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KAMEHAMEHA SCHOOLS

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of TOM GENTRY AND GENTRY-PACIFIC, LTD. To Amend the Agricultural Land Use District Boundary into the Urban Land Use District for Approximately 1,395 Acres of Land at Waiawa, Ewa, O'ahu, City and County of Honolulu, State of Hawai'i, Tax Map Key Nos. 9-4-06: portion of 26; 9-6-04: portion of 1 and portion of 16; and 9-6-05: portion of 1, portion of 7 and portion of 14	DOCKET NO. A87-610 SUCCESSOR PETITIONER'S LIST OF REBUTTAL EXHIBITS; KS EXHIBITS 35 - 39; SUCCESSOR PETITIONER'S SUPPLEMENTED LIST OF WITNESSES; CERTIFICATE OF SERVICE

SUCCESSOR PETITIONER'S LIST OF REBUTTAL EXHIBITS; KS EXHIBITS 35 - 39; SUCCESSOR PETITIONER'S SUPPLEMENTED LIST OF WITNESSES; CERTIFICATE OF SERVICE

Successor Petitioner JANEEN-ANN AHULANI OLDS, LANCE KEAWE WILHELM, ROBERT K.W.H. NOBRIGA, CORBETT AARON KAMOHAIKIOKALANI KALAMA, and MICAH A. KANE, as TRUSTEES OF THE ESTATE OF BERNICE PAUAHI BISHOP, dba KAMEHAMEHA SCHOOLS, by and through its legal counsel, CARLSMITH BALL LLP,

hereby respectfully submits to the Land Use Commission of the State of Hawaii, *Successor Petitioner's List of Rebuttal Exhibits; KS Exhibits 35 - 39; Successor Petitioner's Supplemented List of Witnesses; Certificate of Service.*

DATED: Honolulu, Hawaii, October 10, 2014.

STEVEN S.C. LIM
JENNIFER A. (BENCK) LIM

Attorneys for Successor Petitioner
KAMEHAMEHA SCHOOLS

LAND USE COMMISSION DOCKET NO. A87-610
SUCCESSOR PETITIONER KAMEHAMEHA SCHOOLS LIST OF EXHIBITS

KS EX. NO.	DESCRIPTION	PARTY OBJECTIONS	ADMIT
KS Exhibits 1 - 18 were filed on May 13, 2014 with the Motion for Order Amending the Findings of Fact, Conclusions of Law and Decision and Order dated May 17, 1998 in Docket No. A87-610. Successor Petitioner's KS Exhibit 8 (Errata), and KS Exhibits 19 - 34 in Docket No. A87-610 were filed with the Land Use Commission and copies served on all parties on June 20, 2014. KS Exhibits 35 - 39 (Rebuttal Exhibits) in Docket No. A87-610 were filed with the Land Use Commission and copies served on all parties on October 10, 2014.			
1.	Survey map outlining the 1,395 acre KS Property reclassified to the State Land Use Urban District in LUC Docket No. A87-610		
2.	Graphic showing the State Land Use Districts		
3.	Portions of title reports for the KS Property		
4.	Graphic showing City and County zoning districts		
5.	Map showing locations of the proposed rail transit stations located with 1- and 2-mile radii of the KS Property		
6.	Description of the SunEdison project team		
7.	Curriculum Verite of Nicola Doss, SunEdison Hawai'i		
8.	~~Map showing the approximate locations of solar project (Phase 1 and Phase 2) on the KS Property.~~	WITHDRAWN/ CORRECTED	WITHDRAWN/ CORRECTED

8.	KS Exhibit 8 filed with the Motion on May 13, 2014, is to be replaced with the exhibit marked KS Exhibit 8 (Errata), filed on June 20, 2014		
9.	Visual simulations of Phase 1 and Phase 2 of the proposed solar project on KS property		
10.	Portions of title policy No. 5011415-3549		
11.	Portions of the City and County of Honolulu Land Use Ordinances Master Use Table 21-3		
12.	Pearl City Neighborhood Board resolution, dated April 22, 2014		
13.	Mililani/Waipio/Melemanu Neighborhood Board resolution, dated March 26, 2014		
14.	Letter from George I. Atta, Director, Department of Planning and Permitting, City and County of Honolulu, to Keith Chang, Kamehameha Schools, dated April 29, 2014		
15.	Letter from State of Hawai'i, Department of Health to the State Office of Planning, dated January 2, 1991, re zone of contribution. Letter from Department of the Navy to State Department of Health, dated December 17, 1990 re zone of contribution.		
16.	Central O'ahu Sustainable Communities Plan land use map		
17.	SunEdison sample curriculum for middle school students; SunEdison sample teacher's guide for high school students		
18.	Letter from State Department of Land and Natural Resources to Tosh Hosoda, Senior Vice President, Gentry Homes, Ltd., dated June 21, 2000		

19.	Letter from Don Hibbard, Administrator, SHPD to Patrice Tottori Liu, Vice President, Gentry Hawaii, Ltd., dated July 7, 1992, accepting archaeological inventory survey report.		
20.	Cultural Impact Assessment for 3,600 Acres in Waiawa and Waipi'o Ahupua'a, Oahu (June 2003)		
21.	Cultural Resources Preservation Plan (September 2005)		
22.	Letter from Melanie Chinen, Administrator, SHPD to Patrice Tottori Liu, Waiawa Ridge Development, dated October 25, 2007 re approval of Cultural Resources Preservation Plan		
23.	Letter from Susan A. Lebo, PhD, SHPD to Chris Monahan, PhD, Principal Archaeologist, TCP Hawai'i LLC, dated April 21, 2014		
24.	Graphic showing zone of contribution and location of utility improvements		
25.	Letter from J.W. James, Captain, US Navy Commander, to Keith K.A. Chang, KS regarding zone of contribution, dated May 28, 2014		
26.	Email exchange between M. Hickey, Senior Paralegal, AT&T Services, Inc. and J. Benck, Esq., May 29 - 30, 2014		
27.	Portions of the City and County of Honolulu Land Use Ordinances Master Use Table 21-3 related to livestock grazing		
28.	Letter dated April 9, 2014, from Keith K.A. Chang to Joanna L. Seto, Department of Health, describing proposed solar project and enclosing graphic with zone of contribution and locations of Phase 1 and Phase 2		
29.	Resume of Thomas S. Witten, ASLA, Chairman, PBR Hawaii & Associates, Inc.		

30.	Resume of Paul T. Matsuda, P.E., Director of Civil Engineering, Group 70 International		
31.	Resume of Jason Alapaki Jeremiah, Cultural Resources, Senior Manager, Kamehameha Schools		
32.	Resume of Sohrab Rashid, TE, Principal, Fehr & Peers		
33.	Resume of Chris Monahan, Ph.D., Principal Archaeologist, TCP Hawaii LLC		
34.	Preliminary assessment re solar glare (Sandia Solar Glare Hazard Analysis Tool Report)		
REBUTTAL EXHIBITS, FILED OCTOBER 10, 2014			
35.	Construction Traffic Assessment for the Proposed Waiawa Solar Farm (Oahu, HI) dated August 1, 2014		
36.	Waiawa 50 MW Solar Project – Interconnection Feasibility and Impact Assessment, dated September 16, 2014		
37.	Waiawa Solar Farm Project Preliminary Civil Considerations, dated October 6, 2014		
38.	Kamehameha Schools' Considerations for Development		
39.	Letter to SHPD regarding submission of Archaeological Inventory Survey of 1,395 Acres of Kamehameha Schools' Land, dated September 16, 2014		

LAND USE COMMISSION DOCKET NO. A87-610

SUCCESSOR PETITIONER KAMEHAMEHA SCHOOLS SUPPLEMENTED LIST OF WITNESSES[1]

NAME/ORGANIZATION/POSITION (list in order of appearance)	TO BE QUALIFIED AS A WITNESS IN:	SUBJECT MATTER	EXHIBIT NUMBER(S)	WRITTEN TESTIMONY	LENGTH OF DIRECT
Thomas S. Witten, ASLA / PBR Hawaii & Associates, Inc. / Chairman	Land use planning; environmental review	Land use and environmental planning	1, 2, 4, 5, 8 (Errata), 11, 14, 16, 27, 29	No	30
Giorgio Caldarone / Kamehameha Schools / Regional Asset Manager	N/A	Project development and renewable energy sector lead	1, 2, 3, 10, 15, 18, 24, 25, 26, 28	No	20
Nicola Doss / SunEdison Hawai'i / Senior Manager	Utility scale solar development projects	Overall project analysis	6, 7, 8 (Errata), 9, 12, 13, 17, 32, 34, 35, 36	No	30
Paul T. Matsuda, P.E. /Group 70 International / Director of Civil Engineering	Civil engineering	Civil engineering	24, 30, 37	No	15
Sohrab Rashid T.E. / Fehr & Peers / Principal	Traffic engineering	Traffic management	N/A	No	N/A
Catherine Camp / Kamehameha Schools / Director of Development	N/A	Project development; community relations; future plans for Waiawa property	1, 2, 4, 5, 8 (Errata), 14, 16, 24, 38	No	20

[1] Successor Petitioner's First List of Witnesses was filed on June 16, 2014. Successor Petitioner's First List of Rebuttal Witnesses was filed on June 20, 2014. This Supplemented List of Witnesses identifies the KS Exhibits that will be addressed by the identified witnesses. No new witnesses have been listed.

Chris Monahan, Ph.D. / TCP Hawaii LLC / Principal Archaeologist,	Archaeology	Archaeological and historic resources	23, 33, 39	No	10
Jason Alapaki Jeremiah / Kamehameha Schools / Cultural Resources, Senior Manager	Historic and cultural resources	Archaeological, historic and cultural resources	19, 20, 21, 22, 23, 31	No	10

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To Amend the Agricultural In the Matter of the Petition of TOM GENTRY AND GENTRY-PACIFIC, LTD Land Use District Boundary into the Urban Land Use District for Approximately 1,395 Acres at Waiawa, Ewa, Oahu, State of Hawaii, Tax Map Key Nos." 9-4-06: Portion of 26; 9-6-04: Portion of 1 and Portion of 16; and 9-6-05: Portion of 1, Portion of 7 and Portion of 14	DOCKET NO. A87-610 **CERTIFICATE OF SERVICE**

CERTIFICATE OF SERVICE

I hereby certify that due service of a copy of the foregoing was served upon the following by hand delivery on October 10, 2014, addressed to:

HAND DELIVERY	LEO R. ASUNCION, JR., Acting Director Office of Planning State Office Tower, 6th Floor 235 South Beretania Street Honolulu, HI 96813
HAND DELIVERY	DAVID M. LOUIE, Esq. BRYAN YEE, Esq. Deputy Attorney General Commerce and Economic Development Department of the Attorney General 425 Queen Street Honolulu, Hawaii 96813

HAND DELIVERY	GEORGE I. ATTA, Director Department of Planning and Permitting City & County of Honolulu 650 South King Street, 7th Floor Honolulu, HI 96813
HAND DELIVERY	DONNA Y.L. LEONG, Esq. DON S. KITAOKA, Esq. Deputy Corporation Counsel Department of the Corporation Counsel Honolulu Hale 530 South King Street, Room 110 Honolulu, HI 96813

STEVEN S.C. LIM
JENNIFER A. (BENCK) LIM

Attorneys for Successor Petitioner
KAMEHAMEHA SCHOOLS

Dated: Honolulu, Hawaii, October 10, 2014

FEHR PEERS

August 1, 2014

Nicola Doss
SunEdison
Senior Manager-Hawai'i
North America Project Development
2987 Kalakaua, Suite 104
Honolulu, HI 96815

Subject: ***Construction Traffic Assessment for the Proposed Waiawa Solar Farm (Oahu, HI)***

Dear Ms. Doss:

Fehr & Peers has prepared a traffic assessment for a proposed solar farm to be constructed by SunEdison in the Waiawa area on the island of O'ahu. This assessment was prepared in response to the State of Hawaii Department of Transportation - Highway's Division's (HDOT) request for a traffic assessment of the proposed solar farm project. This letter includes an assessment of the vehicle trip generation anticipated during both project construction and typical project operations, as well as an analysis of intersection operations to determine any traffic-related impacts from the project.

PROJECT DESCRIPTION

The proposed project is a new photovoltaic solar installation located in the Waiawa area, generally east of the H-2 Freeway/Ka Uka Boulevard interchange and west of Pearl City. The solar farm is expected to be constructed in two phases: Phase I will consist of a 50 megawatt (MW) installation in the north/west portion of the site on approximately 300 acres, while Phase II will be located in the south/east portion of the site within a 268-acre easement, but the details of the Phase II installation are yet to be determined. Accordingly, this assessment focuses on the construction and operation of Phase I.

Once operational, the solar farm is anticipated to have no more than five employees on site at any given time. As a result, the number of employee vehicle trips generated by the proposed project during typical operations is considered negligible (i.e., the daily variation in traffic in peak hour volumes on roadways near the site will be greater than the number of trips generated by the site and drivers would not be able to perceive the additional traffic). The primary traffic concerns

for this solar farm project are associated with potential temporary construction traffic impacts. Based on the needs of a 50 MW facility, the project construction is anticipated to take place over the course of 12 months and will require up to 150 workers on site at a given time. According to the construction of similar facilities in other locations, the number of employees for the first three months and the last three months of construction will be lower with peak on-site employment occurring for the five to six months in the middle of the project schedule. The average number of employees during construction is approximately 100.

According to current plans, construction is expected to begin in 2015 and continue into 2016. Thus, the transportation analysis examines impacts using a Year 2016 baseline.

VEHICLE ACCESS

Two potential access points are being considered for construction traffic access:

1. A driveway on Waiawa Prison Road along the northern edge of the project site with regional connections to the H-2 freeway via Ka Uka Boulevard and Mililani Cemetery Road, or
2. A driveway via Waihona Street mauka of Kamehameha Highway near the southern tip of the project site.

Circulation associated with each of these access points is described below.

Under Access Option 1, the project site driveway is expected to be located on Waiawa Prison Road approximately 2,400 feet east of Mililani Cemetery Road at the existing driveway as shown on **Attachment A**. Regional traffic would approach from either Ka Uka Boulevard (from the west) or from either direction on the H-2 Freeway and would turn onto Mililani Cemetery Road. Traveling north, vehicles on Mililani Cemetery Road would negotiate several curves before reaching the Waiawa Prison Road intersection where they would turn right to the existing driveway to the site. Waiawa Prison Road is narrower than the cemetery road but both facilities serve a limited amount of traffic. This access provides the most direct access to the northern area of the site. This location is 1.3 miles from the Ka Uka Boulevard interchange and any temporary queuing at the project driveway would not impact interchange operations.

From a jurisdictional perspective, Ka Uka Boulevard in the immediate vicinity of the H-2 freeway is maintained and operated by the Hawaii Department of Transportation – Highways Division (HDOT). Mililani Cemetery Road is maintained by the City & County of Honolulu Department of Transportation Services (DTS), while Waiawa Prison Road is a private street with multiple owners.

Under Access Option 2, the site driveway intersection would be located on Waihona Street approximately 1,780 feet mauka of Kamehameha Highway as shown on **Attachment A**. At the southern end of the site, the Waihona Street / Kamehameha Highway intersection is a three-legged configuration that is currently stop controlled on Waihona Street. Kamehameha Highway is two lanes in the ewa-bound direction and one lane in the Diamond Head-bound with a raised median separating the directions of travel. Additionally, a channelized right-turn lane is provided for ewa-bound vehicles turning right onto Waihona Street. Waihona Street is one lane in each direction and a short channelized right-turn lane is provided for makai-bound vehicles turning onto Kamehameha Highway (and ultimately mauka-bound H-2 or ewa-bound H-1). Mauka-bound on Waihona Street just before the site driveway intersection, the roadway curves, and sight distance will need to be evaluated to ensure adequacy. It is possible that the existing on-street parking on Waihona Street will need to be removed in order to accommodate the required sight distance. Kamehameha Highway is under the jurisdiction of HDOT, while Waihona Street is under the control of DTS.

ALTERNATIVE MODE ACCESS

BICYCLE AND PEDESTRIAN TRAVEL

Given the undeveloped nature of the project site and the low density development of the immediate surrounding area, the potential conflict is low between site-generated traffic and non-automobile modes including walking and biking. On the northern end of the project site at Ka Uka Boulevard east of the H-2 freeway, the amount of pedestrian and bicycle activity is negligible. Mililani Cemetery Road and Waiawa Prison Road both include vehicle travel lanes only and are not intended to accommodate separate bicycle and pedestrian travel. Given the long distances between the H-2 interchange and both the cemetery (approximately 1.2 miles) and the correctional facility (approximately 2.9 miles), significant use of active transportation modes is not anticipated. In addition, no sidewalks are provided on the Ka Uka Boulevard overcrossing over H-2. While separate bicycle and pedestrian facilities are typically encouraged to reduce vehicle traffic, the rural circulation system and distant land uses in the vicinity of the project site are not conducive to multi-modal travel.

Under Access Option 2 via Waihona Street, pedestrian and bicycle activity is more likely given the development along Waihona Street and the proximity of these land uses to the more urbanized Pearl City area. Accordingly, Waihona Street includes sidewalks on both sides of the roadway and provides additional width in the vehicle travel lanes to accommodate bicyclists. When project-generated trucks or employee vehicles would turn into and out of the site driveway, they would be generally crossing the sidewalk or makai-bound bicycle traffic at a 90-degree angle, which is ideal from a visibility perspective. While Kamehameha Highway does not include sidewalks at the Waihona Street intersection, a shoulder area is provided on both sides of the roadway and includes room for pedestrians to travel without conflicting with vehicles. It should be noted that several existing industrial uses on Waihona Street already generate truck trips that use both roadways in this area.

TRANSIT

There is very minimal existing transit access to the site as there are no bus stops near either of the options for site access. The planned Honolulu High Capacity Transit Corridor extends from Kapolei to Ala Moana Shopping Center and is currently under construction. The rail transit line is expected to be completed and fully operational by 2019. The closest stop to the site will be the Pearl Highlands station, located makai of Kamehameha Highway opposite Waihona Street.

The Pearl Highlands station will serve as a regional transit hub and will include a park and ride facility, as well as a transfer station for buses from Central Oahu. The existing stop-controlled Waihona Street/Kamehameha Highway intersection will be signalized as part of the rail project and will improve overall access to the uses on Waihona Street.

POTENTIAL IMPACTS TO ACTIVE MODES AND TRANSIT

The City and County of Honolulu or HDOT does not specify impact criteria for pedestrian, bicycle, and transit impacts. However, these impacts are generally evaluated based on whether a proposed project would: 1) conflict with existing or planned pedestrian, bicycle, or transit facilities, or 2) create walking, bicycling, or transit use demand without providing adequate and appropriate facilities for non-motorized mobility. The existing amenities for pedestrians, bicycles, and transit users were inventoried to evaluate the quality of the facilities in place today.

TRAFFIC VOLUMES

The addition of traffic from the proposed project may impact operations of intersections adjacent to the project site during the anticipated 12-month construction period. The analysis of the intersections adjacent to each access location is presented below.

YEAR 2016 BASELINE TRAFFIC VOLUMES

Project construction is expected to generally occur during 2016. Existing traffic volumes from previous traffic studies were increased by an average growth factor of one percent per year. Volumes were obtained for the following intersections:

1. Ka Uka Blvd./H-2 Northbound Off-ramp
2. Ka Uka Blvd./H-2 Southbound On-ramp
3. Ka Uka Blvd./H-2 Southbound Off-ramp
4. Kamehameha Hwy./Waihona Street

Traffic from the proposed project was added to the Year 2016 baseline volumes to determine the potential impacts from construction traffic. Project traffic estimates are described below.

ESTIMATED PROJECT TRIP GENERATION

The primary traffic issue for solar farm projects is associated with the temporary construction traffic. Construction traffic comprises private vehicles driven by construction workers plus trips made by trucks delivering materials, hauling earth and debris, and providing other services (e.g., food trucks). In general, workers are assumed to make one inbound trip and one outbound trip for a total of two daily trips. Detailed information on construction activities was provided by SunEdison and included the number of trucks needed to deliver the photovoltaic panels, steel piles for mounting the panels, gravel for on-site roadways, etc. This information was used to estimate the total number of truck trips during the planned construction period of 12 months. The full details of the trip generation analysis and assumptions associated with each scenario are included in **Attachment B**. It is important to note that this information is preliminary and will be refined once a specific contractor is selected to construct the project. At that time, construction traffic management plan will also be prepared.

This traffic assessment report considered two scenarios for project construction. The first scenario represents a conservative approach and assumes that all 150 construction workers drive their own

vehicles to and from the project site, and that the majority of heavy vehicle truck trips occur during the AM and PM peak hours. This situation is not likely to occur since deliveries are expected to occur throughout the day and in many cases, before the AM peak hour. This "Conservative" trip generation is summarized in **Table 1** below and represents an absolute worst-case scenario.

Table 1-Project Construction Trip Generation – Conservative

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Auto[1]	300	150	150	0	150	0	150
Shuttle Bus	0	0	0	0	0	0	0
Trucks[2]	42	18	18	0	18	0	18
Total	342	168	168	0	168	0	168

Note:
[1] Assumes 100% of construction employees drive to project site in a single occupant vehicle
[2] Assumes equipment, debris, hauling, excavation, etc. trucks arrive and depart during peak hours

The second scenario considered for project construction assumes that most employees will drive to an off-site parking lot and will be shuttled to the site via buses to be arranged by the site contractor. This scenario results in a significant reduction in single-occupant vehicle trips compared to the conservative scenario and may be implemented by the project contractor if an appropriate on-site parking area cannot be provided. This scenario also assumes that 75% of the heavy vehicle truck trips would occur during off-peak hours. The trip generation summary for this "with Employee Shuttle" scenario is presented in **Table 2** below.

Table 2-Project Construction Trip Generation – with Employee Shuttles

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Auto[1]	16	8	8	0	8	0	8
Shuttle Bus[2]	8	4	4	0	4	0	4
Trucks[3]	42	7	7	0	6	0	6
Total	66	19	19	0	18	0	18

Note:
[1] Assumes 5% of construction employees drive to project site as single occupant vehicle
[2] Assumes 46 passengers per shuttle bus
[3] Assumes 75% equipment, debris, hauling, excavation, etc. trucks arrive and depart during off-peak hours

Once operational, the solar farm is anticipated to have approximately five (5) employees on site at any given time. As a result, the employee trips generated by the proposed project are nominal. Table 3 below presents the estimated project trip generation once the solar farm is operational.

Table 3-Project Operations Trip Generation

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Employees[1]	10	5	5	0	5	0	5

Note:
[1] Assumes five (5) employees on-site once project is operational

PROJECT TRIP DISTRIBUTION

Based on the available regional access points/interchanges and the fact that materials will be transported between the site and the Sand Island harbor area, all heavy trucks are expected to use the H-2 Freeway and turn right onto Ka Uka Boulevard from the H-2 Northbound Off-Ramp in order to access the site under Access Option 1. Alternatively under Access Option 2, trucks would use ewa-bound Kamehameha Highway and turn right onto Waihona Street to get to the site and return using the opposite movements, Construction workers and employees are expected to come from all over the island to travel to the proposed solar farm, and the assumed trip distribution is listed below:

- To/From the north—20%
- To/From the west—40%
- To/From the east—40%

The trip distribution percentages were applied to the estimated trip generation and assigned to the surrounding roadway network in order to assess any potential traffic impacts.

INTERSECTION OPERATIONS ANALYSIS

The analysis of roadway operations performed for this study is based upon procedures presented in the *Highway Capacity Manual* (HCM), published by the Transportation Research Board. The operations of roadway facilities are described with the term level of service (LOS). LOS is a qualitative description of traffic flow based on such factors as speed, travel time, delay, and freedom to maneuver. Six levels are defined from LOS A, with the least congested operating conditions, to LOS F, with the most congested operating conditions. LOS E represents "at-capacity" operations. Operations are designated as LOS F when volumes exceed capacity, resulting in stop-and-go conditions. The computerized analysis of intersection operations was performed utilizing the SYNCHRO 8.0 traffic analysis software.

SIGNALIZED INTERSECTION ANALYSIS

HCM methodology defines LOS for signalized intersections in terms of delay, or more specifically, average stopped delay per vehicle. Delay is a measure of driver and/or passenger discomfort, frustration, fuel consumption and lost travel time. This technique uses 1,900 vehicles per hour per lane (VPHPL) as the maximum saturation volume of an intersection. This saturation volume is adjusted to account for lane width, on-street parking, pedestrians, traffic composition (i.e., percentage trucks) and shared lane movements (i.e. through and right-turn movements originating from the same lane). The LOS criteria used for this technique are described in **Table 4.**

UNSIGNALIZED INTERSECTION ANALYSIS

The HCM outlines methodology for unsignalized intersections, including two-way and all-way stop controlled intersections. The SYNCHRO 8.0 software supports this methodology and was utilized to produce LOS results. The LOS for a two-way stop controlled (TWSC) intersection is determined by the computed control delay and is defined for each minor movement. **Table 5** summarizes the LOS criteria for unsignalized intersections.

Table 4 – Signalized Intersection Level of Service Criteria	
Average Stopped Delay Per Vehicle (seconds)	**Level of Service (LOS) Characteristics**
<10.0	*LOS A* describes operations with very low delay. This occurs when progression is extremely favorable, and most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
10.1 – 20.0	*LOS B* describes operations with generally good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.
20.1 – 35.0	*LOS C* describes operations with higher delays, which may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
35.1 – 55.0	*LOS D* describes operations with high delay, resulting from some combination of unfavorable progression, long cycle lengths, or high volumes. The influence of congestion becomes more noticeable, and individual cycle failures are noticeable.
55.1 – 80.0	*LOS E* is considered the limit of acceptable delay. Individual cycle failures are frequent occurrences.
>80.0	*LOS F* describes a condition of excessively high delay, considered unacceptable to most drivers. This condition often occurs when arrival flow rates exceed the LOS D capacity of the intersection. Poor progression and long cycle lengths may also be major contributing causes to such delay.

Table 5 – Unsignalized Intersection Level of Service Criteria	
Average Control Delay (sec/veh)	**Level of Service (LOS)**
≤10	A
>10 and ≤15	B
>15 and ≤25	C
>25 and ≤35	D
>35 and ≤50	E
>50	F

INTERSECTION IMPACT CRITERIA

The analysis of future conditions compares baseline scenarios with the project opening year to determine whether the project construction traffic is expected to result in a significant impact on the surrounding roadways. Based on previous studies conducted for both the City & County of Honolulu and HDOT, the minimum acceptable operating standard for a signalized intersection is LOS D. If the addition of project traffic is expected to degrade desirable service levels (LOS D or better) to lower than desirable service levels (LOS E or F) then the project is considered to have a project-specific impact. If the LOS for any roadway is LOS E or F without the project and the project adds traffic to this location, then this would be characterized as a cumulative impact. When evaluating intersection approach LOS at any location, other factors should be considered in the analysis, such as traffic volumes, volume-to-capacity (V/C) ratios (which should ideally be less than 1.00), and secondary impacts to pedestrian, bicycle, and transit travel.

For unsignalized intersections, if the addition of project traffic causes the intersection to degrade from LOS D or better to LOS E or F and satisfies the peak hour signal warrant criteria published in the 2009 edition of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD), then the impact is considered project-specific. The project is determined to have a significant cumulative impact when it adds traffic to a study location that includes a controlled approach that operates at a lower than desirable level (i.e., LOS E or F), and satisfies the peak hour signal warrant.

INTERSECTION LOS RESULTS

The analysis of intersection turning movement volumes was completed for Year 2016 Baseline Conditions without the Project, and for Year 2016 plus Project Conditions with both the Conservative and Employee Shuttle scenarios during the construction period. The results of the intersection LOS analysis are summarized in Table 6, and **Attachment C** includes the detailed LOS calculation worksheets.

Table 6 – Intersection Operations During Project Construction

Intersection	Peak Hour	2016 Baseline without Project		2016 Baseline Plus Project			
				Conservative		w/ Employee Shuttles	
		Delay[1]	LOS[2]	Delay	LOS	Delay	LOS
Access Option 1							
Ka Uka Blvd/H-2 NB Off Ramp	AM	10.2	B	11.1	B	10.3	B
	PM	26.7	C	**63.7**	**E**	45.8	D
Ka Uka Blvd/H-2 SB On Ramp*	AM	0.0	A	0.1	A	0.1	A
	PM	0.0	A	2.2	A	0.5	A
Ka Uka Blvd/H-2 SB Off Ramp	AM	31.7	C	33.2	C	31.7	C
	PM	52.8	D	52.8	D	52.8	D
Access Option 2							
Kamehameha Hwy/ Waihona St*	AM	20.5	C	20.5	C	20.5	C
	PM	**> 200**	**F**	**>200**	**F**	**>200**	**F**

Source: Fehr & Peers, July 2014

[1]. Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The worst movement is presented for unsignalized intersections.
[2]. LOS calculations performed using the *2000 Highway Capacity Manual (HCM)* method.
[3]. LOS E or F operations highlighted in **bold.**
* indicates unsignalized intersection

POTENTIAL IMPACTS AND IMPROVEMENT OPTIONS

Table 6 above indicates that all three intersections under Access Option 1 would operate acceptably during both peak hours under both construction traffic scenarios with one exception. The Ka Uka Boulevard/H-2 Northbound Off-ramp intersection is projected to operate at LOS E during the PM peak hour under the Conservative Scenario which assumes that all construction workers drive themselves to the construction site and that the majority of truck trips occur during the peak periods. Under this scenario, the project construction would result in a significant, albeit temporary impact to the roadway network because of the degradation in LOS from D or better to E or F. However, the Employee Shuttle scenario, which assumes 95% of construction workers would park off-site and be driven to the construction site via shuttle buses, the intersection is anticipated to operate acceptably at LOS D with 45.8 seconds of delay. These findings indicate that one of two actions should be included in the project's construction traffic management plan prepared by the contractor to maintain desired intersection operating levels at the Ka Uka Boulevard interchange:

- Construction workers should not travel during the PM peak hour, which could be implemented through the work hour schedule, or
- Provide employee shuttle service to and from the site for at least 50 percent of construction workers at an off-site location.

Under Access Option 2, the Kamehameha Highway/Waihona Street intersection is projected to operate acceptably under all scenarios during the AM peak hour, but the left-turn movement out of Waihona Street would operate at LOS F with significant delays with or without project construction in 2016. Even with some gaps provided by the upstream traffic signal at Acacia Road, traffic turning out of Waihona Street will be delayed due to the relatively high volume of ewa-bound traffic during this peak period and the limited number of gaps. To provide additional gaps especially for large trucks which accelerate slower than passenger vehicles and light duty trucks, a traffic signal would typically be installed required. However, even with signalization, the intersection is expected to operate at a LOS E during the evening peak hour due to increased ewa-bound traffic. Thus, one of two actions should be included in the project's construction traffic management plan prepared by the contractor to minimize impacts to the Kamehameha Highway/Waihona Street access option:

- Outbound heavy truck traffic and employee vehicle trips should be avoided during the PM peak hour through work schedule management, or
- Install a temporary traffic signal at this location. This would have to be coordinated with any access improvements or construction activities that will occur at the Pearl Highlands Transit Center site.

With typical operation of the project site, a total of 5 trips during each peak hour would occur under either access option. This additional traffic would have a negligible effect on intersection turning movement operations at all study locations and the Year 2016 baseline intersection delay and LOS would essentially be unchanged.

ROADWAY SEGMENT OPERATIONS

In addition to evaluating peak hour intersection operations, it is important to assess the potential impact of construction traffic on all of the access roadway segments leading to the project site. Under Access Option 1, H-2 and Ka Uka Boulevard are higher capacity roadways that include typical lane widths and are built to higher standards than other roadways. Mililani Cemetery Road is a two-lane roadway with lane widths of approximately 12 feet plus shoulder areas along most of the segment between Ka Uka Boulevard and Waiawa Prison Road. Although the prison does

not generate a significant amount of existing traffic, the addition of truck traffic to all of these facilities is not anticipated to result in any operational or apparent safety issues.

A potential issue is the relatively narrow width and alignment of Waiawa Prison Road, particularly for heavy vehicles transporting construction equipment and materials. The width of this roadway varies but is roughly 20 feet along several sections between the cemetery road and the site access driveway. In addition, there are several curves where sight distance and the adjacent shoulder width are limited. While this is not an issue for typical passenger vehicles or light duty trucks, it is possible that large trucks may conflict with opposing traffic on this roadway by reducing the available width. While the estimated volume of project-generated truck traffic is 42 trips over the course of a day (i.e., 21 trucks traveling in and out of the site), this activity would occur over an extended period of time and there would be some new drivers on this road where driving conditions may not be familiar to them.

It is important to note that construction activities have recently occurred in the area that added heavy truck traffic to Waiawa Prison Road and the cemetery road. This activity included the decommissioning of several reservoirs that required trucks to transport heavy material and water along these roadways. For a four month period, at least two heavy trucks would make daily rounds on and off Waiawa Prison Road without incident. No significant operational or safety issues were identified by Kamehameha Schools' representatives who monitored the construction activities.

To minimize the potential for conflicts and to maintain adequate traffic operations, the contractor should prepare a construction traffic management plan that includes the following:

- Signage between the Ka Uka Boulevard interchange and the site access driveway on Waiawa Prison Road that trucks are traveling and entering/exiting the roadway.
- Ensure that adequate sight distance is provided for drivers on Waiawa Prison Road approaching the project site driveway.
- Removal of vegetation including tree limbs and other impediments to allow trucks to stay to the far right of the traveled way on both the cemetery road and Waiawa Prison Road (if needed).
- Manual traffic control on Waiawa Prison Road to manage construction and prison traffic and to minimize conflicts. This could include the use of radios, flagpersons, and/or temporary signals and lighting to assist with the control of vehicles and the provision of adequate sight distance (as needed).

Under Access Option 2, both Kamehameha Highway and Waihona Street include typical lane widths and are built to urban standards. Both facilities are currently used by industrial-related traffic and no special operational or safety concerns were identified for either roadway segment. Temporary manual traffic control may be required at the site driveway intersection on Waihona Street, but only when a large volume of trucks is expected to arrive or depart at one time. The need for this control should be included in the construction traffic management plan.

Conclusion

The proposed project will generate a negligible amount of vehicle traffic when the solar farm is fully constructed and operational. During construction, the site is expected to generate between 66 and 342 daily vehicle trips, and between 18 and 168 vehicle trips during each peak hour depending on the level of employee shuttle service provided and the number of truck trips allowed during the AM and PM peak hours. According to the project sponsor SunEdison, construction activity is planned occur for up to a 12-month period and would only result in temporary traffic impacts. A detailed construction traffic management plan should be prepared prior to the start of construction to ensure that the project has a minimal impact to the transportation system during the construction period.

Based on the evaluation presented in this report, both potential points of access are sufficient for the anticipated construction traffic required to build the solar project provided measures are implemented to mitigate the temporary impacts. These measures include a construction traffic management plan that minimizes traffic during the peak commute hours to the extent possible, ensures adequate sight distance at all driveway access points, and informs other drivers on the roadway of construction activities and heavy vehicle traffic. While the evaluation looked at the use of each access option independently, it would be possible to use both access points (or other feasible access points) during construction to distribute project-generated traffic and minimize the temporary impacts at any one location.

We appreciate the opportunity to assist you with this project. Please let us know if you have any questions on the information in this report.

Sincerely,

FEHR & PEERS

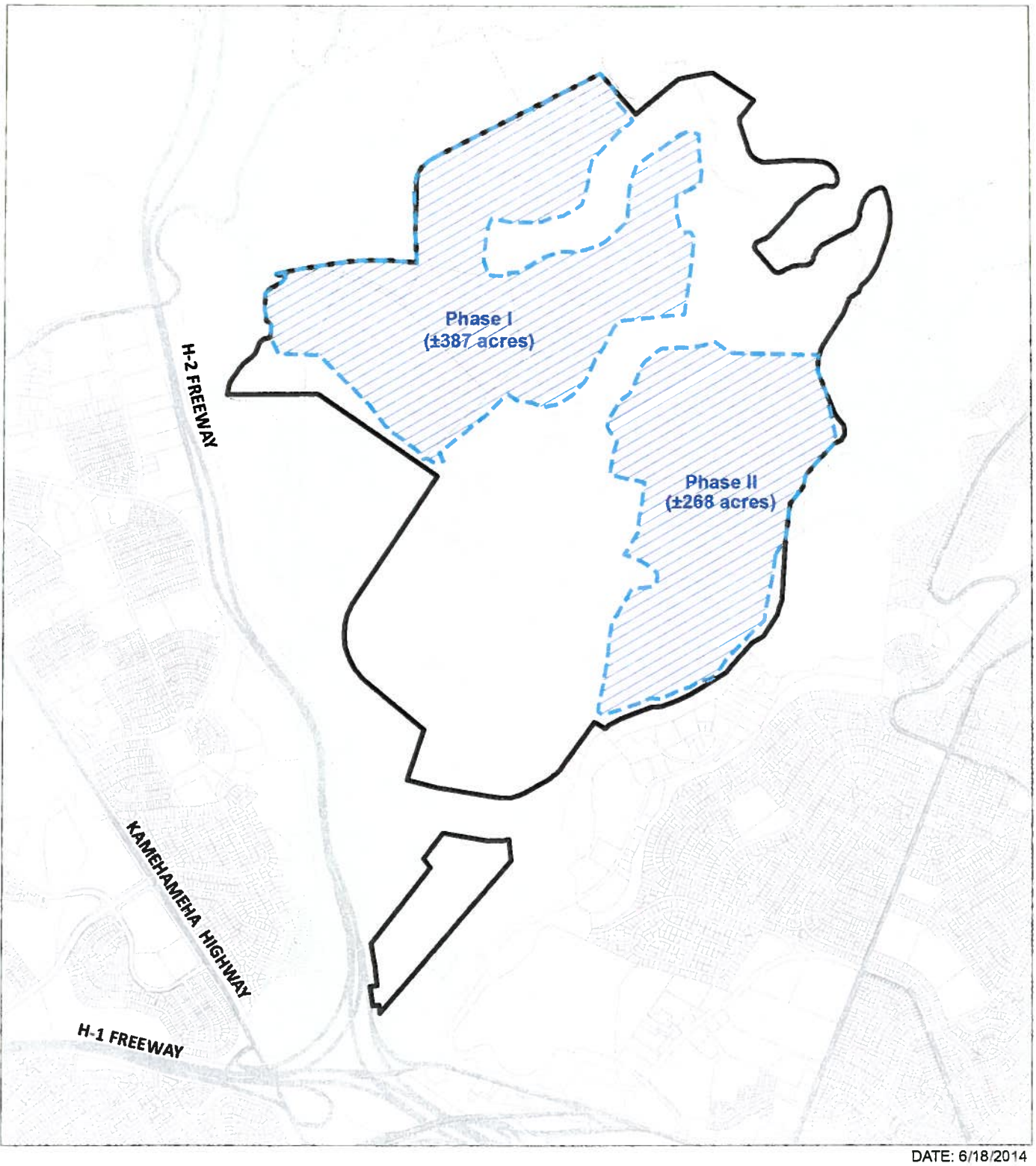
Sohrab Rashid, TE
Principal

Anjuli Bakhru
Transportation Engineer

SD14-0125

Attachment:

Attachment A – Proposed Project Site Plan
Attachment B – Trip Generation Estimates
Attachment C – Intersection Analysis – Project Construction



Q:\Oahu\KS WAIAWA\GIS\PROJECT\Phasing Plan 2014_06.mxd

DATE: 6/18/2014

LEGEND

- KS Waiawa Property (SLU Urban, Docket A87-610)
- Photovoltaic Locations
- Agricultural District
- Conservation District
- Rural District
- Urban District

Source: SunEdison (2014), State Land Use Commission (2014)

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

KS Exhibit 8 Errata (filed 6/20/14)
Phasing Plan
KAMEHAMEHA SCHOOLS WAIAWA MOTION TO AMEND

Island of O'ahu

North

Linear Scale (feet)
0 1,000 2,000

Table 4: Project Trip Generation Calculations - Conservative

Project Trip Type:	Weekday Trip Generation													Notes
		Peak Hours						Off-Peak Hours						
	Daily Trips	AM Peak Hour Trips (6 AM - 7 AM)			PM Peak Hour Trips (4 PM - 5 PM)			Daytime Off-Peak Trips (7 AM - 4 PM)			Nighttime Trips (5 PM - 6 AM)			
	Total	Total	IN	OUT	Total	IN	OUT	Total	IN	OUT	Total	IN	OUT	
Project Construction Phase*														
Automobile Trips:														
Personal Vehicles	300	150	150	0	150	0	150	0	0	0	0	0	0	100% of all construction employees will travel by personal vehicle to the project site
Total Automobile Trips	*300*	*150*	*150*	*0*	*150*	*0*	*150*	*0*	*0*	*0*	*0*	*0*	*0*	
Heavy Vehicle Trips:														
Shuttle Bus	0	0	0	0	0	0	0	0	0	0	0	0	0	
Equipment Deliveries	20	10	10	0	10	0	10	0	0	0	0	0	0	Includes delivery of solar panel and electrical equipment. Assumes that no deliveries are made at night
Employee Food Deliveries	6	0	0	0	0	0	0	6	3	3	0	0	0	Food deliveries to arrive during daytime off-peak hours
Excavation, Debris and Material Hauling, Misc Deliveries	16	8	8	0	8	0	8	0	0	0	0	0	0	Includes miscellaneous deliveries, excavation, debris, and materials hauling
Total Heavy Vehicle Trips	*42*	*18*	*18*	*0*	*18*	*0*	*18*	*6*	*3*	*3*	*0*	*0*	*0*	
Total Construction Phase Trips	**342**	**168**	**168**	**0**	**168**	**0**	**168**	**6**	**3**	**3**	**0**	**0**	**0**	
Project Operational Phase														
Employee Trips (Individual Auto Trips)	*10*	*5*	*5*	*0*	*5*	*0*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	Employee Trips Based Upon Peak Staffing Levels of 5 Full Time Employees
Total Operational Phase Trips	**10**	**5**	**5**	**0**	**5**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	

*Construction Phase Trip Generation Assumptions:

*Based upon peak construction phase of a 50 Megawatt Facility over a 1-Year construction period. If the project construction period lasts for longer than 1-year, the number of peak hour trips would be slightly fewer.

*Project Construction Phase trip generation is based upon a total workforce of 150 employees.

* Automobiles are FHWA Class 1 - 3 vehicles. Heavy vehicles are FHWA Class 4 and above vehicles.

Table 4: Project Trip Generation Calculations - Employee Shuttles and Off-Peak Deliveries

Project Trip Type:	Weekday Trip Generation													Notes
		Peak Hours						Off-Peak Hours						
	Daily Trips	AM Peak Hour Trips (6 AM - 7 AM)			PM Peak Hour Trips (4 PM - 5 PM)			Daytime Off-Peak Trips (7 AM - 4 PM)			Nighttime Trips (5 PM - 6 AM)			
	Total	Total	IN	OUT	Total	IN	OUT	Total	IN	OUT	Total	IN	OUT	
Project Construction Phase*														
Automobile Trips:														
Personal Vehicles	16	8	8	0	8	0	8	0	0	0	0	0	0	5% of all construction employees will travel by personal vehicle to the project site.
Total Automobile Trips	*16*	*8*	*8*	*0*	*8*	*0*	*8*	*0*	*0*	*0*	*0*	*0*	*0*	
Heavy Vehicle Trips: Shuttle Bus	8	4	4	0	4	0	4	0	0	0	0	0	0	95% of all construction employees will travel by shuttle bus to the project site. 4 buses arrive over 1 hour period in the morning and depart in the evening transporting 150 employees
Equipment Deliveries	20	4	4	0	4	0	4	8	4	4	4	2	2	Includes delivery of solar panel and electrical equipment. Assumes that very few deliveries are made at night
Employee Food Deliveries	6	0	0	0	0	0	0	6	3	3	0	0	0	Food deliveries to arrive during daytime off-peak hours
Excavation, Debris and Material Hauling, Misc Deliveries.	16	3	3	0	2	0	2	11	5.5	6	0	0	0	Includes miscellaneous deliveries, excavation, debris, and materials hauling.
Total Heavy Vehicle Trips	*50*	*11*	*11*	*0*	*10*	*0*	*10*	*25*	*13*	*13*	*4*	*2*	*2*	
Total Construction Phase Trips	**66**	**19**	**19**	**0**	**18**	**0**	**18**	**25**	**13**	**13**	**4**	**2**	**2**	
Project Operational Phase														
Employee Trips (Individual Auto Trips)	*10*	*5*	*5*	*0*	*5*	*0*	*5*	*0*	*0*	*0*	*0*	*0*	*0*	Employee Trips Based Upon Peak Staffing Levels of 5 Full Time Employees
Total Operational Phase Trips	**10**	**5**	**5**	**0**	**5**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	

Construction Phase Trip Generation Assumptions:

*Based upon peak construction phase of a 50 Megawatt Facility over a 1 Year construction period. If the project construction period lasts for longer than 1 year, the number of peak hour trips would be slightly

*Project Construction Phase trip generation is based upon a total workforce of 150 employees

** Automobiles are FHWA Class 1 - 3 vehicles. Heavy vehicles are FHWA Class 4 and above vehicles

*Estimated number of shuttle bus trips is based upon 95% of employees transported to the site via shuttle with a single bus capacity of 45 passengers

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/14/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	125	60	747	301	0	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	65	812	327	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	813	406			1139	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	813	406			1139	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	57	89			100	
cM capacity (veh/h)	316	594			609	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	136	65	406	406	327	1
Volume Left	136	0	0	0	0	0
Volume Right	0	65	0	0	327	0
cSH	316	594	1700	1700	1700	609
Volume to Capacity	0.43	0.11	0.24	0.24	0.19	0.00
Queue Length 95th (ft)	52	9	0	0	0	0
Control Delay (s)	24.7	11.8	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	20.5		0.0			0.0
Approach LOS	C					

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	914	56	256	356	0	30	0	473	12	171	207
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.99		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3508		1770	3539		1770		1583		1857	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3508		1770	3539		1770		1583		1857	1583
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)	0	993	61	278	387	0	33	0	514	13	186	225
RTOR Reduction (vph)	0	4	0	0	0	0	0	0	460	0	0	190
Lane Group Flow (vph)	0	1050	0	278	387	0	33	0	54	0	199	35
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		32.4		18.3	54.7		9.4		9.4		13.9	13.9
Effective Green, g (s)		32.4		18.3	54.7		9.4		9.4		13.9	13.9
Actuated g/C Ratio		0.36		0.20	0.61		0.10		0.10		0.15	0.15
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		1262		359	2150		184		165		286	244
v/s Ratio Prot		c0.30		c0.16	0.11		0.02				c0.11	
v/s Ratio Perm									c0.03			0.02
v/c Ratio		0.83		0.77	0.18		0.18		0.33		0.70	0.14
Uniform Delay, d1		26.3		33.9	7.8		36.8		37.4		36.0	32.9
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		4.8		10.0	0.0		0.5		1.2		7.2	0.3
Delay (s)		31.2		43.9	7.8		37.2		38.5		43.2	33.2
Level of Service		C		D	A		D		D		D	C
Approach Delay (s)		31.2			22.9			38.4			37.9	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	31.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	317	34	0	0	8	1	610	0	27	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.98		1.00	0.99				
Flt Protected	0.95	1.00			1.00		0.95	0.96				
Satd. Flow (prot)	1770	1863			3486		1681	1671				
Flt Permitted	0.75	1.00			1.00		0.95	0.96				
Satd. Flow (perm)	1398	1863			3486		1681	1671				
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)	345	37	0	0	9	1	663	0	29	0	0	0
RTOR Reduction (vph)	0	0	0	0	1	0	0	11	0	0	0	0
Lane Group Flow (vph)	345	37	0	0	9	0	345	336	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	15.6	15.6			15.6		16.7	16.7				
Effective Green, g (s)	15.6	15.6			15.6		16.7	16.7				
Actuated g/C Ratio	0.39	0.39			0.39		0.41	0.41				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	541	721			1349		696	692				
v/s Ratio Prot		0.02			0.00							
v/s Ratio Perm	c0.25						c0.21	0.20				
v/c Ratio	0.64	0.05			0.01		0.50	0.49				
Uniform Delay, d1	10.1	7.7			7.6		8.7	8.6				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	2.5	0.0			0.0		0.6	0.5				
Delay (s)	12.5	7.8			7.6		9.3	9.2				
Level of Service	B	A			A		A	A				
Approach Delay (s)		12.1			7.6			9.2			0.0	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	40.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	351	1048	5	612	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	382	1139	5	665	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1521		725	382
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1521		725	382
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	100
cM capacity (veh/h)			435		356	616

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	761	759	5	333	333
Volume Left	0	0	5	0	0
Volume Right	380	759	0	0	0
cSH	1700	1700	435	1700	1700
Volume to Capacity	0.45	0.45	0.01	0.20	0.20
Queue Length 95th (ft)	0	0	1	0	0
Control Delay (s)	0.0	0.0	13.4	0.0	0.0
Lane LOS			B		
Approach Delay (s)	0.0		0.1		
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/21/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	125	60	747	505	0	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	65	812	549	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	813	406			1361	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	813	406			1361	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	57	89			100	
cM capacity (veh/h)	316	594			501	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	136	65	406	406	549	1
Volume Left	136	0	0	0	0	0
Volume Right	0	65	0	0	549	0
cSH	316	594	1700	1700	1700	501
Volume to Capacity	0.43	0.11	0.24	0.24	0.32	0.00
Queue Length 95th (ft)	52	9	0	0	0	0
Control Delay (s)	24.7	11.8	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	20.5		0.0			0.0
Approach LOS	C					

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	41.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	914	56	256	356	0	30	0	473	42	171	207
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.99		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		0.99	1.00
Satd. Flow (prot)		3508		1770	3539		1770		1583		1844	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		0.99	1.00
Satd. Flow (perm)		3508		1770	3539		1770		1583		1844	1583
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)	0	993	61	278	387	0	33	0	514	46	186	225
RTOR Reduction (vph)	0	4	0	0	0	0	0	0	453	0	0	187
Lane Group Flow (vph)	0	1050	0	278	387	0	33	0	61	0	232	38
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		32.6		18.1	54.7		9.4		9.4		15.7	15.7
Effective Green, g (s)		32.6		18.1	54.7		9.4		9.4		15.7	15.7
Actuated g/C Ratio		0.36		0.20	0.60		0.10		0.10		0.17	0.17
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		1245		348	2108		181		162		315	270
v/s Ratio Prot		c0.30		c0.16	0.11		0.02				c0.13	
v/s Ratio Perm									c0.04			0.02
v/c Ratio		0.84		0.80	0.18		0.18		0.37		0.74	0.14
Uniform Delay, d1		27.3		35.1	8.4		37.7		38.5		36.1	32.3
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		5.4		12.1	0.0		0.5		1.5		8.7	0.2
Delay (s)		32.6		47.2	8.5		38.2		39.9		44.8	32.6
Level of Service		C		D	A		D		D		D	C
Approach Delay (s)		32.6			24.6			39.8			38.8	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	33.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	91.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	317	34	0	0	8	1	610	0	201	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.98		1.00	0.92				
Flt Protected	0.95	1.00			1.00		0.95	0.98				
Satd. Flow (prot)	1770	1863			3486		1681	1596				
Flt Permitted	0.75	1.00			1.00		0.95	0.98				
Satd. Flow (perm)	1398	1863			3486		1681	1596				
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)	345	37	0	0	9	1	663	0	218	0	0	0
RTOR Reduction (vph)	0	0	0	0	1	0	0	63	0	0	0	0
Lane Group Flow (vph)	345	37	0	0	9	0	451	367	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	16.2	16.2			16.2		20.2	20.2				
Effective Green, g (s)	16.2	16.2			16.2		20.2	20.2				
Actuated g/C Ratio	0.36	0.36			0.36		0.45	0.45				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	510	679			1271		764	726				
v/s Ratio Prot		0.02			0.00							
v/s Ratio Perm	c0.25						c0.27	0.23				
v/c Ratio	0.68	0.05			0.01		0.59	0.51				
Uniform Delay, d1	11.9	9.1			9.0		9.0	8.6				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	3.5	0.0			0.0		1.2	0.6				
Delay (s)	15.4	9.2			9.0		10.2	9.1				
Level of Service	B	A			A		B	A				
Approach Delay (s)		14.8			9.0			9.7			0.0	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	44.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	381	1048	5	612	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	414	1139	5	665	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1553		758	414
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1553		758	414
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	100
cM capacity (veh/h)			422		339	587

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	794	759	5	333	333
Volume Left	0	0	5	0	0
Volume Right	380	759	0	0	0
cSH	1700	1700	422	1700	1700
Volume to Capacity	0.47	0.45	0.01	0.20	0.20
Queue Length 95th (ft)	0	0	1	0	0
Control Delay (s)	0.0	0.0	13.6	0.0	0.0
Lane LOS			B		
Approach Delay (s)	0.0		0.1		
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/14/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	125	60	747	306	0	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	65	812	333	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	813	406			1145	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	813	406			1145	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	57	89			100	
cM capacity (veh/h)	316	594			606	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	136	65	406	406	333	1
Volume Left	136	0	0	0	0	0
Volume Right	0	65	0	0	333	0
cSH	316	594	1700	1700	1700	606
Volume to Capacity	0.43	0.11	0.24	0.24	0.20	0.00
Queue Length 95th (ft)	52	9	0	0	0	0
Control Delay (s)	24.7	11.8	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	20.5		0.0			0.0
Approach LOS	C					

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	914	56	256	356	0	30	0	473	13	171	207
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.99		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3508		1770	3539		1770		1583		1856	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3508		1770	3539		1770		1583		1856	1583
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)	0	993	61	278	387	0	33	0	514	14	186	225
RTOR Reduction (vph)	0	4	0	0	0	0	0	0	460	0	0	190
Lane Group Flow (vph)	0	1050	0	278	387	0	33	0	54	0	200	35
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		32.4		18.3	54.7		9.4		9.4		14.0	14.0
Effective Green, g (s)		32.4		18.3	54.7		9.4		9.4		14.0	14.0
Actuated g/C Ratio		0.36		0.20	0.61		0.10		0.10		0.16	0.16
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		1261		359	2148		184		165		288	245
v/s Ratio Prot		c0.30		c0.16	0.11		0.02				c0.11	
v/s Ratio Perm									c0.03			0.02
v/c Ratio		0.83		0.77	0.18		0.18		0.32		0.69	0.14
Uniform Delay, d1		26.4		33.9	7.8		36.8		37.4		36.0	32.9
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		4.9		10.0	0.0		0.5		1.2		7.1	0.3
Delay (s)		31.2		43.9	7.8		37.3		38.6		43.1	33.1
Level of Service		C		D	A		D		D		D	C
Approach Delay (s)		31.2			22.9			38.5			37.8	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	31.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	317	34	0	0	8	1	610	0	31	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.98		1.00	0.99				
Flt Protected	0.95	1.00			1.00		0.95	0.96				
Satd. Flow (prot)	1770	1863			3486		1681	1668				
Flt Permitted	0.75	1.00			1.00		0.95	0.96				
Satd. Flow (perm)	1398	1863			3486		1681	1668				
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)	345	37	0	0	9	1	663	0	34	0	0	0
RTOR Reduction (vph)	0	0	0	0	1	0	0	11	0	0	0	0
Lane Group Flow (vph)	345	37	0	0	9	0	351	335	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	15.6	15.6			15.6		16.8	16.8				
Effective Green, g (s)	15.6	15.6			15.6		16.8	16.8				
Actuated g/C Ratio	0.39	0.39			0.39		0.42	0.42				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	539	719			1346		699	693				
v/s Ratio Prot		0.02			0.00							
v/s Ratio Perm	c0.25						c0.21	0.20				
v/c Ratio	0.64	0.05			0.01		0.50	0.48				
Uniform Delay, d1	10.1	7.8			7.6		8.7	8.6				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	2.6	0.0			0.0		0.6	0.5				
Delay (s)	12.7	7.8			7.6		9.3	9.2				
Level of Service	B	A			A		A	A				
Approach Delay (s)		12.2			7.6			9.2			0.0	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	40.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	352	1048	5	612	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	383	1139	5	665	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1522		726	383
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1522		726	383
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	100
cM capacity (veh/h)			434		355	615

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	762	759	5	333	333
Volume Left	0	0	5	0	0
Volume Right	380	759	0	0	0
cSH	1700	1700	434	1700	1700
Volume to Capacity	0.45	0.45	0.01	0.20	0.20
Queue Length 95th (ft)	0	0	1	0	0
Control Delay (s)	0.0	0.0	13.4	0.0	0.0
Lane LOS			B		
Approach Delay (s)	0.0		0.1		
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/21/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	125	60	747	342	0	1
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	136	65	812	372	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	813	406			1184	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	813	406			1184	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	57	89			100	
cM capacity (veh/h)	316	594			586	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	136	65	406	406	372	1
Volume Left	136	0	0	0	0	0
Volume Right	0	65	0	0	372	0
cSH	316	594	1700	1700	1700	586
Volume to Capacity	0.43	0.11	0.24	0.24	0.22	0.00
Queue Length 95th (ft)	52	9	0	0	0	0
Control Delay (s)	24.7	11.8	0.0	0.0	0.0	0.0
Lane LOS	C	B				
Approach Delay (s)	20.5		0.0			0.0
Approach LOS	C					

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	34.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	914	56	256	356	0	30	0	473	14	171	207
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.99		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3508		1770	3539		1770		1583		1856	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3508		1770	3539		1770		1583		1856	1583
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)	0	993	61	278	387	0	33	0	514	15	186	225
RTOR Reduction (vph)	0	4	0	0	0	0	0	0	462	0	0	189
Lane Group Flow (vph)	0	1050	0	278	387	0	33	0	52	0	201	36
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		32.4		18.1	54.5		9.2		9.2		14.4	14.4
Effective Green, g (s)		32.4		18.1	54.5		9.2		9.2		14.4	14.4
Actuated g/C Ratio		0.36		0.20	0.60		0.10		0.10		0.16	0.16
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		1261		355	2140		180		161		296	252
v/s Ratio Prot		c0.30		c0.16	0.11		0.02				c0.11	
v/s Ratio Perm									c0.03			0.02
v/c Ratio		0.83		0.78	0.18		0.18		0.33		0.68	0.14
Uniform Delay, d1		26.4		34.1	7.9		37.0		37.6		35.7	32.5
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		4.9		10.8	0.0		0.5		1.2		6.1	0.3
Delay (s)		31.2		44.9	7.9		37.5		38.8		41.7	32.8
Level of Service		C		D	A		D		D		D	C
Approach Delay (s)		31.2			23.4			38.7			37.0	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	31.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	317	34	0	0	8	1	610	0	66	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.98		1.00	0.97				
Flt Protected	0.95	1.00			1.00		0.95	0.96				
Satd. Flow (prot)	1770	1863			3486		1681	1651				
Flt Permitted	0.75	1.00			1.00		0.95	0.96				
Satd. Flow (perm)	1398	1863			3486		1681	1651				
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)	345	37	0	0	9	1	663	0	72	0	0	0
RTOR Reduction (vph)	0	0	0	0	1	0	0	15	0	0	0	0
Lane Group Flow (vph)	345	37	0	0	9	0	371	349	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	15.8	15.8			15.8		17.4	17.4				
Effective Green, g (s)	15.8	15.8			15.8		17.4	17.4				
Actuated g/C Ratio	0.38	0.38			0.38		0.42	0.42				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	536	714			1336		709	697				
v/s Ratio Prot		0.02			0.00							
v/s Ratio Perm	c0.25						c0.22	0.21				
v/c Ratio	0.64	0.05			0.01		0.52	0.50				
Uniform Delay, d1	10.4	8.0			7.9		8.8	8.7				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	2.6	0.0			0.0		0.7	0.6				
Delay (s)	13.0	8.0			7.9		9.5	9.3				
Level of Service	B	A			A		A	A				
Approach Delay (s)		12.6			7.9			9.4			0.0	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	41.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	352	1048	5	612	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	383	1139	5	665	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1522		726	383
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1522		726	383
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	100
cM capacity (veh/h)			434		355	615

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	762	759	5	333	333
Volume Left	0	0	5	0	0
Volume Right	380	759	0	0	0
cSH	1700	1700	434	1700	1700
Volume to Capacity	0.45	0.45	0.01	0.20	0.20
Queue Length 95th (ft)	0	0	1	0	0
Control Delay (s)	0.0	0.0	13.4	0.0	0.0
Lane LOS			B		
Approach Delay (s)	0.0		0.1		
Approach LOS					

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/14/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	142	152	1851	104	1	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	154	165	2012	113	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2014	1006			2125	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2014	1006			2125	
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	31			100	
cM capacity (veh/h)	51	239			253	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	154	165	1006	1006	113	1
Volume Left	154	0	0	0	0	1
Volume Right	0	165	0	0	113	0
cSH	51	239	1700	1700	1700	253
Volume to Capacity	3.04	0.69	0.59	0.59	0.07	0.00
Queue Length 95th (ft)	Err	113	0	0	0	0
Control Delay (s)	Err	48.0	0.0	0.0	0.0	19.3
Lane LOS	F	E				C
Approach Delay (s)	4854.3		0.0			19.3
Approach LOS	F					

Intersection Summary			
Average Delay	634.3		
Intersection Capacity Utilization	67.2%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	665	81	398	887	0	84	0	754	19	208	193
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.98		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3482		1770	3539		1770		1583		1855	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3482		1770	3539		1770		1583		1855	1583
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)	0	723	88	433	964	0	91	0	820	21	226	210
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	519	0	0	178
Lane Group Flow (vph)	0	803	0	433	964	0	91	0	301	0	247	32
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Effective Green, g (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Actuated g/C Ratio		0.24		0.26	0.53		0.21		0.21		0.15	0.15
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		834		455	1883		370		331		282	240
v/s Ratio Prot		c0.23		c0.24	0.27		0.05				c0.13	
v/s Ratio Perm									c0.19			0.02
v/c Ratio		0.96		0.95	0.51		0.25		0.91		0.88	0.13
Uniform Delay, d1		42.5		41.3	17.0		37.3		43.7		46.9	41.5
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		22.5		30.1	0.2		0.3		28.0		24.7	0.3
Delay (s)		65.0		71.4	17.2		37.6		71.7		71.6	41.8
Level of Service		E		E	B		D		E		E	D
Approach Delay (s)		65.0			34.0			68.3			57.9	
Approach LOS		E			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	52.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	113.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	550	57	0	54	32	1258	0	25	0	0	0
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				
Lane Util. Factor		1.00			0.95		0.95	0.95				
Frt		0.99			0.94		1.00	0.99				
Flt Protected		1.00			1.00		0.95	0.95				
Satd. Flow (prot)		1836			3342		1681	1679				
Flt Permitted		1.00			1.00		0.95	0.95				
Satd. Flow (perm)		1836			3342		1681	1679				
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)	0	598	62	0	59	35	1367	0	27	0	0	0
RTOR Reduction (vph)	0	4	0	0	21	0	0	7	0	0	0	0
Lane Group Flow (vph)	0	656	0	0	73	0	697	690	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)		30.7			30.7		37.6	37.6				
Effective Green, g (s)		30.7			30.7		37.6	37.6				
Actuated g/C Ratio		0.40			0.40		0.49	0.49				
Clearance Time (s)		4.0			4.0		4.0	4.0				
Vehicle Extension (s)		3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)		738			1344		828	827				
v/s Ratio Prot		c0.36			0.02							
v/s Ratio Perm							c0.41	0.41				
v/c Ratio		0.89			0.05		0.84	0.83				
Uniform Delay, d1		21.2			13.9		16.8	16.7				
Progression Factor		1.00			1.00		1.00	1.00				
Incremental Delay, d2		12.6			0.0		7.8	7.3				
Delay (s)		33.8			13.9		24.5	24.0				
Level of Service		C			B		C	C				
Approach Delay (s)		33.8			13.9			24.2			0.0	
Approach LOS		C			B			C			A	

Intersection Summary			
HCM 2000 Control Delay	26.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	76.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	607	831	27	1285	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	660	903	29	1397	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1563		1417	660
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1563		1417	660
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		100	100
cM capacity (veh/h)			419		119	406

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	961	602	29	698	698
Volume Left	0	0	29	0	0
Volume Right	301	602	0	0	0
cSH	1700	1700	419	1700	1700
Volume to Capacity	0.57	0.35	0.07	0.41	0.41
Queue Length 95th (ft)	0	0	6	0	0
Control Delay (s)	0.0	0.0	14.2	0.0	0.0
Lane LOS			B		
Approach Delay (s)	0.0		0.3		
Approach LOS					

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/21/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	256	242	1851	104	1	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	278	263	2012	113	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2014	1006			2125	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2014	1006			2125	
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			100	
cM capacity (veh/h)	51	239			253	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	278	263	1006	1006	113	1
Volume Left	278	0	0	0	0	1
Volume Right	0	263	0	0	113	0
cSH	51	239	1700	1700	1700	253
Volume to Capacity	5.48	1.10	0.59	0.59	0.07	0.00
Queue Length 95th (ft)	Err	288	0	0	0	0
Control Delay (s)	Err	131.5	0.0	0.0	0.0	19.3
Lane LOS	F	F				C
Approach Delay (s)	5203.9		0.0			19.3
Approach LOS	F					

Intersection Summary			
Average Delay	1056.1		
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	665	81	398	887	0	84	0	754	19	208	193
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.98		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3482		1770	3539		1770		1583		1855	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3482		1770	3539		1770		1583		1855	1583
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)	0	723	88	433	964	0	91	0	820	21	226	210
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	519	0	0	178
Lane Group Flow (vph)	0	803	0	433	964	0	91	0	301	0	247	32
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Effective Green, g (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Actuated g/C Ratio		0.24		0.26	0.53		0.21		0.21		0.15	0.15
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		834		455	1883		370		331		282	240
v/s Ratio Prot		c0.23		c0.24	0.27		0.05				c0.13	
v/s Ratio Perm									c0.19			0.02
v/c Ratio		0.96		0.95	0.51		0.25		0.91		0.88	0.13
Uniform Delay, d1		42.5		41.3	17.0		37.3		43.7		46.9	41.5
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		22.5		30.1	0.2		0.3		28.0		24.7	0.3
Delay (s)		65.0		71.4	17.2		37.6		71.7		71.6	41.8
Level of Service		E		E	B		D		E		E	D
Approach Delay (s)		65.0			34.0			68.3			57.9	
Approach LOS		E			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	52.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	113.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	550	57	0	0	228	62	1258	0	25	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.97		1.00	0.99				
Flt Protected	0.95	1.00			1.00		0.95	0.95				
Satd. Flow (prot)	1770	1863			3426		1681	1679				
Flt Permitted	0.56	1.00			1.00		0.95	0.95				
Satd. Flow (perm)	1038	1863			3426		1681	1679				
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)	598	62	0	0	248	67	1367	0	27	0	0	0
RTOR Reduction (vph)	0	0	0	0	29	0	0	8	0	0	0	0
Lane Group Flow (vph)	598	62	0	0	286	0	697	689	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	42.0	42.0			42.0		34.0	34.0				
Effective Green, g (s)	42.0	42.0			42.0		34.0	34.0				
Actuated g/C Ratio	0.50	0.50			0.50		0.40	0.40				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	519	931			1713		680	679				
v/s Ratio Prot		0.03			0.08							
v/s Ratio Perm	c0.58						c0.41	0.41				
v/c Ratio	1.15	0.07			0.17		1.02	1.02				
Uniform Delay, d1	21.0	10.9			11.5		25.0	25.0				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	88.8	0.0			0.0		41.0	38.4				
Delay (s)	109.8	10.9			11.5		66.0	63.4				
Level of Service	F	B			B		E	E				
Approach Delay (s)		100.5			11.5			64.7			0.0	
Approach LOS		F			B			E			A	

Intersection Summary			
HCM 2000 Control Delay	67.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	84.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	84.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	607	831	201	1285	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	660	903	218	1397	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1563		1795	660
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1563		1795	660
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			48		100	100
cM capacity (veh/h)			419		34	406

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	961	602	218	698	698
Volume Left	0	0	218	0	0
Volume Right	301	602	0	0	0
cSH	1700	1700	419	1700	1700
Volume to Capacity	0.57	0.35	0.52	0.41	0.41
Queue Length 95th (ft)	0	0	73	0	0
Control Delay (s)	0.0	0.0	22.6	0.0	0.0
Lane LOS			C		
Approach Delay (s)	0.0		3.1		
Approach LOS					

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	84.4%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/21/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	175	157	1851	104	1	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	190	171	2012	113	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2014	1006			2125	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2014	1006			2125	
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	29			100	
cM capacity (veh/h)	51	239			253	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	190	171	1006	1006	113	1
Volume Left	190	0	0	0	0	1
Volume Right	0	171	0	0	113	0
cSH	51	239	1700	1700	1700	253
Volume to Capacity	3.75	0.71	0.59	0.59	0.07	0.00
Queue Length 95th (ft)	Err	120	0	0	0	0
Control Delay (s)	Err	50.3	0.0	0.0	0.0	19.3
Lane LOS	F	F				C
Approach Delay (s)	5294.4		0.0			19.3
Approach LOS	F					

Intersection Summary			
Average Delay	768.2		
Intersection Capacity Utilization	67.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	665	81	398	887	0	84	0	754	19	208	193
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.98		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3482		1770	3539		1770		1583		1855	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3482		1770	3539		1770		1583		1855	1583
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)	0	723	88	433	964	0	91	0	820	21	226	210
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	519	0	0	178
Lane Group Flow (vph)	0	803	0	433	964	0	91	0	301	0	247	32
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Effective Green, g (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Actuated g/C Ratio		0.24		0.26	0.53		0.21		0.21		0.15	0.15
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		834		455	1883		370		331		282	240
v/s Ratio Prot		c0.23		c0.24	0.27		0.05				c0.13	
v/s Ratio Perm									c0.19			0.02
v/c Ratio		0.96		0.95	0.51		0.25		0.91		0.88	0.13
Uniform Delay, d1		42.5		41.3	17.0		37.3		43.7		46.9	41.5
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		22.5		30.1	0.2		0.3		28.0		24.7	0.3
Delay (s)		65.0		71.4	17.2		37.6		71.7		71.6	41.8
Level of Service		E		E	B		D		E		E	D
Approach Delay (s)		65.0			34.0			68.3			57.9	
Approach LOS		E			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	52.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	113.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	550	57	0	0	91	34	1258	0	25	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.96		1.00	0.99				
Flt Protected	0.95	1.00			1.00		0.95	0.95				
Satd. Flow (prot)	1770	1863			3395		1681	1679				
Flt Permitted	0.67	1.00			1.00		0.95	0.95				
Satd. Flow (perm)	1240	1863			3395		1681	1679				
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)	598	62	0	0	99	37	1367	0	27	0	0	0
RTOR Reduction (vph)	0	0	0	0	20	0	0	7	0	0	0	0
Lane Group Flow (vph)	598	62	0	0	116	0	697	690	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	39.0	39.0			39.0		36.7	36.7				
Effective Green, g (s)	39.0	39.0			39.0		36.7	36.7				
Actuated g/C Ratio	0.47	0.47			0.47		0.44	0.44				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	577	868			1581		737	736				
v/s Ratio Prot		0.03			0.03							
v/s Ratio Perm	c0.48						c0.41	0.41				
v/c Ratio	1.04	0.07			0.07		0.95	0.94				
Uniform Delay, d1	22.4	12.3			12.4		22.5	22.4				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	47.2	0.0			0.0		20.8	19.3				
Delay (s)	69.6	12.4			12.4		43.3	41.7				
Level of Service	E	B			B		D	D				
Approach Delay (s)		64.2			12.4			42.5			0.0	
Approach LOS		E			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	47.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	607	831	63	1285	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	660	903	68	1397	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1563		1495	660
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1563		1495	660
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			84		100	100
cM capacity (veh/h)			419		95	406

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	961	602	68	698	698
Volume Left	0	0	68	0	0
Volume Right	301	602	0	0	0
cSH	1700	1700	419	1700	1700
Volume to Capacity	0.57	0.35	0.16	0.41	0.41
Queue Length 95th (ft)	0	0	14	0	0
Control Delay (s)	0.0	0.0	15.3	0.0	0.0
Lane LOS			C		
Approach Delay (s)	0.0		0.7		
Approach LOS					

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	79.7%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Kamehameha Hwy & Waihona St

7/14/2014

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	144	155	1851	104	1	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	157	168	2012	113	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2014	1006			2125	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2014	1006			2125	
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	30			100	
cM capacity (veh/h)	51	239			253	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1
Volume Total	157	168	1006	1006	113	1
Volume Left	157	0	0	0	0	1
Volume Right	0	168	0	0	113	0
cSH	51	239	1700	1700	1700	253
Volume to Capacity	3.08	0.70	0.59	0.59	0.07	0.00
Queue Length 95th (ft)	Err	117	0	0	0	0
Control Delay (s)	Err	49.4	0.0	0.0	0.0	19.3
Lane LOS	F	E				C
Approach Delay (s)	4841.2		0.0			19.3
Approach LOS	F					

Intersection Summary			
Average Delay	641.9		
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	665	81	398	887	0	84	0	754	19	208	193
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		0.95		1.00	0.95		1.00		1.00		1.00	1.00
Frt		0.98		1.00	1.00		1.00		0.85		1.00	0.85
Flt Protected		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (prot)		3482		1770	3539		1770		1583		1855	1583
Flt Permitted		1.00		0.95	1.00		0.95		1.00		1.00	1.00
Satd. Flow (perm)		3482		1770	3539		1770		1583		1855	1583
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)	0	723	88	433	964	0	91	0	820	21	226	210
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	519	0	0	178
Lane Group Flow (vph)	0	803	0	433	964	0	91	0	301	0	247	32
Turn Type		NA		Prot	NA		Prot		Perm	Split	NA	Perm
Protected Phases		4		3	8		5			6	6	
Permitted Phases									5			6
Actuated Green, G (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Effective Green, g (s)		27.1		29.1	60.2		23.7		23.7		17.2	17.2
Actuated g/C Ratio		0.24		0.26	0.53		0.21		0.21		0.15	0.15
Clearance Time (s)		4.0		4.0	4.0		4.0		4.0		4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0		3.0		3.0		3.0	3.0
Lane Grp Cap (vph)		834		455	1883		370		331		282	240
v/s Ratio Prot		c0.23		c0.24	0.27		0.05				c0.13	
v/s Ratio Perm									c0.19			0.02
v/c Ratio		0.96		0.95	0.51		0.25		0.91		0.88	0.13
Uniform Delay, d1		42.5		41.3	17.0		37.3		43.7		46.9	41.5
Progression Factor		1.00		1.00	1.00		1.00		1.00		1.00	1.00
Incremental Delay, d2		22.5		30.1	0.2		0.3		28.0		24.7	0.3
Delay (s)		65.0		71.4	17.2		37.6		71.7		71.6	41.8
Level of Service		E		E	B		D		E		E	D
Approach Delay (s)		65.0			34.0			68.3			57.9	
Approach LOS		E			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	52.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	113.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	550	57	0	0	58	33	1258	0	25	0	0	0
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				
Lane Util. Factor	1.00	1.00			0.95		0.95	0.95				
Frt	1.00	1.00			0.95		1.00	0.99				
Flt Protected	0.95	1.00			1.00		0.95	0.95				
Satd. Flow (prot)	1770	1863			3346		1681	1679				
Flt Permitted	0.69	1.00			1.00		0.95	0.95				
Satd. Flow (perm)	1285	1863			3346		1681	1679				
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)	598	62	0	0	63	36	1367	0	27	0	0	0
RTOR Reduction (vph)	0	0	0	0	19	0	0	7	0	0	0	0
Lane Group Flow (vph)	598	62	0	0	80	0	697	690	0	0	0	0
Turn Type	Perm	NA			NA		Perm	NA				
Protected Phases		4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	39.0	39.0			39.0		36.7	36.7				
Effective Green, g (s)	39.0	39.0			39.0		36.7	36.7				
Actuated g/C Ratio	0.47	0.47			0.47		0.44	0.44				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	598	868			1559		737	736				
v/s Ratio Prot		0.03			0.02							
v/s Ratio Perm	c0.47						c0.41	0.41				
v/c Ratio	1.00	0.07			0.05		0.95	0.94				
Uniform Delay, d1	22.4	12.3			12.2		22.5	22.4				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	36.8	0.0			0.0		20.8	19.3				
Delay (s)	59.2	12.4			12.2		43.3	41.7				
Level of Service	E	B			B		D	D				
Approach Delay (s)		54.8			12.2			42.5			0.0	
Approach LOS		D			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	44.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	607	831	31	1285	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	660	903	34	1397	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1319		
pX, platoon unblocked						
vC, conflicting volume			1563		1426	660
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1563		1426	660
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		100	100
cM capacity (veh/h)			419		116	406

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3
Volume Total	961	602	34	698	698
Volume Left	0	0	34	0	0
Volume Right	301	602	0	0	0
cSH	1700	1700	419	1700	1700
Volume to Capacity	0.57	0.35	0.08	0.41	0.41
Queue Length 95th (ft)	0	0	7	0	0
Control Delay (s)	0.0	0.0	14.3	0.0	0.0
Lane LOS			B		
Approach Delay (s)	0.0		0.3		
Approach LOS					

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	15		

SunEdison

Waiawa 50 MW Solar Project – Interconnection Feasibility and Impact Assessment

Project Interconnection Characteristics

The 50 MW Waiawa Solar Project could interconnect to one of two nearby existing 46kV circuits that run adjacent to the H-2 Freeway and just west of the proposed project site. The final Interconnection Requirements Study (IRS) will be provided by Hawaiian Electric as per requisite protocols and requirements of the Public Utilities Commission. The final IRS is due to be accepted by SunEdison and Hawaiian Electric as final by October 15th, 2014.

Circuit name: Wahiawa – Waimano 46kV Circuit

Source end: Wahiawa 138kV Substation (Served by the 80MVA Wahiawa 138-46kV Tsf #3)

The circuit conductor size is 336 AL from the Wahiawa 138kV Substation over a roughly 2-1/2 mile section. The conductor size is increased to 556 AL and proceeds for a relatively short segment up to the point of an overhead to underground riser pole located at the northern edge (Wahiawa side) of the Mililani Mauka subdivision. From that point, the circuit proceeds underground using 1500 AL cable for approximately one mile until it risers up, transitioning back to overhead construction. The segment of overhead conductor (a roughly 5,000 feet section of line) is comprised of 556 AL conductor.

Circuit name: Waiau – Wahiawa 46 kV Circuit

Source end: Waiau 138 kV Substation (Served by Waiau 46 kV tied bus)

Circuit Description: The subject circuit serves several distribution substations starting from the source end fed from the Waiau 46 kV bus at Hawaiian Electric's (HECO's) Waiau Power Plant in Pearl City, Oahu, extending to and serving the residential and commercial customers in Mililani and Kunia. It is a relatively lightly loaded circuit during normal operations. The entire 46 kV circuit is overhead construction.

Waiawa Interconnection Study

An interconnection study for the 50 MW Waiawa Solar Project commenced under an Interconnection Requirements Study Letter Agreement executed by SunEdison, LLC and HECO on October 3, 2013. All models of the inverter and photovoltaic system as well as single line diagrams and other requested materials were provided by SunEdison in a timely manner in order to commence the study along with all other utility scale 'low-cost waiver solicitation' projects. Initial feedback from HECO was that the 50 MW Project interconnection is feasible, and would require re-conductoring of 2-4 miles of 46kV lines on the Wahiawa – Waimano 46kV Circuit. Current advice and documentation now indicates HECO's intention to connect the project via 2 X 25MW interconnections to 2 circuits which no longer requires this re-conductoring line work.

March 4, 2014, HECO indicated it wished to increase its understanding of curtailment impacts of the low-cost waiver projects. HECO initiated an assessment of how Distributed Generation fits in with existing System

Base Cases. The HECO analysis is anticipated to be completed after HECO submits its Power Supply Improvement Plan for Oahu to the Public Utilities Commission in August.

The IRS study draft is due to be received by August 19, 2014 and be finalized by October 15, 2014.

Impacts on Residential and Commercial Interconnections

The 50MW Waiawa Solar project will connect to the HECO grid at 46kV where power will flow to two 46-138kV substations and step-up to 138kV via transformers, the same sub-transmission level that some HECO fossil generation is produced at. In contrast, commercial and residential systems are connecting to the grid at 12kV. It is at the 12kV that HECO evaluates limitations on interconnections. Essentially, HECO's evaluations and limitations are based on constraints of individual 12kV feeders (essentially by neighborhood). In HECO's current evaluation process, interconnections at the utility scale/sub transmission level (46 kV) will not impact assessments of individual 12 kV solar photovoltaic interconnections. Residential and commercial project interconnections require a full IRS study when limitations on the 12kV feeders have been reached related to penetration (greater than 15%) or minimum daytime load thresholds (which are being revisited but which have recently been 125% of minimum daytime loading), both of which are not influenced by generation of solar at the 46kV sub-transmission level.

HECO is currently studying the larger impacts of the amount of penetration of solar and other intermittent energy sources (wind, etc.) as a whole on the Oahu grid as part of a Power Supply Improvement Plan which was submitted to the Public Utilities Commission in late August. We trust that the Hawaii PUC will make the right decisions in balancing the energy generation portfolio of the island for the maximum benefit of the ratepayer.

Interconnection Project Engineer

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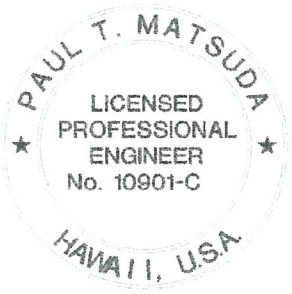
Waiawa Solar Farm Project
Preliminary Civil Considerations

Waiawa, 'Ewa, O'ahu
Tax Map Key Numbers:
(1) 9-4-006: 034 (por.), 035 (por.), 036, 037 (por.);
(1) 9-6-004: 024 (por.), 025, 026;
(1) 9-6-005: 001 (por.)



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE
EXPIRATION DATE: 04/30/2016

Prepared for

SunEdison

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Prepared by:

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October 6, 2014

KS Exhibit 37

GROUP 70
INTERNATIONAL

SunEdison Waiawa Solar Farm Project – Preliminary Civil Considerations

Project Description

The proposed Waiawa Solar Farm Project is located on Kamehameha Schools (KS) property on former agricultural lands in Waiawa, Ewa, Oahu. The solar farm project will be developed in two phases. Phase I is planned to generate approximately 50 MW of power and will be constructed within approximately 300 acre easement area. Phase II is planned to generate approximately 65 MW of power and will constructed within approximately 268 acre easement area. The actual areas of the solar farm will vary depending on existing topography and system design and layout.

Photovoltaic modules (PV Panels) will be mounted on steel racks which are anchored to the ground on piers. The racks will be fixed to the piers and tilted in the southerly direction. Groups of racks will be arranged and combined to deliver power to inverters which will be mounted on concrete pads. These inverters will deliver the power to a dedicated project substation and battery storage system located near the point of interconnection to HECO's existing 46kv transmission line on the west side of the project site in phase I.

Infrastructure improvements required for the solar farm include: substation, battery storage system, PV panels, pad mounted inverters and electrical equipment, access driveways, perimeter fencing, security systems, and drainage and vegetation improvements.

Access

Access to the project site is primarily from the Waiawa Prison Road along the northern edge of the KS property, which connects to the H-2 freeway via Mililani Memorial Cemetery Road and Ka Uka Boulevard. Secondary access to the property is off of Waihona Street, mauka of Kamehameha Highway, in the Pearl City Industrial Park. There are numerous unpaved roads throughout the KS property.

The project area was historically used for sugar cane cultivation, but has remained fallow since 1983. As a result, the former sugar cane fields are overgrown with dense vegetation. The internal access roads have been maintained and cleared by KS to the extent possible to allow vehicular access throughout the property.

Grading and Drainage

In general, the solar farm will be located on the ridgelines where the former tilled sugar cane fields were located. Phase I project area generally slopes mauka to makai down from elevations of 660 feet to 395 feet. Phase II generally slopes mauka to makai from elevation of 520 feet to 240 feet based on available topographic information. Optimal placement of the PV panels will be on the flatter more gradually sloped areas on the ridgelines and away from the steep ravines that lead to the valleys below.

Clearing, grubbing and grading will be needed on the project site for placement of the solar panels, equipment, facilities, access driveways, fence and vegetated buffer. In general, the steeper areas of the project site will be avoided and PV racks will be concentrated in areas of more gradual slopes. The initial rough estimates of potential earthwork volumes for Phase 1 contemplated roughly 400,000 cubic yards of balanced cut/fill across the site in order to install the

fixed tilt racking system of the modules on relatively flat terrain. It is anticipated that the earthwork volumes and related construction costs will be minimized by optimal placement of the PV racks by following the existing grades and elevations. Where possible, the existing agricultural roads will continue to be utilized for access.

Permits and approvals will be required from the State of Hawaii and the City and County of Honolulu (C&C) to allow grading and grubbing of the site including:

- State of Hawaii Department of Health (DOH) - NPDES General Permit for Construction Activities, Notice of Intent (NOI-C)
- City and County of Honolulu - Grading, Grubbing and Stockpiling Permit

The applications for both State and C&C grading and erosion control permits identified above require agency review and approval of Grading and Erosion Control Construction Plans including related Storm Water Pollution Prevention Plans, Erosion Control Calculations, and Drainage Reports.

Stormwater Quantity Management

Since the solar farm is generally located on the ridgelines, the project area is generally not subject to runoff from offsite areas mauka of the site. Existing runoff currently discharges through sheet flow or shallow concentrated flow into swales onto adjacent downstream areas. The existing drainage patterns will not be altered in this project with earthwork limited to leveling for access driveways, equipment pads, and the substation.

Addition of impervious area from concrete equipment pads, equipment buildings and micro-pile/pier foundations will be minimal. Due to the even distribution of impervious area throughout the project site, slight leveling of driveway areas, and use of raised gravel driveways, the increase in impervious area is not anticipated to increase runoff rates. As a result, there will not be a significant pre-development to post-development increase in stormwater flows due to the construction of the project.

Onsite stormwater will be properly directed away from equipment pads and any other structures to minimize erosion. Drainage channels with velocity reduction controls will be constructed in which water will flow to stormwater basin(s) and/or other volume control facilities. The volume control facilities will be situated at the proper downstream locations, and will discharge out with non-erosive velocities back into the natural drainage features.

Offsite flows, to the extent there are any, will be diverted around the site or through the site so as to not impact the existing drainage paths as well as the proposed construction. If required, diversion channels will be constructed with check dams, drop structures or other velocity reducing controls and flow back into the natural drainage features.

Stormwater Quality Management

Both temporary and permanent Best Management Practices (BMPs) are required to be implemented for the project through the grading and erosion control regulations and permits required by the State and C&C agencies. Temporary BMPs are required during construction activities and will remain in place until Permanent BMPs can be established. Temporary erosion

control measures will be incorporated during the construction period to minimize soil loss and erosion hazards. It is anticipated that the erosion control BMPs to be used on-site will include the following:

- Preservation of natural vegetation
- Minimize area of clearing and grubbing
- Vegetated buffers
- Temporary soil stabilization with grass and/or mulch
- Silt fences/fiber filtration tubes
- Gravel bag berms/check dams
- Stabilized construction entrances
- Sediment traps and basins
- Temporary diversion swales and ditches
- Dust control – water application and/or dust screens

Due to the size of the project, the above temporary BMPs will be implemented in a phased manner through grading increments as required by the regulatory agencies. Details on the grading increments and related BMPs will be shown on the Grading and Erosion Control Plans.

Permanent erosion control BMPs will also incorporated into the design and are required to close out grading and erosion control permits. Typically permanent BMPs primarily include final stabilization of exposed soils through landscaping or installation of impervious surfaces including pavement and buildings. Additional BMPs are also typically required to provide treatment of stormwater runoff to remove pollutants. For solar farm projects, the total additional impervious surface is minimal and the PV panels are not pollution generating surfaces. However, C&C regulations include minimum thresholds for requirements related to installation of BMPs for stormwater quality based on total disturbed area regardless of the added impervious area or pollutant generation from a project.

C&C Civil Engineering Branch (CEB) is responsible for interpreting and approving BMP and drainage system designs. For solar farms, CEB has been defining the project's disturbed area as all of the area within the project fence line, regardless of actual ground disturbance. This determination results in the solar farm project being classified as a "Priority A1" project that triggers the following low impact development (LID) requirements:

- Unless infeasibility criteria, as defined in §1-5.2 of the Water Quality Design Standards, can be met for each type of LID feature, Water Quality Volume (WQV) must be calculated using the 1" design storm runoff depth and retained on-site through use of permanent BMPs that utilize infiltration or evapotranspiration.
    - Consultation with CEB resulted in a City determination that the WQV must account for stormwater runoff from the total area within the project fence line.
- If infeasibility criteria are met, any portion of the WQV that is not retained must be bio-filtered using permanent erosion control BMPs.

In summary, the project will likely be required to provide onsite treatment of 1" of runoff over the entire disturbed area. BMP requirements and applicable drainage criteria and standards will be

confirmed with the C&C during design. It is anticipated that permanent BMPs to be utilized on the project include the following:

- Permanent soil stabilization with landscaping, pavement, or gravel
- Infiltration trenches
- Dry wells and sumps
- Grass swales and ditches
- Filter strips
- Sediment traps and basins

PV Panel Maintenance

During operations, the site would be largely unoccupied, other than security staff. Panel cleaning will typically occur a couple of times per year depending on rainfall. It is anticipated that the panels will be cleaned with water delivered by truck to the site unless a closer source of water is identified. Cleaning solutions and other chemicals will not be used to clean the panels.

Noise Impacts

The solar farm is a relatively passive operation. The racking systems are fixed and do not have any motors or moving parts. The electrical equipment does not include any mechanical or motorized equipment that will generate noise. There will be some minimal corona noise coming from the electrical equipment. Operation and maintenance activities may result in minimal vehicular noise from security and maintenance staff. It is not anticipated that operations at the site would generate noise that exceeds acceptable noise levels.

During construction, noise levels are likely to increase as a result of earth moving equipment, installation of solar panels, construction vehicles and other construction activities. Noise generated from construction activities will comply with the regulations for community noise control in the Hawaii Administrative Rules (HAR) Chapter 11-46. Due to the remote location of the project and distance from communities it is anticipated that any impacts would be minimal. If necessary, noise permits will be obtained through DOH.

Air Quality

There are no direct air emissions from operating the solar farm. Operation and maintenance activities may result in small amounts of fugitive dust or tailpipe emissions from vehicular traffic and landscape maintenance. However, it is not anticipated that the operations at the site would adversely affect air quality.

During construction, there will be short-term impacts in the form of exhaust from increased traffic and fugitive dust generated by the construction activity. Temporary BMPs will be used to mitigate impact from fugitive dust during construction. These BMPs may include dust fences, windbreaks, watering of disturbed areas and other soil management measures. BMPs will be identified and included on the erosion control plans that are required for both C&C and State grading and erosion control permit approvals. Construction activities at the site will comply with the regulations for fugitive dust control in HAR, Section 11-60.1.

Groundwater Impacts

The solar farm PV panels are not pollution generating surfaces. The racks will be fixed and do not have any motors or moving parts. Although Phase 2 of the project is located over the US Navy Waiawa Shaft Zone of Contribution, it is not anticipated that the project would have an impact since it does not generate pollutants which would be discharged to groundwater.

Considerations for Development

Kamehameha Schools ("KS") has kuleana of over 300,000 acres of land in the islands that was bequeathed to KS by Bernice Pauahi Bishop for the purpose of serving children of Hawaiian ancestry. The Waiawa lands, which are a part of this legacy, present a tremendous opportunity for honoring her legacy, and the legacy of other ali'i who graced these lands, by choosing and utilizing sustainable methods of land management grounded in a Hawaiian worldview.

The original master plan and the development program created by Gentry for the Waiawa property were made in the 1980s. The Gentry plan appropriately envisioned utilizing the Waiawa property for urban uses (e.g. a variety of residential uses, commercial, industrial and golf course uses). Even at that time it was recognized that the Waiawa property was within the desired path of future urban development on Oahu. In 2002, through the Central Oahu Sustainable Communities Plan, the City and County of Honolulu designated the Waiawa property for urban type uses.

While the Gentry development plan is generally consistent with the intensity of development recognized as appropriate for the Waiawa property and environs, at this point in time the plan is somewhat out of date, and does not recognize the most recent developments in land use planning and environmental considerations. Furthermore, the areas surrounding the Waiawa property have changed, and significant changes are planned in the near future. As a result, the Gentry plan needs to be re-assessed to take into consideration todays' regional and social changes, versus those of 25+ years ago. The jobs and revenues projected to result from the Gentry plan are likely not realistic in the current environment. However, rather than letting the land remain vacant and unproductive, KS has sought out opportunities to make good use of the property in a manner that benefits the State as a whole.

As an institution KS has evolved since the 1980s, and KS has an obligation to evaluate uses of the Waiawa property in a way that is consistent with its mission and obligations to beneficiaries. KS must continually seek ways of securing a financial return from its assets, such as the Waiawa property, while ensuring that the methods to obtain those returns are consistent with the KS values and mission. During this interim period of 30 - 35 years, while SunEdision is utilizing large portions of the Waiawa property, KS will be able to realize some level of financial return on the property, while creating an opportunity for Oahu electricity users to experience a significant reduction in utility costs. An additional benefit to utilizing portions of the Waiawa property as a solar farm is that solar farms uses are not incompatible with other urban-type development. The SunEdision solar farm, projected to use less than 600 acres of the Waiawa property, will not preclude KS from pursuing other development options on the remainder of the Waiawa property.

I. THE KAMEHAMEHA SCHOOLS' PROCESS

a. STRATEGIC PLANNING

Kamehameha Schools is a perpetual charitable trust for the education of the youth of Hawaii, and whose primary mission is to educate Native Hawaiian children. As a perpetual charitable trust, KS

must be particularly cautious about taking any actions that may reduce its limited trust assets. In order to fulfill its educational mission, KS must engage in a strategic planning process that addresses both its plan for education and its investment plan. Strategic plans are prepared in order to chart KS' course for the future. As such, strategic plans must necessarily be updated on a regular basis in order for KS to assess how it is performing in achieving its goals and fulfilling its mission.

The current plan, Kamehameha Schools Strategic Plan 2000 - 2015, is coming to a close. Therefore, KS has recently embarked on an organizational wide Strategic Planning Processes for the 2015-2040 time horizon. As part of this Strategic Plan update process, we have already orchestrated over 100 internal and external input-gathering sessions statewide. Similar to the 2000 - 2015 Strategic Plan, the 2015 - 2040 Strategic Plan will set the overall goals for KS with respect to its educational mission, identify issues, formulate strategies for addressing those issues, and result in goals and priorities to be pursued by KS in the near future. Future uses of the Waiawa property will have to be evaluated against the goals and priorities to be set forth in the 2015 - 2040 Strategic Plan.

b. PLANNING AND EDUCATION

The importance of the upcoming 2015 - 2040 Strategic Plan to the Waiawa Project is that the Waiawa lands will be included in a regional planning effort where learning opportunities in conjunction with commercial development will be considered. The concept of direct collaboration of education with commercial development may present exciting new opportunities for KS. This concept must be explored in order to determine possible implementation strategies and feasibility.

For example, KS would like to explore the feasibility of incorporating learning opportunities on the Waiawa lands including:

- Land stewardship opportunities (aina based learning)
- Potential collaborations with Leeward Community College

Incorporating such educational opportunities necessarily means identifying appropriate development options for the Waiawa property. This will take time and creativity, but KS has already begun to take action on this front.

The agreement between KS and SunEdision, which allows SunEdision to develop a solar farm on portions of the Waiawa property, requires SunEdision to cooperate with KS in supporting educational programs during the term of the solar farm project. SunEdision has offered school programs to middle school and high school students elsewhere, to help students understand renewable energy technology in a hands-on way, so that students can understand how solar energy works within the overall power supply systems.

c. STAKEHOLDERS

Development of the Waiawa property also needs to include the interests of the State, community, KS Beneficiaries, and economic considerations. KS embraces an extensive community consultation

process and works to better align land management decisions consistent with the overall KS Strategic Plan and needs of the community as illustrated by our North Shore, Kapalama, and Kakaako Plans.

One of the challenges with the Gentry plan is that it assumed that half of the housing would be limited to "retirement/leisure housing" available to people aged 55 and over. This type of development is likely no longer practical or desirable. However, that assumption can be confirmed (or refuted) though meetings with stakeholders in the community.

Another matter to be assessed with stakeholders is the impact of rail. Today Honolulu has a rail system that was not envisioned by the Gentry plan. This new mass transit system under construction falls within a quarter mile of the southern portion of the Waiawa property. The proximity of the rail line and the planned stations for Pearl Highlands and Leeward Community College provide an opportunity to reexamine how the southern portion of the Waiawa property could be developed to embrace Transit Oriented Development (TOD). Initial discussions with City officials have resulted in optimism regarding potential TOD opportunities and potential private/public collaborations. However, the Gentry Plan assumes a northerly approach to the property, crossing Ka Uka Boulevard. This northerly approach was planned at a time when rail was not on the horizon. This approach requires expensive infrastructure, and may not make sense in light of the pending rail system. Due to the pending TOD, a more southern approach needs to be evaluated.

There are several potential TOD and collaborative opportunities that could emerge, including:

- The creation of a more sustainable community with direct access to alternative modes of transportation (i.e., rail)
- An opportunity to collaborate with the City to potentially develop affordable and work force housing near the proposed rail station
- An opportunity to collaborate with the City for potential park-and-ride destinations on the southern portion of the property.

However, one of the challenges with this approach is that existing State and County land use designations will need to be evaluated, as some of the southern portion of the Waiawa property falls outside of the State Land Use Urban District. Additional governmental approvals will be necessary to enable full development of the southern portion of the property which will require further studies, planning, and time.

With the significant changes to socio –economic conditions, traffic infrastructure, and environmental changes over the past 25+ years, the Gentry Plan needs to be re-examined. KS is committed to reevaluating the Gentry plan in the context of the current and near-future development environment surrounding the Waiawa property.

d. PLANNING PROCESS

As a first step, KS will complete its 2015 - 2040 Strategic Plan, which necessarily involves engagement with KS stakeholders. Once the new Strategic Plan is in place, KS will be in a position where it can assess the Waiawa property against its established goals and priorities.

As a second step, KS will work within the context of the Strategic Plan and work with community members, educators, beneficiaries on a regional basis to define specific goals and objectives for the Leeward Area Region. This is a large scale planning effort that is necessary to help guide the best decisions for the development of the land. It is estimated that a plan will be defined by 2017.

Upon completion of the regional plan, master planning of the Waiawa lands can commence. The master planning process would involve a community consultation process to align land management decisions with market conditions and the regional plans.

Additional studies to assess infrastructure, traffic, cultural implications, and a host of other planning studies will be required to evaluate the feasibility of desired scenarios. As mentioned above, additional/revised land use approvals may also be required, depending upon the master plan scenarios.

Once specific plans for the Waiawa property are finalized and approved by our Trustees, they can be presented to the Land Use Commission for review. KS acknowledges that with any future development proposals for the Waiawa property, the Commission will have the authority to impose new conditions of approval on the Waiawa property if the Commission deems such conditions necessary to uphold the intent and spirit of Chapter 205.

TCP Hawai'i, LLC

Documenting Traditional Cultural Properties of Hawai'i
Preserving and Restoring Cultural and Natural Resources of Hawai'i

September 16, 2014

To: SHPD-Archaeology Branch

Re: Submittal of Archaeological Inventory Survey of 1,395 Acres of Kamehameha Schools' Land in Waiawa and Waipi'o Ahupua'a, 'Ewa District, O'ahu Island, Hawai'i
TMK (1) 9-4-006:034 por., 035 por., 036, 037 por.; 9-6-004:024 por., 025, 026; 9-6-005:001 por.

Aloha SHPD-Archaeology Branch,

TCP Hawai'i is submitting this Archaeological Inventory Survey (AIS) report of an approximately 1,395-acre project area of Kamehameha Schools' land in Waiawa and Waipi'o Ahupua'a, 'Ewa District, O'ahu, for your review and comment. The project proponent is Kamehameha Schools (567 South King Street, Suite 200, Honolulu, HI 96813). The project representative is Jason Jeremiah, Senior Cultural Resource Manager (541-5376, jajeremi@ksbe.edu). The AIS was conducted in accordance with the general requirements of HRS Chapter 6E-42 and HAR Chapter 13-284; and the specific details in HAR Chapter 13-276.

In addition to the SHPD submittal form and a check for $450, we have included one hardcopy and one CD-ROM of the draft report.

We are requesting your concurrence on the identification of historic properties, significance evaluation and proposed mitigation measures; or, any proposed revisions or changes you would like to see incorporated into the final report.

Please feel free to contact me if you have any questions about this request for consultation.

With aloha,

Christopher M. Monahan, Ph.D.
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