

## Exhibit H

### Traffic Impact Assessment Report Kapa'a Highlands Subdivision Kapa'a, Kaua'i, Hawai'i TMK: (4) 4-3-03:01

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December 9, 2013

Mr. Greg Allen  
Kapa'a Highlands  
161 Wailua Road  
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Re: Traffic Impact Assessment Report Kapa'a Highlands Subdivision  
Kapa'a, Kauai, Hawaii  
TMK: (4) 4-3-03:01

Phillip Rowell and Associates have completed the following Traffic Impact Assessment Report (TIAR) for Kapa'a Highlands Subdivision. The report is presented in the following format:

- A. Project Location and Description
- B. Purpose and Objective of Study
- C. Study Approach
- D. Description of Existing Streets and Intersection Controls
- E. Existing Peak Hour Traffic Volumes
- F. Public Transportation
- G. Level-of-Service Concept
- H. Existing Levels-of-Service
- J. Background Traffic Projections
- K. Project Trip Generation
- L. Background Plus Project Projections
- M. Traffic Impact Assessment
- N. Project Road System
- O. Other Traffic Related Issues
- P. Summary and Recommendations

#### A. Project Location and Description

1. The proposed project is located west of Kapa'a Town and adjacent to Kapa'a Intermediate School, generally in the southwest quadrant of the intersection of Oloheua Road and Kapa'a Bypass. [See Attachment A.](#)
2. The project is a residential subdivision with single-family and multi-family residences and neighborhood supporting retail. The project has two phases as shown on [Attachment B.](#) The development plan is summarized as follows:

| <u>Phase 1</u>         | <u>Phase 2</u>  |
|------------------------|---|
| 16 Single-Family Units | 100 Single-Family Units<br>700 Multi-Family Units<br>8,000 SF Neighborhood Retail |

3. Access to and egress from Phase 1 will be via driveways along the south side of Oloheua Road west of Kapa'a Intermediate School.

4. Access to and egress from Phase 2 will be provided via a new intersection along the north side of Kapa'a Bypass and a new intersection along the south side of Olohehena Road. These two intersections will be connected by a new curvilinear roadway running through the project. For purposes of discussion in the report, this roadway is referred to as Road 'A.'

#### **B. Purpose and Objective of Study**

1. Quantify and describe the traffic related characteristics of the proposed project.
2. Identify potential deficiencies adjacent to the project that will impact traffic operations in the vicinity of the proposed project.

#### **C. Study Approach**

1. A preliminary trip generation analysis was performed to define the scope of work and study area. This analysis determined that the proposed project will generate less than 500 trips during either the morning or afternoon peak hour. Based on Institute of Transportation Engineers standards, the traffic study should be a "small development: traffic impact assessment."<sup>1</sup> Accordingly, the study area was defined to include the intersection of Kapa'a Bypass at Olohehena Road and the intersections providing access to and egress from Phase 2 of the project (Kapaa Bypass at Road 'A' and Olohehena Road at Road 'A'). Phase 1 lots are serviced by individual driveways which will have negligible traffic volumes.

State of Hawaii Department of Transportation reviewed the first draft of the report and directed that the study area be expanded to include the intersections of Kuhio Highway at Kukui Street and Kuhio Highway at Kapaa Bypass. See [Attachment O](#).

The County of Kauai directed that the intersection of Olohehena Road at Kaapuni Road and Kaehula Road be included in the study area. See [Attachment P](#).

2. A field reconnaissance was performed to identify existing roadway cross-sections, intersection lane configurations, traffic control devices, and surrounding land uses.
3. Current weekday peak hour traffic volumes were obtained from manual traffic counts at the study intersections.
4. Existing intersection levels-of-service were determined using the methodology described in the *2000 Highway Capacity Manual*. Existing deficiencies were identified based on the results of the level-of-service analysis and field observations.
5. Peak hour traffic that the proposed project will generate was estimated using trip generation analysis procedures recommended by the Institute of Transportation Engineers. Project generated traffic was distributed and assigned to the adjacent roadway network.
6. A level-of-service analysis for future traffic conditions with traffic generated by the study project was performed.

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<sup>1</sup> Institute of Transportation Engineers, *Transportation and Land Development*, Washington, D.C., 2002, p. 3-6

7. The impacts of traffic generated by the proposed project were quantified and summarized.
8. A report documenting the conclusions of the analyses performed and recommendations was prepared.

#### **D. Description of Existing Streets and Intersection Controls**

Kapa'a Bypass is a two-lane, two-way roadway along the southern and eastern boundaries of the project. This section of Kapa'a Bypass is owned by the Kapa'a Highlands developer, who has entered a memorandum of understanding with State of Hawaii Department of Transportation to dedicate the roadway to the State upon approval of Kapa'a Highlands subdivision<sup>2</sup>. According to State of Hawaii Department of Transportation traffic count data from 2010, Kapa'a Bypass has a weekday traffic volume of 7,400 vehicles per day.

Olohehena Road is a two-lane, two-way roadway along the northern boundary of the project. Olohehena Road also provides service to Kapa'a Intermediate School.

Kuhio Highway through Kapaa Town is a two-lane, two-way State highway along the east of the study area.

##### *Existing Intersections*

The intersection of Kuhio Highway at Kukui Street is a four-legged, signalized intersection located approximately 1,600 feet east of the project. The northbound and southbound approaches are Kuhio Highway and the eastbound and westbound approaches are Kukui Street. The northbound and southbound left turns are protected-permissive.

The intersection of Kuhio Highway at Kapaa Bypass is a three-legged, unsignalized intersection approximately two miles south of Kukui Street. The northbound and southbound approaches are Kuhio Highway. The eastbound approach is the Kapaa Bypass and is the controlled approach. The northbound approach is coned during the morning peak hours to provide on left turn and one through lane. The coning also allows the eastbound to southbound left turn to operate as a free right turn. During the afternoon peak hours and off peak hours, there is one left turn lane and two through lanes. The southbound approach has one through lane and one right turn lane. The eastbound approach has one left turn lane and one right turn lane.

The intersection Kapa'a Bypass and Olohehena Road is a four-legged roundabout. All approaches are one lane only. The north leg of the intersection is one-way southbound into the intersection. The remaining three legs are two-way.

The intersection of Olohehena Road at Kaapuni Road and Kaehula Road is actually two intersections. Olohehena Road is the eastbound and westbound approaches and Kaapuni Road is the STOP sign controlled approach at Olohehena Road. Kaehula Road intersects Kaapuni Road west of Olohehena Road.

The intersection configurations are summarized on [Attachment C](#).

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<sup>2</sup> Honua Engineering, Inc., *Traffic Considerations Kapa'a Highlands Project*, March 28, 2012

**E. Existing Peak Hour Traffic Volumes**

Current weekday peak hour traffic volumes at the intersection of Kapa'a Bypass at Olohena Road were obtained from manual traffic counts. The counts at the intersection of Olohena Road at Kapaa Bypass were performed Tuesday, May 15, 2012. The counts at the intersection of Kuhio Highway at Kapaa Bypass were performed Thursday, August 8, 2013, and the counts at the intersection of Kuhio Highway at Kapaa Bypass were performed on Tuesday, October 29, 2013.

The traffic counts include mopeds, motorcycles, buses, trucks and other large vehicles.

During the surveys, the following was observed at the intersection of Olohena Road at Kapaa Bypass:

1. The number of pedestrians crossing the approaches to the intersection are minimal, even with the bus stop and transfer site at the park along the north side of Olohena Road east of the intersection.
2. Long queues of 15 vehicles or more along the westbound approach of Olohena Road were noted during the morning peak hour.

The existing peak hour traffic volumes are summarized on [Attachments D and E](#).

**F. Public Transportation**

The Kauai Bus operates along Olohena Road and Kapa'a Bypass. A major bus stop and transfer point is located along Olohena Road east of Kapa'a Bypass in the parking lot adjacent to the park.

**G. Level-of-Service Concept**

"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 1](#). 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.*<sup>3</sup>

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

<sup>3</sup> Institute of Transportation Engineers, *Transportation Impact Analyses for Site Development: A Recommended Practice*, 2006, page 60

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 1 Level-of-Service Definitions for Signalized Intersections<sup>(1)</sup>**

| Level of Service | Interpretation   | Volume-to-Capacity Ratio <sup>(2)</sup> | Stopped Delay (Seconds) |
|------------------|--|---|-------------------------|
| A, B             | Uncongested operations; all vehicles clear in a single cycle.  | 0.000-0.700                             | <20.0                   |
| C                | Light congestion; occasional backups on critical approaches  | 0.701-0.800                             | 20.1-35.0               |
| 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                             | 35.1-55.0               |
| 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                             | 55.1-80.0               |
| 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.

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 2](#) summarizes the definitions for level-of-service and the corresponding delay.

**Table 2 Level-of-Service Definitions for Unsignalized Intersections<sup>(1)</sup>**

| Level-of-Service | Expected Delay to Minor Street Traffic | Delay (Seconds) |
|------------------|--|-----------------|
| A                | Little or no delay                     | <10.0           |
| 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.

**H. Existing Levels-of-Service**

The results of the level-of-service analysis of the intersection of Kuhio Highway at Kukui Street is summarized in **Table 3**. Since this intersection is signalized, the volume-to-capacity ratio, delay and level-of-service is shown for the overall intersection and each controlled movement. The traffic signal timing was estimated by manually timing the traffic signals during the peak hours.

**Table 3 Existing Levels-of-Service - Signalized Intersections<sup>(1)</sup>**

| Intersection and Movement            | AM Peak Hour                             |                      |                    | PM Peak Hour              |             |          |
|--------------------------------------|--|----------------------|--------------------|---------------------------|-------------|----------|
|                                      | V/C <sup>(2)</sup>                       | Delay <sup>(3)</sup> | LOS <sup>(4)</sup> | V/C                       | Delay       | LOS      |
|                                      | Cycle Length = 60 Seconds <sup>(5)</sup> |                      |                    | Cycle Length = 60 Seconds |             |          |
| <b>Kuhio Highway at Kuhio Street</b> | <b>0.51</b>                              | <b>11.5</b>          | <b>B</b>           | <b>0.49</b>               | <b>11.1</b> | <b>B</b> |
| Eastbound Left & Thru                | 0.10                                     | 17.0                 | B                  | 0.09                      | 16.9        | B        |
| Eastbound Right                      | 0.03                                     | 16.4                 | B                  | 0.01                      | 16.3        | B        |
| Westbound Right                      | 0.00                                     | 16.2                 | B                  | 0.01                      | 16.2        | B        |
| Northbound Left                      | 0.03                                     | 5.0                  | A                  | 0.02                      | 5.0         | A        |
| Northbound Thru & Right              | 0.68                                     | 11.5                 | B                  | 0.61                      | 10.1        | B        |
| Southbound Left & Thru               | 0.65                                     | 10.9                 | B                  | 0.67                      | 11.5        | B        |
| Southbound Right                     | 0.00                                     | 4.8                  | A                  | 0.00                      | 4.8         | A        |

NOTES:  
 (1) See Attachments F and G for Level-of-Service Worksheets.  
 (2) Volume-to-Capacity ratio.  
 (3) Delay is in seconds per vehicle.  
 (4) Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. Level-of-Service is based on delay.  
 (5) Traffic signal cycle length determined by timing the traffic signal during peak hours.

The overall intersection operates at Level-of-Service B during both peak periods. All controlled lane groups operate at Level-of-Service A or B. This indicates good operating conditions.

The results of the level-of-service analysis of the intersection of Kapa'a Bypass and Olohehena Road are summarized in **Table 4**. For roundabout intersections, the HCS methodology calculates volume-to-capacity ratios for the intersection approaches, which is then related to the volume-to-capacity ratio definitions for levels-of-service discussed previously. The levels-of-service calculations indicate that the eastbound approach is near capacity during the morning peak hour with a volume-to-capacity ratio of 0.92. All the remaining movements operate at Level-of-Service A or B.

**Table 4 Existing Levels-of-Service - Kapa'a Bypass at Olohehena Road**

| Approach                    | AM Peak Hour       |                    | PM Peak Hour    |          |
|-----------------------------|--------------------|--------------------|-----------------|----------|
|                             | Without Project    |                    | Without Project |          |
|                             | V/C <sup>(1)</sup> | LOS <sup>(2)</sup> | V/C             | LOS      |
| <b>Overall Intersection</b> | <b>0.92</b>        | <b>E</b>           | <b>0.50</b>     | <b>A</b> |
| Eastbound Approach          | 0.92               | E                  | 0.49            | A        |
| Westbound Approach          | 0.18               | A                  | 0.42            | A        |
| Northbound Approach         | 0.09               | A                  | 0.38            | A        |
| Southbound Approach         | 0.63               | B                  | 0.62            | B        |

NOTES:  
 (1) V/C denotes volume-to-capacity ratio.  
 (2) LOS denotes Level-of-Service.  
 (3) See Attachments F and G for Level-of-Service Worksheets.

The results of the level-of-service analysis of the remaining unsignalized intersections are summarized in **Table 5**. The HCM methodology calculates only delays for controlled lane groups only. Volume-to-capacity ratios are not calculated. The 95<sup>th</sup> percentile queue lengths as reported by Synchro are also shown.

**Table 5 Existing Levels-of-Service of Unsignalized Intersections**

| Intersection, Approach and Movement   | AM Peak Hour                             |                    |                                       | PM Peak Hour              |          |                        |
|---------------------------------------|--|--------------------|---------------------------------------|---------------------------|----------|------------------------|
|                                       | Delay <sup>(1)</sup>                     | LOS <sup>(2)</sup> | 95 <sup>th</sup> Queue <sup>(3)</sup> | Delay                     | LOS      | 95 <sup>th</sup> Queue |
|                                       | Cycle Length = 60 Seconds <sup>(5)</sup> |                    |                                       | Cycle Length = 60 Seconds |          |                        |
| <b>Kuhio Highway at Kapaa Bypass</b>  | <b>95.3</b>                              | <b>F</b>           | <b>NC</b>                             | <b>12.3</b>               | <b>B</b> | <b>NC</b>              |
| Eastbound Left                        | 273.5                                    | F                  | 999                                   | 57.9                      | F        | 227                    |
| Eastbound Right                       | Uncontrolled Lane Group                  |                    |                                       | Uncontrolled Lane Group   |          |                        |
| Northbound Left                       | 9.2                                      | A                  | 8                                     | 13.2                      | B        | 82                     |
| Northbound Thru                       | Uncontrolled Lane Group                  |                    |                                       | Uncontrolled Lane Group   |          |                        |
| Southbound Thru                       | Uncontrolled Lane Group                  |                    |                                       | Uncontrolled Lane Group   |          |                        |
| Southbound Right                      | Uncontrolled Lane Group                  |                    |                                       | Uncontrolled Lane Group   |          |                        |
| <b>Olohehena Road at Kaapuni Road</b> | <b>9.8</b>                               | <b>A</b>           | <b>NC</b>                             | <b>3.1</b>                | <b>A</b> | <b>NC</b>              |
| Eastbound Left & Thru                 | 0.9                                      | A                  | 2                                     | 1.7                       | A        | 2                      |
| Westbound Thru & Right                | Uncontrolled Lane Group                  |                    |                                       | Uncontrolled Lane Group   |          |                        |
| Southbound Left & Right               | 22.5                                     | C                  | 112                                   | 13.5                      | B        | 26                     |
| <b>Kaapuni Road at Kaehula Road</b>   | <b>0.7</b>                               | <b>A</b>           | <b>NC</b>                             | <b>0.3</b>                | <b>A</b> | <b>NC</b>              |
| Westbound Left & Right                | 11.5                                     | B                  | 4                                     | 11.4                      | B        | 1                      |
| Northbound Thru & Right               | Uncontrolled Lane Group                  |                    |                                       | Uncontrolled Lane Group   |          |                        |
| Southbound Left & Thru                | 0.0                                      | A                  | 0                                     | 0.1                       | A        | 0                      |

NOTES:  
 (1) Delay is in seconds per vehicle.  
 (2) LOS denotes Level-of-Service.  
 (3) 95<sup>th</sup> percentile queue in feet as reported by Synchro.  
 (4) NC = Not calculated  
 (5) See Attachments F and G for Level-of-Service Worksheets.

The intersection of Kuhio Highway at Kapaa Bypass operates at Level-of-Service F during the morning peak hour and Level-of-Service B during the afternoon peak hour. It is the eastbound left turn lane with a delay so long that it impacts of the overall intersection, resulting in the poor level-of-service.

The intersection of Olohena Road at Kaapuni Road and Kaehula Road is actually two intersections. Olohena Road is the eastbound and westbound approaches and Kaapuni Road is the STOP sign controlled approach at Olohena Road. Kaehula Road intersects Kaapuni Road west of Olohena Road. Therefore, the level-of-service results are shown for two intersections. The intersections of Olohena Road at Kaapuni Road and Olohena Road at Kaehula Road both operate at Level-of-Service A during both peak periods.

**I. Existing Deficiencies**

The eastbound approach at the intersection of Olohena Road at Kapaa Bypass is at or near capacity during the morning peak hour with a volume-to-capacity ratio of 0.92 and a Level-of-Service of E. The deficient movement is mitigated when the project is constructed as traffic will be redistributed as a result of constructing Road A through the project. This redistribution will be addressed later in this report as part of the traffic impact analysis of the project.

The eastbound to northbound left turns at the intersection of Kuhio Highway at Kapaa Bypass operate at Level-of-Service F during both peak hours. However, the morning and afternoon volumes are only 5 and 12 vehicles, respectively. Since the volumes are so low, mitigation has been deferred. It should also be noted that the proposed development project adds no traffic to these movements.

**J. Background Traffic Projections**

Based on data in the *Kauai Long-Range Land Transportation Plan*<sup>4</sup>, population growth in the Kawaihau District, which includes Kapa'a, will be less than one percent per year until 2020. Also, we are not aware of any approved projects in the vicinity that will impact traffic conditions along Kapa'a Bypass or Olohena Road before the design year of this project. Therefore, for this particular study, it was assumed that there will be no significant increase in peak hour traffic at the study intersections as a result of regional background growth or traffic generated by approved new projects in the vicinity of the project. Future 2020 background (without project) traffic volumes were estimated to be comparable to existing peak hour traffic volumes at the study intersections.

**K. Project Trip Generation**

Future traffic volumes generated by Kapa'a Highlands Subdivision (Phases 1 and 2) were estimated using the methodology described in the *Trip Generation Handbook*<sup>5</sup> and data provided in *Trip Generation*<sup>6</sup>. This method uses trip generation equations or rates to estimate the number of trips that the project will generate during the peak hours of the project and along the adjacent street.

<sup>4</sup> Austin, Tsutsumi & Associates, *Kauai Long-Range Land Transportation Plan*, May 2004

<sup>5</sup> Institute of Transportation Engineers, *Trip Generation Handbook*, Washington, D.C., 2004, p. 7-12

<sup>6</sup> Institute of Transportation Engineers, *Trip Generation, 7th Edition*, Washington, D.C., 2003

The equations used for the trip generation analysis are summarized in [Table 6](#). The trip generation equations for the residential uses are based on the number of planned residential units. The equations for the retail portion of the project are based on the gross leasable square footage of the retail area. The equations shown estimate the number of peak hour trips during the peak hours of the generator, which may or may not coincide with the peak hour of the adjacent street. *Trip Generation* does not note the peak hours of the generators.

A portion of the trips to and from the retail area will be from the adjacent traffic stream. These trips are referred to as "pass by trips" and are deducted from the total number of trip to estimate the number of new trips generated by the project. However, these trips are added to the driveway volumes at the retail areas. The equation for estimating the percent pass by trips is also provided. This equation is based on the gross leasable square footage of the retail area. Pass by equations are provided of the PM peak hour only.

It should be noted that the percentage of pass by trip estimated from the equation provided in the *Trip Generation Handbook* is 81%. State of Hawaii Department of Transportation felt that this percentage was too high. It was agreed with State of Hawaii Department of Transportation that 34% would be used for the trip generation calculations. Refer to [Attachment O](#).

**Table 6 Trip Generation Equations<sup>(1)</sup>**

| Period & Direction | Single Family Units<br>(Land Use Code 210) | Multi-Family Units<br>(Land Use Code 230) | Neighborhood<br>Commercial<br>(Land Use Code 820) | Pass By Trips                      |
|--------------------|--|---|---|------------------------------------|
|                    | Equation or Percent <sup>(1)</sup>         | Equation or Percent <sup>(1)</sup>        | Equation or Percent <sup>(1)</sup>                | Equation or Percent <sup>(2)</sup> |
| Weekday Total      | $\ln(T) = 0.92 \ln(X) + 2.71$              | $\ln(T) = 0.85 \ln(X) + 2.55$             | $\ln(T) = 0.65 \ln(x) + 5.83$                     | No Equation Provided               |
| AM Peak Hour       | $T = 0.70(X) + 12.05$                      | $\ln(T) = 0.82 \ln(X) + 0.171$            | $\ln(T) = 0.60 \ln(A) + 2.29$                     | No Equation Provided               |
|                    | Inbound 25%                                | 18%                                       | 61%   |                                    |
|                    | Outbound 75%                               | 82%                                       | 39%   |                                    |
| PM Peak Hour       | $\ln(T) = 0.89 \ln(X) + 9.61$              | $T = 0.34(X) + 38.31$                     | $\ln(T) = 0.66 \ln(A) + 3.40$                     | $\ln(T) = -0.29 \ln(A) + 5.00$     |
|                    | Inbound 63%                                | 64%                                       | 48%   | 50%                                |
|                    | Outbound 37%                               | 36%                                       | 52%   | 50%                                |

Notes:  
 (1) Source: Institute of Transportation Engineers, *Trip Generation, 7th Edition*, Washington, D.C., 2003  
 (2) Source: Institute of Transportation Engineers, *Trip Generation Handbook*, Washington, D.C., 2004, p. 47  
 (3) T = Trips, X = Number of Units, A = Gross Leasable Square Feet

The results of the trip generation analysis are summarized in [Table 7](#). The conclusion of the trip generation analysis is that Phases 1 and 2 will generate a total of 394 trips during the morning peak hour and 487 trips during the afternoon peak hour. As noted earlier, the numbers of peak hour trips shown are the trips generated during the peak hour of the generator, which may or may not coincide with the peak hours of the adjacent streets.

**Table 7 Trip Generation Calculations**

| Period & Direction | Phase 1       |               | Phase 2      |                         |                              |                    |       |               | Total Project Trips |             |               |           |     |
|--------------------|---------------|---------------|--------------|-------------------------|------------------------------|--------------------|-------|---------------|---------------------|-------------|---------------|-----------|-----|
|                    | Single Family | Single Family | Multi-Family | Neighborhood Commercial |                              | Phase 2 Total Trip |       |               | (Phases 1 and 2)    |             |               |           |     |
|                    | 16 Units      | 100 Units     | 700 Units    | 8,000 TLSF              |                              |                    |       |               |                     |             |               |           |     |
|                    | Trips         | Trips         | Trips        | Trips                   | Pass By Trips <sup>(1)</sup> | New Trips          | Trips | Pass By Trips | New Trips           | Total Trips | Pass By Trips | New Trips |     |
| AM Peak Hour       | Total         | 23            | 82           | 255                     | 34                           | 0                  | 34    | 371           | 0                   | 371         | 394           | 0         | 394 |
|                    | Inbound       | 6             | 21           | 46                      | 21                           | 0                  | 21    | 88            | 0                   | 88          | 94            | 0         | 94  |
|                    | Outbound      | 17            | 61           | 209                     | 13                           | 0                  | 13    | 283           | 0                   | 283         | 300           | 0         | 300 |
| PM Peak Hour       | Total         | 22            | 111          | 276                     | 118                          | 40                 | 78    | 505           | 96                  | 409         | 527           | 40        | 487 |
|                    | Inbound       | 14            | 71           | 177                     | 57                           | 20                 | 37    | 305           | 48                  | 257         | 319           | 20        | 299 |
|                    | Outbound      | 8             | 40           | 99                      | 61                           | 20                 | 41    | 200           | 48                  | 152         | 208           | 20        | 188 |

Notes:  
 (1) The percentage of pass by trips is 34% of the afternoon peak hour trips.

Project trips were distributed and assigned based on existing traffic approach and departure patterns of traffic into and out of the study area as estimated from the traffic counts. Given the location of the retail, which is the center of Phase 2, it was assumed that all the pass by trips would be diverted from the internal road system of Phase 2. The project trip assignments for Phases 1 and 2 are shown on [Attachment H](#) and [I](#), respectively.

**L. Background Plus Project Projections**

Background plus project traffic projections were estimated by superimposing the peak hourly traffic generated by the proposed project on the background (without project) peak hour traffic projections. This assumes that the peak hourly trips generated by the project coincide with the peak hour of the adjacent street. This represents a worse-case condition as it assumes that the peak hours of the intersection approaches and the peak hour of the study project coincide.

As noted earlier, construction of Road 'A' will divert traffic from the eastbound to southbound right turns and northbound to westbound left turns from the intersection of Olohena Road at Kapaa Bypass. The redistribution of traffic is summarized on [Attachment J](#).

The resulting background plus project peak hour traffic projections are shown in [Attachments K](#) and [L](#).

**M. Traffic Impact Assessment**

The traffic impact of the proposed project was assessed by analyzing changes in traffic volumes at the study intersections and changes on the level-of-service.

*Changes in Total Intersection Volumes*

An analysis of the project's share of 2020 background plus project intersection approach volumes at the study intersections is summarized in [Table 8](#). The table summarizes the project's share of total 2020 peak hour approach volumes at each intersection. Also shown are the percentages of 2020 background plus project traffic that is the result of background growth and traffic generated by related projects. The negative percentages reflect the redistribution of traffic as a result of Road 'A'.

**Table 8 Analysis of Project's Share of Total Intersection Approach Volumes <sup>(1)</sup>**

| Intersection                  | Period | Existing | 2020 Background Plus Project | Project Traffic |       |
|-------------------------------|--------|----------|------------------------------|-----------------|-------|
|                               |        |          |                              |                 |       |
| Kukui Highway at Kukui Street | AM     | 1441     | 1453                         | 12              | 0.8%  |
|                               | PM     | 1370     | 1385                         | 15              | 1.1%  |
| Olohena Road at Kapaa Bypass  | AM     | 1447     | 1372                         | -75             | -5.5% |
|                               | PM     | 1459     | 1407                         | -52             | -3.7% |
| Kuhio Highway at Kapaa Bypass | AM     | 1990     | 2266                         | 276             | 12.2% |
|                               | PM     | 2176     | 2518                         | 342             | 13.6% |

Notes:  
 (1) Volumes shown are total intersection approach volumes or projections.  
 (2) Percentage of total 2015 background plus project traffic.  
 (3) Data to be provided in final draft report.

The percentage of project traffic at the intersection of Kuhio Highway at Kukui Street is 0.8% during the morning peak hour and 1.1% during the afternoon peak hour. The analysis indicates that the peak hour traffic volumes at the intersection of Olohena Road at Kapaa Bypass will be less than existing because of the redistribution of traffic to Road 'A.'

The analysis indicates that peak hour traffic at the intersection of Kuhio Highway at Kapaa Bypass will increase 12.2 % during the morning peak hour and 13.6% during the afternoon peak hour. These increases are higher than desirable but the intersection is over two miles from the project. Typically, the study area for a project that generates the amount of traffic that this project generates should be limited to one-half mile, or less.

*Changes of Levels-of-Service*

A level-of-service analysis was performed for "without project" and "with project" conditions to confirm that the intersections will operate at an acceptable level-of-service and that there are no traffic operational deficiencies.

The results of the 2020 level-of-service analysis of the intersection of Kuhio Highway at Kukui Street are summarized in [Table 9](#). The overall intersection and all controlled movements will

operate at Level-of-Service B without and with project generated traffic. There are no changes in the level-of-service of the intersections or controlled lane groups as a result of project related traffic.

**Table 9 2020 Levels-of-Service - Kuhio Highway at Kukui Street <sup>(1)</sup>**

| Intersection and Movement   | AM Peak Hour                             |                      |                    |              |             |          | PM Peak Hour              |             |          |              |             |          |
|-----------------------------|--|----------------------|--------------------|--------------|-------------|----------|---------------------------|-------------|----------|--------------|-------------|----------|
|                             | Without Project                          |                      |                    | With Project |             |          | Without Project           |             |          | With Project |             |          |
|                             | V/C <sup>(2)</sup>                       | Delay <sup>(3)</sup> | LOS <sup>(4)</sup> | V/C          | Delay       | LOS      | V/C                       | Delay       | LOS      | V/C          | Delay       | LOS      |
| <b>Overall Intersection</b> | Cycle Length = 60 Seconds <sup>(5)</sup> |                      |                    |              |             |          | Cycle Length = 60 Seconds |             |          |              |             |          |
|                             | <b>0.51</b>                              | <b>11.5</b>          | <b>B</b>           | <b>0.51</b>  | <b>11.6</b> | <b>B</b> | <b>0.49</b>               | <b>11.1</b> | <b>B</b> | <b>0.50</b>  | <b>11.1</b> | <b>B</b> |
| Eastbound Left & Thru       | 0.10                                     | 17.0                 | B                  | 0.11         | 17.1        | B        | 0.09                      | 16.9        | B        | 0.10         | 17.0        | B        |
| Eastbound Right             | 0.03                                     | 16.4                 | B                  | 0.04         | 16.5        | B        | 0.01                      | 16.3        | B        | 0.02         | 16.3        | B        |
| Westbound Right             | 0.00                                     | 16.2                 | B                  | 0.00         | 16.2        | B        | 0.01                      | 16.2        | B        | 0.01         | 16.2        | B        |
| Northbound Left             | 0.03                                     | 5.0                  | A                  | 0.03         | 5.1         | A        | 0.02                      | 5.0         | A        | 0.04         | 5.2         | A        |
| Northbound Thru & Right     | 0.68                                     | 11.5                 | B                  | 0.68         | 11.5        | B        | 0.61                      | 10.1        | B        | 0.61         | 10.1        | B        |
| Southbound Left & Thru      | 0.65                                     | 10.9                 | B                  | 0.65         | 10.9        | B        | 0.67                      | 11.5        | B        | 0.67         | 11.5        | B        |
| Southbound Right            | 0.00                                     | 4.8                  | A                  | 0.00         | 4.8         | A        | 0.00                      | 4.8         | A        | 0.00         | 4.8         | A        |

- NOTES:  
 (1) See Attachment M for AM peak hour Level-of-Service Worksheets and Attachment N for PM peak hour Level-of-Service Worksheets.  
 (2) Volume-to-Capacity ratio.  
 (3) Delay is in seconds per vehicle.  
 (4) Level-of-Service calculated using the operations method described in *Highway Capacity Manual*. Level-of-Service is based on delay.  
 (5) Traffic signal cycle length determined by timing the traffic signal during peak hours.

The results of the level-of-service analysis for the intersection of the Kapa'a Bypass at Olohehena Road, the only existing study intersection, are summarized in Table 10. The Highway Capacity Manual methodology for analysis of roundabouts calculates only the volume-to-capacity ratio of each intersection approach. The volume-to-capacity ratio is then referenced to the level-of-service definitions for signalized intersection to determine the level-of-service of each approach.

**Table 10 Future (2020) Levels-of-Service - Kapa'a Bypass at Olohehena Road**

| Approach                    | AM Peak Hour       |                    |              |          | PM Peak Hour    |          |              |          |
|-----------------------------|--------------------|--------------------|--------------|----------|-----------------|----------|--------------|----------|
|                             | Without Project    |                    | With Project |          | Without Project |          | With Project |          |
|                             | V/C <sup>(1)</sup> | LOS <sup>(2)</sup> | V/C          | LOS      | V/C             | LOS      | V/C          | LOS      |
| <b>Overall Intersection</b> | <b>0.92</b>        | <b>E</b>           | <b>0.83</b>  | <b>D</b> | <b>0.50</b>     | <b>A</b> | <b>0.64</b>  | <b>B</b> |
| Eastbound Approach          | 0.92               | E                  | 0.83         | D        | 0.49            | A        | 0.43         | A        |
| Westbound Approach          | 0.18               | A                  | 0.19         | A        | 0.42            | A        | 0.42         | A        |
| Northbound Approach         | 0.09               | A                  | 0.05         | A        | 0.38            | A        | 0.30         | A        |
| Southbound Approach         | 0.63               | B                  | 0.63         | B        | 0.62            | B        | 0.64         | B        |

- NOTES:  
 (1) V/C denotes volume-to-capacity ratio.  
 (2) LOS denotes Level-of-Service.  
 (3) See Attachment M for AM peak hour Level-of-Service Worksheets and Attachment N for PM peak hour Level-of-Service Worksheets.

The analysis concluded that the eastbound approach is over-capacity ( Level-of-Service E) during the morning peak hour without the project but will operate at Level-of-Service D with the project. This improvement is because eastbound to southbound traffic will be diverted to Road A.

The results of the level-of-service analysis for the remaining unsignalized intersections are summarized in Table 11. Shown are the delays, levels-of-service and 95<sup>th</sup> percentile queues.

**Table 11 2020 Levels-of-Service of Unsignalized Intersections**

| Intersection, Approach and Movement   | AM Peak Hour            |                    |                                       |              |          |                        | PM Peak Hour    |          |                        |              |          |                        |
|---------------------------------------|-------------------------|--------------------|---------------------------------------|--------------|----------|------------------------|-----------------|----------|------------------------|--------------|----------|------------------------|
|                                       | Without Project         |                    |                                       | With Project |          |                        | Without Project |          |                        | With Project |          |                        |
|                                       | Delay <sup>(1)</sup>    | LOS <sup>(2)</sup> | 95 <sup>th</sup> Queue <sup>(3)</sup> | Delay        | LOS      | 95 <sup>th</sup> Queue | Delay           | LOS      | 95 <sup>th</sup> Queue | Delay        | LOS      | 95 <sup>th</sup> Queue |
| <b>Kuhio Highway at Kapaa Bypass</b>  | <b>95.3</b>             | <b>F</b>           | <b>NC</b>                             | <b>191.4</b> | <b>F</b> | <b>NC</b>              | <b>12.3</b>     | <b>B</b> | <b>NC</b>              | <b>42.4</b>  | <b>E</b> | <b>NC</b>              |
| Eastbound Left                        | 273.5                   | F                  | 999                                   | 479.7        | F        | 1676                   | 57.9            | F        | 227                    | 190.1        | F        | 1116                   |
| Eastbound Right                       | Uncontrolled Lane Group |                    |                                       |              |          |                        |                 |          |                        |              |          |                        |
| Northbound Left                       | 9.2                     | A                  | 8                                     | 9.6          | A        | 15                     | 13.2            | B        | 82                     | 21.0         | C        | 203                    |
| Northbound Thru                       | Uncontrolled Lane Group |                    |                                       |              |          |                        |                 |          |                        |              |          |                        |
| Southbound Thru                       | Uncontrolled Lane Group |                    |                                       |              |          |                        |                 |          |                        |              |          |                        |
| Southbound Right                      | Uncontrolled Lane Group |                    |                                       |              |          |                        |                 |          |                        |              |          |                        |
| <b>Olohehena Road at Kaapuni Road</b> | <b>9.8</b>              | <b>A</b>           | <b>NC</b>                             | <b>10.1</b>  | <b>B</b> | <b>NC</b>              | <b>3.1</b>      | <b>A</b> | <b>NC</b>              | <b>3.3</b>   | <b>A</b> | <b>NC</b>              |
| Eastbound Left & Thru                 | 0.9                     | A                  | 2                                     | 0.9          | A        | 2                      | 1.7             | A        | 2                      | 1.5          | A        | 2                      |
| Westbound Thru & Right                | Uncontrolled Lane Group |                    |                                       |              |          |                        |                 |          |                        |              |          |                        |
| Southbound Left & Right               | 22.5                    | C                  | 112                                   | 24.0         | C        | 121                    | 13.5            | B        | 26                     | 14.4         | B        | 32                     |
| <b>Kaapuni Road at Kaehula Road</b>   | <b>0.7</b>              | <b>A</b>           | <b>NC</b>                             | <b>0.6</b>   | <b>A</b> | <b>NC</b>              | <b>0.3</b>      | <b>A</b> | <b>NC</b>              | <b>0.3</b>   | <b>A</b> | <b>NC</b>              |
| Westbound Left & Right                | 11.5                    | B                  | 4                                     | 11.7         | B        | 4                      | 11.4            | B        | 1                      | 11.6         | B        | 1                      |
| Northbound Thru & Right               | Uncontrolled Lane Group |                    |                                       |              |          |                        |                 |          |                        |              |          |                        |
| Southbound Left & Thru                | 0.0                     | A                  | 0                                     | 0.0          | A        | 0                      | 0.1             | A        | 0                      | 0.1          | A        | 0                      |

- NOTES:  
 (1) Delay is in seconds per vehicle.  
 (2) LOS denotes Level-of-Service.  
 (3) 95<sup>th</sup> percentile queue in feet as reported by Synchro.  
 (4) NC = Not calculated  
 (5) See Attachment M for AM peak hour Level-of-Service Worksheets and Attachment N for PM peak hour Level-of-Service Worksheets.

The intersection of Kuhio Highway at Kapaa Bypass will operate at Level-of-Service F without and with the project during the morning and afternoon peak hours. The delay of the eastbound to northbound left turn increases even though the project adds no traffic to this movement. The delay of this movement is so long that it affects the level-of-service of the overall intersections.

The remaining unsignalized intersections will operate at Level-of-Service A without and with project traffic.

The results of the level-of-service analysis of the new STOP sign controlled intersections are summarized in Table 12. As shown, all lane groups will operate at Level-of-Service C, or better.

**Table 12 2020 Levels-of-Service - New Intersections**

| Intersection and Movement        | AM Peak Hour       |                  |                              | PM Peak Hour |          |                 |
|----------------------------------|--------------------|------------------|------------------------------|--------------|----------|-----------------|
|                                  | Delay <sup>1</sup> | LOS <sup>2</sup> | Queue <sup>3</sup><br>(Feet) | Delay        | LOS      | Queue<br>(Feet) |
| <b>Kapa'a Bypass at Road 'A'</b> | <b>6.5</b>         | <b>A</b>         | <b>NC</b>                    | <b>5.3</b>   | <b>A</b> | <b>NC</b>       |
| Eastbound Left & Thru            | 6.2                | A                | 10                           | 5.3          | A        | 24              |
| Southbound Left & Right          | 16.5               | C                | 93                           | 12.0         | B        | 33              |
| <b>Oloheua Road at Road 'A'</b>  | <b>3.0</b>         | <b>A</b>         | <b>NC</b>                    | <b>3.7</b>   | <b>A</b> | <b>NC</b>       |
| Westbound Left & Thru            | 1.5                | A                | 2                            | 1.5          | A        | 4               |
| Northbound Left & Right          | 17.1               | C                | 36                           | 16.8         | C        | 35              |

NOTES:  
 (1) Delay is in seconds per vehicle.  
 (2) LOS denotes Level-of-Service. Level-of-Service is based on delay.  
 (3) 95<sup>th</sup> Percentile in feet as reported by Synchro.  
 (4) See Attachment M for AM peak hour Level-of-Service Worksheets and Attachment N for PM peak hour Level-of-Service Worksheets.  
 (5) NC = Not calculated.

**N. Project Road System**

For signalized intersections, Level-of-Service D is the minimum acceptable Level-of-Service<sup>7</sup> and that this standard is applicable to the overall intersection rather than each controlled lane group. Minor movements, such as left turns, and minor side street approaches may operate at Level-of-Service E or F for short periods of time during the peak hours so that the overall intersection and major movements along the major highway will operate at Level-of-Service D, or better. All volume-to-capacity ratios must be 1.00 or less<sup>8</sup>.

A standard has not been established for unsignalized intersections. Therefore, we have used a standard that Level-of-Service D is an acceptable level-of-service for any major controlled lane groups, such as left turns from a major street to a minor street. Side street approaches may operate at Level-of-Service E or F for short periods of time. This is determined from the delays of the individual lane groups. If the delay of any of the side street approaches appears to be so long that it will affect the overall level-of-service of the intersection, then roadway improvements should be identified and accessed.

Using this standard, no additional roadway improvements are recommended to accommodate project related traffic.

The eastbound to northbound left turns at the intersection of Kuhio Highway at Kapa'a Bypass will operate at Level-of-Service F, without and with project traffic. The proposed project adds no traffic to this movement. The proposed project adds traffic to the northbound to westbound left turn, which increases the delay to the eastbound to northbound left turn.

<sup>7</sup> Institute of Transportation Engineers, *Transportation Impact Analyses for Site Development: A Recommended Practice*, 2006, page 60.

<sup>8</sup> Transportation Research Board, *Highway Capacity Manual*, Washington, D.C., 2000, p. 16-35.

The level-of-service of the eastbound approach of Oloheua Road to Kapa'a Bypass improves from Level-of-Service E to Level-of-Service D with project as a result of construction of Road 'A' between Kapa'a Bypass and Olowena Road, providing an alternate route and diverting traffic from the intersection. Thus, Road 'A' running through the project connecting these two intersections, redistributes traffic and reduces traffic of the overcapacity movement at this intersection during the AM peak hour.

**O. Other Traffic Related Issues**

1. Impacts of Closing Kapa'a Bypass

Based on the traffic counts performed for this study, the Kapa'a Bypass accommodates between 600 and 700 vehicles per hour during the peak hours. A closure of the bypass would force this traffic to use Kuhio Highway. During the field reconnaissance for this project, it was noted that traffic flow along Kuhio Highway is congested, especially during the afternoons, with very slow speeds and long delays indicating low levels-of-service. It would be difficult for the intersections along Kuhio Highway in Kapa'a Town to accommodate this additional traffic at acceptable levels-of-service. The addition of traffic that now uses Kapa'a Bypass to current traffic along Kuhio Highway would result in longer delays and therefore lower levels-of-service. The conclusion is that Kapa'a Bypass serves as a major mitigation to potential traffic congestion and low levels-of-service along Kuhio Highway.

2. Pedestrian and Traffic

It is reasonable that there will be a small amount of pedestrian and bicycle activity along Oloheua Road in the vicinity of Kapa'a Intermediate School. Some of this pedestrian activity may be generated from Kapa'a Highlands Subdivision. Accordingly, the intersections into and out of the subdivisions should provide pedestrian crosswalks to accommodate this activity.

3. Speed Control Along Road 'A'

As noted earlier in this report, Road 'A' will provide an alternate route to Kapa'a Intermediate School since it will be a more direct route for northbound traffic. Since Road 'A' will be through a residential area, traffic calming measure should be provided to control vehicle speeds and enhance the safety of pedestrians. Measures that should be considered include four-way stops, speed humps or tables.

**P. Summary and Recommendations**

1. Kapa'a Highlands subdivision is located west of Kapa'a Town and adjacent to Kapa'a Intermediate High School. The project is a residential subdivision with single-family and multi-family residences and neighborhood supporting retail.
2. The project has two phases. Phase 1 will be 16 single-family agricultural lots. Access to and egress from these lot will via driveways along Oloheua Road west of Kapa'a Intermediate School.



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3. The second phase will consist of 100 single-family units, 700 multi-family units and 8,000 square feet of neighborhood supporting retail. Access to and egress from Phase 2 will be provided via a new intersection along the north side of Kapa'a Bypass and a new intersection along the south side of Oloheua Road.
4. The conclusion of the trip generation analysis is that Phases 1 and 2 will generate a total of 394 trips during the morning peak hour and 487 trips during the afternoon peak hour.
5. The level-of-service analysis of the intersection of Kuhio Highway at Kukui Street determined that the overall intersection and all controlled movements will operate at Level-of-Service B without and with project generated traffic. There are no changes in the level-of-service of the intersections or controlled lane groups as a result of project related traffic.
6. A level-of-service analysis of the intersection of Kapa'a Bypass at Oloheua Road concluded that the eastbound approach to the roundabout is currently over-capacity (Level-of-Service E) during the morning peak hour without the project but will operate at Level-of-Service D with the project. This improvement is because eastbound to southbound traffic will be diverted from the intersection to Road A.
7. The intersection of Kuhio Highway at Kapa'a Bypass will operate at Level-of-Service F without and with the project during the morning and afternoon peak hours. The delay of the eastbound to northbound left turn increases even though the project adds no traffic to this movement. The delay of this movement is so long that it affects the level-of-service of the overall intersections. The proposed project adds no traffic to this movement. The proposed project adds traffic to the northbound to westbound left turn, which increases the delay to the eastbound to northbound left turn, but is not considered significant. The morning and afternoon peak hour projections for this lane group are 5 and 12 vehicles per hour, respectively. Traffic impacts due to the project are not considered significant.

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8. Based on the results of the level-of-service analysis, no roadway improvements are recommended to accommodate project related traffic. The project actually has a positive impact as a result of constructing Road 'A', which will divert traffic away from the intersection of Oloheua Road and Kapa'a Bypass. The eastbound to southbound movement will be over-capacity without Road 'A'.

Respectfully submitted,  
**PHILLIP ROWELL AND ASSOCIATES**

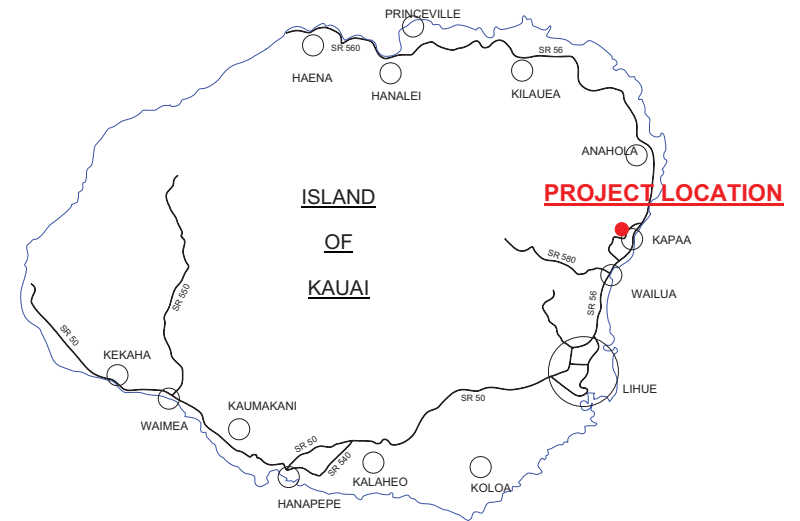


Phillip J. Rowell, P.E.  
Principal



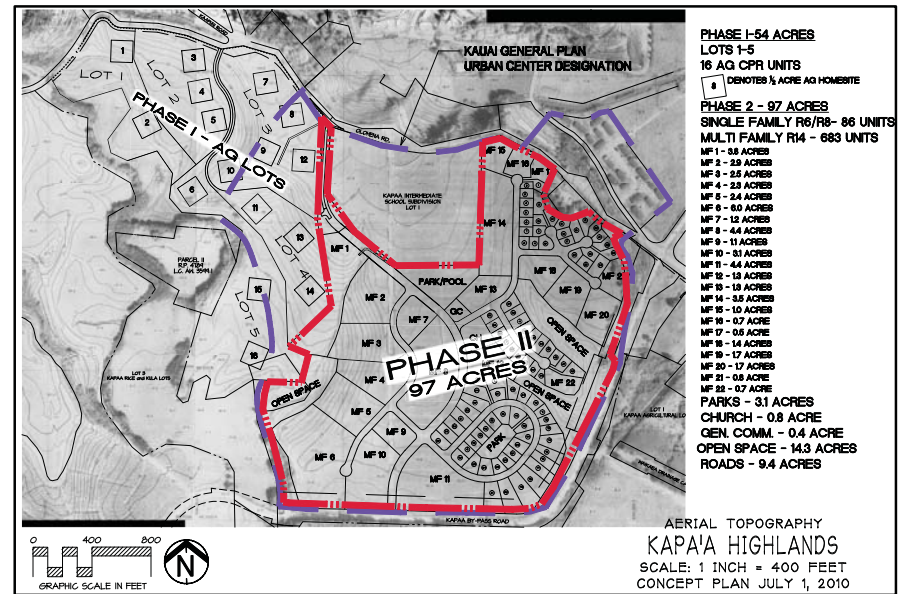
**List of Attachments**

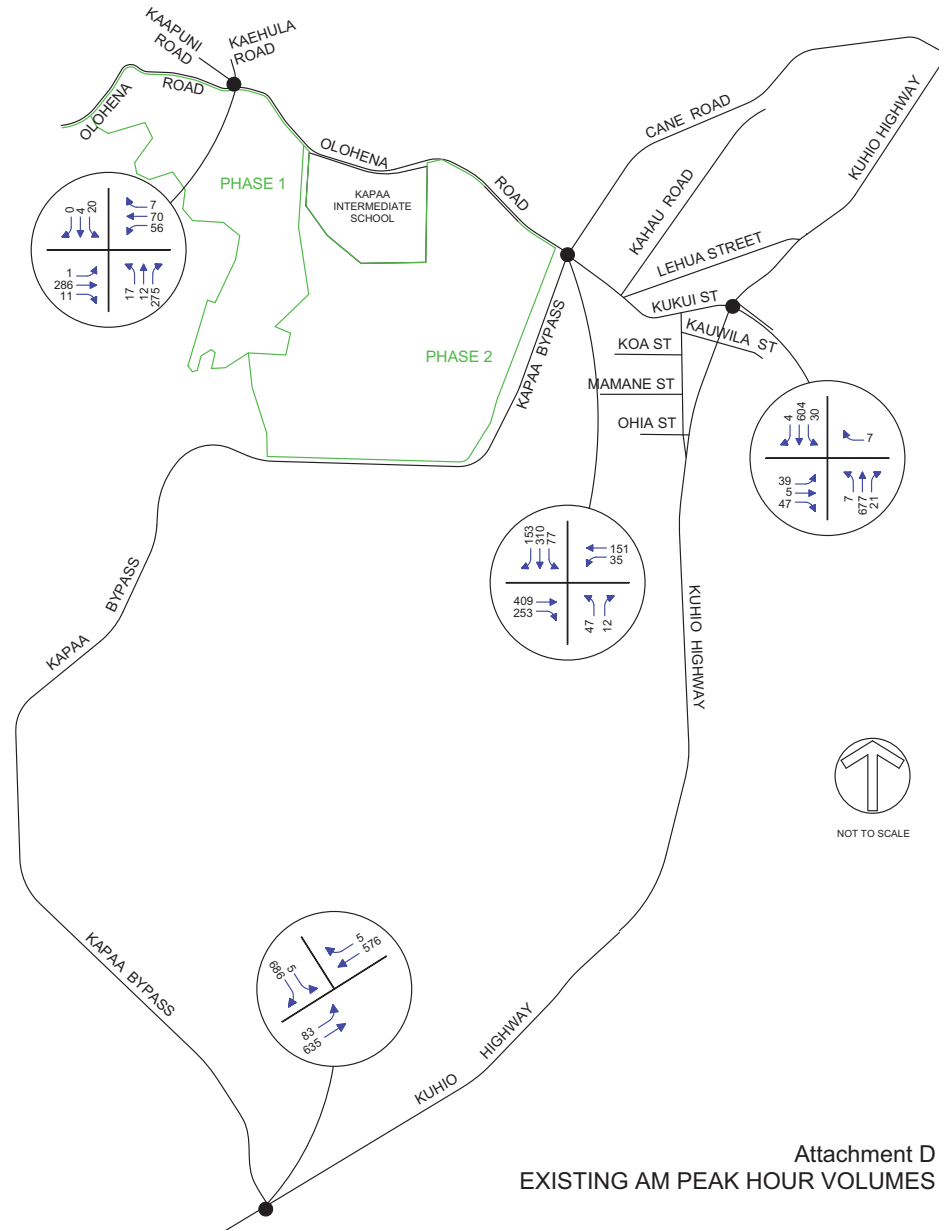
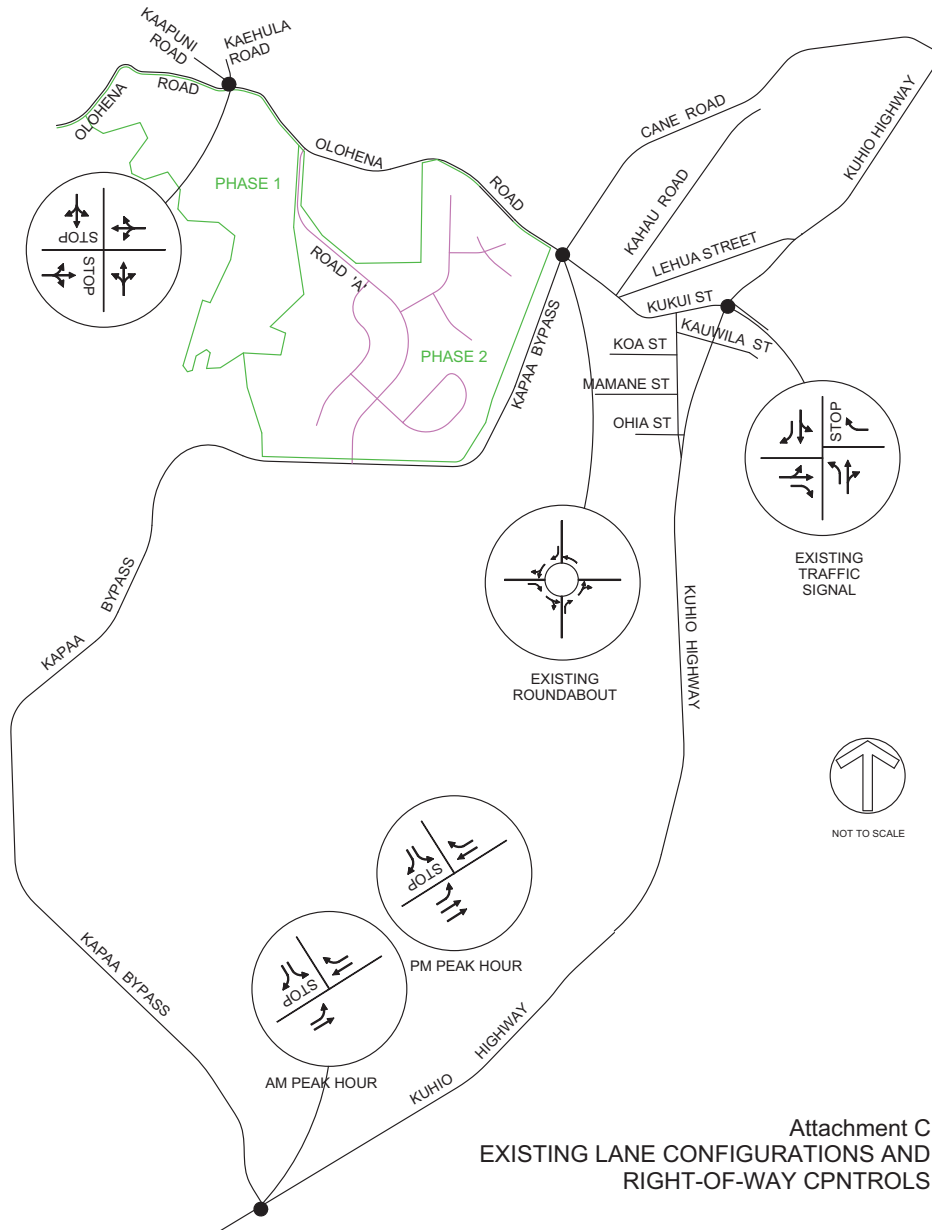
- A. Project Location of Kauai
- B. Subdivision Plan
- C. Existing Lane Configurations
- D. Existing AM Peak Hour Traffic Volumes
- E. Existing PM Peak Hour Traffic Volumes
- F. Level-of-Service Worksheets for Existing AM Peak Hour Conditions
- G. Level-of-Service Worksheets for Existing PM Peak Hour Conditions
- H. Phase 1 Trip Assignments
- I. Phase 2 Trip Assignments
- J. Reassignment of Existing Trips
- K. 2020 Background Plus Project AM Peak Hour Traffic Projections
- L. 2020 Background Plus Project PM Peak Hour Traffic Projections
- M. Level-of-Service Worksheets for 2020 Background Plus Project AM Peak Hour Conditions
- N. Level-of-Service Worksheets for 2020 Background Plus Project PM Peak Hour Conditions
- O. Comments from State of Hawaii Department of Transportation and Responses
- P. Comments from County of Kauai Department of Public Works and Responses



**Attachment A  
PROJECT LOCATION ON KAUAI**

Attachment B  
 Subdivision Plan  
 (Provided By Others)







HCM Signalized Intersection Capacity Analysis  
1: KUKUI STREET & KUHIO HIGHWAY

11/15/2013

| Movement               | EBL  | EBT  | EBR  | WBL  | WBT  | WBR    | NBL   | NBT  | NBR  | SBL  | SBT  | SBR  |      |
|------------------------|------|------|------|------|------|--------|-------|------|------|------|------|------|------|
| Lane Configurations    |      | ↕    | ↕    |      |      | ↕      | ↕     | ↕    |      |      | ↕    | ↕    |      |
| Ideal Flow (vphpl)     | 1900 | 1900 | 1900 | 1900 | 1900 | 1900   | 1900  | 1900 | 1900 | 1900 | 1900 | 1900 |      |
| Total Lost time (s)    |      | 4.0  | 4.0  |      |      | 4.0    | 4.0   | 4.0  |      |      | 4.0  | 4.0  |      |
| Lane Util. Factor      |      | 1.00 | 1.00 |      |      | 1.00   | 1.00  | 1.00 |      |      | 1.00 | 1.00 |      |
| Frt                    |      | 1.00 | 0.85 |      |      | 0.86   | 1.00  | 1.00 |      |      | 1.00 | 0.85 |      |
| Flt Protected          |      | 0.96 | 1.00 |      |      | 1.00   | 0.95  | 1.00 |      |      | 1.00 | 1.00 |      |
| Satd. Flow (prot)      |      | 1783 | 1583 |      |      | 1611   | 1770  | 1854 |      |      | 1858 | 1583 |      |
| Flt Permitted          |      | 0.96 | 1.00 |      |      | 1.00   | 0.28  | 1.00 |      |      | 0.95 | 1.00 |      |
| Satd. Flow (perm)      |      | 1783 | 1583 |      |      | 1611   | 523   | 1854 |      |      | 1774 | 1583 |      |
| Volume (vph)           |      | 39   | 5    | 47   | 0    | 0      | 7     | 7    | 677  | 21   | 30   | 604  | 4    |
| Peak-hour factor, PHF  |      | 0.92 | 0.92 | 0.92 | 0.92 | 0.92   | 0.92  | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph)        |      | 42   | 5    | 51   | 0    | 0      | 8     | 8    | 736  | 23   | 33   | 657  | 4    |
| RTOR Reduction (vph)   |      | 0    | 0    | 37   | 0    | 0      | 6     | 0    | 2    | 0    | 0    | 0    | 2    |
| Lane Group Flow (vph)  |      | 0    | 47   | 14   | 0    | 0      | 2     | 8    | 757  | 0    | 0    | 690  | 2    |
| Turn Type              |      | Perm | Perm |      |      | custom | Perm  |      |      | Perm |      | Perm |      |
| Protected Phases       |      | 4    |      |      |      |        |       | 2    |      |      |      | 6    |      |
| Permitted Phases       |      | 4    | 4    |      |      | 8      | 2     |      |      | 6    |      | 6    |      |
| Actuated Green, G (s)  |      | 16.0 | 16.0 |      |      | 16.0   | 36.0  | 36.0 |      | 36.0 |      | 36.0 |      |
| Effective Green, g (s) |      | 16.0 | 16.0 |      |      | 16.0   | 36.0  | 36.0 |      | 36.0 |      | 36.0 |      |
| Actuated g/C Ratio     |      | 0.27 | 0.27 |      |      | 0.27   | 0.60  | 0.60 |      | 0.60 |      | 0.60 |      |
| Clearance Time (s)     |      | 4.0  | 4.0  |      |      | 4.0    | 4.0   | 4.0  |      | 4.0  |      | 4.0  |      |
| Lane Grp Cap (vph)     |      | 475  | 422  |      |      | 430    | 314   | 1112 |      | 1064 |      | 950  |      |
| v/s Ratio Prot         |      |      |      |      |      |        | c0.41 |      |      |      |      |      |      |
| v/s Ratio Perm         |      | 0.03 | 0.03 |      |      | 0.00   | 0.02  |      |      | 0.39 |      | 0.00 |      |
| v/c Ratio              |      | 0.10 | 0.03 |      |      | 0.00   | 0.03  | 0.68 |      | 0.65 |      | 0.00 |      |
| Uniform Delay, d1      |      | 16.6 | 16.3 |      |      | 16.2   | 4.9   | 8.1  |      | 7.9  |      | 4.8  |      |
| Progression Factor     |      | 1.00 | 1.00 |      |      | 1.00   | 1.00  | 1.00 |      | 1.00 |      | 1.00 |      |
| Incremental Delay, d2  |      | 0.4  | 0.1  |      |      | 0.0    | 0.1   | 3.4  |      | 3.1  |      | 0.0  |      |
| Delay (s)              |      | 17.0 | 16.4 |      |      | 16.2   | 5.0   | 11.5 |      | 10.9 |      | 4.8  |      |
| Level of Service       |      | B    | B    |      |      | B      | A     | B    |      | B    |      | A    |      |
| Approach Delay (s)     |      | 16.7 |      |      | 16.2 |        |       | 11.4 |      | 10.9 |      |      |      |
| Approach LOS           |      | B    |      |      | B    |        |       | B    |      | B    |      |      |      |

| Intersection Summary              |       |                      |     |
|-----------------------------------|-------|----------------------|-----|
| HCM Average Control Delay         | 11.5  | HCM Level of Service | B   |
| HCM Volume to Capacity ratio      | 0.51  |                      |     |
| Actuated Cycle Length (s)         | 60.0  | Sum of lost time (s) | 8.0 |
| Intersection Capacity Utilization | 66.2% | ICU Level of Service | C   |
| Analysis Period (min)             | 15    |                      |     |
| c Critical Lane Group             |       |                      |     |

Queues  
1: KUKUI STREET & KUHIO HIGHWAY

11/15/2013

| Lane Group              | EBT   | EBR   | WBR    | NBL   | NBT   | SBL   | SBT   | SBR   |
|-------------------------|-------|-------|--------|-------|-------|-------|-------|-------|
| Lane Configurations     | ↕     | ↕     | ↕      | ↕     | ↕     |       | ↕     | ↕     |
| Volume (vph)            | 5     | 47    | 7      | 7     | 677   | 30    | 604   | 4     |
| Lane Group Flow (vph)   | 47    | 51    | 8      | 8     | 759   | 0     | 690   | 4     |
| Turn Type               |       | Perm  | custom | Perm  |       | Perm  |       | Perm  |
| Protected Phases        | 4     |       |        |       | 2     |       |       | 6     |
| Permitted Phases        |       | 4     | 8      | 2     |       | 6     |       | 6     |
| Minimum Split (s)       | 20.0  | 20.0  | 20.0   | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  |
| Total Split (s)         | 20.0  | 20.0  | 20.0   | 40.0  | 40.0  | 40.0  | 40.0  | 40.0  |
| Total Split (%)         | 33.3% | 33.3% | 33.3%  | 66.7% | 66.7% | 66.7% | 66.7% | 66.7% |
| Yellow Time (s)         | 3.5   | 3.5   | 3.5    | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   |
| All-Red Time (s)        | 0.5   | 0.5   | 0.5    | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   |
| Lead/Lag                |       |       |        |       |       |       |       |       |
| Lead-Lag Optimize?      |       |       |        |       |       |       |       |       |
| v/c Ratio               | 0.10  | 0.11  | 0.01   | 0.03  | 0.68  |       | 0.65  | 0.00  |
| Control Delay           | 17.3  | 6.6   | 0.0    | 5.1   | 12.0  |       | 11.5  | 3.5   |
| Queue Delay             | 0.0   | 0.0   | 0.0    | 0.0   | 0.0   |       | 0.0   | 0.0   |
| Total Delay             | 17.3  | 6.6   | 0.0    | 5.1   | 12.0  |       | 11.5  | 3.5   |
| Queue Length 50th (ft)  | 13    | 0     | 0      | 1     | 160   |       | 141   | 0     |
| Queue Length 95th (ft)  | 34    | 21    | 0      | 5     | 270   |       | 241   | 3     |
| Internal Link Dist (ft) | 1654  |       |        | 6852  |       |       | 2720  |       |
| Turn Bay Length (ft)    |       |       |        |       |       |       |       |       |
| Base Capacity (vph)     | 475   | 460   | 591    | 314   | 1114  |       | 1064  | 951   |
| Starvation Cap Reductn  | 0     | 0     | 0      | 0     | 0     |       | 0     | 0     |
| Spillback Cap Reductn   | 0     | 0     | 0      | 0     | 0     |       | 0     | 0     |
| Storage Cap Reductn     | 0     | 0     | 0      | 0     | 0     |       | 0     | 0     |
| Reduced v/c Ratio       | 0.10  | 0.11  | 0.01   | 0.03  | 0.68  |       | 0.65  | 0.00  |

| Intersection Summary   |  |
|------------------------|--|
| Cycle Length:          | 60   |
| Actuated Cycle Length: | 60   |
| Offset:                | 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green |
| Natural Cycle:         | 55   |
| Control Type:          | Pretimed   |

Splits and Phases: 1: KUKUI STREET & KUHIO HIGHWAY



HCM Unsignalized Intersection Capacity Analysis  
2: OLOHENA ROAD & KAPAA BYPASS

11/15/2013

| Movement                          | EBL   | EBT  | EBR                  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|-----------------------------------|-------|------|----------------------|------|------|------|------|------|------|------|------|------|
| Right Turn Channelized            |       |      |                      |      |      |      |      |      |      |      |      |      |
| Volume (veh/h)                    | 0     | 409  | 253                  | 35   | 151  | 0    | 47   | 0    | 12   | 77   | 310  | 153  |
| Peak Hour Factor                  | 0.92  | 0.92 | 0.92                 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 0     | 445  | 275                  | 38   | 164  | 0    | 51   | 0    | 13   | 84   | 337  | 166  |
| Approach Volume (veh/h)           |       | 720  |                      |      | 202  |      |      | 64   |      |      | 587  |      |
| Crossing Volume (veh/h)           |       | 459  |                      |      | 51   |      |      | 528  |      |      | 253  |      |
| High Capacity (veh/h)             |       | 965  |                      |      | 1331 |      |      | 913  |      |      | 1135 |      |
| High v/c (veh/h)                  |       | 0.75 |                      |      | 0.15 |      |      | 0.07 |      |      | 0.52 |      |
| Low Capacity (veh/h)              |       | 782  |                      |      | 1112 |      |      | 736  |      |      | 935  |      |
| Low v/c (veh/h)                   |       | 0.92 |                      |      | 0.18 |      |      | 0.09 |      |      | 0.63 |      |
| <b>Intersection Summary</b>       |       |      |                      |      |      |      |      |      |      |      |      |      |
| Maximum v/c High                  | 0.75  |      |                      |      |      |      |      |      |      |      |      |      |
| Maximum v/c Low                   | 0.92  |      |                      |      |      |      |      |      |      |      |      |      |
| Intersection Capacity Utilization | 73.5% |      | ICU Level of Service |      |      |      | D    |      |      |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
3: KAPAA BYPASS & KUHIO HIGHWAY

11/15/2013

| Movement                          | EBL   | EBR  | NBL                  | NBT  | SBT  | SBR  |
|-----------------------------------|-------|------|----------------------|------|------|------|
| Lane Configurations               |       |      |                      |      |      |      |
| Sign Control                      | Stop  |      |                      | Free | Free |      |
| Grade                             | 0%    |      |                      | 0%   | 0%   |      |
| Volume (veh/h)                    | 5     | 686  | 83                   | 635  | 576  | 5    |
| Peak Hour Factor                  | 0.92  | 0.92 | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 5     | 746  | 90                   | 690  | 626  | 5    |
| Pedestrians                       |       |      |                      |      |      |      |
| Lane Width (ft)                   |       |      |                      |      |      |      |
| Walking Speed (ft/s)              |       |      |                      |      |      |      |
| Percent Blockage                  |       |      |                      |      |      |      |
| Right turn flare (veh)            |       | 10   |                      |      |      |      |
| Median type                       | None  |      |                      |      |      |      |
| Median storage veh                |       |      |                      |      |      |      |
| Upstream signal (ft)              |       |      |                      |      |      |      |
| pX, platoon unblocked             |       |      |                      |      |      |      |
| vC, conflicting volume            | 1497  | 626  | 632                  |      |      |      |
| vC1, stage 1 conf vol             |       |      |                      |      |      |      |
| vC2, stage 2 conf vol             |       |      |                      |      |      |      |
| vCu, unblocked vol                | 1497  | 626  | 632                  |      |      |      |
| tC, single (s)                    | 6.4   | 6.2  | 4.1                  |      |      |      |
| tC, 2 stage (s)                   |       |      |                      |      |      |      |
| tF (s)                            | 3.5   | 3.3  | 2.2                  |      |      |      |
| p0 queue free %                   | 96    | 0    | 91                   |      |      |      |
| cM capacity (veh/h)               | 122   | 484  | 951                  |      |      |      |
| <b>Direction, Lane #</b>          |       |      |                      |      |      |      |
|                                   | EB 1  | NB 1 | NB 2                 | SB 1 | SB 2 |      |
| Volume Total                      | 751   | 90   | 690                  | 626  | 5    |      |
| Volume Left                       | 5     | 90   | 0                    | 0    | 0    |      |
| Volume Right                      | 746   | 0    | 0                    | 0    | 5    |      |
| cSH                               | 488   | 951  | 1700                 | 1700 | 1700 |      |
| Volume to Capacity                | 1.54  | 0.09 | 0.41                 | 0.37 | 0.00 |      |
| Queue Length 95th (ft)            | 999   | 8    | 0                    | 0    | 0    |      |
| Control Delay (s)                 | 273.5 | 9.2  | 0.0                  | 0.0  | 0.0  |      |
| Lane LOS                          | F     | A    |                      |      |      |      |
| Approach Delay (s)                | 273.5 | 1.1  |                      | 0.0  |      |      |
| Approach LOS                      | F     |      |                      |      |      |      |
| <b>Intersection Summary</b>       |       |      |                      |      |      |      |
| Average Delay                     | 95.3  |      |                      |      |      |      |
| Intersection Capacity Utilization | 79.5% |      | ICU Level of Service |      |      |      |
| Analysis Period (min)             | 15    |      | D                    |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
4: OLOHENA ROAD & KAAPUNI ROAD

11/15/2013

| Movement                          | EBL         | EBT         | WBT         | WBR                  | SBL  | SBR  |
|-----------------------------------|-------------|-------------|-------------|----------------------|------|------|
| Lane Configurations               |             | ↕           | ↕           |                      | ↕    |      |
| Sign Control                      |             | Free        | Free        |                      | Stop |      |
| Grade                             |             | 0%          | 0%          |                      | 0%   |      |
| Volume (veh/h)                    | 29          | 275         | 66          | 77                   | 306  | 15   |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 32          | 299         | 72          | 84                   | 333  | 16   |
| Pedestrians                       |             |             |             |                      |      |      |
| Lane Width (ft)                   |             |             |             |                      |      |      |
| Walking Speed (ft/s)              |             |             |             |                      |      |      |
| Percent Blockage                  |             |             |             |                      |      |      |
| Right turn flare (veh)            |             |             |             |                      |      |      |
| Median type                       |             |             |             | None                 |      |      |
| Median storage (veh)              |             |             |             |                      |      |      |
| Upstream signal (ft)              |             |             |             |                      |      |      |
| pX, platoon unblocked             |             |             |             |                      |      |      |
| vC, conflicting volume            | 155         |             |             |                      | 476  | 114  |
| vC1, stage 1 conf vol             |             |             |             |                      |      |      |
| vC2, stage 2 conf vol             |             |             |             |                      |      |      |
| vCu, unblocked vol                | 155         |             |             |                      | 476  | 114  |
| tC, single (s)                    | 4.1         |             |             |                      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |             |                      |      |      |
| IF (s)                            | 2.2         |             |             |                      | 3.5  | 3.3  |
| p0 queue free %                   | 98          |             |             |                      | 38   | 98   |
| cM capacity (veh/h)               | 1425        |             |             |                      | 536  | 939  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>SB 1</b> |                      |      |      |
| Volume Total                      | 330         | 155         | 349         |                      |      |      |
| Volume Left                       | 32          | 0           | 333         |                      |      |      |
| Volume Right                      | 0           | 84          | 16          |                      |      |      |
| cSH                               | 1425        | 1700        | 547         |                      |      |      |
| Volume to Capacity                | 0.02        | 0.09        | 0.64        |                      |      |      |
| Queue Length 95th (ft)            | 2           | 0           | 112         |                      |      |      |
| Control Delay (s)                 | 0.9         | 0.0         | 22.5        |                      |      |      |
| Lane LOS                          | A           |             | C           |                      |      |      |
| Approach Delay (s)                | 0.9         | 0.0         | 22.5        |                      |      |      |
| Approach LOS                      |             |             | C           |                      |      |      |
| <b>Intersection Summary</b>       |             |             |             |                      |      |      |
| Average Delay                     |             |             | 9.8         |                      |      |      |
| Intersection Capacity Utilization |             |             | 52.1%       | ICU Level of Service | A    |      |
| Analysis Period (min)             |             |             | 15          |                      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
5: KAEHULA ROAD & KAAPUNI ROAD

11/15/2013

| Movement                          | WBL         | WBR         | NBT         | NBR                  | SBL  | SBT  |
|-----------------------------------|-------------|-------------|-------------|----------------------|------|------|
| Lane Configurations               | ↕           |             | ↕           |                      | ↕    | ↕    |
| Sign Control                      | Stop        |             | Free        |                      |      | Free |
| Grade                             | 0%          |             | 0%          |                      |      | 0%   |
| Volume (veh/h)                    | 24          | 0           | 87          | 19                   | 1    | 298  |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 26          | 0           | 95          | 21                   | 1    | 324  |
| Pedestrians                       |             |             |             |                      |      |      |
| Lane Width (ft)                   |             |             |             |                      |      |      |
| Walking Speed (ft/s)              |             |             |             |                      |      |      |
| Percent Blockage                  |             |             |             |                      |      |      |
| Right turn flare (veh)            |             |             |             |                      |      |      |
| Median type                       | None        |             |             |                      |      |      |
| Median storage (veh)              |             |             |             |                      |      |      |
| Upstream signal (ft)              |             |             |             |                      |      |      |
| pX, platoon unblocked             |             |             |             |                      |      |      |
| vC, conflicting volume            | 431         | 105         |             |                      | 115  |      |
| vC1, stage 1 conf vol             |             |             |             |                      |      |      |
| vC2, stage 2 conf vol             |             |             |             |                      |      |      |
| vCu, unblocked vol                | 431         | 105         |             |                      | 115  |      |
| tC, single (s)                    | 6.4         | 6.2         |             |                      | 4.1  |      |
| tC, 2 stage (s)                   |             |             |             |                      |      |      |
| IF (s)                            | 3.5         | 3.3         |             |                      | 2.2  |      |
| p0 queue free %                   | 96          | 100         |             |                      | 100  |      |
| cM capacity (veh/h)               | 581         | 950         |             |                      | 1474 |      |
| <b>Direction, Lane #</b>          | <b>WB 1</b> | <b>NB 1</b> | <b>SB 1</b> |                      |      |      |
| Volume Total                      | 26          | 115         | 325         |                      |      |      |
| Volume Left                       | 26          | 0           | 1           |                      |      |      |
| Volume Right                      | 0           | 21          | 0           |                      |      |      |
| cSH                               | 581         | 1700        | 1474        |                      |      |      |
| Volume to Capacity                | 0.04        | 0.07        | 0.00        |                      |      |      |
| Queue Length 95th (ft)            | 4           | 0           | 0           |                      |      |      |
| Control Delay (s)                 | 11.5        | 0.0         | 0.0         |                      |      |      |
| Lane LOS                          | B           |             | A           |                      |      |      |
| Approach Delay (s)                | 11.5        | 0.0         | 0.0         |                      |      |      |
| Approach LOS                      | B           |             |             |                      |      |      |
| <b>Intersection Summary</b>       |             |             |             |                      |      |      |
| Average Delay                     |             |             | 0.7         |                      |      |      |
| Intersection Capacity Utilization |             |             | 26.5%       | ICU Level of Service | A    |      |
| Analysis Period (min)             |             |             | 15          |                      |      |      |



HCM Signalized Intersection Capacity Analysis  
 1: KUKUI STREET & KUHIO HIGHWAY

11/15/2013

| Movement                          | EBL                 | EBT   | EBR  | WBL    | WBT  | WBR                  | NBL  | NBT  | NBR  | SBL  | SBT   | SBR  |
|-----------------------------------|---------------------|-------|------|--------|------|----------------------|------|------|------|------|-------|------|
| Lane Configurations               |                     | ↕     | ↕    |        |      | ↕                    | ↕    | ↕    |      |      | ↕     | ↕    |
| Ideal Flow (vphpl)                | 1900                | 1900  | 1900 | 1900   | 1900 | 1900                 | 1900 | 1900 | 1900 | 1900 | 1900  | 1900 |
| Total Lost time (s)               |                     | 4.0   | 4.0  |        |      | 4.0                  | 4.0  | 4.0  |      |      | 4.0   | 4.0  |
| Lane Util. Factor                 |                     | 1.00  | 1.00 |        |      | 1.00                 | 1.00 | 1.00 |      |      | 1.00  | 1.00 |
| Frt                               |                     | 1.00  | 0.85 |        |      | 0.86                 | 1.00 | 0.99 |      |      | 1.00  | 0.85 |
| Flt Protected                     |                     | 0.96  | 1.00 |        |      | 1.00                 | 0.95 | 1.00 |      |      | 1.00  | 1.00 |
| Satd. Flow (prot)                 |                     | 1788  | 1583 |        |      | 1611                 | 1770 | 1844 |      |      | 1858  | 1583 |
| Flt Permitted                     |                     | 0.96  | 1.00 |        |      | 1.00                 | 0.26 | 1.00 |      |      | 0.95  | 1.00 |
| Satd. Flow (perm)                 |                     | 1788  | 1583 |        |      | 1611                 | 489  | 1844 |      |      | 1776  | 1583 |
| Volume (vph)                      | 34                  | 6     | 20   | 0      | 0    | 15                   | 6    | 585  | 42   | 33   | 627   | 2    |
| Peak-hour factor, PHF             | 0.92                | 0.92  | 0.92 | 0.92   | 0.92 | 0.92                 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92  | 0.92 |
| Adj. Flow (vph)                   | 37                  | 7     | 22   | 0      | 0    | 16                   | 7    | 636  | 46   | 36   | 682   | 2    |
| RTOR Reduction (vph)              | 0                   | 0     | 16   | 0      | 0    | 12                   | 0    | 4    | 0    | 0    | 0     | 1    |
| Lane Group Flow (vph)             | 0                   | 44    | 6    | 0      | 0    | 4                    | 7    | 678  | 0    | 0    | 718   | 1    |
| Turn Type                         | Perm                | Perm  | Perm | custom | Perm | Perm                 | Perm | Perm | Perm | Perm | Perm  | Perm |
| Protected Phases                  |                     | 4     |      |        |      |                      | 2    |      |      | 6    |       | 6    |
| Permitted Phases                  | 4                   |       | 4    |        |      | 8                    | 2    |      |      | 6    |       | 6    |
| Actuated Green, G (s)             |                     | 16.0  | 16.0 |        |      | 16.0                 | 36.0 | 36.0 |      |      | 36.0  | 36.0 |
| Effective Green, g (s)            |                     | 16.0  | 16.0 |        |      | 16.0                 | 36.0 | 36.0 |      |      | 36.0  | 36.0 |
| Actuated g/C Ratio                |                     | 0.27  | 0.27 |        |      | 0.27                 | 0.60 | 0.60 |      |      | 0.60  | 0.60 |
| Clearance Time (s)                |                     | 4.0   | 4.0  |        |      | 4.0                  | 4.0  | 4.0  |      |      | 4.0   | 4.0  |
| Lane Grp Cap (vph)                |                     | 477   | 422  |        |      | 430                  | 293  | 1106 |      |      | 1066  | 950  |
| v/s Ratio Prot                    |                     |       |      |        |      |                      |      | 0.37 |      |      |       |      |
| v/s Ratio Perm                    |                     | 0.02  | 0.01 |        |      | 0.01                 | 0.01 |      |      |      | c0.40 | 0.00 |
| v/c Ratio                         |                     | 0.09  | 0.01 |        |      | 0.01                 | 0.02 | 0.61 |      |      | 0.67  | 0.00 |
| Uniform Delay, d1                 |                     | 16.5  | 16.2 |        |      | 16.2                 | 4.9  | 7.6  |      |      | 8.1   | 4.8  |
| Progression Factor                |                     | 1.00  | 1.00 |        |      | 1.00                 | 1.00 | 1.00 |      |      | 1.00  | 1.00 |
| Incremental Delay, d2             |                     | 0.4   | 0.1  |        |      | 0.0                  | 0.2  | 2.5  |      |      | 3.4   | 0.0  |
| Delay (s)                         |                     | 16.9  | 16.3 |        |      | 16.2                 | 5.0  | 10.1 |      |      | 11.5  | 4.8  |
| Level of Service                  |                     | B     | B    |        |      | B                    | A    | B    |      |      | B     | A    |
| Approach Delay (s)                |                     | 16.7  |      |        | 16.2 |                      |      | 10.1 |      |      | 11.4  |      |
| Approach LOS                      |                     | B     |      |        | B    |                      |      | B    |      |      | B     |      |
| <b>Intersection Summary</b>       |                     |       |      |        |      |                      |      |      |      |      |       |      |
| HCM Average Control Delay         |                     | 11.1  |      |        |      |                      |      |      |      |      | B     |      |
| HCM Volume to Capacity ratio      |                     | 0.49  |      |        |      |                      |      |      |      |      |       |      |
| Actuated Cycle Length (s)         |                     | 60.0  |      |        |      | Sum of lost time (s) |      | 8.0  |      |      |       |      |
| Intersection Capacity Utilization |                     | 69.9% |      |        |      | ICU Level of Service |      | C    |      |      |       |      |
| Analysis Period (min)             |                     | 15    |      |        |      |                      |      |      |      |      |       |      |
| c                                 | Critical Lane Group |       |      |        |      |                      |      |      |      |      |       |      |

Attachment G  
 Level-of-Service Worksheets for Existing PM Peak Hour  
 Conditions

Queues

1: KUKUI STREET & KUHIO HIGHWAY

11/15/2013

|                         | →           | ↘     | ↙     | ↗     | ↖     | ↑     | ↘     | ↙     |
|-------------------------|-------------|-------|-------|-------|-------|-------|-------|-------|
| Lane Group              | EBT         | EBR   | WBR   | NBL   | NBT   | SBL   | SBT   | SBR   |
| Lane Configurations     | ↖           | ↖     | ↖     | ↖     | ↖     | ↖     | ↖     | ↖     |
| Volume (vph)            | 6           | 20    | 15    | 6     | 585   | 33    | 627   | 2     |
| Lane Group Flow (vph)   | 44          | 22    | 16    | 7     | 682   | 0     | 718   | 2     |
| Turn Type               | Perm custom |       | Perm  |       | Perm  | Perm  |       | Perm  |
| Protected Phases        | 4           |       |       |       | 2     |       | 6     |       |
| Permitted Phases        |             | 4     | 8     | 2     |       | 6     |       | 6     |
| Minimum Split (s)       | 20.0        | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  |
| Total Split (s)         | 20.0        | 20.0  | 20.0  | 40.0  | 40.0  | 40.0  | 40.0  | 40.0  |
| Total Split (%)         | 33.3%       | 33.3% | 33.3% | 66.7% | 66.7% | 66.7% | 66.7% | 66.7% |
| Yellow Time (s)         | 3.5         | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   |
| All-Red Time (s)        | 0.5         | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   |
| Lead/Lag                |             |       |       |       |       |       |       |       |
| Lead-Lag Optimize?      |             |       |       |       |       |       |       |       |
| v/c Ratio               | 0.09        | 0.05  | 0.03  | 0.02  | 0.61  |       | 0.67  | 0.00  |
| Control Delay           | 17.3        | 8.3   | 0.1   | 5.2   | 10.5  |       | 12.1  | 3.5   |
| Queue Delay             | 0.0         | 0.0   | 0.0   | 0.0   | 0.0   |       | 0.0   | 0.0   |
| Total Delay             | 17.3        | 8.3   | 0.1   | 5.2   | 10.5  |       | 12.1  | 3.5   |
| Queue Length 50th (ft)  | 12          | 0     | 0     | 1     | 132   |       | 151   | 0     |
| Queue Length 95th (ft)  | 33          | 14    | 0     | 5     | 223   |       | 257   | 2     |
| Internal Link Dist (ft) | 1654        |       |       | 6852  |       |       | 2720  |       |
| Turn Bay Length (ft)    |             |       |       |       |       |       |       |       |
| Base Capacity (vph)     | 477         | 438   | 631   | 293   | 1111  |       | 1066  | 951   |
| Starvation Cap Reductn  | 0           | 0     | 0     | 0     | 0     |       | 0     | 0     |
| Spillback Cap Reductn   | 0           | 0     | 0     | 0     | 0     |       | 0     | 0     |
| Storage Cap Reductn     | 0           | 0     | 0     | 0     | 0     |       | 0     | 0     |
| Reduced v/c Ratio       | 0.09        | 0.05  | 0.03  | 0.02  | 0.61  |       | 0.67  | 0.00  |

| Intersection Summary   |  |
|------------------------|--|
| Cycle Length:          | 60   |
| Actuated Cycle Length: | 60   |
| Offset:                | 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green |
| Natural Cycle:         | 55   |
| Control Type:          | Pretimed   |

Splits and Phases: 1: KUKUI STREET & KUHIO HIGHWAY



HCM Unsignalized Intersection Capacity Analysis

2: OLOHENA ROAD & KAPAA BYPASS

11/15/2013

|                         | ↖    | →    | ↘    | ↙    | ←    | ↖    | ↙    | ↑    | ↘    | ↙    | ↓    | ↘    |
|-------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Movement                | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
| Right Turn Channelized  |      |      |      |      |      |      |      |      |      |      |      |      |
| Volume (veh/h)          | 0    | 253  | 116  | 79   | 310  | 0    | 143  | 0    | 155  | 77   | 209  | 117  |
| Peak Hour Factor        | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)  | 0    | 275  | 126  | 86   | 337  | 0    | 155  | 0    | 168  | 84   | 227  | 127  |
| Approach Volume (veh/h) |      | 401  |      |      | 423  |      |      | 324  |      |      | 438  |      |
| Crossing Volume (veh/h) |      | 397  |      |      | 155  |      |      | 359  |      |      | 578  |      |
| High Capacity (veh/h)   |      | 1014 |      |      | 1226 |      |      | 1045 |      |      | 877  |      |
| High v/c (veh/h)        |      | 0.40 |      |      | 0.34 |      |      | 0.31 |      |      | 0.50 |      |
| Low Capacity (veh/h)    |      | 826  |      |      | 1017 |      |      | 854  |      |      | 704  |      |
| Low v/c (veh/h)         |      | 0.49 |      |      | 0.42 |      |      | 0.38 |      |      | 0.62 |      |

| Intersection Summary              |       |
|-----------------------------------|-------|
| Maximum v/c High                  | 0.50  |
| Maximum v/c Low                   | 0.62  |
| Intersection Capacity Utilization | 88.5% |
| ICU Level of Service              | E     |

HCM Unsignalized Intersection Capacity Analysis  
3: KAPAA BYPASS & KUHIO HIGHWAY

11/15/2013

| Movement                          | EBL         | EBR         | NBL                  | NBT         | SBT         | SBR         |
|-----------------------------------|-------------|-------------|----------------------|-------------|-------------|-------------|
| Lane Configurations               | ↔           | ↔           | ↔                    | ↕           | ↕           | ↔           |
| Sign Control                      | Stop        |             |                      | Free        | Free        |             |
| Grade                             | 0%          |             |                      | 0%          | 0%          |             |
| Volume (veh/h)                    | 12          | 343         | 464                  | 766         | 577         | 14          |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92                 | 0.92        | 0.92        | 0.92        |
| Hourly flow rate (vph)            | 13          | 373         | 504                  | 833         | 627         | 15          |
| Pedestrians                       |             |             |                      |             |             |             |
| Lane Width (ft)                   |             |             |                      |             |             |             |
| Walking Speed (ft/s)              |             |             |                      |             |             |             |
| Percent Blockage                  |             |             |                      |             |             |             |
| Right turn flare (veh)            |             |             | 10                   |             |             |             |
| Median type                       | None        |             |                      |             |             |             |
| Median storage (veh)              |             |             |                      |             |             |             |
| Upstream signal (ft)              |             |             |                      |             |             |             |
| pX, platoon unblocked             |             |             |                      |             |             |             |
| vC, conflicting volume            | 2052        | 627         | 642                  |             |             |             |
| vC1, stage 1 conf vol             |             |             |                      |             |             |             |
| vC2, stage 2 conf vol             |             |             |                      |             |             |             |
| vCu, unblocked vol                | 2052        | 627         | 642                  |             |             |             |
| tC, single (s)                    | 6.8         | 6.9         | 4.1                  |             |             |             |
| tC, 2 stage (s)                   |             |             |                      |             |             |             |
| IF (s)                            | 3.5         | 3.3         | 2.2                  |             |             |             |
| p0 queue free %                   | 41          | 13          | 46                   |             |             |             |
| cM capacity (veh/h)               | 22          | 426         | 938                  |             |             |             |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>NB 1</b> | <b>NB 2</b>          | <b>NB 3</b> | <b>SB 1</b> | <b>SB 2</b> |
| Volume Total                      | 386         | 504         | 416                  | 416         | 627         | 15          |
| Volume Left                       | 13          | 504         | 0                    | 0           | 0           | 0           |
| Volume Right                      | 373         | 0           | 0                    | 0           | 0           | 15          |
| cSH                               | 441         | 938         | 1700                 | 1700        | 1700        | 1700        |
| Volume to Capacity                | 0.87        | 0.54        | 0.24                 | 0.24        | 0.37        | 0.01        |
| Queue Length 95th (ft)            | 227         | 82          | 0                    | 0           | 0           | 0           |
| Control Delay (s)                 | 57.9        | 13.2        | 0.0                  | 0.0         | 0.0         | 0.0         |
| Lane LOS                          | F           | B           |                      |             |             |             |
| Approach Delay (s)                | 57.9        | 5.0         |                      |             | 0.0         |             |
| Approach LOS                      | F           |             |                      |             |             |             |
| <b>Intersection Summary</b>       |             |             |                      |             |             |             |
| Average Delay                     | 12.3        |             |                      |             |             |             |
| Intersection Capacity Utilization | 69.4%       |             | ICU Level of Service |             | C           |             |
| Analysis Period (min)             | 15          |             |                      |             |             |             |

HCM Unsignalized Intersection Capacity Analysis  
4: OLOHENA ROAD & KAAPUNI ROAD

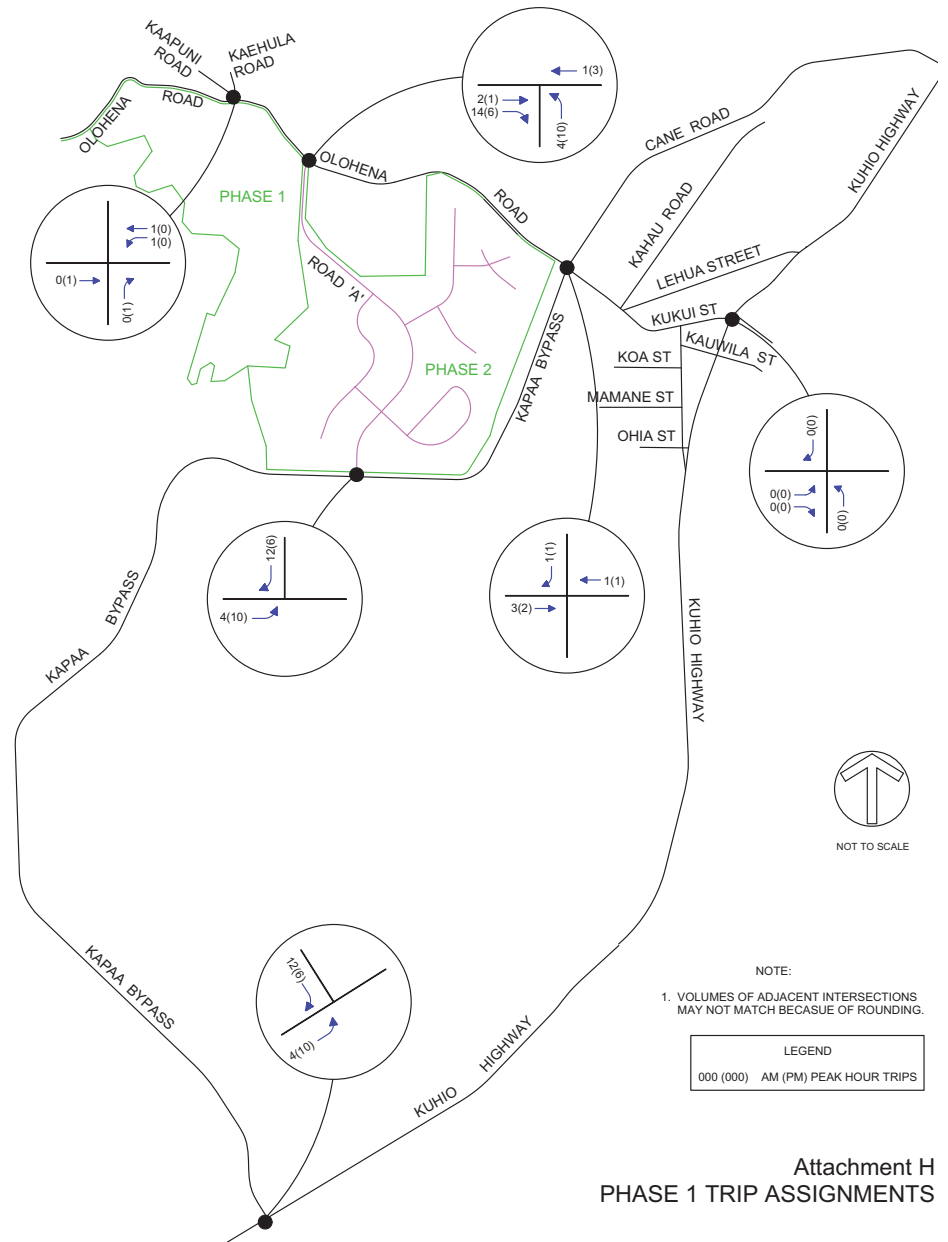
11/15/2013

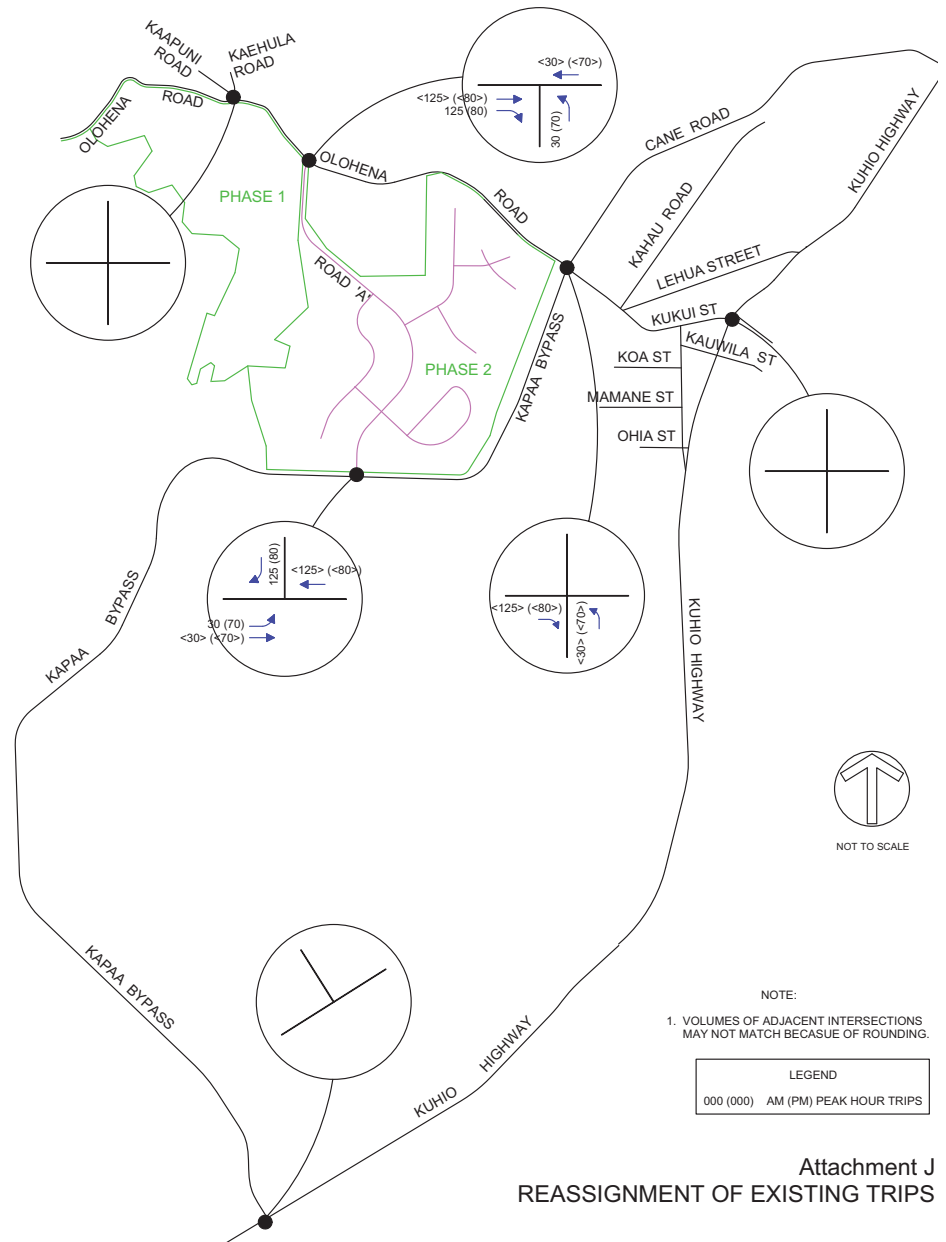
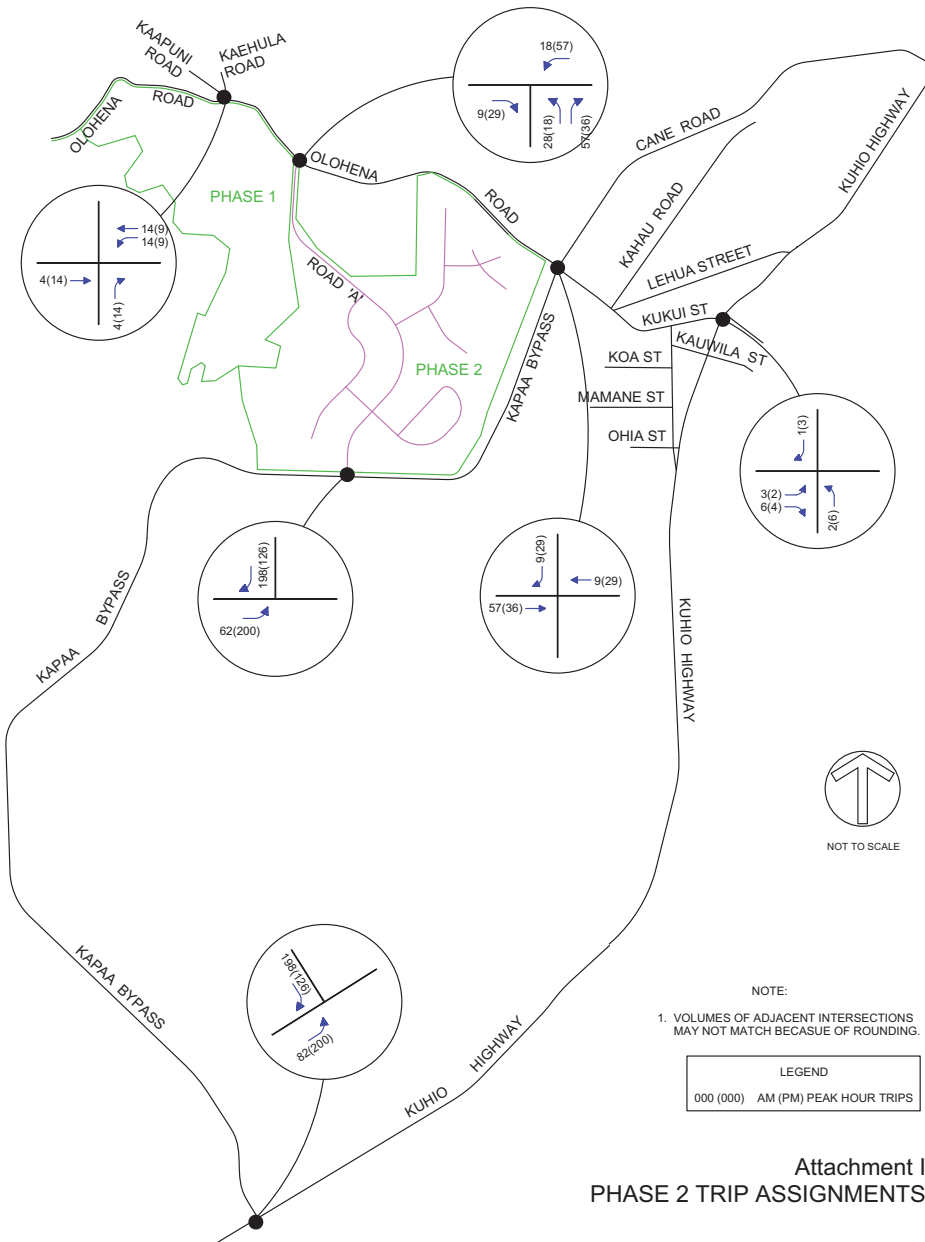
| Movement                          | EBL         | EBT         | WBT                  | WBR  | SBL  | SBR  |
|-----------------------------------|-------------|-------------|----------------------|------|------|------|
| Lane Configurations               | ↔           | ↔           | ↔                    | ↔    | ↔    | ↔    |
| Sign Control                      |             | Free        | Free                 |      | Stop |      |
| Grade                             | 0%          | 0%          | 0%                   | 0%   | 0%   | 0%   |
| Volume (veh/h)                    | 20          | 87          | 169                  | 257  | 110  | 30   |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 22          | 95          | 184                  | 279  | 120  | 33   |
| Pedestrians                       |             |             |                      |      |      |      |
| Lane Width (ft)                   |             |             |                      |      |      |      |
| Walking Speed (ft/s)              |             |             |                      |      |      |      |
| Percent Blockage                  |             |             |                      |      |      |      |
| Right turn flare (veh)            |             |             |                      |      |      |      |
| Median type                       |             |             |                      |      | None |      |
| Median storage (veh)              |             |             |                      |      |      |      |
| Upstream signal (ft)              |             |             |                      |      |      |      |
| pX, platoon unblocked             |             |             |                      |      |      |      |
| vC, conflicting volume            | 463         |             |                      |      | 461  | 323  |
| vC1, stage 1 conf vol             |             |             |                      |      |      |      |
| vC2, stage 2 conf vol             |             |             |                      |      |      |      |
| vCu, unblocked vol                | 463         |             |                      |      | 461  | 323  |
| tC, single (s)                    | 4.1         |             |                      |      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |                      |      |      |      |
| IF (s)                            | 2.2         |             |                      |      | 3.5  | 3.3  |
| p0 queue free %                   | 98          |             |                      |      | 78   | 95   |
| cM capacity (veh/h)               | 1098        |             |                      |      | 547  | 718  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>SB 1</b>          |      |      |      |
| Volume Total                      | 116         | 463         | 152                  |      |      |      |
| Volume Left                       | 22          | 0           | 120                  |      |      |      |
| Volume Right                      | 0           | 279         | 33                   |      |      |      |
| cSH                               | 1098        | 1700        | 577                  |      |      |      |
| Volume to Capacity                | 0.02        | 0.27        | 0.26                 |      |      |      |
| Queue Length 95th (ft)            | 2           | 0           | 26                   |      |      |      |
| Control Delay (s)                 | 1.7         | 0.0         | 13.5                 |      |      |      |
| Lane LOS                          | A           |             | B                    |      |      |      |
| Approach Delay (s)                | 1.7         | 0.0         | 13.5                 |      |      |      |
| Approach LOS                      |             |             | B                    |      |      |      |
| <b>Intersection Summary</b>       |             |             |                      |      |      |      |
| Average Delay                     | 3.1         |             |                      |      |      |      |
| Intersection Capacity Utilization | 39.2%       |             | ICU Level of Service |      | A    |      |
| Analysis Period (min)             | 15          |             |                      |      |      |      |

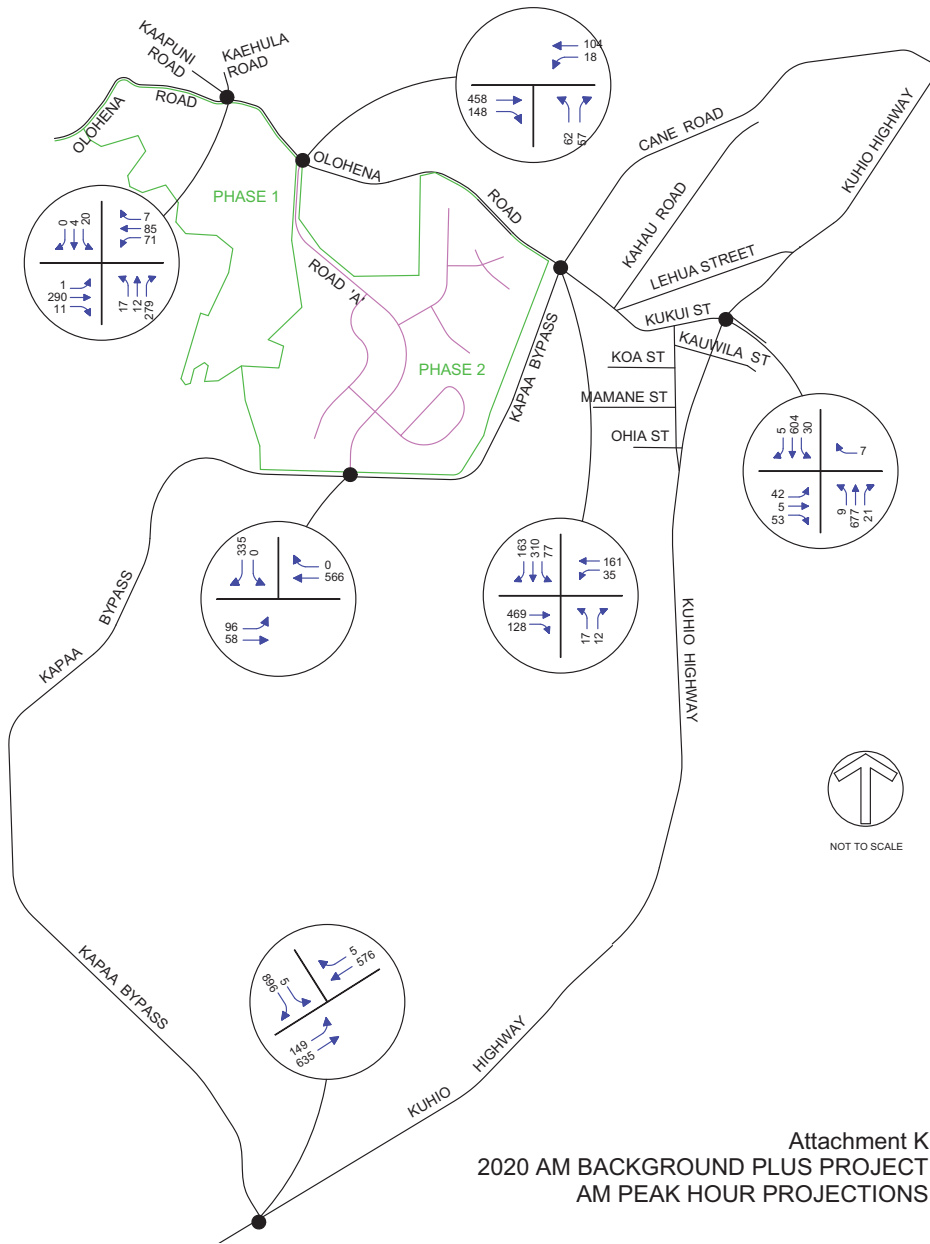
HCM Unsignalized Intersection Capacity Analysis  
 5: KAEHULA ROAD & KAAPUNI ROAD

11/15/2013

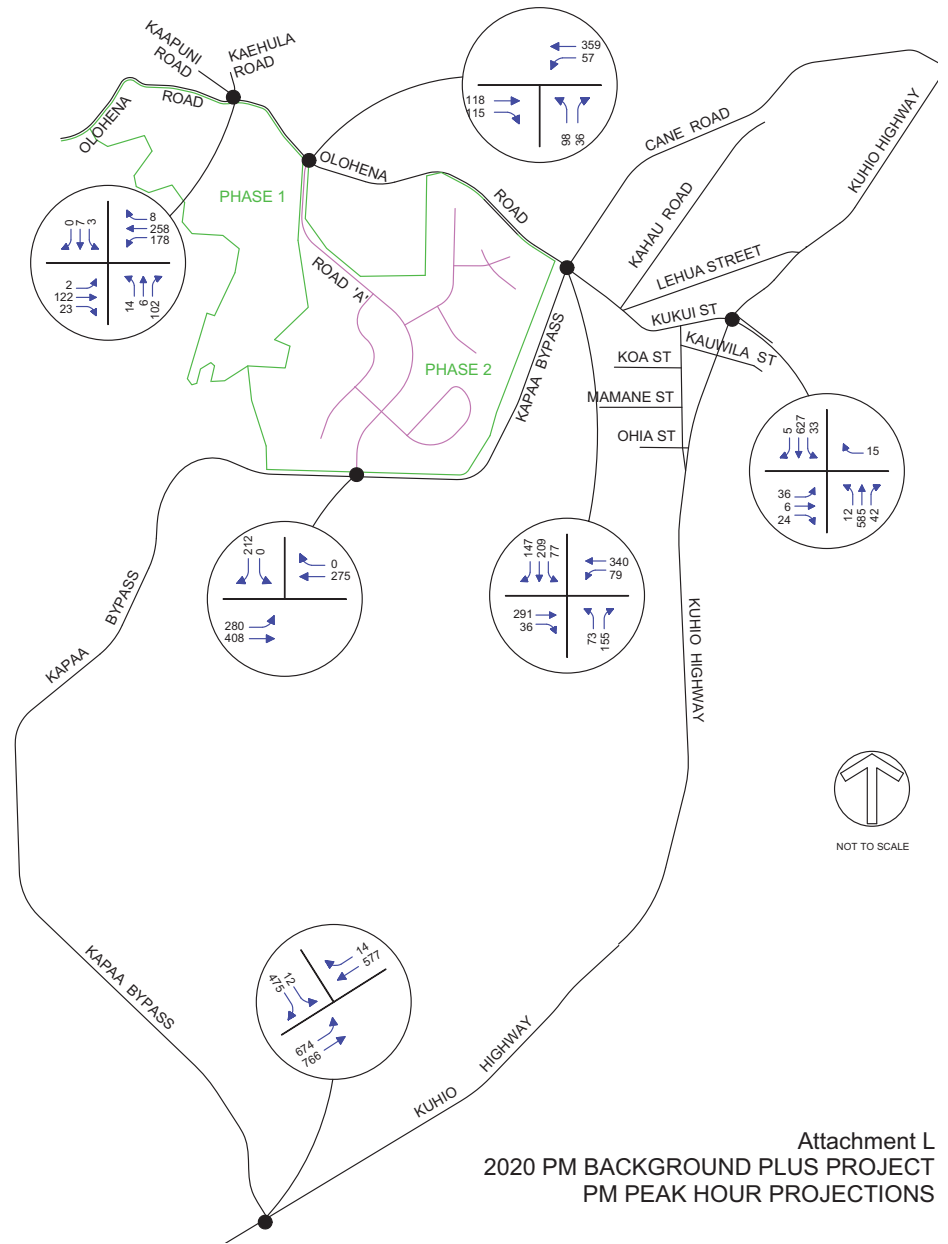
| Movement                          | WBL         | WBR         | NBT                  | NBR  | SBL  | SBT  |
|-----------------------------------|-------------|-------------|----------------------|------|------|------|
| Lane Configurations               | ↔           | ↔           | ↔                    | ↔    | ↔    | ↔    |
| Sign Control                      | Stop        |             | Free                 |      |      | Free |
| Grade                             | 0%          |             | 0%                   |      |      | 0%   |
| Volume (veh/h)                    | 10          | 0           | 263                  | 14   | 2    | 130  |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 11          | 0           | 286                  | 15   | 2    | 141  |
| Pedestrians                       |             |             |                      |      |      |      |
| Lane Width (ft)                   |             |             |                      |      |      |      |
| Walking Speed (ft/s)              |             |             |                      |      |      |      |
| Percent Blockage                  |             |             |                      |      |      |      |
| Right turn flare (veh)            |             |             |                      |      |      |      |
| Median type                       | None        |             |                      |      |      |      |
| Median storage (veh)              |             |             |                      |      |      |      |
| Upstream signal (ft)              |             |             |                      |      |      |      |
| pX, platoon unblocked             |             |             |                      |      |      |      |
| vC, conflicting volume            | 439         | 293         |                      |      | 301  |      |
| vC1, stage 1 conf vol             |             |             |                      |      |      |      |
| vC2, stage 2 conf vol             |             |             |                      |      |      |      |
| vCu, unblocked vol                | 439         | 293         |                      |      | 301  |      |
| tC, single (s)                    | 6.4         | 6.2         |                      |      | 4.1  |      |
| tC, 2 stage (s)                   |             |             |                      |      |      |      |
| IF (s)                            | 3.5         | 3.3         |                      |      | 2.2  |      |
| p0 queue free %                   | 98          | 100         |                      |      | 100  |      |
| cM capacity (veh/h)               | 574         | 746         |                      |      | 1260 |      |
| <b>Direction, Lane #</b>          | <b>WB 1</b> | <b>NB 1</b> | <b>SB 1</b>          |      |      |      |
| Volume Total                      | 11          | 301         | 143                  |      |      |      |
| Volume Left                       | 11          | 0           | 2                    |      |      |      |
| Volume Right                      | 0           | 15          | 0                    |      |      |      |
| cSH                               | 574         | 1700        | 1260                 |      |      |      |
| Volume to Capacity                | 0.02        | 0.18        | 0.00                 |      |      |      |
| Queue Length 95th (ft)            | 1           | 0           | 0                    |      |      |      |
| Control Delay (s)                 | 11.4        | 0.0         | 0.1                  |      |      |      |
| Lane LOS                          | B           |             | A                    |      |      |      |
| Approach Delay (s)                | 11.4        | 0.0         | 0.1                  |      |      |      |
| Approach LOS                      | B           |             |                      |      |      |      |
| <b>Intersection Summary</b>       |             |             |                      |      |      |      |
| Average Delay                     | 0.3         |             |                      |      |      |      |
| Intersection Capacity Utilization | 24.7%       |             | ICU Level of Service |      | A    |      |
| Analysis Period (min)             | 15          |             |                      |      |      |      |







Attachment K  
2020 AM BACKGROUND PLUS PROJECT  
AM PEAK HOUR PROJECTIONS



Attachment L  
2020 PM BACKGROUND PLUS PROJECT  
PM PEAK HOUR PROJECTIONS

HCM Signalized Intersection Capacity Analysis  
 1: KUKUI STREET & KUHIO HIGHWAY

12/2/2013

| Movement                          | EBL  | EBT  | EBR   | WBL    | WBT  | WBR  | NBL   | NBT  | NBR  | SBL  | SBT  | SBR  |
|-----------------------------------|------|------|-------|--------|------|------|-------|------|------|------|------|------|
| Lane Configurations               |      | ↕    | ↕     |        |      | ↕    | ↕     | ↕    |      |      | ↕    | ↕    |
| Ideal Flow (vphpl)                | 1900 | 1900 | 1900  | 1900   | 1900 | 1900 | 1900  | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s)               |      | 4.0  | 4.0   |        |      | 4.0  | 4.0   | 4.0  |      |      | 4.0  | 4.0  |
| Lane Util. Factor                 |      | 1.00 | 1.00  |        |      | 1.00 | 1.00  | 1.00 |      |      | 1.00 | 1.00 |
| Frt                               |      | 1.00 | 0.85  |        |      | 0.86 | 1.00  | 1.00 |      |      | 1.00 | 0.85 |
| Flt Protected                     |      | 0.96 | 1.00  |        |      | 1.00 | 0.95  | 1.00 |      |      | 1.00 | 1.00 |
| Satd. Flow (prot)                 |      | 1782 | 1583  |        |      | 1611 | 1770  | 1854 |      |      | 1858 | 1583 |
| Flt Permitted                     |      | 0.96 | 1.00  |        |      | 1.00 | 0.28  | 1.00 |      |      | 0.95 | 1.00 |
| Satd. Flow (perm)                 |      | 1782 | 1583  |        |      | 1611 | 523   | 1854 |      |      | 1774 | 1583 |
| Volume (vph)                      | 42   | 5    | 53    | 0      | 0    | 7    | 9     | 677  | 21   | 30   | 604  | 5    |
| Peak-hour factor, PHF             | 0.92 | 0.92 | 0.92  | 0.92   | 0.92 | 0.92 | 0.92  | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph)                   | 46   | 5    | 58    | 0      | 0    | 8    | 10    | 736  | 23   | 33   | 657  | 5    |
| RTOR Reduction (vph)              | 0    | 0    | 43    | 0      | 0    | 6    | 0     | 2    | 0    | 0    | 0    | 2    |
| Lane Group Flow (vph)             | 0    | 51   | 15    | 0      | 0    | 2    | 10    | 757  | 0    | 0    | 690  | 3    |
| Turn Type                         | Perm | Perm | Perm  | custom | Perm | Perm | Perm  | Perm | Perm | Perm | Perm | Perm |
| Protected Phases                  |      | 4    |       |        |      |      | 2     |      |      | 6    |      | 6    |
| Permitted Phases                  | 4    |      | 4     |        |      | 8    | 2     |      |      | 6    |      | 6    |
| Actuated Green, G (s)             |      | 16.0 | 16.0  |        |      | 16.0 | 36.0  | 36.0 |      |      | 36.0 | 36.0 |
| Effective Green, g (s)            |      | 16.0 | 16.0  |        |      | 16.0 | 36.0  | 36.0 |      |      | 36.0 | 36.0 |
| Actuated g/C Ratio                |      | 0.27 | 0.27  |        |      | 0.27 | 0.60  | 0.60 |      |      | 0.60 | 0.60 |
| Clearance Time (s)                |      | 4.0  | 4.0   |        |      | 4.0  | 4.0   | 4.0  |      |      | 4.0  | 4.0  |
| Lane Grp Cap (vph)                |      | 475  | 422   |        |      | 430  | 314   | 1112 |      |      | 1064 | 950  |
| v/s Ratio Prot                    |      |      |       |        |      |      | c0.41 |      |      |      |      |      |
| v/s Ratio Perm                    |      | 0.03 | 0.04  |        |      | 0.00 | 0.02  |      |      |      | 0.39 | 0.00 |
| v/c Ratio                         |      | 0.11 | 0.04  |        |      | 0.00 | 0.03  | 0.68 |      |      | 0.65 | 0.00 |
| Uniform Delay, d1                 |      | 16.6 | 16.3  |        |      | 16.2 | 4.9   | 8.1  |      |      | 7.9  | 4.8  |
| Progression Factor                |      | 1.00 | 1.00  |        |      | 1.00 | 1.00  | 1.00 |      |      | 1.00 | 1.00 |
| Incremental Delay, d2             |      | 0.5  | 0.2   |        |      | 0.0  | 0.2   | 3.4  |      |      | 3.1  | 0.0  |
| Delay (s)                         |      | 17.1 | 16.5  |        |      | 16.2 | 5.1   | 11.5 |      |      | 10.9 | 4.8  |
| Level of Service                  |      | B    | B     |        |      | B    | A     | B    |      |      | B    | A    |
| Approach Delay (s)                |      | 16.7 |       |        | 16.2 |      |       | 11.4 |      |      | 10.9 |      |
| Approach LOS                      |      | B    |       |        | B    |      |       | B    |      |      | B    |      |
| <b>Intersection Summary</b>       |      |      |       |        |      |      |       |      |      |      |      |      |
| HCM Average Control Delay         |      |      | 11.6  |        |      |      |       |      |      |      | B    |      |
| HCM Volume to Capacity ratio      |      |      | 0.51  |        |      |      |       |      |      |      |      |      |
| Actuated Cycle Length (s)         |      |      | 60.0  |        |      |      |       |      |      | 8.0  |      |      |
| Intersection Capacity Utilization |      |      | 66.2% |        |      |      |       |      |      |      | C    |      |
| Analysis Period (min)             |      |      | 15    |        |      |      |       |      |      |      |      |      |
| c Critical Lane Group             |      |      |       |        |      |      |       |      |      |      |      |      |

Attachment M  
 Level-of-Service Worksheets for 2020 Background Plus Project  
 AM Peak Hour Conditions

Queues

1: KUKUI STREET & KUHIO HIGHWAY

12/2/2013

| Lane Group              | EBT         | EBR   | WBR   | NBL   | NBT   | SBL   | SBT   | SBR   |
|-------------------------|-------------|-------|-------|-------|-------|-------|-------|-------|
| Lane Configurations     | ↖           | ↗     | ↖     | ↗     | ↖     | ↖     | ↗     | ↗     |
| Volume (vph)            | 5           | 53    | 7     | 9     | 677   | 30    | 604   | 5     |
| Lane Group Flow (vph)   | 51          | 58    | 8     | 10    | 759   | 0     | 690   | 5     |
| Turn Type               | Perm custom |       | Perm  |       | Perm  |       | Perm  |       |
| Protected Phases        | 4           |       |       |       | 2     |       | 6     |       |
| Permitted Phases        |             | 4     | 8     | 2     |       | 6     |       | 6     |
| Minimum Split (s)       | 20.0        | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  |
| Total Split (s)         | 20.0        | 20.0  | 20.0  | 40.0  | 40.0  | 40.0  | 40.0  | 40.0  |
| Total Split (%)         | 33.3%       | 33.3% | 33.3% | 66.7% | 66.7% | 66.7% | 66.7% | 66.7% |
| Yellow Time (s)         | 3.5         | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   |
| All-Red Time (s)        | 0.5         | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   |
| Lead/Lag                |             |       |       |       |       |       |       |       |
| Lead-Lag Optimize?      |             |       |       |       |       |       |       |       |
| v/c Ratio               | 0.11        | 0.12  | 0.01  | 0.03  | 0.68  |       | 0.65  | 0.01  |
| Control Delay           | 17.4        | 6.4   | 0.0   | 5.3   | 12.0  |       | 11.5  | 3.2   |
| Queue Delay             | 0.0         | 0.0   | 0.0   | 0.0   | 0.0   |       | 0.0   | 0.0   |
| Total Delay             | 17.4        | 6.4   | 0.0   | 5.3   | 12.0  |       | 11.5  | 3.2   |
| Queue Length 50th (ft)  | 14          | 0     | 0     | 1     | 160   |       | 141   | 0     |
| Queue Length 95th (ft)  | 36          | 23    | 0     | 6     | 270   |       | 241   | 3     |
| Internal Link Dist (ft) | 1654        |       |       | 6852  |       |       | 2720  |       |
| Turn Bay Length (ft)    |             |       |       |       |       |       |       |       |
| Base Capacity (vph)     | 475         | 465   | 591   | 314   | 1114  |       | 1064  | 952   |
| Starvation Cap Reductn  | 0           | 0     | 0     | 0     | 0     |       | 0     | 0     |
| Spillback Cap Reductn   | 0           | 0     | 0     | 0     | 0     |       | 0     | 0     |
| Storage Cap Reductn     | 0           | 0     | 0     | 0     | 0     |       | 0     | 0     |
| Reduced v/c Ratio       | 0.11        | 0.12  | 0.01  | 0.03  | 0.68  |       | 0.65  | 0.01  |

| Intersection Summary   |  |
|------------------------|--|
| Cycle Length:          | 60   |
| Actuated Cycle Length: | 60   |
| Offset:                | 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green |
| Natural Cycle:         | 55   |
| Control Type:          | Pretimed   |

Splits and Phases: 1: KUKUI STREET & KUHIO HIGHWAY



HCM Unsignalized Intersection Capacity Analysis

2: OLOHENA ROAD & KAPAA BYPASS

12/2/2013

| Movement                | EBL  | EBT  | EBR  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|-------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Right Turn Channelized  |      |      |      |      |      |      |      |      |      |      |      |      |
| Volume (veh/h)          | 0    | 469  | 128  | 35   | 161  | 0    | 17   | 0    | 12   | 77   | 310  | 163  |
| Peak Hour Factor        | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)  | 0    | 510  | 139  | 38   | 175  | 0    | 18   | 0    | 13   | 84   | 337  | 177  |
| Approach Volume (veh/h) |      | 649  |      |      | 213  |      |      | 32   |      |      | 598  |      |
| Crossing Volume (veh/h) |      | 459  |      |      | 18   |      |      | 593  |      |      | 232  |      |
| High Capacity (veh/h)   |      | 965  |      |      | 1365 |      |      | 866  |      |      | 1155 |      |
| High v/c (veh/h)        |      | 0.67 |      |      | 0.16 |      |      | 0.04 |      |      | 0.52 |      |
| Low Capacity (veh/h)    |      | 782  |      |      | 1143 |      |      | 695  |      |      | 953  |      |
| Low v/c (veh/h)         |      | 0.83 |      |      | 0.19 |      |      | 0.05 |      |      | 0.63 |      |

| Intersection Summary              |       |
|-----------------------------------|-------|
| Maximum v/c High                  | 0.67  |
| Maximum v/c Low                   | 0.83  |
| Intersection Capacity Utilization | 75.6% |
| ICU Level of Service              | D     |



HCM Unsignalized Intersection Capacity Analysis  
3: KAPAA BYPASS & KUHIO HIGHWAY

12/2/2013

| Movement                          | EBL         | EBR         | NBL         | NBT                  | SBT         | SBR  |
|-----------------------------------|-------------|-------------|-------------|----------------------|-------------|------|
| Lane Configurations               | ↔           | ↔           | ↔           | ↕                    | ↕           | ↔    |
| Sign Control                      | Stop        |             |             | Free                 | Free        |      |
| Grade                             | 0%          |             |             | 0%                   | 0%          |      |
| Volume (veh/h)                    | 5           | 896         | 149         | 635                  | 576         | 5    |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92        | 0.92                 | 0.92        | 0.92 |
| Hourly flow rate (vph)            | 5           | 974         | 162         | 690                  | 626         | 5    |
| Pedestrians                       |             |             |             |                      |             |      |
| Lane Width (ft)                   |             |             |             |                      |             |      |
| Walking Speed (ft/s)              |             |             |             |                      |             |      |
| Percent Blockage                  |             |             |             |                      |             |      |
| Right turn flare (veh)            |             |             | 10          |                      |             |      |
| Median type                       | None        |             |             |                      |             |      |
| Median storage (veh)              |             |             |             |                      |             |      |
| Upstream signal (ft)              |             |             |             |                      |             |      |
| pX, platoon unblocked             |             |             |             |                      |             |      |
| vC, conflicting volume            | 1640        | 626         | 632         |                      |             |      |
| vC1, stage 1 conf vol             |             |             |             |                      |             |      |
| vC2, stage 2 conf vol             |             |             |             |                      |             |      |
| vCu, unblocked vol                | 1640        | 626         | 632         |                      |             |      |
| tC, single (s)                    | 6.4         | 6.2         | 4.1         |                      |             |      |
| tC, 2 stage (s)                   |             |             |             |                      |             |      |
| IF (s)                            | 3.5         | 3.3         | 2.2         |                      |             |      |
| p0 queue free %                   | 94          | 0           | 83          |                      |             |      |
| cM capacity (veh/h)               | 91          | 484         | 951         |                      |             |      |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>NB 1</b> | <b>NB 2</b> | <b>SB 1</b>          | <b>SB 2</b> |      |
| Volume Total                      | 979         | 162         | 690         | 626                  | 5           |      |
| Volume Left                       | 5           | 162         | 0           | 0                    | 0           |      |
| Volume Right                      | 974         | 0           | 0           | 0                    | 5           |      |
| cSH                               | 487         | 951         | 1700        | 1700                 | 1700        |      |
| Volume to Capacity                | 2.01        | 0.17        | 0.41        | 0.37                 | 0.00        |      |
| Queue Length 95th (ft)            | 1676        | 15          | 0           | 0                    | 0           |      |
| Control Delay (s)                 | 479.7       | 9.6         | 0.0         | 0.0                  | 0.0         |      |
| Lane LOS                          | F           | A           |             |                      |             |      |
| Approach Delay (s)                | 479.7       | 1.8         |             | 0.0                  |             |      |
| Approach LOS                      | F           |             |             |                      |             |      |
| <b>Intersection Summary</b>       |             |             |             |                      |             |      |
| Average Delay                     |             | 191.4       |             |                      |             |      |
| Intersection Capacity Utilization |             | 92.5%       |             | ICU Level of Service | F           |      |
| Analysis Period (min)             |             | 15          |             |                      |             |      |

HCM Unsignalized Intersection Capacity Analysis  
4: OLOHENA ROAD & KAAPUNI ROAD

12/2/2013

| Movement                          | EBL         | EBT         | WBT         | WBR                  | SBL  | SBR  |
|-----------------------------------|-------------|-------------|-------------|----------------------|------|------|
| Lane Configurations               | ↔           | ↔           | ↔           | ↔                    | ↔    | ↔    |
| Sign Control                      |             | Free        | Free        |                      | Stop |      |
| Grade                             | 0%          | 0%          | 0%          | 0%                   | 0%   | 0%   |
| Volume (veh/h)                    | 29          | 279         | 71          | 92                   | 310  | 15   |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 32          | 303         | 77          | 100                  | 337  | 16   |
| Pedestrians                       |             |             |             |                      |      |      |
| Lane Width (ft)                   |             |             |             |                      |      |      |
| Walking Speed (ft/s)              |             |             |             |                      |      |      |
| Percent Blockage                  |             |             |             |                      |      |      |
| Right turn flare (veh)            |             |             |             |                      |      |      |
| Median type                       |             |             |             |                      | None |      |
| Median storage (veh)              |             |             |             |                      |      |      |
| Upstream signal (ft)              |             |             |             |                      |      |      |
| pX, platoon unblocked             |             |             |             |                      |      |      |
| vC, conflicting volume            | 177         |             |             |                      | 493  | 127  |
| vC1, stage 1 conf vol             |             |             |             |                      |      |      |
| vC2, stage 2 conf vol             |             |             |             |                      |      |      |
| vCu, unblocked vol                | 177         |             |             |                      | 493  | 127  |
| tC, single (s)                    | 4.1         |             |             |                      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |             |                      |      |      |
| IF (s)                            | 2.2         |             |             |                      | 3.5  | 3.3  |
| p0 queue free %                   | 98          |             |             |                      | 36   | 98   |
| cM capacity (veh/h)               | 1399        |             |             |                      | 523  | 923  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>SB 1</b> |                      |      |      |
| Volume Total                      | 335         | 177         | 353         |                      |      |      |
| Volume Left                       | 32          | 0           | 337         |                      |      |      |
| Volume Right                      | 0           | 100         | 16          |                      |      |      |
| cSH                               | 1399        | 1700        | 534         |                      |      |      |
| Volume to Capacity                | 0.02        | 0.10        | 0.66        |                      |      |      |
| Queue Length 95th (ft)            | 2           | 0           | 121         |                      |      |      |
| Control Delay (s)                 | 0.9         | 0.0         | 24.0        |                      |      |      |
| Lane LOS                          | A           |             | C           |                      |      |      |
| Approach Delay (s)                | 0.9         | 0.0         | 24.0        |                      |      |      |
| Approach LOS                      |             |             | C           |                      |      |      |
| <b>Intersection Summary</b>       |             |             |             |                      |      |      |
| Average Delay                     |             |             | 10.1        |                      |      |      |
| Intersection Capacity Utilization |             | 53.7%       |             | ICU Level of Service | A    |      |
| Analysis Period (min)             |             | 15          |             |                      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
5: KAEHULA ROAD & KAAPUNI ROAD

12/2/2013

| Movement                          | WBL         | WBR         | NBT                  | NBR  | SBL  | SBT  |
|-----------------------------------|-------------|-------------|----------------------|------|------|------|
| Lane Configurations               | ↔           | ↔           | ↕                    | ↕    | ↔    | ↔    |
| Sign Control                      | Stop        |             | Free                 |      |      | Free |
| Grade                             | 0%          |             | 0%                   |      |      | 0%   |
| Volume (veh/h)                    | 24          | 0           | 102                  | 19   | 1    | 301  |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 26          | 0           | 111                  | 21   | 1    | 327  |
| Pedestrians                       |             |             |                      |      |      |      |
| Lane Width (ft)                   |             |             |                      |      |      |      |
| Walking Speed (ft/s)              |             |             |                      |      |      |      |
| Percent Blockage                  |             |             |                      |      |      |      |
| Right turn flare (veh)            |             |             |                      |      |      |      |
| Median type                       | None        |             |                      |      |      |      |
| Median storage (veh)              |             |             |                      |      |      |      |
| Upstream signal (ft)              |             |             |                      |      |      |      |
| pX, platoon unblocked             |             |             |                      |      |      |      |
| vC, conflicting volume            | 451         | 121         |                      |      | 132  |      |
| vC1, stage 1 conf vol             |             |             |                      |      |      |      |
| vC2, stage 2 conf vol             |             |             |                      |      |      |      |
| vCu, unblocked vol                | 451         | 121         |                      |      | 132  |      |
| tC, single (s)                    | 6.4         | 6.2         |                      |      | 4.1  |      |
| tC, 2 stage (s)                   |             |             |                      |      |      |      |
| IF (s)                            | 3.5         | 3.3         |                      |      | 2.2  |      |
| p0 queue free %                   | 95          | 100         |                      |      | 100  |      |
| cM capacity (veh/h)               | 566         | 930         |                      |      | 1454 |      |
| <b>Direction, Lane #</b>          | <b>WB 1</b> | <b>NB 1</b> | <b>SB 1</b>          |      |      |      |
| Volume Total                      | 26          | 132         | 328                  |      |      |      |
| Volume Left                       | 26          | 0           | 1                    |      |      |      |
| Volume Right                      | 0           | 21          | 0                    |      |      |      |
| cSH                               | 566         | 1700        | 1454                 |      |      |      |
| Volume to Capacity                | 0.05        | 0.08        | 0.00                 |      |      |      |
| Queue Length 95th (ft)            | 4           | 0           | 0                    |      |      |      |
| Control Delay (s)                 | 11.7        | 0.0         | 0.0                  |      |      |      |
| Lane LOS                          | B           |             | A                    |      |      |      |
| Approach Delay (s)                | 11.7        | 0.0         | 0.0                  |      |      |      |
| Approach LOS                      | B           |             |                      |      |      |      |
| <b>Intersection Summary</b>       |             |             |                      |      |      |      |
| Average Delay                     | 0.6         |             |                      |      |      |      |
| Intersection Capacity Utilization | 26.6%       |             | ICU Level of Service |      | A    |      |
| Analysis Period (min)             | 15          |             |                      |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
6: KAPAA BYPASS & ROAD 'A'

12/2/2013

| Movement                          | EBL         | EBT         | WBT                  | WBR  | SBL  | SBR  |
|-----------------------------------|-------------|-------------|----------------------|------|------|------|
| Lane Configurations               | ↔           | ↔           | ↔                    | ↔    | ↔    | ↔    |
| Sign Control                      |             | Free        | Free                 |      | Stop |      |
| Grade                             |             | 0%          | 0%                   |      | 0%   |      |
| Volume (veh/h)                    | 96          | 58          | 0                    | 566  | 0    | 335  |
| Peak Hour Factor                  | 0.87        | 0.87        | 0.90                 | 0.90 | 0.80 | 0.80 |
| Hourly flow rate (vph)            | 110         | 67          | 0                    | 629  | 0    | 419  |
| Pedestrians                       |             |             |                      |      |      |      |
| Lane Width (ft)                   |             |             |                      |      |      |      |
| Walking Speed (ft/s)              |             |             |                      |      |      |      |
| Percent Blockage                  |             |             |                      |      |      |      |
| Right turn flare (veh)            |             |             |                      |      |      |      |
| Median type                       | None        |             |                      |      |      |      |
| Median storage (veh)              |             |             |                      |      |      |      |
| Upstream signal (ft)              |             |             |                      |      |      |      |
| pX, platoon unblocked             |             |             |                      |      |      |      |
| vC, conflicting volume            | 629         |             |                      |      | 602  | 314  |
| vC1, stage 1 conf vol             |             |             |                      |      |      |      |
| vC2, stage 2 conf vol             |             |             |                      |      |      |      |
| vCu, unblocked vol                | 629         |             |                      |      | 602  | 314  |
| tC, single (s)                    | 4.1         |             |                      |      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |                      |      |      |      |
| IF (s)                            | 2.2         |             |                      |      | 3.5  | 3.3  |
| p0 queue free %                   | 88          |             |                      |      | 100  | 42   |
| cM capacity (veh/h)               | 953         |             |                      |      | 409  | 726  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>SB 1</b>          |      |      |      |
| Volume Total                      | 177         | 629         | 419                  |      |      |      |
| Volume Left                       | 110         | 0           | 0                    |      |      |      |
| Volume Right                      | 0           | 629         | 419                  |      |      |      |
| cSH                               | 953         | 1700        | 726                  |      |      |      |
| Volume to Capacity                | 0.12        | 0.37        | 0.58                 |      |      |      |
| Queue Length 95th (ft)            | 10          | 0           | 93                   |      |      |      |
| Control Delay (s)                 | 6.2         | 0.0         | 16.5                 |      |      |      |
| Lane LOS                          | A           |             | C                    |      |      |      |
| Approach Delay (s)                | 6.2         | 0.0         | 16.5                 |      |      |      |
| Approach LOS                      |             |             | C                    |      |      |      |
| <b>Intersection Summary</b>       |             |             |                      |      |      |      |
| Average Delay                     | 6.5         |             |                      |      |      |      |
| Intersection Capacity Utilization | 74.2%       |             | ICU Level of Service |      | D    |      |
| Analysis Period (min)             | 15          |             |                      |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
 7: OLOHENA ROAD & ROAD 'A'

12/2/2013

| Movement                          | EBT         | EBR         | WBL         | WBT                  | NBL  | NBR  |
|-----------------------------------|-------------|-------------|-------------|----------------------|------|------|
| Lane Configurations               | ↔           |             | ↔           |                      | ↔    |      |
| Sign Control                      | Free        |             | Free        |                      | Stop |      |
| Grade                             | 0%          |             | 0%          |                      | 0%   |      |
| Volume (veh/h)                    | 458         | 148         | 18          | 104                  | 62   | 57   |
| Peak Hour Factor                  | 0.95        | 0.95        | 0.91        | 0.91                 | 0.80 | 0.80 |
| Hourly flow rate (vph)            | 482         | 156         | 20          | 114                  | 78   | 71   |
| Pedestrians                       |             |             |             |                      |      |      |
| Lane Width (ft)                   |             |             |             |                      |      |      |
| Walking Speed (ft/s)              |             |             |             |                      |      |      |
| Percent Blockage                  |             |             |             |                      |      |      |
| Right turn flare (veh)            |             |             |             |                      |      |      |
| Median type                       | None        |             |             |                      |      |      |
| Median storage (veh)              |             |             |             |                      |      |      |
| Upstream signal (ft)              |             |             |             |                      |      |      |
| pX, platoon unblocked             |             |             |             |                      |      |      |
| vC, conflicting volume            |             |             | 638         |                      | 714  | 560  |
| vC1, stage 1 conf vol             |             |             |             |                      |      |      |
| vC2, stage 2 conf vol             |             |             |             |                      |      |      |
| vCu, unblocked vol                |             |             | 638         |                      | 714  | 560  |
| tC, single (s)                    |             |             | 4.1         |                      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |             |                      |      |      |
| IF (s)                            |             |             | 2.2         |                      | 3.5  | 3.3  |
| p0 queue free %                   |             |             | 98          |                      | 80   | 87   |
| cM capacity (veh/h)               |             |             | 946         |                      | 390  | 528  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>NB 1</b> |                      |      |      |
| Volume Total                      | 638         | 134         | 149         |                      |      |      |
| Volume Left                       | 0           | 20          | 78          |                      |      |      |
| Volume Right                      | 156         | 0           | 71          |                      |      |      |
| cSH                               | 1700        | 946         | 446         |                      |      |      |
| Volume to Capacity                | 0.38        | 0.02        | 0.33        |                      |      |      |
| Queue Length 95th (ft)            | 0           | 2           | 36          |                      |      |      |
| Control Delay (s)                 | 0.0         | 1.5         | 17.1        |                      |      |      |
| Lane LOS                          |             | A           | C           |                      |      |      |
| Approach Delay (s)                | 0.0         | 1.5         | 17.1        |                      |      |      |
| Approach LOS                      |             |             | C           |                      |      |      |
| <b>Intersection Summary</b>       |             |             |             |                      |      |      |
| Average Delay                     |             |             | 3.0         |                      |      |      |
| Intersection Capacity Utilization |             |             | 46.7%       | ICU Level of Service | A    |      |
| Analysis Period (min)             | 15          |             |             |                      |      |      |

Attachment N  
 Level-of-Service Worksheets for 2020 Background Plus Project  
 PM Peak Hour Conditions

HCM Signalized Intersection Capacity Analysis  
1: KUKUI STREET & KUHIO HIGHWAY

11/15/2013

| Movement               | EBL  | EBT  | EBR  | WBL  | WBT  | WBR    | NBL  | NBT  | NBR  | SBL   | SBT  | SBR  |   |
|------------------------|------|------|------|------|------|--------|------|------|------|-------|------|------|---|
| Lane Configurations    |      | ↕    | ↕    |      |      | ↕      | ↕    | ↕    |      |       | ↕    | ↕    |   |
| Ideal Flow (vphpl)     | 1900 | 1900 | 1900 | 1900 | 1900 | 1900   | 1900 | 1900 | 1900 | 1900  | 1900 | 1900 |   |
| Total Lost time (s)    |      | 4.0  | 4.0  |      |      | 4.0    | 4.0  | 4.0  |      |       | 4.0  | 4.0  |   |
| Lane Util. Factor      |      | 1.00 | 1.00 |      |      | 1.00   | 1.00 | 1.00 |      |       | 1.00 | 1.00 |   |
| Frt                    |      | 1.00 | 0.85 |      |      | 0.86   | 1.00 | 0.99 |      |       | 1.00 | 0.85 |   |
| Flt Protected          |      | 0.96 | 1.00 |      |      | 1.00   | 0.95 | 1.00 |      |       | 1.00 | 1.00 |   |
| Satd. Flow (prot)      |      | 1787 | 1583 |      |      | 1611   | 1770 | 1844 |      |       | 1858 | 1583 |   |
| Flt Permitted          |      | 0.96 | 1.00 |      |      | 1.00   | 0.26 | 1.00 |      |       | 0.95 | 1.00 |   |
| Satd. Flow (perm)      |      | 1787 | 1583 |      |      | 1611   | 489  | 1844 |      |       | 1776 | 1583 |   |
| Volume (vph)           |      | 36   | 6    | 24   | 0    | 0      | 15   | 12   | 585  | 42    | 33   | 627  | 5 |
| Peak-hour factor, PHF  |      | 0.92 | 0.92 | 0.92 | 0.92 | 0.92   | 0.92 | 0.92 | 0.92 | 0.92  | 0.92 | 0.92 |   |
| Adj. Flow (vph)        |      | 39   | 7    | 26   | 0    | 0      | 16   | 13   | 636  | 46    | 36   | 682  | 5 |
| RTOR Reduction (vph)   |      | 0    | 0    | 19   | 0    | 0      | 12   | 0    | 4    | 0     | 0    | 0    | 2 |
| Lane Group Flow (vph)  |      | 0    | 46   | 7    | 0    | 0      | 4    | 13   | 678  | 0     | 0    | 718  | 3 |
| Turn Type              |      | Perm | Perm |      |      | custom | Perm |      | Perm |       | Perm | Perm |   |
| Protected Phases       |      | 4    |      |      |      |        | 2    |      |      |       | 6    |      |   |
| Permitted Phases       |      | 4    | 4    |      |      | 8      | 2    |      |      | 6     | 6    | 6    |   |
| Actuated Green, G (s)  |      | 16.0 | 16.0 |      |      | 16.0   | 36.0 | 36.0 |      |       | 36.0 | 36.0 |   |
| Effective Green, g (s) |      | 16.0 | 16.0 |      |      | 16.0   | 36.0 | 36.0 |      |       | 36.0 | 36.0 |   |
| Actuated g/C Ratio     |      | 0.27 | 0.27 |      |      | 0.27   | 0.60 | 0.60 |      |       | 0.60 | 0.60 |   |
| Clearance Time (s)     |      | 4.0  | 4.0  |      |      | 4.0    | 4.0  | 4.0  |      |       | 4.0  | 4.0  |   |
| Lane Grp Cap (vph)     |      | 477  | 422  |      |      | 430    | 293  | 1106 |      |       | 1066 | 950  |   |
| v/s Ratio Prot         |      |      |      |      |      |        | 0.37 |      |      |       |      |      |   |
| v/s Ratio Perm         |      | 0.03 | 0.02 |      |      | 0.01   | 0.03 |      |      | c0.40 | 0.00 |      |   |
| v/c Ratio              |      | 0.10 | 0.02 |      |      | 0.01   | 0.04 | 0.61 |      |       | 0.67 | 0.00 |   |
| Uniform Delay, d1      |      | 16.6 | 16.2 |      |      | 16.2   | 4.9  | 7.6  |      |       | 8.1  | 4.8  |   |
| Progression Factor     |      | 1.00 | 1.00 |      |      | 1.00   | 1.00 | 1.00 |      |       | 1.00 | 1.00 |   |
| Incremental Delay, d2  |      | 0.4  | 0.1  |      |      | 0.0    | 0.3  | 2.5  |      |       | 3.4  | 0.0  |   |
| Delay (s)              |      | 17.0 | 16.3 |      |      | 16.2   | 5.2  | 10.1 |      |       | 11.5 | 4.8  |   |
| Level of Service       |      | B    | B    |      |      | B      | A    | B    |      |       | B    | A    |   |
| Approach Delay (s)     |      | 16.7 |      |      | 16.2 |        |      | 10.0 |      |       | 11.4 |      |   |
| Approach LOS           |      | B    |      |      | B    |        |      | B    |      |       | B    |      |   |

| Intersection Summary              |       |                      |     |
|-----------------------------------|-------|----------------------|-----|
| HCM Average Control Delay         | 11.1  | HCM Level of Service | B   |
| HCM Volume to Capacity ratio      | 0.50  |                      |     |
| Actuated Cycle Length (s)         | 60.0  | Sum of lost time (s) | 8.0 |
| Intersection Capacity Utilization | 69.9% | ICU Level of Service | C   |
| Analysis Period (min)             | 15    |                      |     |
| c Critical Lane Group             |       |                      |     |

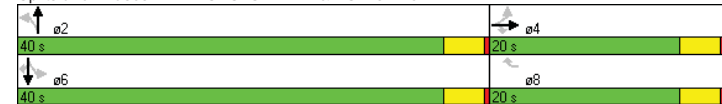
Queues  
1: KUKUI STREET & KUHIO HIGHWAY

11/15/2013

| Lane Group              | EBT   | EBR   | WBR    | NBL   | NBT   | SBL   | SBT   | SBR   |
|-------------------------|-------|-------|--------|-------|-------|-------|-------|-------|
| Lane Configurations     | ↕     | ↕     | ↕      | ↕     | ↕     |       | ↕     | ↕     |
| Volume (vph)            | 6     | 24    | 15     | 12    | 585   | 33    | 627   | 5     |
| Lane Group Flow (vph)   | 46    | 26    | 16     | 13    | 682   | 0     | 718   | 5     |
| Turn Type               |       | Perm  | custom | Perm  |       | Perm  |       | Perm  |
| Protected Phases        | 4     |       |        |       | 2     |       | 6     |       |
| Permitted Phases        |       | 4     | 8      | 2     |       | 6     | 6     | 6     |
| Minimum Split (s)       | 20.0  | 20.0  | 20.0   | 20.0  | 20.0  | 20.0  | 20.0  | 20.0  |
| Total Split (s)         | 20.0  | 20.0  | 20.0   | 40.0  | 40.0  | 40.0  | 40.0  | 40.0  |
| Total Split (%)         | 33.3% | 33.3% | 33.3%  | 66.7% | 66.7% | 66.7% | 66.7% | 66.7% |
| Yellow Time (s)         | 3.5   | 3.5   | 3.5    | 3.5   | 3.5   | 3.5   | 3.5   | 3.5   |
| All-Red Time (s)        | 0.5   | 0.5   | 0.5    | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   |
| Lead/Lag                |       |       |        |       |       |       |       |       |
| Lead-Lag Optimize?      |       |       |        |       |       |       |       |       |
| v/c Ratio               | 0.10  | 0.06  | 0.03   | 0.04  | 0.61  |       | 0.67  | 0.01  |
| Control Delay           | 17.3  | 8.0   | 0.1    | 5.5   | 10.5  |       | 12.1  | 3.2   |
| Queue Delay             | 0.0   | 0.0   | 0.0    | 0.0   | 0.0   |       | 0.0   | 0.0   |
| Total Delay             | 17.3  | 8.0   | 0.1    | 5.5   | 10.5  |       | 12.1  | 3.2   |
| Queue Length 50th (ft)  | 13    | 0     | 0      | 2     | 132   |       | 151   | 0     |
| Queue Length 95th (ft)  | 34    | 15    | 0      | 7     | 223   |       | 257   | 3     |
| Internal Link Dist (ft) |       |       |        |       | 6852  |       | 2720  |       |
| Turn Bay Length (ft)    |       |       |        |       |       |       |       |       |
| Base Capacity (vph)     | 476   | 441   | 631    | 293   | 1111  |       | 1066  | 952   |
| Starvation Cap Reductn  | 0     | 0     | 0      | 0     | 0     |       | 0     | 0     |
| Spillback Cap Reductn   | 0     | 0     | 0      | 0     | 0     |       | 0     | 0     |
| Storage Cap Reductn     | 0     | 0     | 0      | 0     | 0     |       | 0     | 0     |
| Reduced v/c Ratio       | 0.10  | 0.06  | 0.03   | 0.04  | 0.61  |       | 0.67  | 0.01  |

| Intersection Summary   |  |
|------------------------|--|
| Cycle Length:          | 60   |
| Actuated Cycle Length: | 60   |
| Offset:                | 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green |
| Natural Cycle:         | 55   |
| Control Type:          | Pretimed   |

Splits and Phases: 1: KUKUI STREET & KUHIO HIGHWAY



HCM Unsignalized Intersection Capacity Analysis  
2: OLOHENA ROAD & KAPAA BYPASS

12/2/2013

| Movement                          | EBL   | EBT  | EBR                  | WBL  | WBT  | WBR  | NBL  | NBT  | NBR  | SBL  | SBT  | SBR  |
|-----------------------------------|-------|------|----------------------|------|------|------|------|------|------|------|------|------|
| Right Turn Channelized            |       |      |                      |      |      |      |      |      |      |      |      |      |
| Volume (veh/h)                    | 0     | 291  | 36                   | 79   | 340  | 0    | 73   | 0    | 155  | 77   | 209  | 147  |
| Peak Hour Factor                  | 0.92  | 0.92 | 0.92                 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 0     | 316  | 39                   | 86   | 370  | 0    | 79   | 0    | 168  | 84   | 227  | 160  |
| Approach Volume (veh/h)           |       | 355  |                      |      | 455  |      |      | 248  |      |      | 471  |      |
| Crossing Volume (veh/h)           |       | 397  |                      |      | 79   |      |      | 400  |      |      | 535  |      |
| High Capacity (veh/h)             |       | 1014 |                      |      | 1302 |      |      | 1011 |      |      | 908  |      |
| High v/c (veh/h)                  |       | 0.35 |                      |      | 0.35 |      |      | 0.25 |      |      | 0.52 |      |
| Low Capacity (veh/h)              |       | 826  |                      |      | 1086 |      |      | 823  |      |      | 732  |      |
| Low v/c (veh/h)                   |       | 0.43 |                      |      | 0.42 |      |      | 0.30 |      |      | 0.64 |      |
| <b>Intersection Summary</b>       |       |      |                      |      |      |      |      |      |      |      |      |      |
| Maximum v/c High                  | 0.52  |      |                      |      |      |      |      |      |      |      |      |      |
| Maximum v/c Low                   | 0.64  |      |                      |      |      |      |      |      |      |      |      |      |
| Intersection Capacity Utilization | 77.3% |      | ICU Level of Service |      |      |      | D    |      |      |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
3: KAPAA BYPASS & KUHIO HIGHWAY

12/2/2013

| Movement                          | EBL   | EBR  | NBL                  | NBT  | SBT  | SBR  |
|-----------------------------------|-------|------|----------------------|------|------|------|
| Lane Configurations               |       |      |                      |      |      |      |
| Sign Control                      | Stop  |      |                      | Free | Free |      |
| Grade                             | 0%    |      |                      | 0%   | 0%   |      |
| Volume (veh/h)                    | 12    | 475  | 674                  | 766  | 577  | 14   |
| Peak Hour Factor                  | 0.92  | 0.92 | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 13    | 516  | 733                  | 833  | 627  | 15   |
| Pedestrians                       |       |      |                      |      |      |      |
| Lane Width (ft)                   |       |      |                      |      |      |      |
| Walking Speed (ft/s)              |       |      |                      |      |      |      |
| Percent Blockage                  |       |      |                      |      |      |      |
| Right turn flare (veh)            |       | 10   |                      |      |      |      |
| Median type                       | None  |      |                      |      |      |      |
| Median storage veh                |       |      |                      |      |      |      |
| Upstream signal (ft)              |       |      |                      |      |      |      |
| pX, platoon unblocked             |       |      |                      |      |      |      |
| vC, conflicting volume            | 2509  | 627  | 642                  |      |      |      |
| vC1, stage 1 conf vol             |       |      |                      |      |      |      |
| vC2, stage 2 conf vol             |       |      |                      |      |      |      |
| vCu, unblocked vol                | 2509  | 627  | 642                  |      |      |      |
| tC, single (s)                    | 6.8   | 6.9  | 4.1                  |      |      |      |
| tC, 2 stage (s)                   |       |      |                      |      |      |      |
| tF (s)                            | 3.5   | 3.3  | 2.2                  |      |      |      |
| p0 queue free %                   | 0     | 0    | 22                   |      |      |      |
| cM capacity (veh/h)               | 5     | 426  | 938                  |      |      |      |
| <b>Direction, Lane #</b>          |       |      |                      |      |      |      |
|                                   | EB 1  | NB 1 | NB 2                 | NB 3 | SB 1 | SB 2 |
| Volume Total                      | 529   | 733  | 416                  | 416  | 627  | 15   |
| Volume Left                       | 13    | 733  | 0                    | 0    | 0    | 0    |
| Volume Right                      | 516   | 0    | 0                    | 0    | 0    | 15   |
| cSH                               | 208   | 938  | 1700                 | 1700 | 1700 | 1700 |
| Volume to Capacity                | 2.55  | 0.78 | 0.24                 | 0.24 | 0.37 | 0.01 |
| Queue Length 95th (ft)            | 1116  | 203  | 0                    | 0    | 0    | 0    |
| Control Delay (s)                 | 190.1 | 21.0 | 0.0                  | 0.0  | 0.0  | 0.0  |
| Lane LOS                          | F     | C    |                      |      |      |      |
| Approach Delay (s)                | 190.1 | 9.8  |                      |      | 0.0  |      |
| Approach LOS                      | F     |      |                      |      |      |      |
| <b>Intersection Summary</b>       |       |      |                      |      |      |      |
| Average Delay                     | 42.4  |      |                      |      |      |      |
| Intersection Capacity Utilization | 81.0% |      | ICU Level of Service |      |      |      |
| Analysis Period (min)             | 15    |      |                      |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
4: OLOHENA ROAD & KAAPUNI ROAD

12/2/2013

| Movement                          | EBL         | EBT         | WBT         | WBR                  | SBL  | SBR  |
|-----------------------------------|-------------|-------------|-------------|----------------------|------|------|
| Lane Configurations               |             | ↕           | ↕           |                      | ↕    |      |
| Sign Control                      |             | Free        | Free        |                      | Stop |      |
| Grade                             |             | 0%          | 0%          |                      | 0%   |      |
| Volume (veh/h)                    | 20          | 102         | 178         | 266                  | 125  | 30   |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 22          | 111         | 193         | 289                  | 136  | 33   |
| Pedestrians                       |             |             |             |                      |      |      |
| Lane Width (ft)                   |             |             |             |                      |      |      |
| Walking Speed (ft/s)              |             |             |             |                      |      |      |
| Percent Blockage                  |             |             |             |                      |      |      |
| Right turn flare (veh)            |             |             |             |                      |      |      |
| Median type                       |             |             |             | None                 |      |      |
| Median storage (veh)              |             |             |             |                      |      |      |
| Upstream signal (ft)              |             |             |             |                      |      |      |
| pX, platoon unblocked             |             |             |             |                      |      |      |
| vC, conflicting volume            | 483         |             |             |                      | 492  | 338  |
| vC1, stage 1 conf vol             |             |             |             |                      |      |      |
| vC2, stage 2 conf vol             |             |             |             |                      |      |      |
| vCu, unblocked vol                | 483         |             |             |                      | 492  | 338  |
| tC, single (s)                    | 4.1         |             |             |                      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |             |                      |      |      |
| IF (s)                            | 2.2         |             |             |                      | 3.5  | 3.3  |
| p0 queue free %                   | 98          |             |             |                      | 74   | 95   |
| cM capacity (veh/h)               | 1080        |             |             |                      | 525  | 704  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>SB 1</b> |                      |      |      |
| Volume Total                      | 133         | 483         | 168         |                      |      |      |
| Volume Left                       | 22          | 0           | 136         |                      |      |      |
| Volume Right                      | 0           | 289         | 33          |                      |      |      |
| cSH                               | 1080        | 1700        | 552         |                      |      |      |
| Volume to Capacity                | 0.02        | 0.28        | 0.31        |                      |      |      |
| Queue Length 95th (ft)            | 2           | 0           | 32          |                      |      |      |
| Control Delay (s)                 | 1.5         | 0.0         | 14.4        |                      |      |      |
| Lane LOS                          | A           |             | B           |                      |      |      |
| Approach Delay (s)                | 1.5         | 0.0         | 14.4        |                      |      |      |
| Approach LOS                      |             |             | B           |                      |      |      |
| <b>Intersection Summary</b>       |             |             |             |                      |      |      |
| Average Delay                     |             |             | 3.3         |                      |      |      |
| Intersection Capacity Utilization | 41.1%       |             |             | ICU Level of Service | A    |      |
| Analysis Period (min)             | 15          |             |             |                      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
5: KAEHULA ROAD & KAAPUNI ROAD

12/2/2013

| Movement                          | WBL         | WBR         | NBT         | NBR                  | SBL  | SBT  |
|-----------------------------------|-------------|-------------|-------------|----------------------|------|------|
| Lane Configurations               | ↕           | ↕           | ↕           |                      | ↕    | ↕    |
| Sign Control                      | Stop        |             | Free        |                      |      | Free |
| Grade                             | 0%          |             | 0%          |                      |      | 0%   |
| Volume (veh/h)                    | 10          | 0           | 272         | 14                   | 2    | 145  |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 11          | 0           | 296         | 15                   | 2    | 158  |
| Pedestrians                       |             |             |             |                      |      |      |
| Lane Width (ft)                   |             |             |             |                      |      |      |
| Walking Speed (ft/s)              |             |             |             |                      |      |      |
| Percent Blockage                  |             |             |             |                      |      |      |
| Right turn flare (veh)            |             |             |             |                      |      |      |
| Median type                       | None        |             |             |                      |      |      |
| Median storage (veh)              |             |             |             |                      |      |      |
| Upstream signal (ft)              |             |             |             |                      |      |      |
| pX, platoon unblocked             |             |             |             |                      |      |      |
| vC, conflicting volume            | 465         | 303         |             |                      | 311  |      |
| vC1, stage 1 conf vol             |             |             |             |                      |      |      |
| vC2, stage 2 conf vol             |             |             |             |                      |      |      |
| vCu, unblocked vol                | 465         | 303         |             |                      | 311  |      |
| tC, single (s)                    | 6.4         | 6.2         |             |                      | 4.1  |      |
| tC, 2 stage (s)                   |             |             |             |                      |      |      |
| IF (s)                            | 3.5         | 3.3         |             |                      | 2.2  |      |
| p0 queue free %                   | 98          | 100         |             |                      | 100  |      |
| cM capacity (veh/h)               | 555         | 736         |             |                      | 1250 |      |
| <b>Direction, Lane #</b>          | <b>WB 1</b> | <b>NB 1</b> | <b>SB 1</b> |                      |      |      |
| Volume Total                      | 11          | 311         | 160         |                      |      |      |
| Volume Left                       | 11          | 0           | 2           |                      |      |      |
| Volume Right                      | 0           | 15          | 0           |                      |      |      |
| cSH                               | 555         | 1700        | 1250        |                      |      |      |
| Volume to Capacity                | 0.02        | 0.18        | 0.00        |                      |      |      |
| Queue Length 95th (ft)            | 1           | 0           | 0           |                      |      |      |
| Control Delay (s)                 | 11.6        | 0.0         | 0.1         |                      |      |      |
| Lane LOS                          | B           |             | A           |                      |      |      |
| Approach Delay (s)                | 11.6        | 0.0         | 0.1         |                      |      |      |
| Approach LOS                      | B           |             |             |                      |      |      |
| <b>Intersection Summary</b>       |             |             |             |                      |      |      |
| Average Delay                     |             |             | 0.3         |                      |      |      |
| Intersection Capacity Utilization | 25.2%       |             |             | ICU Level of Service | A    |      |
| Analysis Period (min)             | 15          |             |             |                      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
6: KAPAA BYPASS & ROAD 'A'

12/2/2013

| Movement                          | EBL         | EBT         | WBT                  | WBR  | SBL  | SBR  |
|-----------------------------------|-------------|-------------|----------------------|------|------|------|
| Lane Configurations               |             | ↕           | ↕                    |      | ↕    | ↕    |
| Sign Control                      |             | Free        | Free                 |      | Stop |      |
| Grade                             |             | 0%          | 0%                   |      | 0%   |      |
| Volume (veh/h)                    | 280         | 408         | 275                  | 0    | 0    | 212  |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 304         | 443         | 299                  | 0    | 0    | 230  |
| Pedestrians                       |             |             |                      |      |      |      |
| Lane Width (ft)                   |             |             |                      |      |      |      |
| Walking Speed (ft/s)              |             |             |                      |      |      |      |
| Percent Blockage                  |             |             |                      |      |      |      |
| Right turn flare (veh)            |             |             |                      |      |      |      |
| Median type                       |             |             |                      | None |      |      |
| Median storage (veh)              |             |             |                      |      |      |      |
| Upstream signal (ft)              |             |             |                      |      |      |      |
| pX, platoon unblocked             |             |             |                      |      |      |      |
| vC, conflicting volume            | 299         |             |                      |      | 1351 | 299  |
| vC1, stage 1 conf vol             |             |             |                      |      |      |      |
| vC2, stage 2 conf vol             |             |             |                      |      |      |      |
| vCu, unblocked vol                | 299         |             |                      |      | 1351 | 299  |
| tC, single (s)                    | 4.1         |             |                      |      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |                      |      |      |      |
| IF (s)                            | 2.2         |             |                      |      | 3.5  | 3.3  |
| p0 queue free %                   | 76          |             |                      |      | 100  | 69   |
| cM capacity (veh/h)               | 1262        |             |                      |      | 126  | 741  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>SB 1</b>          |      |      |      |
| Volume Total                      | 748         | 299         | 230                  |      |      |      |
| Volume Left                       | 304         | 0           | 0                    |      |      |      |
| Volume Right                      | 0           | 0           | 230                  |      |      |      |
| cSH                               | 1262        | 1700        | 741                  |      |      |      |
| Volume to Capacity                | 0.24        | 0.18        | 0.31                 |      |      |      |
| Queue Length 95th (ft)            | 24          | 0           | 33                   |      |      |      |
| Control Delay (s)                 | 5.3         | 0.0         | 12.0                 |      |      |      |
| Lane LOS                          | A           |             | B                    |      |      |      |
| Approach Delay (s)                | 5.3         | 0.0         | 12.0                 |      |      |      |
| Approach LOS                      |             |             | B                    |      |      |      |
| <b>Intersection Summary</b>       |             |             |                      |      |      |      |
| Average Delay                     | 5.3         |             |                      |      |      |      |
| Intersection Capacity Utilization | 74.6%       |             | ICU Level of Service |      | D    |      |
| Analysis Period (min)             | 15          |             |                      |      |      |      |

HCM Unsignalized Intersection Capacity Analysis  
7: OLOHENA ROAD & ROAD 'A'

12/2/2013

| Movement                          | EBT         | EBR         | WBL                  | WBT  | NBL  | NBR  |
|-----------------------------------|-------------|-------------|----------------------|------|------|------|
| Lane Configurations               | ↕           | ↕           |                      | ↕    | ↕    | ↕    |
| Sign Control                      | Free        |             |                      | Free | Stop |      |
| Grade                             | 0%          |             |                      | 0%   | 0%   |      |
| Volume (veh/h)                    | 118         | 115         | 57                   | 359  | 98   | 36   |
| Peak Hour Factor                  | 0.92        | 0.92        | 0.92                 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph)            | 128         | 125         | 62                   | 390  | 107  | 39   |
| Pedestrians                       |             |             |                      |      |      |      |
| Lane Width (ft)                   |             |             |                      |      |      |      |
| Walking Speed (ft/s)              |             |             |                      |      |      |      |
| Percent Blockage                  |             |             |                      |      |      |      |
| Right turn flare (veh)            |             |             |                      |      |      |      |
| Median type                       |             |             |                      |      | None |      |
| Median storage (veh)              |             |             |                      |      |      |      |
| Upstream signal (ft)              |             |             |                      |      |      |      |
| pX, platoon unblocked             |             |             |                      |      |      |      |
| vC, conflicting volume            |             |             | 253                  |      | 705  | 191  |
| vC1, stage 1 conf vol             |             |             |                      |      |      |      |
| vC2, stage 2 conf vol             |             |             |                      |      |      |      |
| vCu, unblocked vol                |             |             | 253                  |      | 705  | 191  |
| tC, single (s)                    |             |             | 4.1                  |      | 6.4  | 6.2  |
| tC, 2 stage (s)                   |             |             |                      |      |      |      |
| IF (s)                            |             |             | 2.2                  |      | 3.5  | 3.3  |
| p0 queue free %                   |             |             | 95                   |      | 72   | 95   |
| cM capacity (veh/h)               |             |             | 1312                 |      | 384  | 851  |
| <b>Direction, Lane #</b>          | <b>EB 1</b> | <b>WB 1</b> | <b>NB 1</b>          |      |      |      |
| Volume Total                      | 253         | 452         | 146                  |      |      |      |
| Volume Left                       | 0           | 62          | 107                  |      |      |      |
| Volume Right                      | 125         | 0           | 39                   |      |      |      |
| cSH                               | 1700        | 1312        | 450                  |      |      |      |
| Volume to Capacity                | 0.15        | 0.05        | 0.32                 |      |      |      |
| Queue Length 95th (ft)            | 0           | 4           | 35                   |      |      |      |
| Control Delay (s)                 | 0.0         | 1.5         | 16.8                 |      |      |      |
| Lane LOS                          |             | A           | C                    |      |      |      |
| Approach Delay (s)                | 0.0         | 1.5         | 16.8                 |      |      |      |
| Approach LOS                      |             |             | C                    |      |      |      |
| <b>Intersection Summary</b>       |             |             |                      |      |      |      |
| Average Delay                     | 3.7         |             |                      |      |      |      |
| Intersection Capacity Utilization | 52.9%       |             | ICU Level of Service |      | A    |      |
| Analysis Period (min)             | 15          |             |                      |      |      |      |

Attachment O  
Comments from State of Hawaii Department of Transportation and Responses  
Relative to DRAFT TIAR Submitted June 6, 2012

| Comment   | Response   |
|---|--|
| 1. The study area is too limited. The limits of the study area needs to be expanded to include the Kuhio Highway/Olohehena Road intersection, Kuhio Highway/Temporary Kapaa Bypass Road intersection and other intersections along Kuhio Highway to a point where the development's project generated traffic impact is less than 3%. | Per our telephone conversation, we believe that the Kuhio Highway/Olohehena Road intersection referred to is the intersection of Kuhio Highway at Kukui Street. It was also agreed that the study area would be expanded to include the two intersections noted. Based on the traffic distribution patterns noted during the traffic counts and the existing street network, only a small amount of will have a destination along Kuhio Highway between Kukui Street and Kapaa Bypass. |
| 2. The traffic volumes from the Kapaa County swimming pool and park on the 3.1 acre park site shall be in the trip generation and distribution calculations.  | Based on trip generation data provided in Trip Generation, 8 <sup>th</sup> Edition, the park will generate less than five (5) trips per hour during either the a morning or afternoon peak hour. This amount of traffic is too little to impact the level-of-service calculations. Therefore, this project was not included in the trip generation calculations.   |
| 3. The average pass-by trip percentage of approximately 80% for land use 820 appears to be too high for the commercial uses. The pass-by trip percentage shall be validated.  | Per our telephone conversation, it was agreed that the trip generation calculations would be revised to use a pass-by percentage of 34% rather than 80%. The report has been revised accordingly.  |

Attachment P  
Comments from County of Kauai Department of Public Works and Responses  
Relative to DRAFT TIAR Submitted June 6, 2012

| Comment | Response  |
|---------|---|
| 1 & 2   | Comments not related to TIAR.   |
| 3.      | The Traffic Impact Assessment Report (TIAR) needs to be finalized. The report states "A preliminary trip generation analysis was performed to define the scope of work and the study area." in compliance with Hawaii Administrative Rule 16-115-9 which states "all plans, specifications, maps, reports, survey descriptions, and every sheet in a set of design drawings prepared by or under the supervision of a licensed professional engineer, architect, land surveyor, or landscape architect <b>shall</b> be stamped with the authorized seal or stamp when filed with public officials, and under the seal or stamp, the authentication <b>shall</b> state, "This work was prepared by me or under my supervision," be signed by the licensee, and <b>shall</b> state the expiration date of the licensee. |
| 4       | The TIAR needs to evaluate the development impacts and mitigation actions needed to improve the existing 3-way, skewed intersection of Olohehena, Kaapuni and Kaehulua Roads. The report indicates Road 'A' will provide an alternate route to Kapaa Intermediate School since it will be a more direct route for northbound traffic. We are concerned that increased traffic volumes would increase the likelihood of accidents at the 3-way intersection. Realignment of the roadway angles of the intersection may be warranted to increase sight distances and ease turning movements at the intersection.  |
| 5       | The Kapaa Bypass Road is under the jurisdiction of the State Department of Transportation (DOT), Highways Division. Comments relating to access and traffic improvements need to be solicited from State DOT, Highways Division.  |
| 6 - 24  | Comments not related to TIAR.   |



Comments from State of Hawaii Department of Transportation and Responses  
Relative to TIAR Submitted December 9, 2013

|    | Comment  | Response  |
|----|--|---|
| 1. | In Section K - Project Trip Generation, there is a typographical error for PM single-family units and the AM/PM multifamily formulas should be from 7:00-9:00 and from 4:00 to 6:00 rather than peak hour of generator.  | Acknowledged.   |
| 2. | In Section M - Traffic Impact Assessment, the southern termini of the Kapaa Bypass being more than two miles away from the project does not alter the fact that the bypass is a limited access facility so traffic on the bypass has limited chance to disperse to other destinations. The trip distribution and volumes at the southern termini was no shown in any table. The increase in the amount of traffic is substantial at 12.2% AM and 13.6% PM. The results of the analysis of the Kuhio Highway at Kapaa Bypass intersection in Table 11 (2020 Level-of-Service (LOS) at Unsignalized Intersections) indicates significant increases in delay (LOS F becoming much worse LOS F) for the East to North (left turn out of the bypass) in both AM and PM, and moderate delay increase for the North to West (left turn into the bypass) (LOS B going to C) in the PM. We do not agree with the TIAR conclusion that the project contribution to these LOS conditions is not significant. A traffic signal warrant analysis for the intersection shall be prepared. Queuing analysis of the left-turn movements are required and queuing onto Kuhio Highway and Kapaa Bypass shall not be allowed. Transportation improvements shall be recommended to mitigate project generated impacts. | <p>First, the project trip assignments are shown on Attachments H, I and J of the TIAR. Trip distributions are not typically included in a TIAR.</p> <p>The critical movement at this intersection is the eastbound to northbound left turn, which is 5 vehicles per hour during the morning peak hour and 12 vehicles per hour during the afternoon peak hour. The volumes of this movement did not change as a result of project generated traffic as the project did not add traffic to this movement. All outbound traffic from the project will make right turns at the intersection, which is a free movement during the morning peak hour and STOP sign controlled during the afternoon peak hour.</p> <p>It was determined that a signal warrant analysis of this intersection was not appropriate since the eastbound to southbound right turn is a free movement and therefore would not be considered in the side street approach volume and the eastbound to northbound volumes do not even approach the minimum approach volumes to trigger the signal warrants, which is 80 vehicles per hour for the Four Hour Volume Warrant.</p> <p>Lastly, since the developer has provided the Kapaa Bypass, he has already done more than his fair share to mitigate traffic in the Kapaa area. Without the Kapaa Bypass, traffic volumes and traffic congestion along Kuhio Highway in Kapaa would be intolerable.</p> |
| 3. | In Section M, the TIAR also makes reference to the project Road A serving as a alternative route from Olohehena Road to the Kapaa Bypass, diverting traffic fro and thereby improving LOS at the roundabout (Olohehena Road and Kapaa Bypass). However, since Road A will pass through the Project's Phase 2 residential area the TIAR recommended   | The traffic calming recommendations for Road A are intended to slow traffic down, not to force traffic to another roadway. A simple look at the map indicates that Road A will be a shorter trip for traffic between Olohehena Road, including traffic to and from the Kapaa Intermediate School, and the southern part of Kapaa Bypass. Since traffic will take the  |

|    |  |  |
|----|--|--|
|    | that various traffic calming measure, including all-way stops, be provided for pedestrian safety. Being that the foregoing objectives are in conflict with each other, the traffic diversion and LOS improvement must be verified. Otherwise, mitigation improvements at the eastbound approach of the roundabout may be required to achieve acceptable LOS.   | shorter route, in terms of time and distance, it is appropriate to divert some traffic to Road A, especially during the morning peak hour when the eastbound approach of Olohehena Road to the roundabout operates at a low LOS E.   |
| 4. | The northern end of the Kapaa Bypass Road intersection with Kuhio Highway shall be included in the TIAR. Although it is a single lane, one-way road from Kuhio Highway to the Olohehena Roundabout, the entry intersections needs to be evaluated.   | Per our discussions with the Planning Branch of SDOT, it was agreed that the study area would be expanded to include the intersection of Kuhio Highway at Kukui Street and the southern intersection of Kuhio Highway at Kapaa Bypass. Since Kapaa Bypass at the northern intersection of Kuhio Highway at Kapaa Bypass is one-way southbound, any project traffic added to the intersection would be free flow southbound. Since the movement is free flowing, it would no be considered in the LOS analysis. |
| 5. | A left -turn warrant study should be conducted for the Kapaa Bypass Road intersection with Road A and a conceptual configuration of the intersection should be provided in the TIAR. Queuing onto the through lanes of the Kapaa Bypass Road shall not be allowed. Access to the Kapaa Bypass Road must be coordinated with and constructed to the satisfaction of the Highways Division, Kauai District Engineer. | First, both the FHWA and NCHRP data that are presented as "warrants" are actually "guidelines." It was decided that a separate left turn lane along Kapaa Bypass at Road A was not "needed" since this movement was projected to operate at LOS A during both morning and afternoon peak hours and that the 95 <sup>th</sup> percentile queues are less than one vehicle. Refer to Table 12, page 14.  |

NEIL ABERCROMBIE  
GOVERNOR



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

March 26, 2014

GLENN M. OKIMOTO  
DIRECTOR

Deputy Directors  
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RANDY GRUNE  
AUDREY HIDANO  
JADINE URASAKI  
IN REPLY REFER TO:  
HWY-PS 2.6887

Mr. Phillip J. Rowell, P.E.  
Phillip Rowell and Associates  
47-273 D Hui Iwa Street  
Kaneohe, Hawaii 96744

Dear Mr. Rowell:

Subject: Traffic Impact Assessment Report for Kapaa Highlands Subdivision  
Kauai, Kapaa, TMK: (4) 4-3-003: 001

Thank you for the opportunity to review the subject Traffic Impact Assessment Report (TIAR) dated December 9, 2013, which evaluates the traffic impact of the proposed Kapaa Highlands Subdivision, a two-phase development consisting of a total of approximately 116 single-family and 700 multi-family units and an 8,000 square feet (SF) neighborhood retail area. The project is located approximately at the intersection of Oloheua Road and the (temporary) Kapaa Bypass Road, State Route 5600, with proposed access to both roads. Oloheua Road ends on the west side of the intersection with the Kapaa Bypass Road and continues as Kukui Street on the east side of the intersection and Kukui Street which intersects with Kuhio Highway, State Route 56. The Kapaa Bypass Road continues southwest past the proposed subdivision and intersects with Kuhio Highway to the south of Kapaa, thereby bypassing a heavily used segment of Kuhio Highway.

The portion of the Kapaa Bypass that borders the proposed subdivision is still privately owned, however the land owner has agreed by Memorandum of Understanding to dedicate the land under the road upon final subdivision approval being granted.

We have the following comments:

1. In Section K - Project Trip Generation, there is a typographical error for PM single-family units and the AM/PM multi-family formulas should be from 7:00-9:00 am and 4:00-6:00 pm rather than peak hour of generator.
2. In Section M - Traffic Impact Assessment, the southern termini of the Kapaa Bypass being more than two miles away from the project does not alter the fact that the bypass is a limited access facility so traffic on the bypass has limited chance to disperse to other destinations. The trip distribution and volume at the southern termini was not shown in any table. The increase in the amount of traffic is substantial at 12.2% AM and 13.6% PM. The results of the analysis of the Kuhio Highway at Kapaa Bypass Road intersection in Table 11 (2020 Level of Service (LOS) of Unsignalized Intersections) indicates significant increases in delay (LOS F becoming much worse LOS F) for the East to North (left-turn out of the bypass) in both AM and PM, and a moderate delay

Mr. Phillip J. Rowell, P.E.  
March 26, 2014  
Page 2

HWY-PS 2.6887

increase for the North to West (left-turn into the bypass) (LOS B going to C) in PM. We do not agree with the TIAR conclusion that the project contribution to these LOS F conditions is not significant. A traffic signal warrant analysis of the intersection shall be prepared. Queuing analysis of the left-turn movements are required and queuing onto Kuhio Highway and Kapaa Bypass Road shall not be allowed. Transportation improvements shall be recommended to mitigate project generated impacts.

3. In Section M, the TIAR also makes reference to the project Road A serving as an alternative route from Oloheua Road to the Kapaa Bypass, diverting traffic from and thereby improving LOS at the roundabout (Oloheua Road and Kapaa Bypass). However, since Road A will pass through the project's Phase 2 residential area the TIAR recommends that various traffic calming measures, including possible all-way stops, be provided for pedestrian safety. Being that the foregoing objectives are in conflict with each other, the traffic diversion and LOS improvement must be verified. Otherwise, mitigation improvements at the eastbound approach of the roundabout may be required to achieve acceptable LOS.
4. The northern end of the Kapaa Bypass Road at its intersection with Kuhio Highway shall be included in the TIAR. Although it is a single lane, one-way road from Kuhio Highway to the Oloheua Roundabout, the entry intersection needs to be evaluated.
5. A left-turn warrant study should be conducted for the Kapaa Bypass Road intersection with Road A and a conceptual configuration of the intersection should be provided in the TIAR. Queuing onto the through lanes of the Kapaa Bypass Road shall not be allowed. Access to the Kapaa Bypass Road must be coordinated with and constructed to the satisfaction of the Highways Division, Kauai District Engineer.

If there are any questions, please contact Ken Tatsuguchi, Engineering Program Manager, Highways Planning Branch, at 587-1830. Please reference File Review Number 2014-006 in all contacts and correspondence regarding these comments.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.  
Director of Transportation

cc: Mr. Greg Allen, Kapaa Highlands

NEIL ABERGROMBIE  
GOVERNOR



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

June 6, 2014

COPY

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INTERIM DIRECTOR

Deputy Director  
BARRY GRUPE  
AUBREY HIGANO  
ROSS M. HIGASHI  
JADINE URAKAWA  
IN REPLY REFER TO:

HWY-PS 2.7311

Mr. Phillip J. Rowell, P.E.  
Phillip Rowell and Associates  
47-273 D Hui Iwa Street  
Kaneohe, Hawaii 96744

Dear Mr. Rowell:

Subject: Traffic Consultant Response to HWY-PS 2.6887, Traffic Impact Assessment Report (December 9, 2013), Kapaa Highlands Subdivision, Kapaa, Kauai  
TMK: (4) 4-3-003:001

Thank you for your response, transmitted by Greg Allen on April 9, 2014, via email, to our comment letter, HWY-PS 2.6887, dated March 26, 2014, on the traffic impact of the proposed Kapaa Highlands Subdivision.

We amend our prior comments as follows:

1. Comment 2 – Your justification that a traffic signal warrant and queue analysis would not be appropriate is acceptable.
2. Comment 3 – Our concern over “traffic calming” measures along Road A through the subdivision remain, since it would potentially reduce the utility that Road A would divert significant traffic; however your justification is acceptable.
3. Comment 4 – Your explanation is acceptable.
4. Comment 5 – A left-turn storage lane from the Kapaa Bypass into Road A of the subdivision may be deferred for the immediate future but the subdivision is still required to provide one should traffic conditions warrant it at no cost to the Department of Transportation (DOT).

With reference to the executed Memorandum of Agreement dated May 30, 2002, the appropriate right-of-way of the Kapaa Bypass with “No Access Permitted” except at existing access (i.e. Road A) along the project frontage, shall be dedicated to the DOT as a condition of the Land Use Commission.

Mr. Phillip J. Rowell, P.E.  
June 6, 2014  
Page 2

HWY-PS 2.7311

If you have any questions, please contact Gary Ashikawa, Systems Planning Engineer, Highways Division, Planning Branch, at 587-6336. Please reference file review number 2014-006-1 in all contacts and correspondence regarding these comments.

Very truly yours,

FORD N. FUCHIGAMI  
Interim Director of Transportation

c: Mr. Greg Allen, Kapaa Highlands, LLC