaheo. Service starts at 6:15 AM and extends to 10:00 PM on the weekdays. Weekend and holiday service starts at 7:15 AM and ends at 6:00 PM.

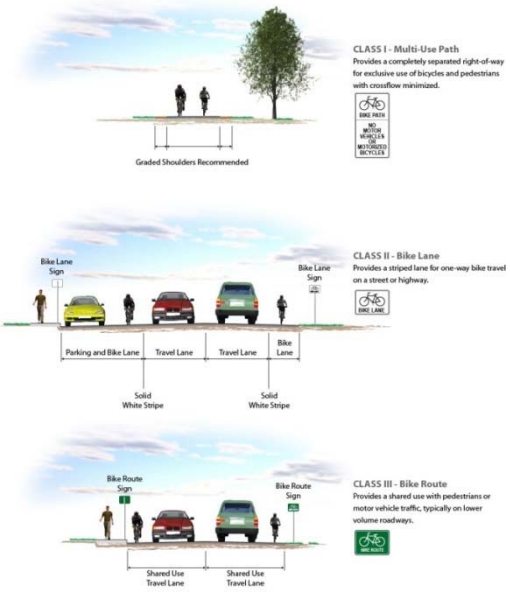
According to the *Kauai 2012 Transportation Data Book*, the Kekaha Mainline route is the second busiest route on the system, with daily ridership of over 750 persons per day, 2011. The ridership increased by nearly 90% when compared to previous data collected in 2007. The Koloa Shuttle route carried 33 persons per day in 2011, which is a near tripling as compared to data collected in 2007.

One metric commonly applied to transit routes is number of persons board per hour, which is a function of total persons boarding a bus divided by total number of hours the buses are in service. According to the *Transportation Data Book*, the boardings per hour on the Kekaha Mainline were 11.1, some of the highest in the system. This value is consistent with the overall averages for the system. Conversely, the Koloa Shuttle route has only 3.6 boardings per hour, which is substantially below the system wide average.

3.3 BICYCLE FACILITIES

As shown in the graphics to the right, bicycle facilities fall within three broad categories when typically described by planners and engineers which include:

- Class I Trails- These facilities are off-road routes which are generally accessible by both bicyclists and pedestrians
- Class II Lanes- In-street bicycle lanes provide dedicated lanes for bicycles to travel within the roadway



- Class III Routes- These facilities are designated through signage and indicate that bicyclists may use a roadway without providing a dedicated facility

There are also several innovative approaches toward bicycle facilities that could potentially be implemented including:

- Cycle tracks- Cycle tracks represent an amalgam of Class I and Class II facilities. They share the characteristics of Class II facilities in that they are provided within the curb-to-curb area; however these facilities are physically separated from the travel lanes unlike a typical Class II facility. As such, cycle tracks provide a higher degree of perceived safety as compared to a traditional on-street facility.
- Colored bicycle lanes- Another recent innovation is the use of colored pavement for on-street cycling facilities. A commonly used color is green, which reinforces that the on-street lane is treated differently than the remaining areas of the roadway.

There are currently no Class I, II, or III facilities within the study area.

3.4 TRAFFIC DATA COLLECTION

The Hawaii Department of Transportation provides yearly traffic count data for major roadways. These counts are summarized in Table 3-1.

Table 3-1
Existing Year Traffic Count Data

Roadway	Location	ADT
Kaumuali`i Highway	West of Paplina Road	16,300
Kaumuali`i Highway	Between Paplina Road and Koloa Road	19,900
Kaumuali`i Highway	Between Koloa Road and Omao Road	9,600
Kaumuali`i Highway	East of Omao Road	14,300
Maluhia Road	North of Alakinoiki Road	6,100
Alakinoiki Road	East of Maluhia Road	8,000
Alakinoiki Road	North of Poipu Road	5,500
Papalina Road	South of Kaumuali`i Highway	5,300
Koloa Road	South of Kaumuali`i Highway	6,000

Table 3-1 Existing Year Traffic Count Data		
Roadway	**Location**	**ADT**
Koloa Road	North of Poipu Road	6,500
Poipu Road	South of Koloa Road	5,200
Poipu Road	West of Alakinoiki Road	5,400
Source: Hawaii Department of Transportation, 2009-2010 Traffic Data		

As shown in the Table above, the majority of the roadways within the study area carry less than 10,000 vehicles per day with many carrying approximately 5,000 vehicles per day. The highest volumes of traffic are on Kaumuali`i Highway, particularly where it intersects with Koloa Road.

Using the capacities and V/C ratios identified in Tables 2-1 and 2-2, we evaluated the existing roadway operations.

Table 3-2 Existing Traffic Evaluation				
Roadway	**Location**	**Volume**	**Capacity**	**V/C Ratio**
Kaumuali`i Highway	West of Paplina Road	16,300	19,800	0.82
Kaumuali`i Highway	Between Paplina Road and Koloa Road	19,900	19,900	1.00
Kaumuali`i Highway	Between Koloa Road and Omao Road	9,600	19,800	0.48
Kaumuali`i Highway	East of Omao Road	14,300	24,800	0.58
Maluhia Road	North of Alakinoiki Road	6,100	24,800	0.25
Alakinoiki Road	East of Maluhia Road	8,000	16,800	0.48
Alakinoiki Road	North of Poipu Road	5,500	16,200	0.34

Papalina Road	South of Kaumuali`i Highway	5,300	15,800	0.34
Koloa Road	South of Kaumuali`i Highway	6,000	19,000	0.32
Koloa Road	North of Poipu Road	6,500	22,200	0.29
Poipu Road	South of Koloa Road	5,200	19,000	0.27
Poipu Road	West of Alakinoiki Road	5,400	15,800	0.34
Note: Deficient segments shown in bold Source: Fehr & Peers, 2014 and Kauai 2035 TDFM.				

The roadway segment analysis data above is supplemented through the use of Inrix data to provide another perspective on roadway operations. Inrix uses crowd-sourcing technology to record travel speeds and congestion levels. Data on travel speeds are obtained from GPS units, commercial vehicles, cell phones, and a variety of other sources. This data is then aggregated and reported through a centralized database. Data was obtained for the study area, focusing on Kaumuali`i Highway as the most reliable data is available for this facility.

Figures 3-1 and 3-2 present speed and congestion data for the morning peak hour (8 AM on a weekday) while Figures 3-3 and 3-4 provide similar data for the afternoon or evening peak hour (4 PM on a weekday). As shown in the exhibits, there is limited congestion on Kaumuali`i Highway as most vehicles are able to travel between 30 and 50 miles per hour during these peak traffic periods.

Figure 3-1 Weekday Morning Travel Speeds

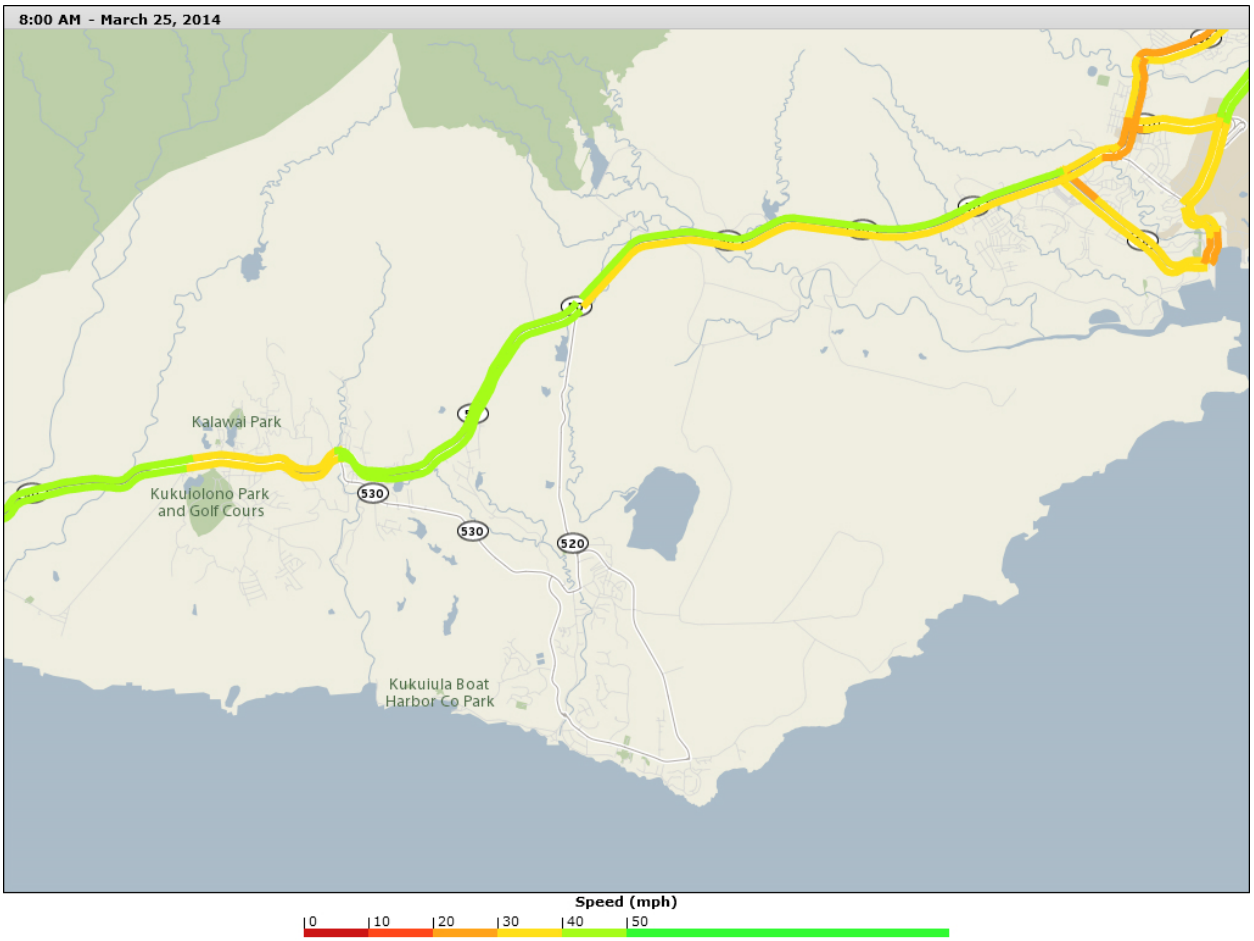


Figure 3-2 Weekday Morning Congestion

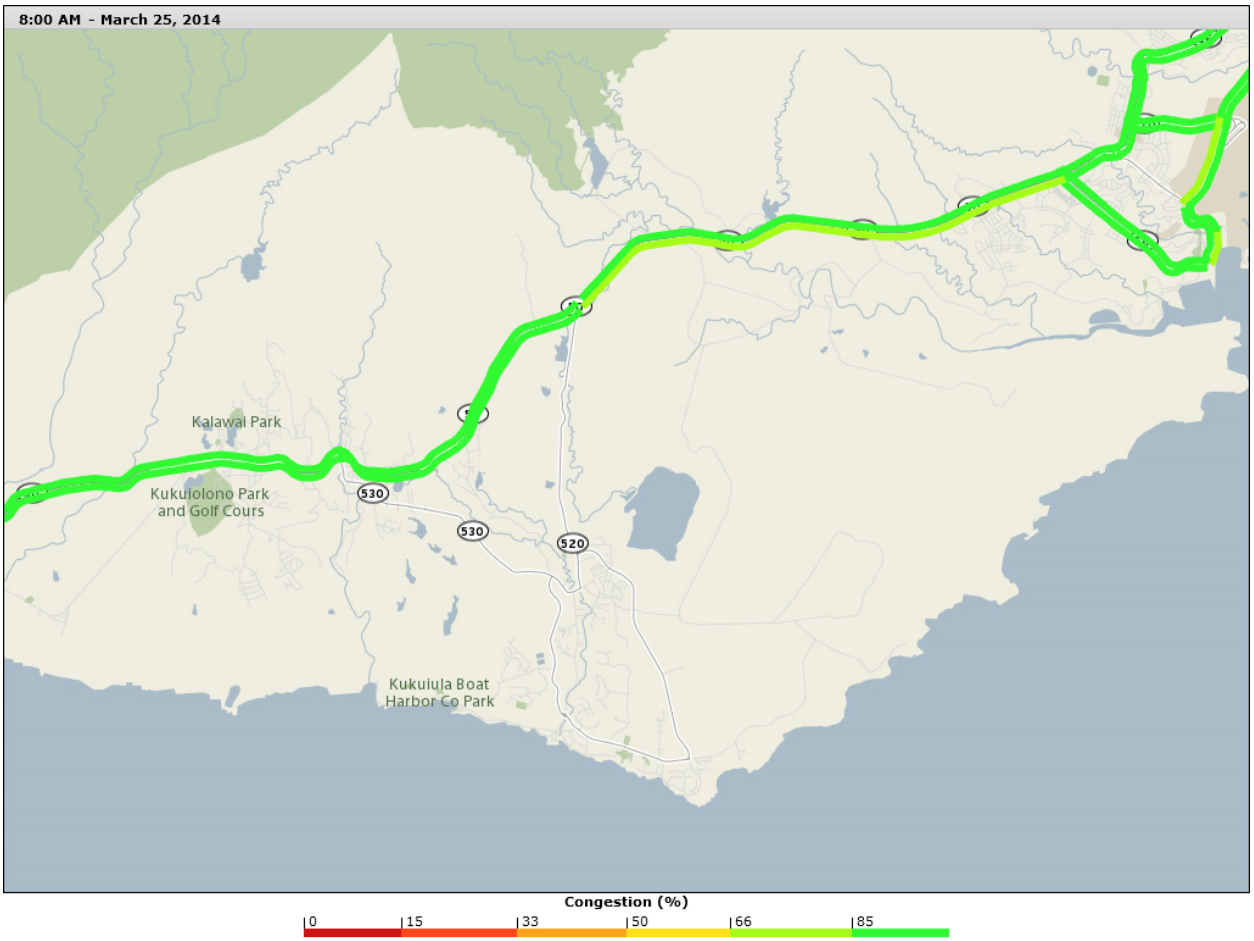


Figure 3-3 Weekday Afternoon Travel Speeds

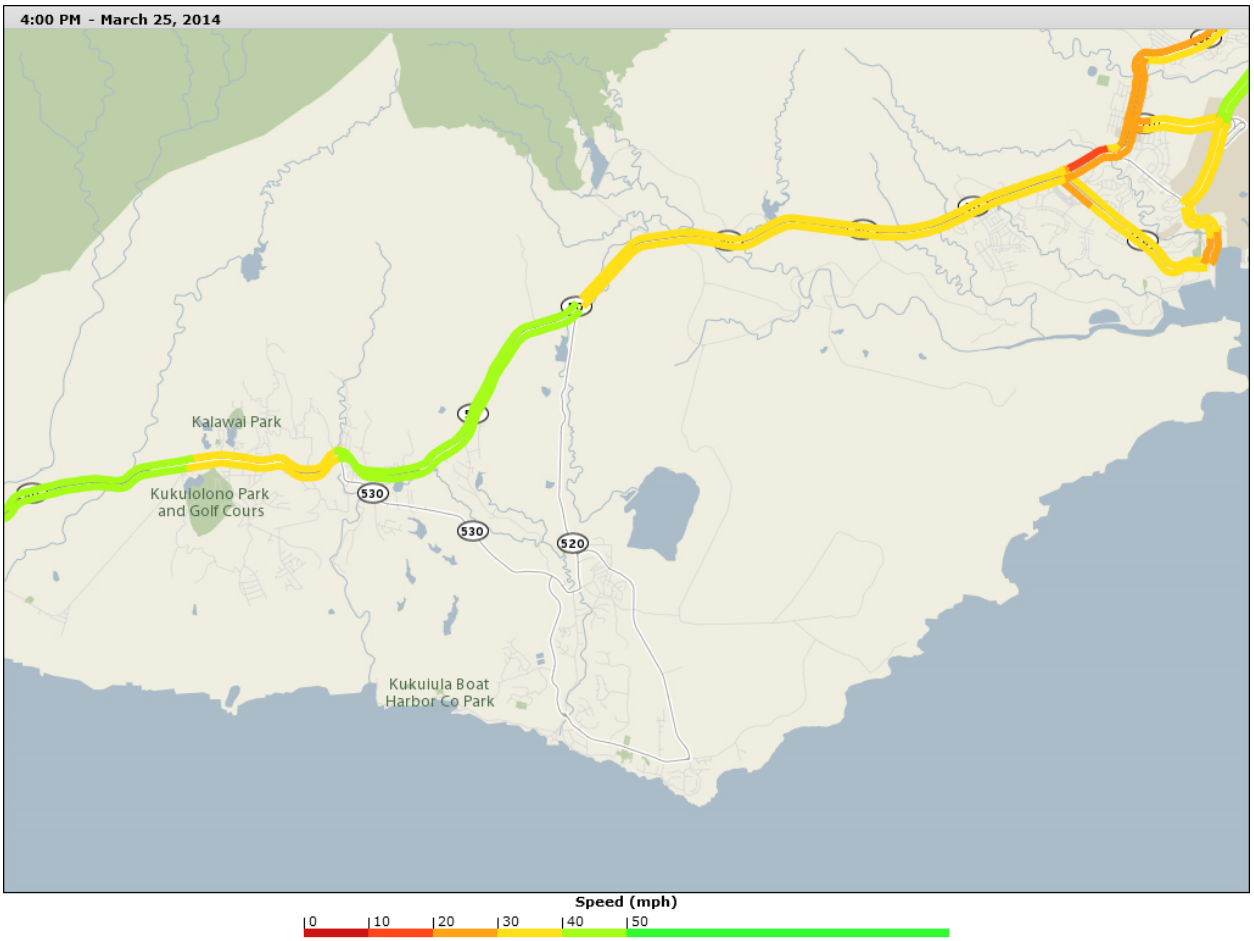
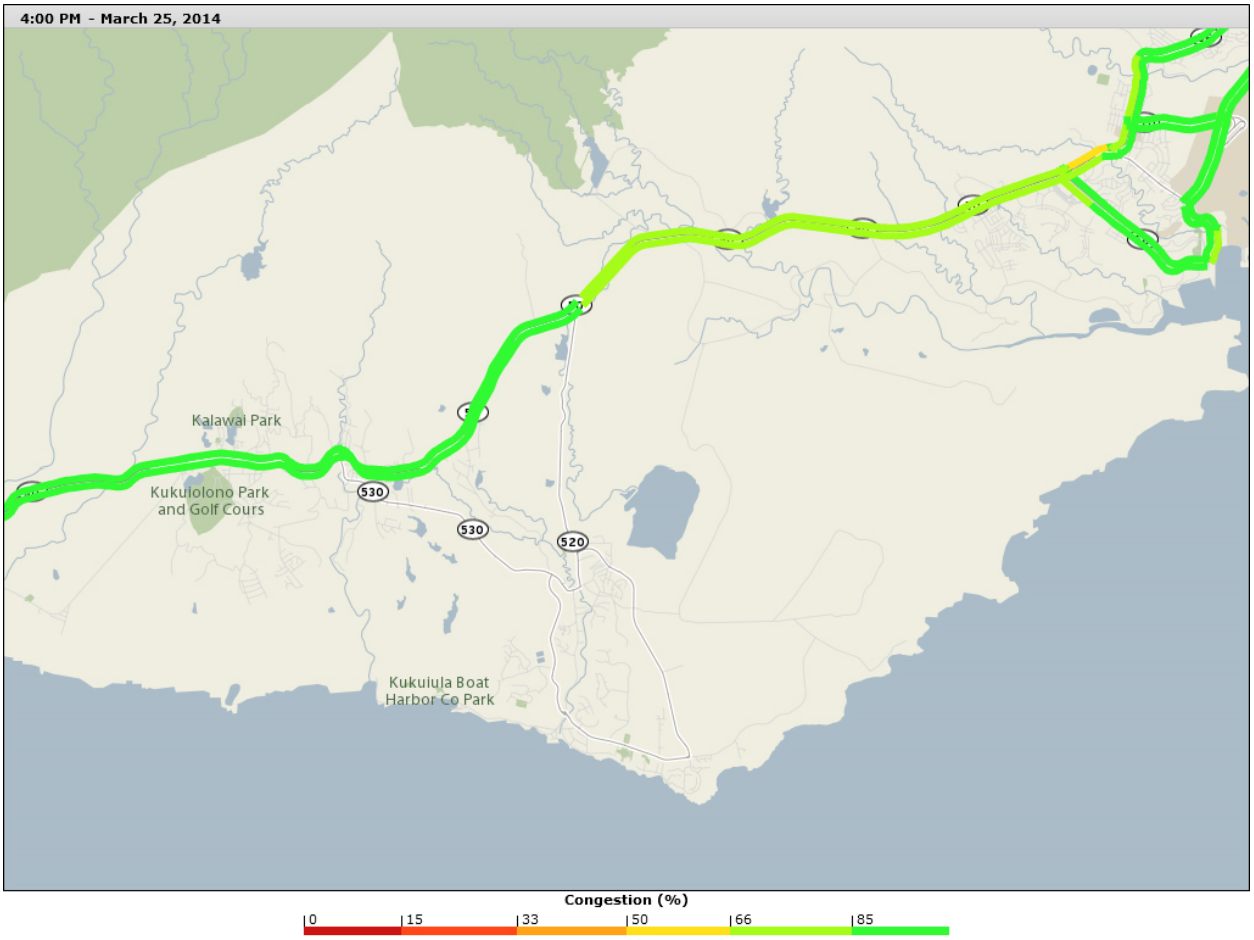


Figure 3-4 Weekday Afternoon Congestion



4.0 South Kauai Community Plan

This section documents the proposed development associated with the South Kauai Community Plan (SKCP) including the proposed roadway network and land use changes.

4.1 Proposed Transportation Network

Figure 4-1 provides the proposed transportation network associated with SKCP. Key elements of this network include:

- No significant roadway widening- A key focus of the planning efforts is maintaining the existing roadways within the two travel lanes already provided
- Intersection improvements- Identifying locations where intersections can be improved through the installation of traffic signals, roundabouts, and other similar measures
- Bicycle and pedestrian improvements- Installing bicycle and pedestrian pathways to address the limited facilities which currently exist in the study area

4.2 Proposed Land Use Changes

The proposed land use changes anticipated by the Regulatory Plan are shown on Figure 4-2. The primary change in the Regulatory Plan is the addition of 1,860 dwelling units which are distributed as described in Table 4-1. The distribution of this growth to sub-areas within the Kauai TDFM is provided in this table as well. These sub-areas are referred to as Traffic Analysis Zones (TAZ's) and are discussed further in Chapter 4.

Table 4-1
Residential Growth Allocation

Area	Allocation Percentage	Number of DU's	TAZ Distribution
Homesteads	5%	93	27,28,30,32 33,34,35,36
Poipu Mixed-Use Village	60%	1,116	46

Table 4-1 **Residential Growth Allocation**			
Area	**Allocation Percentage**	**Number of DU's**	**TAZ Distribution**
Numila	8%	150	25
Koloa Town	24%	451	38,39,42,43
Kalaheo Town	3%	50	31,32
Total	**100%**	**1,860**	**N/A**
Source: PBR, 2014			

Figure 4-1 Multi-Modal Transportation Network

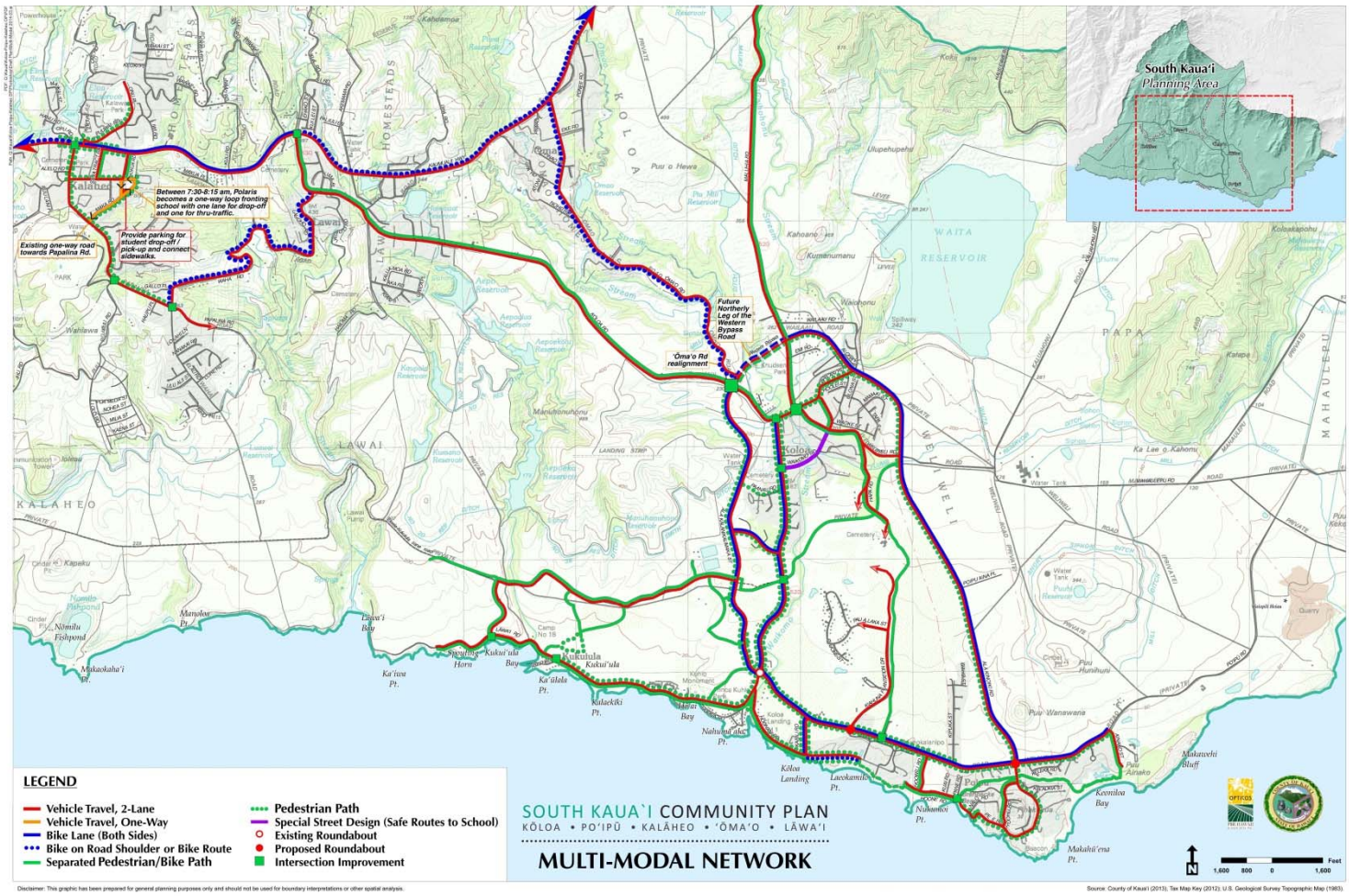
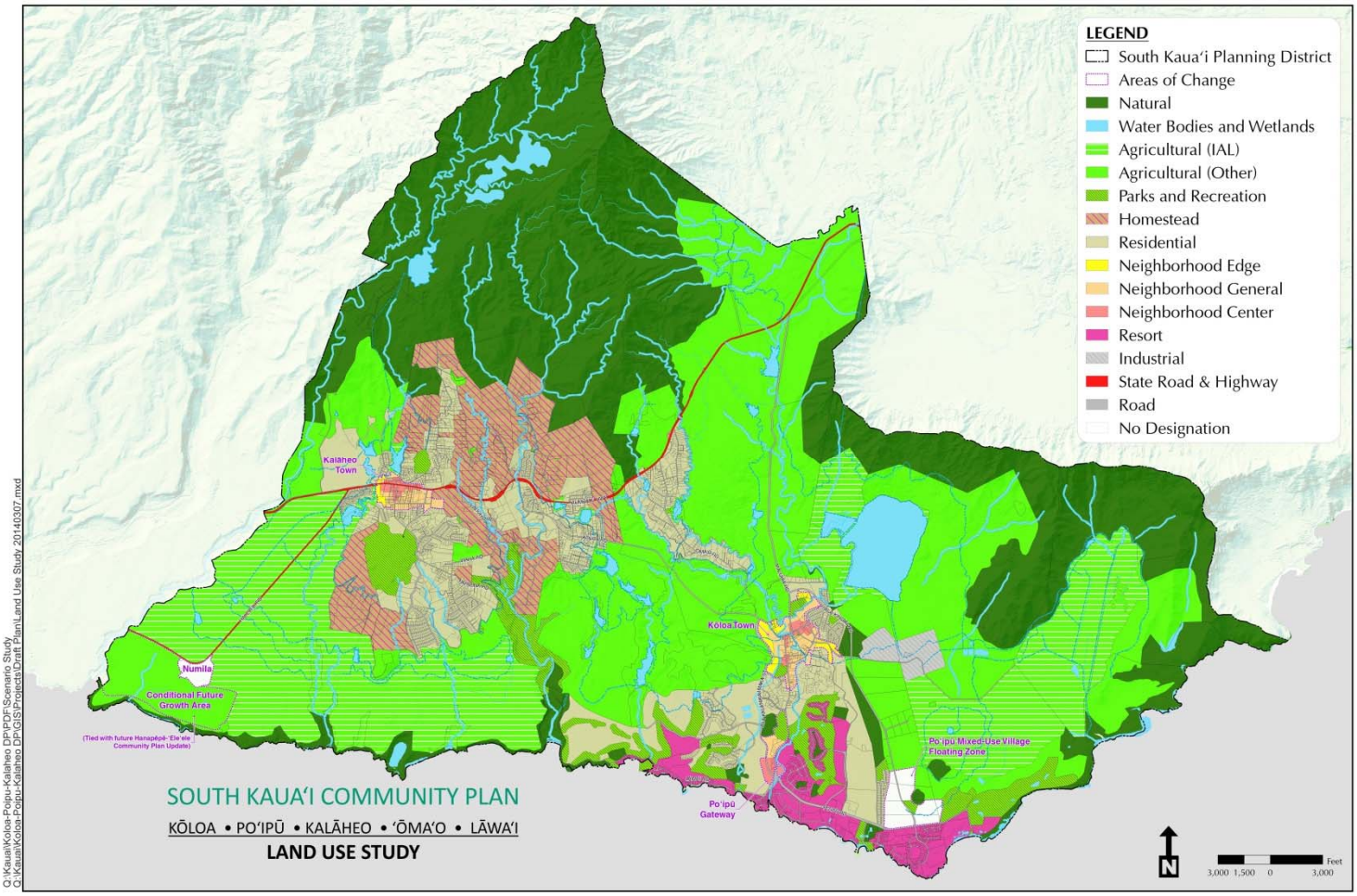


Figure 4-2 Regulatory Plan



Disclaimer: This graphic has been prepared for general planning purposes only and should not be used for boundary interpretations or other spatial analysis.

Source: County of Kaua'i (2012) and General Plan (2000).

5.0 Kauai Travel Demand Forecasting Model (TDFM)

This section documents the proposed development associated with the South Kauai Community Plan including the proposed roadway network and land use changes.

5.1 Model Background

According to documentation provided to Fehr & Peers, the Kauai TDFM was developed by the State of Hawaii to facilitate the development of Long-Range Land Use and Transportation Plans for the Islands of Maui, Hawaii, and Kauai. The model was a collaborative effort between HDOT and CH2MHill, a private consultant.

A technical memorandum describing the Kauai TDFM including all input and output data is provided as Appendix A. Summary information germane to this study related to the structure of the model and the model assumptions are discussed below.

One key element of the model is that it is intended to be a tool to support long-range planning efforts. According to Kauai TDFM documentation provided to Fehr & Peers, the following should be noted:

> The travel demand model is developed as a tool to assist in understanding the relationship between the socio-economic patterns on each island along with the roadway network. The model assists in understanding where capacity issues may occur given the network and socio-economic assumptions. The travel demand model is not able to perform detailed operational analysis, such as adding turn lanes at an intersection.

For purposes of this study, the model is primarily used to test the effects of alternative land use development patterns on the transportation network.

5.2 Model Structure

Like many other similar tools, the Kauai TDFM is a three-step travel demand model which has the following phases:

- Trip generation- This process involves the calculation of trips produced by land uses within the model. Land use data, broken down into sub-areas known as traffic analysis zones (TAZ's) is one of the two major inputs into any travel model. The development of TAZ's typically follows the boundaries of Census Blocks and Census Block Groups. In the case of the Kauai TDFM, the TAZ

land use data reflects households, employment, and visitor trips which are associated with hotels and major attractions. The input land use data reflects updated information as of 2007, when the model development process began. The documentation supplied for each model indicates that sources such as the County Assessor were used to develop and verify land use data.

- Trip distribution- Once trips are generated by each land use and aggregated to the TAZ level, these trips are distributed. For example, trips generated at the household level (productions) are matched with employment locations (attractions). This distribution process considers the relative location of each trip and the time required to travel for this trip in match trips up to their origin and destination.
- Trip assignment- The final step of the process is the assignment process in which trips are assigned to roadways within the model. These roadway networks are the second major input to the travel model.

Following the development of the model data, a validation process is implemented which compares the model results for the Existing Year against traffic count data. Once a travel model meets standardized criteria related to its performance during the validation process, the model can be used for future traffic forecasts. As noted in the Kauai TDFM documentation, the model met accepted guidelines for validation at the overall island-wide level. The documentation notes several locations where the model was either under predicting or over predicting as compared to existing counts; however none of the identified locations were within the study area.

2020 and 2035 Future Year models were also developed. Fehr & Peers employed the 2035 Kauai TDFM in this analysis since it represents a reasonable build out scenario time frame.

5.3 Key Model Assumptions

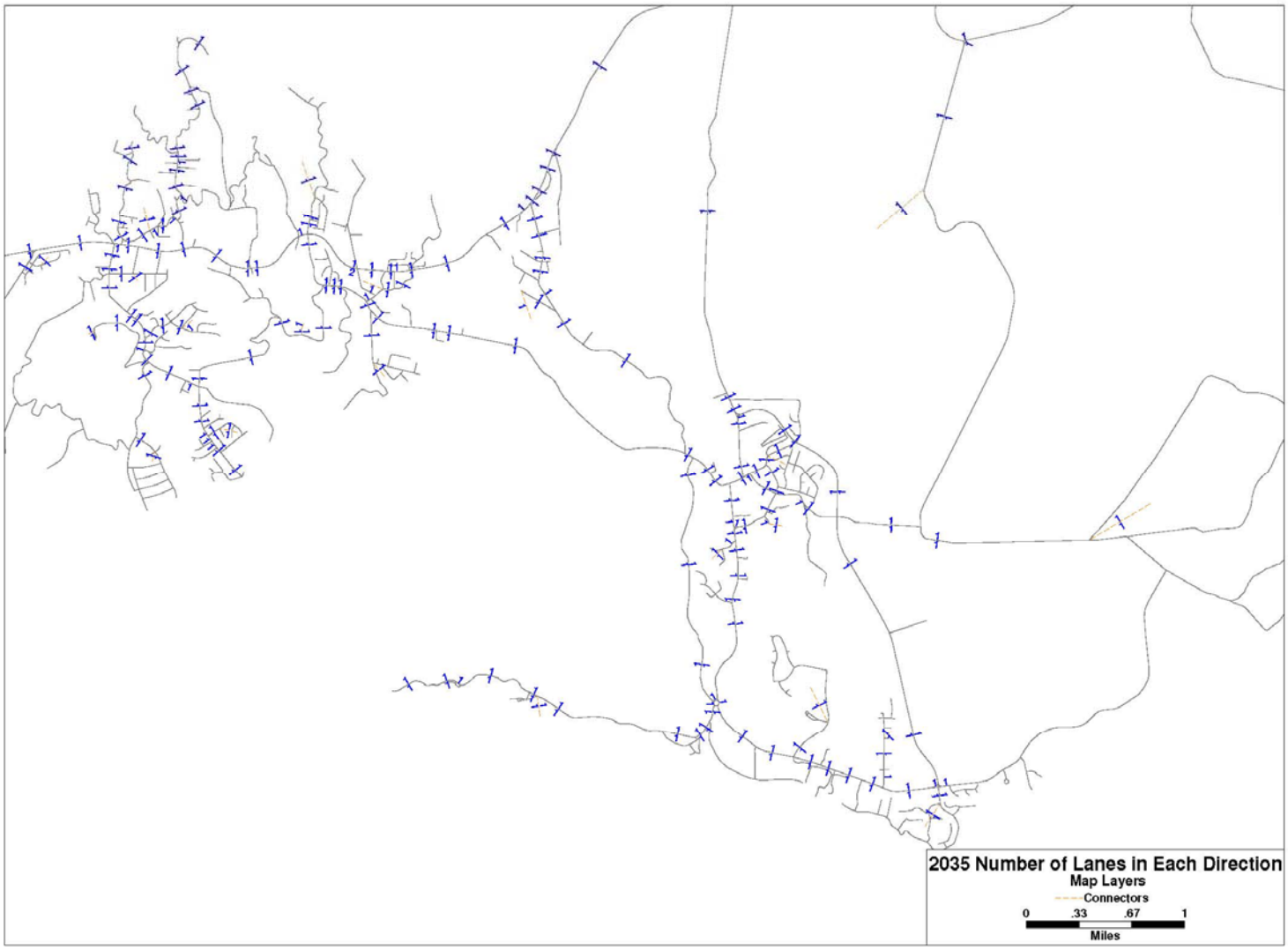
For a variety of reasons including the size of the island, the configuration of the transportation network and the propensity for persons to travel to varied destinations, any analysis of transportation conditions in any sub-area of Kauai needs to also consider changes in other areas at a general level. Our review of the Kauai TDFM documentation indicates the following items:

- Only a few fully funded regional transportation improvements are assumed in the model. According to the documentation provided, several improvements to sections of Kaumuali`i Highway are assumed. However; no significant changes in the roadway network are assumed for the future 2020 and 2035 scenarios. As shown in Figure 5-1, all of the study area roadways are

projected to maintain one (1) lane in each direction for the 2035 analysis scenario except for one (1) short segment of Kaumuali`I which currently has three travel lanes, two (2) in one direction, one (1) in the other direction .

- Growth is assumed in several locations throughout the island in terms of additional residential units, incremental employment, and visitor travel. Maps showing this incremental change by TAZ are provided in Appendix B.

Figure 5-1 Kauai TDFM Number of Lanes (2035)



6.0 2035 Future No Project Conditions

This chapter addresses future conditions prior to the implementation of the Regulatory Plan in terms of future roadway volumes and roadway operations. For purposes of this discussion, conditions before the implementation of the Regulatory Plan are referred to as the No Project. These forecasts are provided for the 2035 scenario, as obtained from the Kauai TDFM.

6.1 Roadway Volumes

Table 6-1 provides future roadway volumes on the study area roadways for the 2035 No Project scenario. This table also provides the capacity and the estimated V/C ratio. Kauai TDFM outputs documenting the roadway volumes and V/C ratio are provided in Appendix C.

6.2 Roadway Operations

As shown in Table 6-1, three roadway segments are projected to operate at LOS F under the No Project Scenario, based on criteria identified in Table 2-2. These segments are on Kaumuali`i Highway, which is projected to operate at LOS F prior to the addition of the trips associated with the Regulatory Plan. A review of data from the Kauai TDFM indicates that this LOS F condition is due to a variety of factors including additional development in other locations on Kauai, which results in additional trips that will travel through the study area on Kaumuali`i Highway.

Table 6-1
2035 No Project Traffic Evaluation

Roadway	Location	Volume	Capacity	V/C Ratio
Kaumuali`i Highway	**West of Paplina Road**	**21,600**	**19,800**	**1.09**
Kaumuali`i Highway	**Between Paplina Road and Koloa Road**	**22,200**	**19,900**	**1.12**
Kaumuali`i Highway	**Between Koloa Road and Omao Road**	**21,400**	**19,800**	**1.08**
Kaumuali`i Highway	East of Omao Road	21,800	24,800	0.88
Maluhia Road	North of Alakinoiki Road	18,200	24,800	0.73
Alakinoiki Road	East of Maluhia Road	7,200	16,800	0.43
Alakinoiki Road	North of Poipu Road	11,100	16,200	0.69
Papalina Road	South of Kaumuali`i Highway	3,100	15,800	0.20
Koloa Road	South of Kaumuali`i Highway	13,000	19,000	0.68
Koloa Road	North of Poipu Road	9,500	22,200	0.43
Poipu Road	South of Koloa Road	7,000	19,000	0.37
Poipu Road	West of Alakinoiki Road	11,500	15,800	0.73

Note: Deficient segments shown in bold
Source: Fehr & Peers, 2014 and Kauai 2035 TDFM.

7.0 2035 Future With Project Traffic Conditions

This chapter provides traffic conditions with the implementation of the Regulatory Plan in 2035.

7.1 Roadway Volumes

Table 7-1 provides the anticipated roadway volumes associated with the development of new housing as outlined in the Regulatory Plan. Additional information regarding the distribution of the new housing associated with the Regulatory Plan is provided in Table 4-1 and graphically described in Chapter 4. Outputs from the Kauai TDFM documenting the traffic volumes and V/C ratios are provided in Appendix D. Appendix E documents the land use changes to the Kauai TDFM to reflect the incremental growth associated with the Regulatory Plan.

Table 7-1
2035 With Project Traffic Evaluation

Roadway	Location	Volume	Capacity	V/C Ratio
Kaumuali`i Highway	**West of Papalina Road**	**23,100**	**19,800**	**1.17**
Kaumuali`i Highway	**Between Papalina Road and Koloa Road**	**23,500**	**19,900**	**1.18**
Kaumuali`i Highway	**Between Koloa Road and Omao Road**	**22,900**	**19,800**	**1.16**
Kaumuali`i Highway	East of Omao Road	23,400	24,800	0.94
Maluhia Road	North of Alakinoiki Road	21,000	24,800	0.85
Alakinoiki Road	East of Maluhia Road	7,200	16,800	0.43
Alakinoiki Road	North of Poipu Road	10,900	16,200	0.67

Table 7-1 (con't) 2035 With Project Volumes				
Roadway	**Location**	**Volume**	**Capacity**	**V/C Ratio**
Papalina Road	South of Kaumuali`i Highway	3,600	15,800	0.23
Koloa Road	South of Kaumuali`i Highway	14,200	19,000	0.75
Koloa Road	North of Poipu Road	10,400	22,200	0.47
Poipu Road	South of Koloa Road	7,000	19,000	0.37
Poipu Road	West of Alakinoiki Road	12,000	15,800	0.76
Note: Deficient segments shown in bold Source: Fehr & Peers, 2014				

7.2 Roadway Operations

As shown in Table 7-1, three roadway segments on Kaumuali`i Highway are projected to operate at LOS F with the addition of incremental traffic associated with the Regulatory Plan. These locations are all projected to operate at LOS F, exceeding the capacity by approximately 15 to 20 percent. There is a fourth segment which is approaching capacity.

For a driver within the corridor using Kaumuali`i Highway, this LOS F condition will likely manifest itself through two occurrences. First, we would expect a reduction in travel speeds beyond what is currently measured. As shown in Chapter 3, vehicles are generally able to travel at near free-flow speeds along Kaumuali`i Highway. For many drivers, the speed that they will experience, particularly during the peak hours, will be significantly reduced. Similarly, congestion would be significantly increased. This level of congestion would be manifested in terms of higher time spent waiting to travel through intersections. A reduction in travel speed and an increase in congestion would also increase the time required to transverse the corridor, likely to levels that would be noticeable to drivers using the roadway beyond today's levels.

7.3 Comparison With No Project Conditions

As shown in Table 7-2, there are three segments where the addition of traffic associated with the Regulatory Plan will cause the V/C ratio to increase on segments that are projected to operate at LOS F. While the implementation of the Regulatory Plan will cause traffic to increase on multiple roadway segments, those identified below are the only ones which are projected to operate unacceptably (i.e., at LOS F) in 2035.

Table 7-2
2035 No Project and With Project V/C Ratios

Roadway	Location	V/C Ratio No Project	V/C Ratio With Project	Difference
Kaumuali`i Highway	West of Papalina Road	1.09	1.17	0.08
Kaumuali`i Highway	Between Papalina Road and Koloa Road	1.12	1.18	0.06
Kaumuali`i Highway	Between Koloa Road and Omao Road	1.08	1.16	0.08

Source: Fehr & Peers, 2014

7.4 Potential Mitigation Strategies

While the traditional approach for many traffic engineers and transportation planners would be to recommend the expansion of a roadway which is projected to operate deficiently, our recommendations recognize many factors which are unique to transportation in Kauai and reflect the context environment. These factors include:

- Widening significant sections of Kaumuali`i Highway would likely be extremely costly and have significant negative impacts on the adjacent properties and the environment
- The study area currently lacks significant facilities for alternative travel modes; thereby forcing people to drive where they might otherwise want to walk, bike, or use transit
- The widening of the roadway may not be fully compatible with recent long-range transportation planning efforts

- The assessment of daily capacity often does not fully address the benefits of targeted improvements such as the addition of turn lanes, roundabouts, traffic signal upgrades, and other related strategies to increase capacity at intersections, which are the constraint points of the roadway network

Therefore, we recommend that the analysis consider the likely effects of targeted improvements and policies which would moderate travel demand and minimize congestion. These policies and targeted improvements are already included in the proposed Multi-Modal Transportation Plan as described below:

- There are two locations on Kaumuali`i Highway where intersection improvements such as additional turn lanes are proposed including Papalina Road and Koloa Road
- A continuous series of bicycle facilities are proposed on Kaumuali`i Highway which would include an on-street bicycle lane (Class II) from Papalina Road to Koloa Road. East and west of this section, a bicycle route (Class III) would be implemented
- Pedestrian pathways and other improvements are also recommended for Kalaheo, to limit the need to use Kaumuali`i Highway for short-distance travel

7.5 TRAVEL MODE SHIFT ANALYSIS

Using the data above, we can estimate the required level of vehicle trip reduction using the following approach:

- Identifying the change in V/C ratio between the No Project and With Project Scenario. As the segments of Kaumuali`i Highway are already projected to operate at LOS F above the 1.0 capacity threshold, any reduction in vehicular trips would be limited to the incremental trips associated with the Regulatory Plan.
- Using the process above, we estimated that approximately 1,800 daily vehicle trips would need to be diverted to use alternative travel modes. When typical auto occupancy factors are applied to this number of vehicle trips, it results in approximately 2,000 daily person trips that would need to change modes.
- While transit is one likely mode of diversion, it may not provide sufficient capacity for these additional 2,000 daily person trips. For example, between 2007 and 2011, the ridership on the route which uses Kaumuali`i Highway nearly doubled, increasing to almost 750 riders per day.

Shifting 2,000 persons to transit could occur but may be unlikely. A comparable increase in ridership either in terms of percentage or absolute magnitude might be possible, though peak hour capacity constraints would be a limiting factor. Currently, the Kekaha-Lihue Mainline route operates 6 buses during the morning and evening peak hours which may only provide capacity for another 300 to 500 persons per day.

- Another transit-related set of improvements would be local shuttles which could supplement the fixed-route transit service. However; the existing shuttles on routes through Koloa and other comparable routes only carry 30 persons per day. Additionally, there is only one shuttle provided on the route through Koloa. Any benefits from shuttles are likely to relate to persons traveling to specific destinations such as large hotels or employment centers rather than residential locations.
- Any significant reductions in traffic volumes along Kaumualiʻi Highway would therefore require some diversion of vehicular traffic to bicycle and pedestrian routes. According to data provided by the American Community Survey (ACS) for 2012, nearly 20 percent of all commute trips on the island of Kauai travel by car but have a work trip of 10 minutes or less. Trips of this distance are often able to be easily made by walking or bicycling if the facilities are present. By providing bicycle and pedestrian facilities where they currently do not exist, some level of diversion may be possible. An analysis of travel patterns on Kaumualiʻi Highway indicates that as much of 10 percent of the vehicular traffic on these deficient segments of the highway are local as opposed to longer-distance through trips. Diverting a significant portion of these local trips is one way to reduce vehicle demand associated with the Regulatory Plan.
- Therefore, reducing vehicular demand along Kaumualiʻi Highway will require implementing the multi-modal transportation measures identified on Figure 4-1 along with a meaningful diversion of trips to transit. This diversion of transit trips can only occur if there is sufficient capacity in the transit system, which will require some expansion of service in the future along the Kekaha-Lihue Mainline route beyond what is provided today.

8.0 Evaluation of Multi-Modal Transportation Network

This chapter provides an overview of the proposed multi-modal transportation network, as provided on Figure 4-2.

8.1 Existing Conditions

As discussed in Chapter 3, there are limited non-automotive facilities within the study area.

The most robust facilities are related to transit. One of the primary transit routes on the island travels through Kalaheo on Kaumuali`i Highway, traveling east-west through the island from Kekaha to Lihue. This fixed-route service is supplement by a local shuttle. The Kekaha to Lihue bus route has some of the highest boardings of all of the transit routes within the service and also provides a high level of efficiency as measured as boardings per service hour.

Bus lines within the study area often operate at capacity during peak travel hours. To address this capacity issues, a new bus route has been added between Kaumakani and Lihu'e in March 2014. There are two buses operated in the morning with two buses in the afternoon along the line (Line #150). Additional capacity may also be provided as the Kauai Transportation Agency increases the bus sizes to provide additional capacity along these routes.

Where the study area is most deficient is in terms of bicycle and pedestrian conditions. Sidewalks are generally absent through the study area as shown in the photos below.

Kaumuali`i Highway in Kalaheo

Koloa Road in Koloa

Sidewalk on Koloa Road in Koloa

Pedestrian access often occurs through de facto sidewalks such as those shown in the photo above where parking lots provide some limited level of connectivity between parcels. In many instances, pedestrians are forced to walk in shoulders or in the grass along the front of each parcel. Where sidewalks are present, such as in the photo above showing the Chevron parking lot, sidewalks are discontinuous and limited in terms of length.

Designated bicycle facilities are even sparser than the pedestrian facilities. Currently, there are no designated Class I, Class II, or Class III facilities within the study area. Similar to pedestrians, cyclists are

forced to use shoulders and areas of the roadway, often having no recourse but to mix with automobile traffic.

8.2 Multi-Modal Transportation Plan Improvements

The proposed Multi- Modal Transportation Plan responds to existing deficiencies by providing an extensive network of bicycle and pedestrian facilities on many of the major roadways in the area. Key elements of this plan include:

- Providing continuous bicycle facilities along Kaumuali`i Highway where none currently existing. An on-street bicycle lane (Class II) would be provided from Papalina Road to Koloa Road with bicycle routes (Class III) to the west and and east of this designated facility.
- Koloa Road would have an off-street bicycle facility (Class I) extending from Kaumuali`i Highway to Koloa.
- In Koloa, this Class I facility would connect with a similar north-south Class I facility extending along Maluhia Road from Kaumuali`i Highway south to Poipu
- Pedestrian pathways would be provided in many of the towns in the study area including Kalaheo, Koloa, and Poipu

8.3 Multi-Modal Transportation Plan Non-Automotive Evaluation

Our evaluation of the proposed Multi-Modal Transportation Plan indicates that this plan provides a significant level of improvement over the existing condition. As such, the residents, workers, and visitors in the area will see the following benefits:

- The primary benefit is the segregation of bicycles and pedestrians from automobiles. By providing dedicated facilities, bicyclists and pedestrians will be physically separated from vehicles which should reduce the incidents of collisions between the travel modes. One aspect of collisions between automobiles and bicyclists or pedestrians is that any collisions often result in serious injuries or fatalities. Therefore, any improvement which segregates automobiles from other modes often provides a significant benefit to their safety.
- A secondary benefit is the potential diversion of vehicular trips to non-vehicular modes, as discussed in Chapter 7. Providing opportunities for people to walk and bike will incentivize this

mode shift, which is needed to meet the traffic operational needs for Kamuali'i Highway, as well as sections of other roadways.

9.0 Evaluation of Site Specific Intersection Configurations

This chapter provides an overview of several specific intersection locations to determine whether one or more proposed improvements would address multi-modal transportation needs.

9.1 Papalina Road/ Kaumuali`i Highway Intersection

Three proposed alternatives have been proposed for improving this intersection including:

- Option 1: Signalized intersection, pre*tty much as is,* with pedestrian and striping improvements. One key aspect of this approach is that a merge area would be added for vehicles turning left from Puuwai Rd. on to Kaumuali`i Hwy.
- Option 2: Signalized intersection, with realignment of Opu Road with Papalina Road and striping and pedestrian improvements noted above.
- Option 3: Single lane roundabout at Papalina/Hwy intersection only. Under this approach, Puuwai would be restricted to right/right out/left in. Cars wanting to turn left from Puuwai onto Kaumuali`i Hwy would use the roundabout.

9.1.1 OPTION 1 EVALUATION

The traffic forecasts indicate that Kaumuali`i Hwy will exceed the daily capacity by nearly 20%, which means that the roadway will likely be operating at capacity throughout peak travel hours, which means that there may be significant congestion during these periods. Therefore, this option would not significant reduce the level of congestion. However, this approach would significantly improve pedestrian access and circulation, which would be beneficial given the lack of facilities which currently exist as of today.

One way in which this option differs from others is that the traffic signal would operate under a split approach under which vehicles on Opu Road would be under signal control. Typically split intersections are less than ideal but we anticipate the limited number of cars on Opu Road mean that the signal would only be tripped when a car is there. The majority of the time, the light would be green on Kaumuali`i Hwy, turning red only when cars are there on Opu Road or Papalina Road.

9.1.2 OPTION 2 EVALUATION

As noted above, we estimate that there are a limited number of cars using Opu Road, which means that most of the time the light would remain green for traffic on Kamualii Hwy. What that means is that we do not see a significant benefit to realigning Opu Road since the split phase will often operate as a single phase.

9.1.3 OPTION 3 EVALUATION

The third option would be to reconstruction the intersection as a roundabout. We concluded that there are five potential issues related to the implementation of a roundabout.

The first issue is a geometric one. A preliminary inspection of the intersection indicates that right-of-way impacts may be extensive, particularly if elements such as splitter islands are provided on roadways such as Papalina Road.

The second issue is one of traffic volumes. Roundabouts work best when traffic flows are balanced. However, over 90% of the vehicles using this intersection are on Kaumuali`i Hwy, meaning that vehicles entering the roundabout from Papalina would likely face delays. These side street vehicles may have to wait significant times for gaps in oncoming traffic.

The third concern relates to access from Opu Road. Providing left-turn lane access from Opu Road would be problematic. Allowing access from Opu Road would require that another intersection be placed within the roundabout, which is likely to cause significant conflicts.

The fourth area of concern relates to emergency vehicle access. A review of the roadway network indicates that Opu Road connects to a residential area with one exit. If there is queuing through the roundabout, then emergency vehicles may have problems navigating through the roundabout. In congested locations, emergency vehicles are often able to navigate through traffic signals more easily since the cars physically pull to the side of the intersection if needed.

The final issue is one of overall capacity. A review of the peak hour volumes provided by the Travel Demand Model indicates that this location is at the upper limit of the capacity for a single-lane roundabout.

9.1.4 RECOMMENDATION

We recommend that Option #1 be implemented at this location for the reasons identified above.

9.2 Koloa Town Intersection Improvements

We also evaluated potential intersection improvements in Koloa Town for Koloa Road and Maluhia Road including four options:

- Option #1- A roundabout at Koloa Road/Maluhia Road
- Option #2- Creating a couplet system, with a two-lane segment within the couplet
- Option #3- Having a couplet system without the two-lane segment
- Option #4- Roundabout at Ala Kinoiki and Maluhia Road, with all-way stops and pedestrian improvements at Koloa Road/Maluhia Road

Our evaluation of these options is presented below.

9.2.1 OPTION 1 EVALUATION

From a traffic perspective, a roundabout would seem to provide the highest level of benefits. Unlike other locations, the volumes are balanced and an analysis of existing and future traffic volumes indicates that this alternative would likely provide the most even flow of traffic with limited delays for all of the vehicles in the intersection.

The two limitations for the roundabout would be whether a roundabout could be accommodated geometrically and whether sufficient pedestrian gaps could be provided. These issues could be addressed through the design of the roundabout as further work on this intersection is performed.

9.2.2 OPTION 2 EVALUATION

The primary concern with this alternative is that it could encourage higher travel speeds, which commonly occur in couplets. Providing a two-lane segment could mitigate these speeds to some extent. However, a couplet system would likely have impacts to adjacent properties.

9.2.3 OPTION 3 EVALUATION

Similar to Option #2, this option would also create a couplet system without a two-lane segment. Also similar to Option #2, this alternative could create higher vehicular travel speeds and could also impact the adjacent properties when the couplet is implemented.

9.2.4 OPTION 4 EVALUATION

This alternative would implement an all-way stop controlled intersection at the Koloa Road/Maluhia Road intersection. Pedestrian improvements would be implemented at this location as well. These improvements would be paired with a roundabout at Ala Kinoiki and Maluhia Road.

9.2.5 RECOMMENDATION

Our recommendation would be to implement Option #4, as it provides an optimal mix of local access and pedestrian circulation. An exhibit showing this option is provided below.

One issue related to this alternative is whether parking would be provided adjacent to the Sueoka Market along Koloa Road. Our recommendation is to remove the parking which is located in the intersection adjacent to the market (approximately 5 spaces) as vehicles exiting those spaces would be backing directly into other vehicles waiting at the stop sign.

10.0 CONCLUSION/FINDINGS

This chapter summarizes our conclusions and findings.

10.1 KEY QUESTIONS

Key items addressed by this study include:

- How does the roadway network perform prior to the buildout of the Regulatory Plan?
- How does the roadway network perform after the buildout of the Regulatory Plan?
- Does the implementation of the Regulatory Plan cause any element of the roadway network to fail that would otherwise operate at an acceptable level?
- How would the non-vehicular transportation system operate after the implementation of the Regulatory Plan and the Multi-Modal Transportation Plan?
- If there are roadway segments which operate in a deficient fashion after the implementation of the Regulatory Plan, what policy options or physical improvements might be available to reduce vehicular demand?
- Can several site specific improvements be implemented within the constraints of the overall transportation system?

10.2 Key Findings

The analysis concluded that there are several segments of Kaumuali`i Highway, which would operate at LOS F prior to and after the implementation of the Regulatory Plan associated with the South Kauai Community Plan. While the typical approach would be to recommend widening the roadway to accommodate additional projected demand, we recommend that alternative approaches be implemented as defined below.

10.2.1 IMPLEMENT INTERSECTION IMPROVEMENTS

Chapter 9 addresses potential intersection improvements, particularly along Kaumuali`i Highway. These improvements would add turn lanes, which would reduce conflicts and delay associated with vehicles turning to and from Kaumuali`i Highway. Since most roadway congestion occurs at intersections, these focused improvements can provide additional capacity without having to widen the entire roadway.

10.2.2 ADD BICYCLE FACILITIES

The Multi-Modal Transportation Plan also envisions that bicycle facilities would be added throughout the Community Plan area including both on-street and off-street facilities. As such, bicycle facilities have the potential to replace short-distance vehicular trips with the added benefits of increased physical activity for their users. This diversion of automobile travel to bicycle trips will reduce some of the projected vehicle congestion. Given the lack of existing bicycle facilities as noted in Chapter 8, any expansion of these facilities has the potential to significantly increase the number of persons bicycling as compared to the current level.

10.2.3 EXPAND PEDESTRIAN FACILITIES

Similar to bicycle facilities, the pedestrian facilities within the Community Plan area are limited, with significant gaps in the pedestrian network. There are numerous locations where persons are unable to walk, even to adjacent properties because of a lack of designated facilities for pedestrians. Expanding the pedestrian facilities will provide additional options for travelers, particularly for the shorter distance vehicular trips which currently occur because of a lack of travel options.

10.2.4 ADDITIONAL BUS SERVICE

The one strategy which has the highest likelihood of reducing congestion along Kaumuali`i Highway is an expansion of transit service. As noted in Chapter 8, several bus routes in the Community Plan area operate at or near capacity, which has lead the County Transportation Agency to add bus routes and also to consider procuring larger buses. This reliance on diverting vehicular trips to transit trips is likely to provide significant benefits for the following reasons:

- Owning and operating a private automobile is likely to remain costly for the foreseeable future, which will mean that many citizens may be challenged to afford vehicles as other expenses continue to increase concurrently.
- As the population continues to age, persons may be unable to drive or may be forced to drive less because of restrictions on their usage of vehicles
- Much of the travel along Kaumuali`i Highway are long-distance through trips (approximately 70% based on information provided by the Kauai TDFM), which are persons who are most able to divert to transit.

APPENDIX A: TRAVEL MODEL BACKGROUND DATA

APPENDIX B: KAUAI TDFM GROWTH PROJECTIONS

APPENDIX C: 2035 NO PROJECT MODEL OUTPUT

APPENDIX D: 2035 WITH PROJECT MODEL OUTPUT

APPENDIX E: KAUAI TDFM LAND USE CHANGES