FEHR PEERS

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w/ copy to:
Ms. Tracy Camuso, Group 70
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Subject: **Mobility Assessment for the Proposed Waiawa Phase 2 Solar Plus Storage Project (Oahu, HI)**

Executive Summary

Fehr & Peers has prepared a mobility assessment for a proposed solar project to be constructed by Waiawa Phase 2 Solar, LLC in the Waiawa area on the island of O'ahu. This assessment was prepared to support the project in obtaining permits and approvals from the City and County of Honolulu Department of Planning and Permitting (DPP) and possibly the State Land Use Commission. 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 transportation-related impacts from the project.

The solar farm will generate a negligible amount of vehicle traffic once fully operational. The primary traffic issues for solar farm projects are associated with temporary construction traffic impacts and site access. Construction for the proposed project is anticipated to occur over a 15 to 18-month period and is forecast to generate up to a total of 348 daily vehicle trips during the peak of construction, including up to 142 trips in the AM and PM peak hours. The assessment concludes that the study intersections and proposed point of access for the project via Ka Uka Boulevard are sufficient for accommodating the anticipated construction traffic generated by the project. All study intersections are forecast to operate at level of service (LOS) D or better under all study scenarios. A detailed traffic management plan will be prepared and submitted for approval prior to the start of construction to minimize impacts to the transportation system during the construction period.

Once operational, the site will be primarily self-sustaining with minimal periodic maintenance required. The solar farm is anticipated to have no more than five (5) employees on-site at any given time. No traffic impacts are anticipated once the site is operational.

EXHIBIT "5"

Project Description

The Project involves construction and operation of a 30-megawatt (MW) alternating current/60 MW direct current (approx.) ground-mounted solar photovoltaic system coupled with a 240 MW-hour battery energy storage system, a substation, and related interconnection and ancillary facilities. A series of solar photovoltaic panels would be mounted on a racking system arranged in evenly spaced rows throughout the Project area. The energy storage system would consist of containerized lithium-ion battery units distributed throughout the solar arrays. This equipment would connect via underground and overhead electrical wiring with a Project substation. The substation would be located near the existing Hawaiian Electric Company, Inc. (Hawaiian Electric) Waiau-Mililani and Wahiawa-Waimano 46-kilovolt (kV) sub-transmission lines and would include equipment to allow interconnection with the electrical grid; (2) 46 kV overhead lines would deliver power from the Project substation to the existing Waiau-Mililani and Wahiawa-Waimano 46 kV sub-transmission lines. The Project would be accessed via an existing gated entry off Waiawa Prison Road and would utilize a network of existing on-site access roads. Within the Project area, a series of new gravel access roads would be installed to accommodate construction vehicles and to allow ongoing access for operations and maintenance. Temporary construction staging and laydown occurs within the Project area. The power generated by the Project would be sold to Hawaiian Electric under a new power purchase agreement. At the end of the Project's useful life, the Project equipment would be decommissioned, and the land would be returned to substantially the same condition as existed prior to Project development.

This assessment focuses on transportation impacts related to the construction and operations of the proposed facility.

The project site will be accessed from Ka Uka Boulevard just east of the Ka Uka Boulevard/H-2 Interchange. Materials for construction are expected to be transported from the Sand Island area in Honolulu to the site. All truck trips are expected to be made to and from Sand Island along the H-1 and H-2 freeways. It is anticipated that all project traffic will pass through the interchange to access the project site. **Figure 1** shows the project location and vicinity.

The project is anticipated to open for operation in fall of 2023 following construction. Construction is expected to begin spring 2022 and continue through the fall of 2023, for a duration of approximately 15 to 18 months. Construction is anticipated to require up to 200 workers per day on-site during the peak three months of construction, with fewer workers needed throughout the remaining 12 to 15 months of the construction period. As a conservative approach, this assessment evaluates the peak construction level with 200 workers on-site. Construction workers will be encouraged to carpool, and the analysis assumes 1.5 employees per vehicle; therefore, it is estimated that up to 134 construction worker vehicles will be arriving and departing the site each day during the peak of construction. Workers will generally be on-site between 7:00 AM and 4:00 PM Monday through Friday.

Once operational, the site will be primarily self-sustaining with minimal periodic maintenance required. The solar farm is anticipated to have no more than five (5) employees on-site at any given time. No permanent employees will be on-site; however, employees will visit the site over the course of the year to perform maintenance activities. As a result, the number of employee vehicle trips generated by the proposed project during typical operations is considered negligible (i.e., far less than the standard daily variation in traffic during peak hours).

Project Location and Study Area

The proposed project will be constructed on an undeveloped site in Pearl City, east of the H-2 freeway near Waipio Village and southeast of the Mililani Cemetery. The project will be accessed via Ka Uka Boulevard east of the Ka Uka Boulevard/H-2 interchange. The traffic assessment evaluated the operations at the following three (3) intersections near the site and along the primary vehicular travel route:

1. Ka Uka Boulevard/H-2 Southbound Off-Ramp/Moaniani Street
2. Ka Uka Boulevard/H-2 Southbound On-Ramp
3. Ka Uka Boulevard/H-2 Northbound Ramps

Figure 2 shows the locations of the study intersections as well as the project site and site access.

Study Scenarios

The operations of the study intersections were evaluated during the busiest peak (one) hour in the morning (between 7:00 and 9:00 AM) and in the afternoon (between 4:00 and 6:00 PM). The peak hour for each intersection was determined from traffic count data collected in 2019, which serves as the basis of the Existing Conditions analysis. Construction of the project site is anticipated to occur from spring 2022 through fall 2023, with the project beginning operations in fall of 2023.

Traffic operations were evaluated for the following scenarios:

- **Existing Conditions** – New traffic count data was not collected for the project in 2020 due to travel restrictions related to the COVID-19 global pandemic and shifts in travel patterns. Therefore, the analysis of existing traffic conditions was based on peak hour intersection turning movement counts collected in February 2019, which were increased by a growth factor to estimate traffic volumes for Year 2021 under typical travel conditions (i.e. unrestricted by travel restrictions).
- **2023 No Project Conditions** – Construction year volumes without the project were estimated based on existing conditions volumes plus traffic from ambient growth from approved projects in the vicinity of the project site. Expected traffic generated by Increment 1 Phase 1 of the Koa Ridge development was added to the existing conditions

traffic volumes, plus ambient growth in regional traffic to calculate 2023 No Project traffic volumes.

- **2023 Plus Project Construction Conditions** – Analysis of 2023 Plus Project Construction traffic conditions includes 2023 No Project peak hour traffic volumes plus the estimated maximum traffic generated by the project during the approximately 15-month construction period.
- **2023 Plus Project Typical Operating Conditions** – This scenario includes 2023 No Project peak hour traffic volumes plus the addition of project-generated traffic once the project is fully operational.

Vehicle Access

The proposed access for construction traffic, including trucks and employees' personal vehicles, is from Ka Uka Boulevard east of the Ka Uka Boulevard/H-2 interchange. From there, vehicles will travel along Mililani Cemetery Road and Waiawa Prison Road to reach the project site. The site access driveway is located approximately one (1) mile from the Ka Uka Boulevard interchange and any temporary queueing at the project driveway would not impact freeway interchange operations. **Figure 2** shows the access roads serving the project site.

Traveling north from Ka Uka Boulevard, vehicles on Mililani Cemetery Road will approach the Waiawa Prison Road intersection, then turn right (east) onto the existing road and drive approximately one-half mile before arriving at the construction staging area south of Waiawa Prison Road. Mililani Cemetery Road and Waiawa Prison Road serve a limited amount of traffic and provide for travel in both directions; however, Waiawa Prison Road generally includes a narrower paved section of roughly 18 to 20 feet and includes a one lane bridge section just east of Mililani Cemetery Road where the posted speed limit is 15 miles per hour.

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

Existing Traffic Volumes

The addition of traffic from the proposed project may temporarily impact operations of intersections near the site during the anticipated construction period. To determine potential impacts, the operations of the three (3) study intersections were evaluated during weekday AM and PM peak hour conditions. Traffic counts were collected at the study intersections in February 2019 and are included in **Attachment A**. Existing lane configurations and signal controls were obtained as part of the 2019 data collection effort. Due to the COVID19 pandemic and impact to travel patterns, new count data could not be obtained for the project and new data for the study intersections was unavailable. Therefore, existing traffic volumes were estimated at each location

based on available 2019 traffic and field data. Year 2019 volumes were grown by one percent per year to estimate typical traffic volumes for Year 2021. This rate was determined by considering the difference between historic and future traffic projections and planned growth in the study area and accounts for the recent completion of the first phases of the Koa Ridge development. **Figure 3** shows the 2021 existing traffic volumes and lane configurations.

2023 Transportation Improvements

Local roadway improvements are currently under construction by the Koa Ridge development with scheduled completion in 2021. The following improvements are assumed to be completed by 2023 for the purposes of this analysis:

- **Ka Uka Boulevard/H-2 Southbound Off-Ramp/Moaniani Street:**
  - Westbound: two left-turn lanes and two through lanes on Ka Uka Boulevard.
  - Southbound: two southbound departure lanes along Moaniani Street to accommodate the double left-turn lanes from westbound Ka Uka Boulevard.
  - Southbound: Provide additional lane on the southbound approach that results in an exclusive left-turn lane, exclusive through lane, and an exclusive right-turn lane.
  - Eastbound: additional through lane on Ka Uka Boulevard between Moaniani Street and the H-2 Southbound On-Ramp.
  - Northbound: Channelized right-turn lane on Moaniani Street.
  - Modified traffic signal timing to provide simultaneous left-turn movements for the northbound and southbound approaches.
- **Ka Uka Boulevard/H-2 Southbound On-Ramp:**
  - Eastbound: two exclusive right-turn lanes and a through lane on Ka Uka Boulevard.
- **Ka Uka Boulevard/H-2 Northbound Ramps:**
  - Eastbound: Provide an exclusive left-turn lane and a shared left-turn/through lane.
  - Northbound: Widen the northbound on-ramp to provide two left-turn lanes.
  - Modified traffic signal system to accommodate lane changes.
  - Modified traffic signal system and operations to provide split phasing.

2023 No Project Traffic Volumes

For purposes of this analysis, 2019 traffic volumes were increased by a growth factor of one percent per year and rounded to the nearest ten to forecast 2023 traffic volumes accounting for ambient growth. This rate was determined by considering the difference between historic and future traffic projections and planned growth in the study area.

Traffic generated by Increment 1 Phase 1 of the Koa Ridge development was then added to the grown volumes to determine 2023 No Project traffic volumes. The Koa Ridge development is located west of H-2 and north of Ka Uka Boulevard. Increment 1 Phase 1 of the Koa Ridge Development will include 1,754 housing units, 384,000 square feet of retail, 83,000 square feet of industrial, 16 acres of parks, 28.38 acres of healthcare, a 150-room hotel, 12.59 acres of schools, and a fire station, daycare, community center, and church. This analysis conservatively assumed all of Increment 1 Phase 1 being completed by 2023, although development completed by 2023 may be less. **Figure 4** shows the 2023 No Project traffic volumes and lane configurations.

Project Trip Generation Estimates

Construction traffic is comprised of private vehicles driven by construction workers and trucks delivering materials, hauling earth and debris, and providing other services (e.g., water trucks). In general, workers are assumed to make one (1) inbound trip and one (1) outbound trip for a total of two (2) daily trips. Detailed information on construction activities was provided by AES and included the number of trucks needed to deliver major project components and equipment This information was used to estimate the total number of truck trips during the planned construction period of 15 to 18 months. It is important to note that this information is preliminary and may be refined once a specific contractor is selected to construct the project. At that time, a construction traffic management plan must be prepared and submitted to the City and County of Honolulu DPP Traffic Review Branch (TRB) for review and approval.

This assessment considered two (2) project scenarios: the first, 2023 Plus Project Construction, represents 2023 No Project traffic volumes plus the forecasted construction-related traffic during the peak of construction when the highest volume of trucks and worker vehicles will be on-site. The second scenario, 2023 Plus Typical Project Operations, represents 2023 No Project traffic volumes plus the addition of project-generated traffic once the site is fully operational.

The 2023 Plus Project Construction scenario evaluates the peak periods of construction when a maximum of 200 workers are anticipated to be on-site. All construction worker-related traffic was conservatively assumed to occur during the peak hours of the study intersections. With an anticipated carpool factor of 1.5 workers per vehicle, the assessment estimates approximately 134 construction worker vehicles will arrive at the project site during the AM peak hour and depart from the project site during PM peak hour. In reality, it is expected that additional carpooling will occur, and that many worker trips would be made outside of the peak hours because they will be expected to be on-site between 7:00 AM and 4:00 PM.

Construction truck traffic was spread equally throughout the hours of operation to reflect the rotation of trips typical for construction activity. Ten percent of construction truck trips or eight (8) trips were assumed to occur during each of the AM and PM the peak hours . Trip generation for the project during construction is summarized in **Table 1**. The project is expected to generate 348 daily vehicle trips and 142 trips during each of the peak hours.

Table 1 –Construction Vehicle Trip Generation

Trip Type	Daily Trips	AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Auto[1]	268	134	134	0	134	0	134
Trucks[2,3]	80	8	4	4	8	4	4
Total	348	142	138	4	142	4	138

[1] Assumes 134 worker vehicles arrive and depart during peak hours
[2] Assumes equipment debris, hauling, excavation, etc. trucks arrive and depart during peak hours as well as off peak hours
[3] This analysis estimates 40 daily construction and work trucks, or 80 daily round trips. In the intersection operations calculation, a PCE factor of 2.5 per truck was applied to all truck trips. The resulting PCE trip generation is 200 daily truck trips.

Once operational, the solar project is anticipated to have a maximum of five (5) employees on site at any given time. As a result, the employee trips generated by the proposed project are nominal. The trip generation summary for the project during typical operations is presented in **Table 2**. Under this scenario, the project is expected to generate a negligible amount of traffic including 10 daily vehicle trips and five (5) trips each during the AM and PM peak hours.

Table 2 – Typical 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

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

Project Trip Distribution and Assignment

Based on the available regional access points/interchanges and the fact that materials will be transported from the Sand Island area in Honolulu to the site, all heavy trucks are expected to use the H-2 Freeway and access the site via the Ka Uka Boulevard interchange. Construction workers and employees are expected to travel to the site via Ka Uka Boulevard west of H-2, as well as the northbound and southbound directions on the freeway.

The trip distribution for the project was estimated based on the locations of urbanized residential communities on Oahu and the likelihood of workers to commute to and from those areas. The estimated trip distribution for construction worker vehicle trips is listed below:

- To/From the north – 20%
- To/From the south –75%
- To/From the west – 5%

Trip distribution percentages were applied to the forecasted trip generation for each scenario and assigned to the surrounding roadway network to assess potential traffic impacts in the area. **Figure 5** illustrates the project trip distribution and trip assignment. It should be noted that 75%

of construction worker traffic is expected to travel in the opposite direction of peak traffic flows during each peak hour.

2023 Plus Project Construction Traffic Volumes

Construction traffic generated by Waiawa Phase 2 Solar Plus Storage was added to the 2023 No Project traffic volumes to determine 2023 Plus Project Construction traffic volumes. **Figure 6** shows the 2023 Plus Project Construction traffic volumes and lane configurations.

2023 Plus Typical Project Operations Traffic Volumes

Typical operations traffic generated by Waiawa Phase 2 Solar Plus Storage was added to the 2023 No Project traffic volumes to determine 2023 Plus Typical Project Operating Conditions traffic volumes. **Figure 7** shows the 2023 Plus Typical Project Operating Conditions traffic volumes and lane configurations.

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 factors such as speed, travel time, delay, and freedom to maneuver. Six (6) 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. A computerized analysis of intersection operations was performed utilizing the SYNCHRO 10 traffic analysis software.

For construction trucks, a Passenger Car Equivalent (PCE) factor of 2.5 vehicle trips per truck was applied in the intersection operations calculation to account for the slower speeds of construction vehicles and greater impact to roadway network operations as compared to a typical passenger vehicle or light-duty truck. This approach is consistent with standard traffic engineering practice and appropriate given the temporary but concentrated truck activity associated with construction.

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 3**.

Table 3 – 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 reasonable 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.

Unsignalized Intersection Analysis

The HCM outlines methodology for unsignalized intersections, including two-way and all-way stop controlled intersections. The SYNCHRO 10 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 4** summarizes the LOS criteria for unsignalized intersections.

Table 4 – 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 Methodology and Criteria

The analysis compares 2023 No Project Conditions to 2023 Plus Project Construction Conditions to determine if the addition of estimated construction traffic to existing roadways is expected to result in a significant impact on the surrounding area. Similarly, the results of the 2023 Plus Typical Project Operating Conditions analysis is compared to 2023 No Project Conditions to determine whether or not project implementation is expected to result in significant impacts. Typically, construction-related impacts are considered temporary and are addressed with provisional mitigation measures during construction.

Based on previous studies conducted for both HDOT and DPP TRB, the minimum desirable operating level 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. Impacts are also defined to occur when the addition of project traffic exacerbates locations already operating or projected to operate at LOS E or F, which are referred to as cumulative impacts. An impact is also considered a cumulative impact at a signalized intersection if the addition of project trips exacerbates baseline (or no project) LOS E or F operations and increase overall intersection delay by more than five (5) seconds.

For unsignalized intersections, the criterion for a project-specific impact is the same as for signalized intersections regarding LOS as described above, but one or more signal warrants must also be met. The signal warrants used for this evaluation are described in Chapter 4V of the Manual on Uniform Traffic Control Devices (MUTCD, 2009) published by the U.S. Department of Transportation Federal Highways Administration (FHWA). However, the project is determined to have a potentially significant cumulative impact when it adds any amount of traffic to a study location which includes a controlled approach operating at an unacceptable level (i.e., LOS E or F) and one or more volume-based signal warrants are met.

Impacts to public transit, pedestrian facilities and travel, and bicycle facilities and travel are considered significant if the proposed project conflicts with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or if it will generate additional demand that cannot be reasonably accommodated by existing or planned multi-modal facilities.

Intersection Operations Analysis Results

The analysis of intersection operations was completed for all scenarios, including Existing Conditions, 2023 No Project Conditions, 2023 Plus Construction Conditions, and 2023 Plus Project Typical Operating Conditions. The results of the intersection LOS analysis are summarized in **Table 5**. **Attachment B** includes the detailed LOS calculation worksheets. Peak hour traffic volumes and LOS results for 2023 No Project Conditions, 2023 Plus Construction Conditions, and 2023 Plus Operating Conditions are shown on **Figures 4, 5, and 6**, respectively.

Table 5 – Peak Hour Intersection Operations LOS Summary

Intersection	Peak Hour	Existing		2023 No Project		2023 Plus Construction		2023 Plus Typical Operations	
		Delay[1]	LOS	Delay[1]	LOS	Delay[1]	LOS	Delay[1]	LOS
1. Ka Uka Blvd/H-2 SB Off-Ramp	AM	14.3	B	19.2	B	19.5	B	19.3	B
	PM	50.3	D	26.7	C	26.7	C	26.7	C
2. Ka Uka Blvd/H-2 SB On-Ramp*	AM	8.2	A	8.5	A	8.6	A	8.5	A
	PM	9.6	A	10.4	B	11.5	B	10.4	B
3. Ka Uka Blvd/H-2 NB Ramps	AM	8.2	A	11.0	B	11.8	B	11.2	B
	PM	47.9	D	24.6	C	31.8	D	24.9	C

Source: Fehr & Peers, January 2021 *indicates unsignalized intersection
[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle for signalized intersections. The worst movement is presented for unsignalized intersections.
LOS calculations performed using the Highway Capacity Manual (HCM) 6th Edition method.

As shown, all study intersections currently operate at desirable (LOS D or better) levels and are expected to continue to operate at LOS D or better conditions under all study scenarios.

Decreases in delay from Existing to 2023 conditions during the PM peak hour are a result from planned intersection improvements at the Ka Uka Boulevard/H-2 intersections, which are expected to be completed by 2023. Small increases in delay during the AM peak hour at all study intersections and the PM peak hour at the SB On-Ramp are a result of traffic growth due to the Koa Ridge development on critical movements where infrastructure improvements provide less benefit. An increase in delay is forecast with the addition of project construction traffic, however none of the study intersections are forecast to result in LOS E or F under any study scenario. In addition, the relatively minor increases in delay during project construction will be temporary.

Once operational, the solar site is anticipated to generate a maximum of five (5) trips per peak hour. This additional traffic would have a negligible effect on intersection turning movement operations at all study locations. If Mililani Cemetery Road becomes unavailable in the future when the project is operational, alternate project access may occur on Waihona Street. However, the addition of operational project traffic (i.e., less than 10 total daily trips) would be imperceptible to drivers and the volume is well within the daily variation of volumes in the area.

No study intersections are expected to be significantly impacted by project construction (i.e., temporarily) or typical operations on a permanent basis. Therefore, no improvements are recommended at the study intersections.

Roadway Segment Operations

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 in each direction plus shoulder areas along most of the segment between Ka Uka Boulevard and Waiawa Prison Road. The cemetery and prison do not generate a substantial amount of existing traffic, and the addition of truck traffic to these roadways is not anticipated to result in excess demand compared to capacity.

Waiawa Prison Road is relatively narrow, particularly for heavy vehicles transporting construction equipment and materials. The width of the roadway varies between approximately 18 to 20 feet along several sections between Mililani Cemetery Road and the staging area, with some curves in the roadway where sight distance and shoulder width may be limited. A construction traffic management plan will be required to address how adequate sight distance will be provided for drivers on Waiawa Prison Road approaching and departing the staging area. Separate construction activities have previously occurred in the area that added heavy truck traffic to Waiawa Prison Road and Mililani 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. In addition, Hawaiian Electric (HECO) recently used Kamehameha School lands as a laydown area for 138kV (kilovolt) pole replacements with no known complaints during construction activity.

To minimize the potential for conflicts and to maintain adequate traffic operations, the contractor will be responsible for preparing a construction traffic management plan (CMP) for review and approval by DPP TRB that may address the following:

- Provide signage between the Ka Uka Boulevard interchange and the staging area off Waiawa Prison Road that trucks are travelling and entering/exiting the roadway.
- Ensure that adequate sight distance is provided for drivers on Waiawa Prison Road approaching and departing the staging area. Measures may include traffic control signage (e.g., stop or yield signs) and removal of vegetation that impede standard approach, departure, and height sight distances.
- Coordinate with the City and County of Honolulu if needed to prune or remove vegetation in the public right of way that might impede large construction vehicles on both Mililani Cemetery Road and Waiawa Prison Road.
- Provide manual traffic control on Waiawa Prison Road to manage construction and prison traffic and to minimize conflicts. This could include the use of radios, flag persons, and/or temporary signals and lighting to assist with the control of vehicles and the provision of adequate sight distance (as needed).

- Maintain access to the Waiawa Correctional Facility.

Non-Automobile Mode Access

Bicycle and Pedestrian Travel

Given the undeveloped nature of the 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. North of the 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 non-automobile modes is not anticipated. In addition, no sidewalks or bike lanes are currently provided or planned on the Ka Uka Boulevard overcrossing over H-2.

Transit

Transit service in the study area consists of one route makai of H-2; no transit service is currently provided mauka of the freeway. The nearest existing transit stop to the site is the Moaniani Street/Ka Uka Boulevard bus stop served by TheBus route 433, which provides access between Waipahu and Waikele. Route 433 operates with 30-minute headways during the AM and PM peak hours.

In the future, planned rail service operated by the Honolulu Authority for Rapid Transportation (HART) will initially extend from Kapolei to Aloha Stadium and is expected to initiate service later in 2021. Full operations with service from the stadium station to Ala Moana Shopping Center is anticipated sometime after 2026. 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 center for buses from Central Oahu including service from Waipio and Mililani. 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.

While separate bicycle, pedestrian, and transit facilities are typically encouraged to reduce vehicle traffic, the rural circulation system, distant land uses in the vicinity of the site, and nature of the proposed project are typically not conducive to multi-modal travel.

Potential Impacts to Active Modes and Transit

The City and County of Honolulu and HDOT do 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. As noted above, the project is not expected to conflict with any existing active transportation modes (i.e., bicycling and walking) or transit, and it would not create demand for these modes given its isolated location. Accordingly, no impacts to non-automobile travel are anticipated.

Conclusion

The proposed project will generate a negligible amount of vehicle traffic when fully constructed and operational. The project is expected to generate approximately 348 daily vehicle trips during the peak of construction, including 142 vehicle trips during the AM and PM peak hours. Construction activity is planned to occur over a 15- to 18-month period and any construction-related traffic will be temporary. Based on the evaluation presented in this report, the proposed point of access is sufficient for the anticipated construction traffic generated by the project. A detailed construction management plan (CMP) will be prepared and submitted for approval prior to the start of construction to minimize impacts to the transportation system during the construction period.

Sincerely,

FEHR & PEERS

Sohrab Rashid, TE
Principal

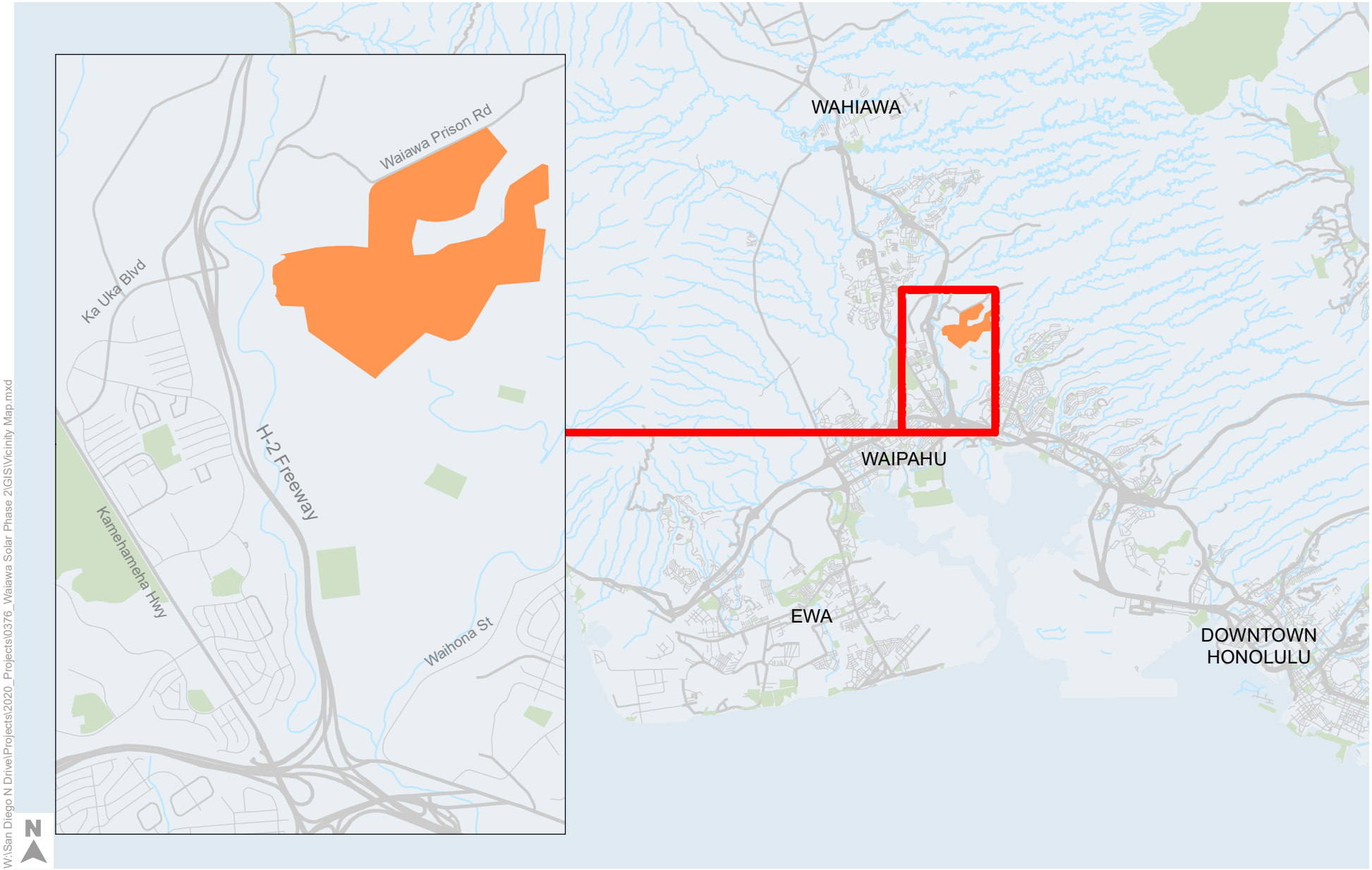
Andrew Scher
Transportation Engineer

SD20-0376

Attachments:

Figure 1 – Project Location and Vicinity
Figure 2 – Project Site and Study Intersections
Figure 3 – Peak Hour Traffic Volumes and Lane Configurations – Existing Conditions
Figure 4 – Project Construction Trip Distribution and Peak Hour Trip Assignment
Figure 5 – Peak Hour Traffic Volumes and Lane Configurations – 2023 No Project Conditions
Figure 6 – Peak Hour Traffic Volumes and Lane Configurations – 2023 Plus Project Construction Conditions
Figure 7 – Peak Hour Traffic Volumes and Lane Configurations – 2023 Plus Typical Project Operating Conditions

Attachment A – Traffic Count Data
Attachment B – Level of Service Analysis Worksheets



LEGEND

Project Site

Figure 1

Project Location and Vicinity

Waiawa Solar Phase 2 Mobility Assessment

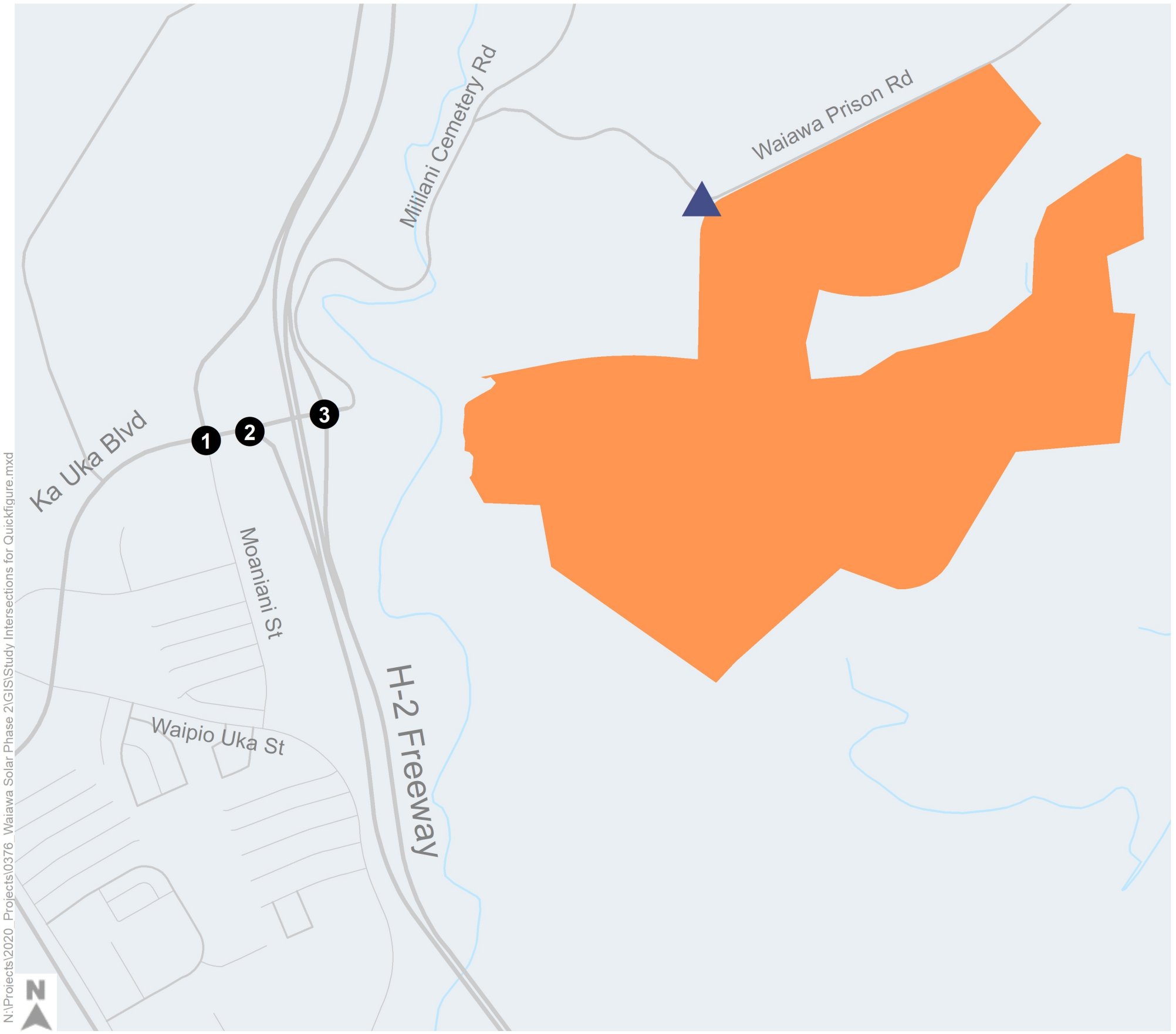
LEGEND

- Study Intersections
- Site Access
- Project Site

Figure 2

Project Site & Study Intersections

Waiawa Solar Phase 2 Mobility Assessment



LEGEND

- Study Intersections
- Site Access
- AM (PM) Peak Hour Traffic Volumes
- Project Site
- Lane Configuration
- AM / PM Level of Service (LOS)

A-C | E | D | F

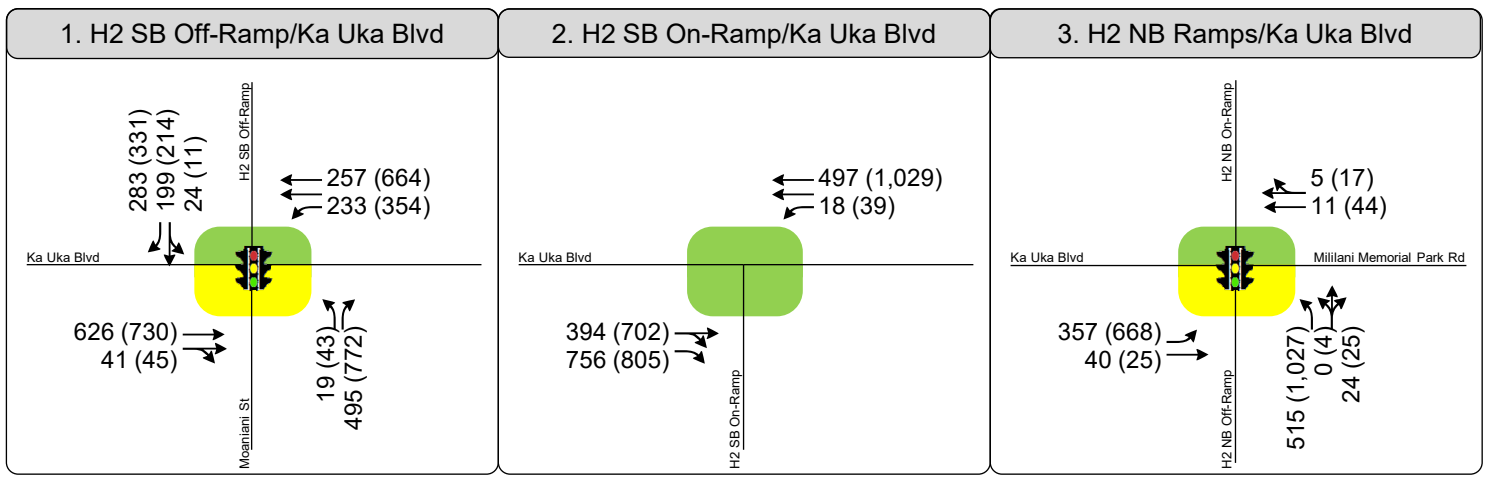
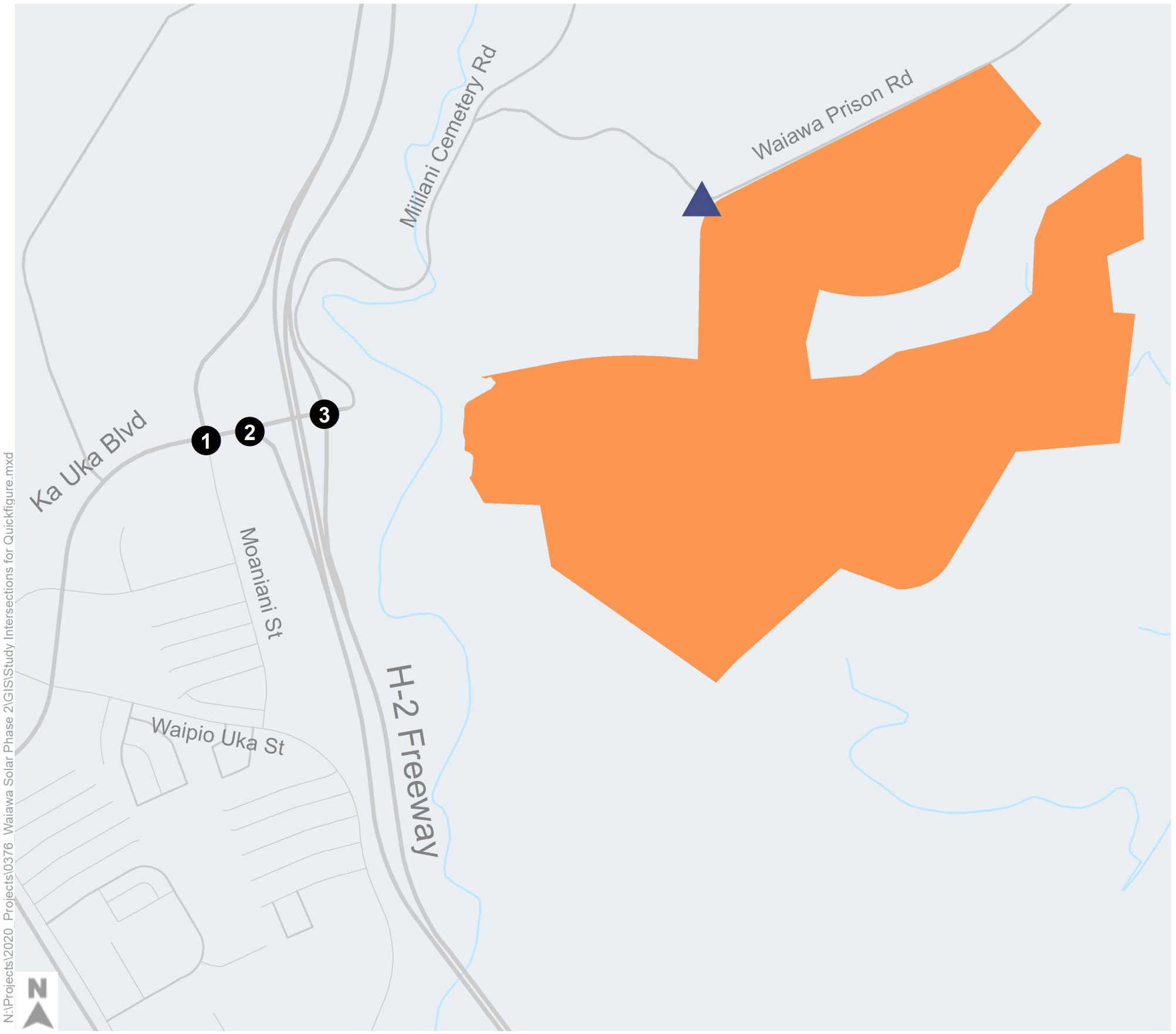


Figure 3

Peak Hour Traffic Volumes and Lane Configurations - Existing Conditions



LEGEND

- Study Intersections
- Site Access
- AM (PM) Peak Hour Traffic Volumes
- Project Site
- Lane Configuration
- AM / PM Level of Service (LOS)

A-C | E | D | F

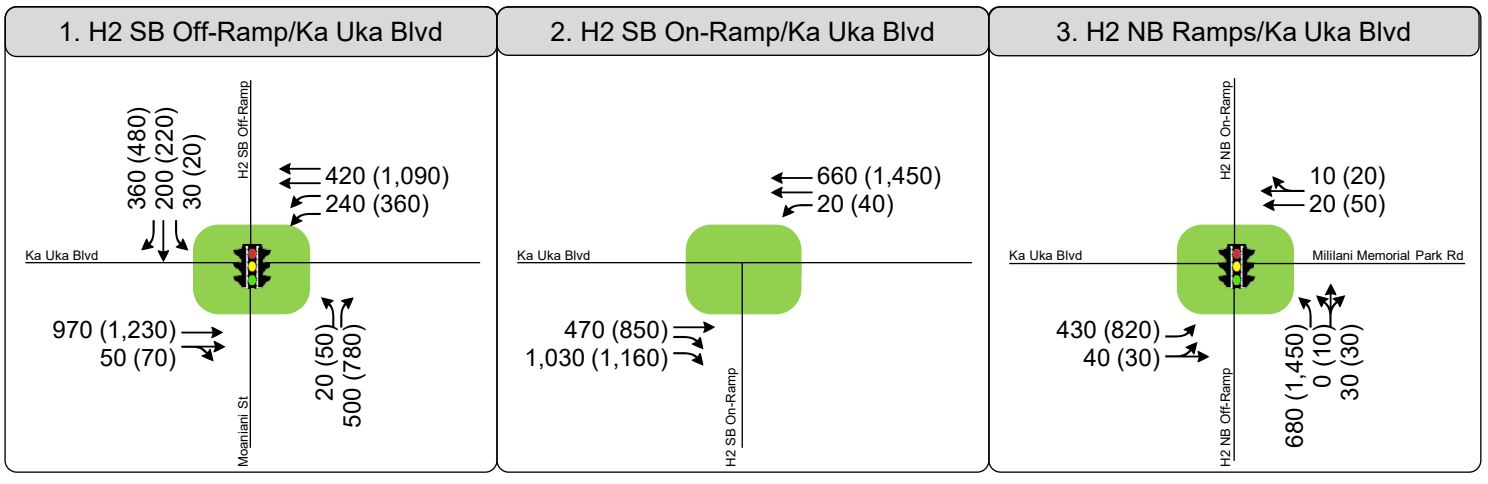
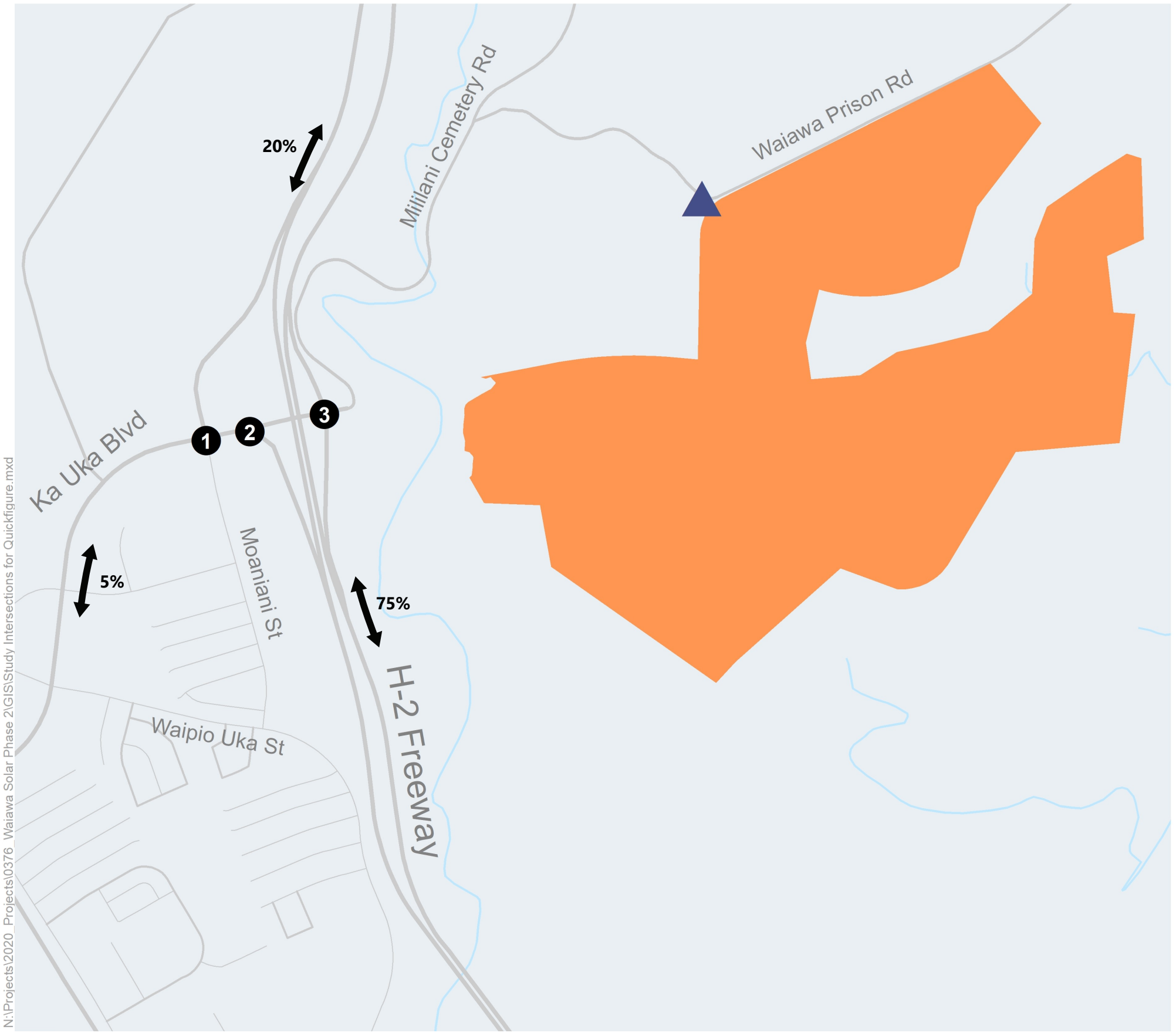


Figure 4

Peak Hour Traffic Volumes and Lane Configurations - 2023 No Project Conditions



LEGEND

- Study Intersections
- Site Access
- AM (PM) Peak Hour Traffic Volumes
- Project Site
- Lane Configuration
- % Project Trip Distribution

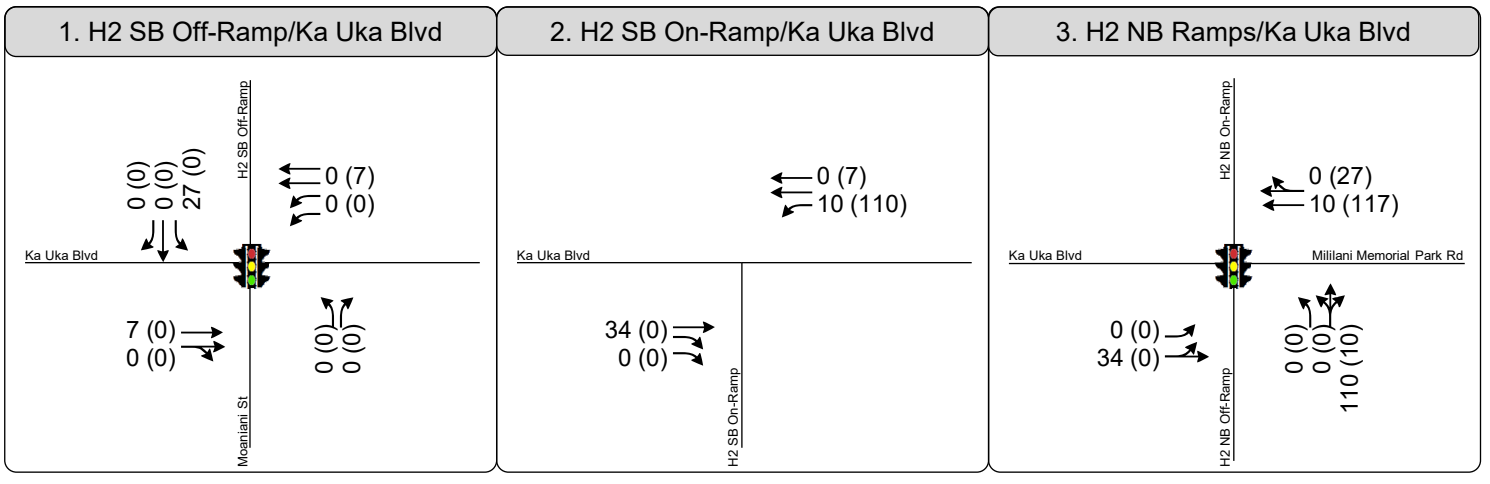
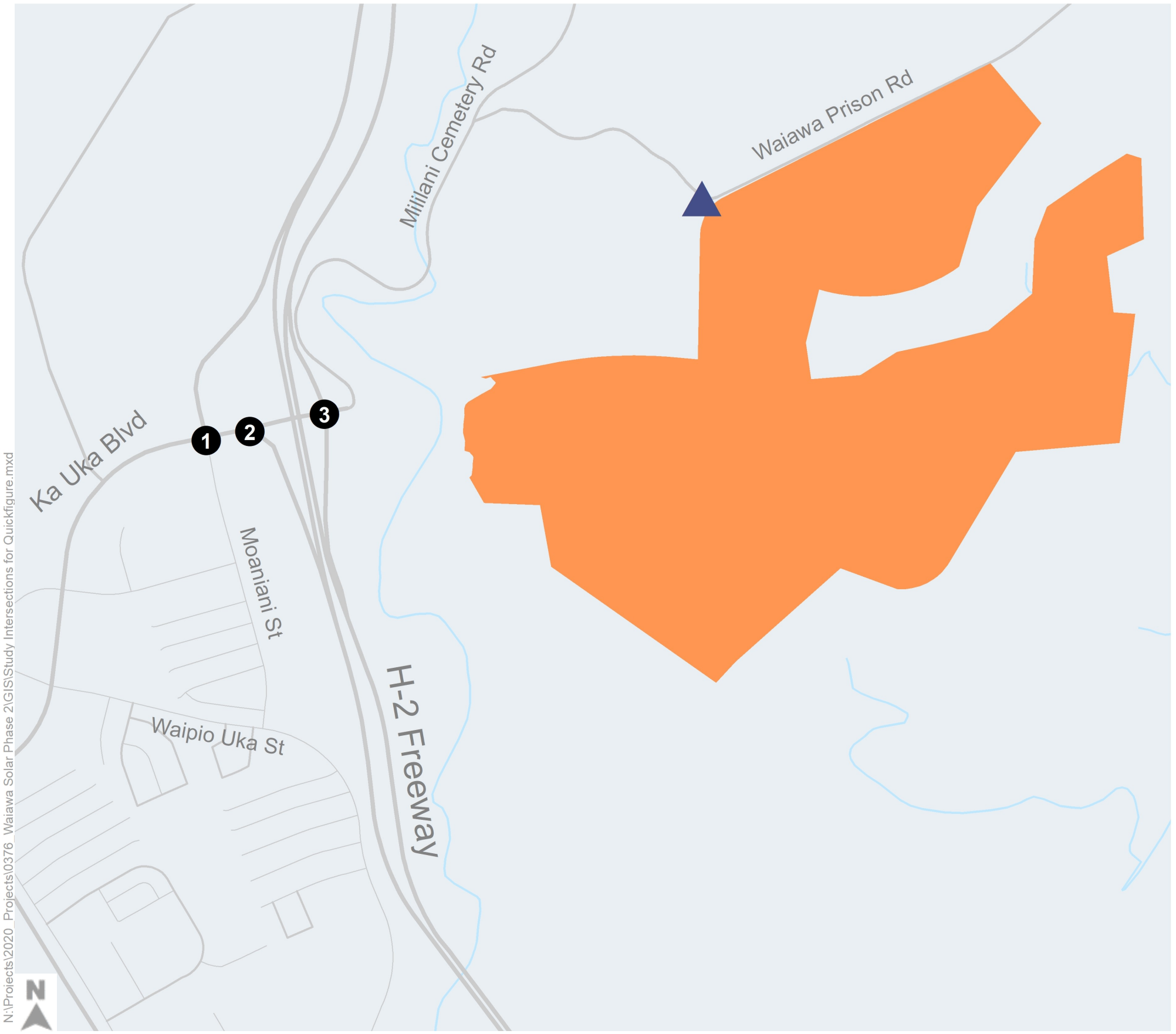


Figure 5

Project Construction Trip Distribution and Peak Hour Trip Assignment



LEGEND

- Study Intersections
- Site Access
- AM (PM) Peak Hour Traffic Volumes
- Project Site
- Lane Configuration
- AM / PM Level of Service (LOS)

A-C | E | D | F

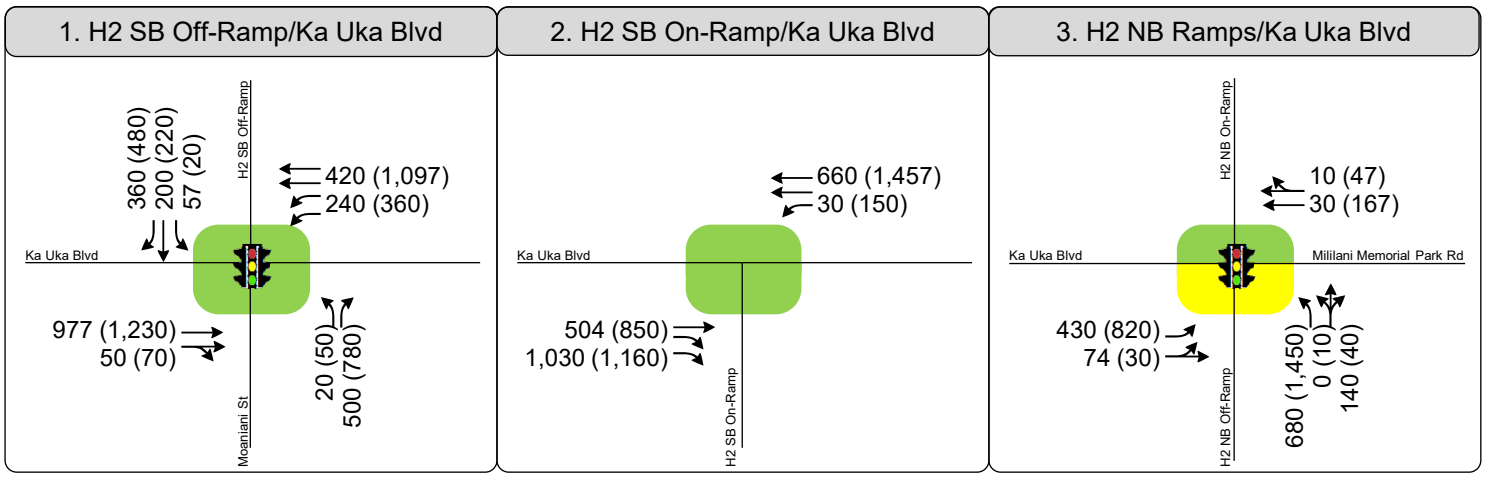
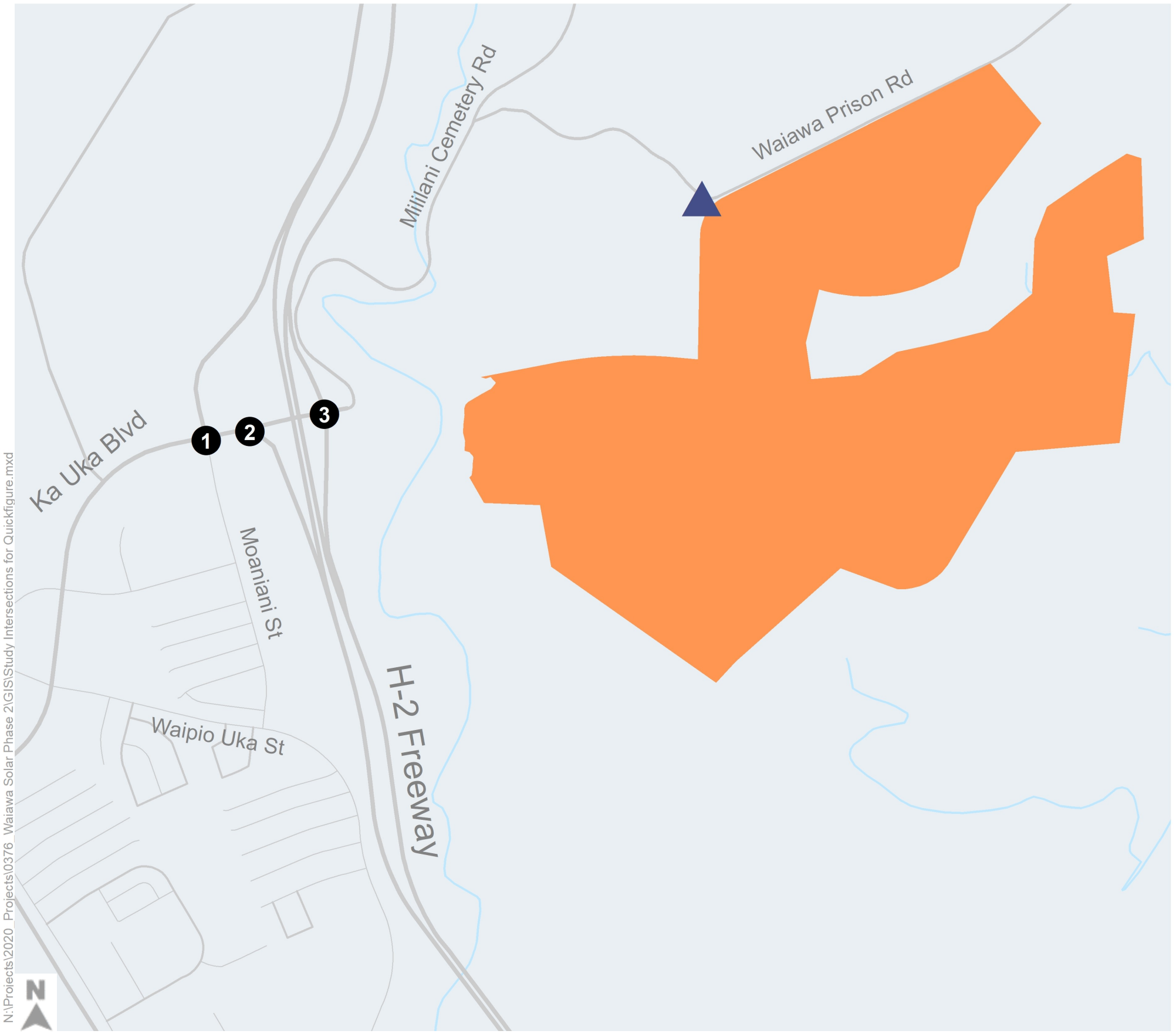


Figure 6

Peak Hour Traffic Volumes and Lane Configurations - 2023 Plus Project Construction Conditions



LEGEND

- Study Intersections
- Site Access
- AM (PM) Peak Hour Traffic Volumes
- Project Site
- Lane Configuration
- AM / PM Level of Service (LOS)

A-C | E | D | F

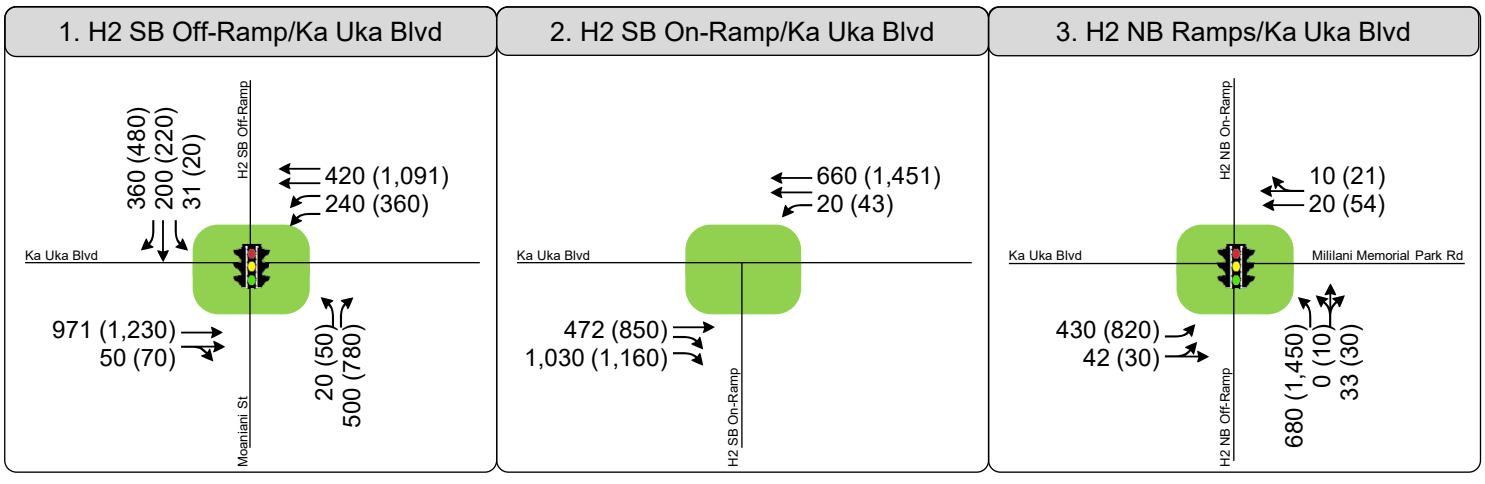


Figure 7

Peak Hour Traffic Volumes and Lane Configurations - 2023 Plus Typical Project Operating Conditions

Attachment A: Traffic Count Data

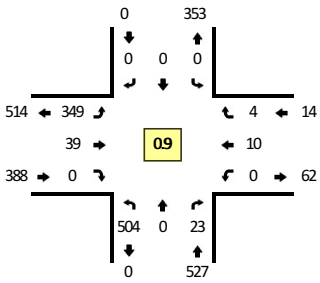
Type of peak hour being reported: User-Defined

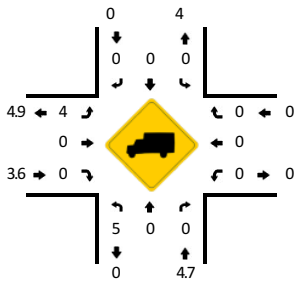
Method for determining peak hour: Total Entering Volume

LOCATION: I- H-2 NB Off Ramp -- Mililani Memorial Park Rd
CITY/STATE: Waipahu, HI

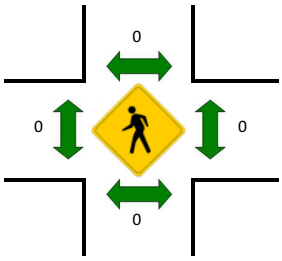
QC JOB #: 14901903
DATE: Tue, Feb 19 2019

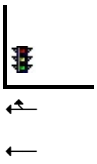
Peak-Hour: 7:15 AM -- 8:15 AM
Peak 15-Min: 7:45 AM -- 8:00 AM

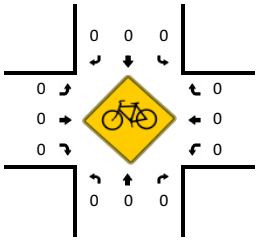


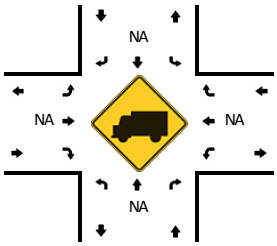


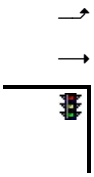
Quality Counts
DATA THAT DRIVES COMMUNITIES

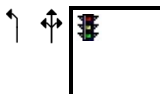


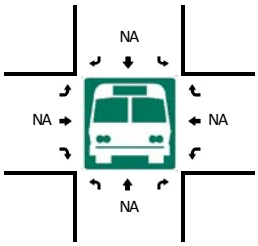












15-Min Count Period Beginning At	I- H-2 NB Off Ramp (Northbound)				I- H-2 NB Off Ramp (Southbound)				Mililani Memorial Park Rd (Eastbound)				Mililani Memorial Park Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	76	0	1	0	0	0	0	0	79	3	0	0	0	4	0	0	163	
7:15 AM	108	0	3	0	0	0	0	0	97	2	0	0	0	2	1	0	213	
7:30 AM	115	0	6	0	0	0	0	0	102	18	0	0	0	1	0	0	242	
7:45 AM	154	0	8	0	0	0	0	0	76	14	0	0	0	5	2	0	259	877
8:00 AM	127	0	6	0	0	0	0	0	74	5	0	0	0	2	1	0	215	929
8:15 AM	160	0	5	0	0	0	0	0	66	3	0	0	0	2	1	0	237	953
8:30 AM	95	0	8	0	0	0	0	0	68	5	0	0	0	4	1	0	181	892
8:45 AM	133	0	4	0	0	0	0	0	75	11	0	0	0	7	0	0	230	863

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	616	0	32	0	0	0	0	0	304	56	0	0	0	20	8	0	1036
Heavy Trucks	36	0	0		0	0	0		24	0	0		0	0	0		60
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Railroad Stopped Buses																	

Comments:

Report generated on 2/22/2019 2:54 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

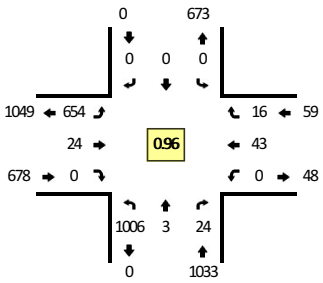
Type of peak hour being reported: User-Defined

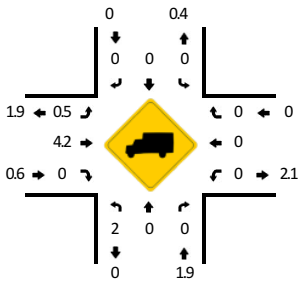
Method for determining peak hour: Total Entering Volume

LOCATION: I- H-2 NB Off Ramp -- Mililani Memorial Park Rd
CITY/STATE: Waipahu, HI

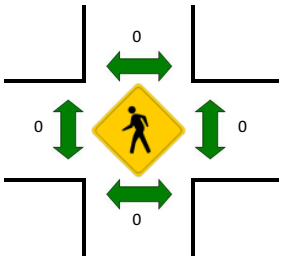
QC JOB #: 14901904
DATE: Tue, Feb 19 2019

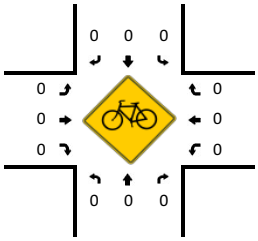
Peak-Hour: 4:30 PM -- 5:30 PM
Peak 15-Min: 5:00 PM -- 5:15 PM

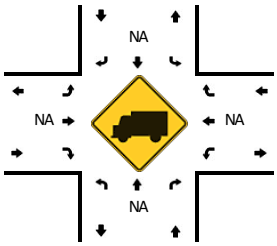


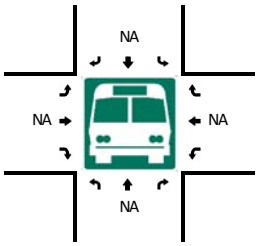


Quality Counts
DATA THAT DRIVES COMMUNITIES









15-Min Count Period Beginning At	I- H-2 NB Off Ramp (Northbound)				I- H-2 NB Off Ramp (Southbound)				Mililani Memorial Park Rd (Eastbound)				Mililani Memorial Park Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	262	2	1	0	0	0	0	0	147	4	0	0	0	12	3	0	431	
4:15 PM	248	0	5	0	0	0	0	0	149	8	0	0	0	12	1	0	423	
4:30 PM	225	2	9	0	0	0	0	0	165	6	0	0	0	14	4	0	425	
4:45 PM	283	0	7	0	0	0	0	0	149	6	0	0	0	6	4	0	455	1734
5:00 PM	262	0	3	0	0	0	0	0	176	6	0	0	0	10	4	0	461	1764
5:15 PM	236	1	5	0	0	0	0	0	164	6	0	0	0	13	4	0	429	1770
5:30 PM	309	0	5	0	0	0	0	0	130	8	0	0	0	4	4	0	460	1805
5:45 PM	232	0	7	0	0	0	0	0	138	7	0	0	0	11	2	0	397	1747

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	1048	0	12	0	0	0	0	0	704	24	0	0	0	40	16	0	1844
Heavy Trucks	28	0	0		0	0	0		0	0	0		0	0	0		28
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Railroad																	
Stopped Buses																	

Comments:

Report generated on 2/22/2019 2:55 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

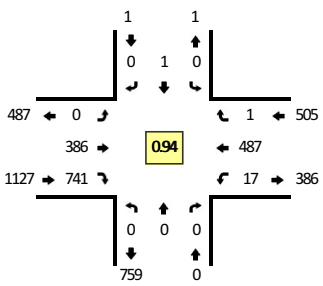
Type of peak hour being reported: User-Defined

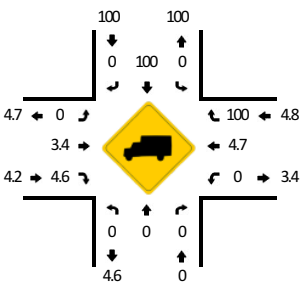
Method for determining peak hour: Total Entering Volume

LOCATION: I- H-2 SB On Ramp -- Ka Uka Blvd
CITY/STATE: Waipahu, HI

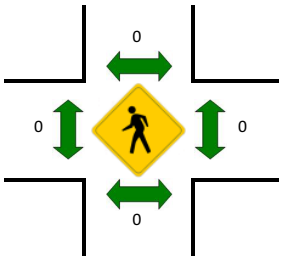
QC JOB #: 14901905
DATE: Tue, Feb 19 2019

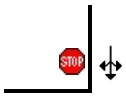
Peak-Hour: 7:15 AM -- 8:15 AM
Peak 15-Min: 7:30 AM -- 7:45 AM

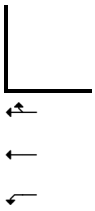


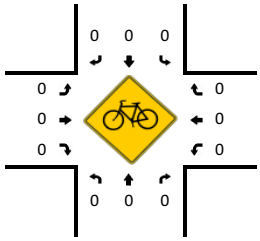


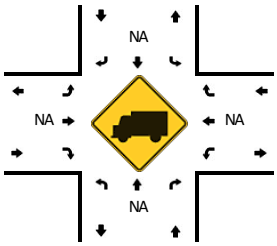
Quality Counts
DATA THAT DRIVES COMMUNITIES

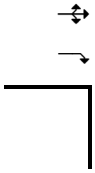


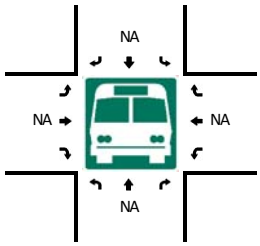












15-Min Count Period Beginning At	I- H-2 SB On Ramp (Northbound)				I- H-2 SB On Ramp (Southbound)				Ka Uka Blvd (Eastbound)				Ka Uka Blvd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	0	0	0	0	0	0	0	0	87	214	0	3	77	0	0	381	
7:15 AM	0	0	0	0	0	0	0	0	0	97	197	0	7	100	0	0	401	
7:30 AM	0	0	0	0	0	0	0	0	0	121	196	0	3	113	1	0	434	
7:45 AM	0	0	0	0	0	1	0	0	0	91	181	0	4	155	0	0	432	1648
8:00 AM	0	0	0	0	0	0	0	0	0	77	167	0	3	119	0	0	366	1633
8:15 AM	0	0	0	0	0	0	0	0	0	65	146	0	8	153	0	0	372	1604
8:30 AM	0	0	0	0	0	0	0	0	0	72	160	0	3	99	0	0	334	1504
8:45 AM	0	0	0	0	0	0	0	0	0	82	146	1	10	128	0	0	367	1439

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	0	0	0	0	0	0	0	0	484	784	0	12	452	4	0	1736
Heavy Trucks	0	0	0		0	0	0		0	12	40		0	12	4		68
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Railroad																	
Stopped Buses																	

Comments:

Report generated on 2/22/2019 2:54 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

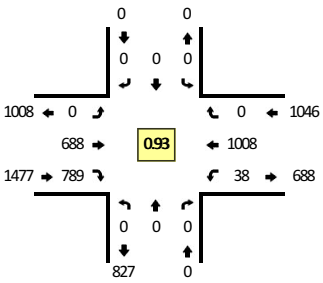
Type of peak hour being reported: User-Defined

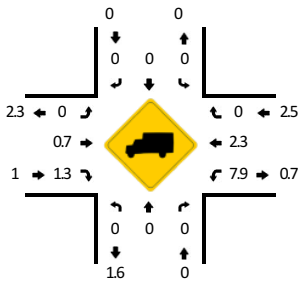
Method for determining peak hour: Total Entering Volume

LOCATION: I- H-2 SB On Ramp -- Ka Uka Blvd
CITY/STATE: Waipahu, HI

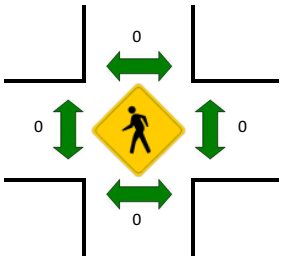
QC JOB #: 14901906
DATE: Tue, Feb 19 2019

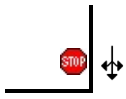
Peak-Hour: 4:30 PM -- 5:30 PM
Peak 15-Min: 5:00 PM -- 5:15 PM

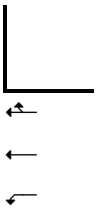


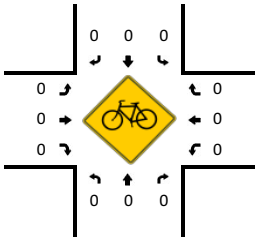


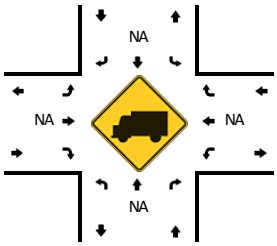
Quality Counts
DATA THAT DRIVES COMMUNITIES

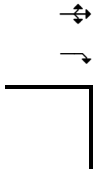


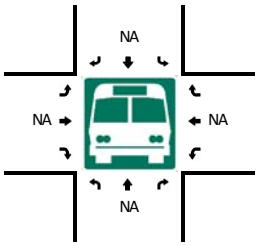












15-Min Count Period Beginning At	I- H-2 SB On Ramp (Northbound)				I- H-2 SB On Ramp (Southbound)				Ka Uka Blvd (Eastbound)				Ka Uka Blvd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	0	0	0	0	0	0	0	0	0	162	194	0	13	261	0	0	630	
4:15 PM	0	0	0	0	0	0	0	0	0	150	162	0	8	252	0	0	572	
4:30 PM	0	0	0	0	0	0	0	0	0	172	178	0	13	226	0	0	589	
4:45 PM	0	0	0	0	0	0	0	0	0	164	178	0	9	280	0	0	631	2422
5:00 PM	0	0	0	0	0	0	0	0	0	183	222	1	10	260	0	0	676	2468
5:15 PM	0	0	0	0	0	0	0	0	0	168	211	0	6	242	0	0	627	2523
5:30 PM	0	0	0	0	0	0	0	0	0	150	178	0	7	295	0	0	630	2564
5:45 PM	0	0	0	0	0	0	0	0	0	139	142	0	7	245	0	0	533	2466

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	0	0	0	0	0	0	0	0	0	736	888	4	40	1040	0	0	2708
Heavy Trucks	0	0	0		0	0	0		0	0	8		0	28	0		36
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Railroad																	
Stopped Buses																	

Comments:

Report generated on 2/22/2019 2:55 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

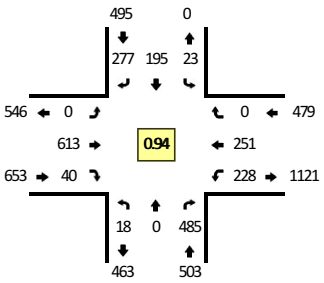
Type of peak hour being reported: User-Defined

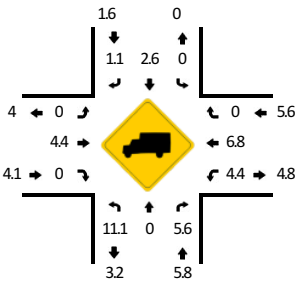
Method for determining peak hour: Total Entering Volume

LOCATION: Moaniani St/H2 SB Off Ramp -- Ka Uka Blvd
CITY/STATE: Waipahu, HI

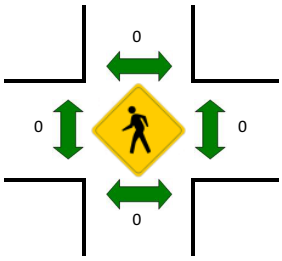
QC JOB #: 14901907
DATE: Tue, Feb 19 2019

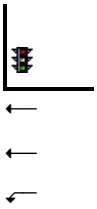
Peak-Hour: 7:15 AM -- 8:15 AM
Peak 15-Min: 7:45 AM -- 8:00 AM

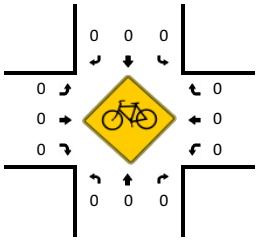


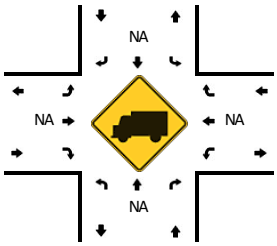


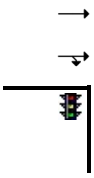
Quality Counts
DATA THAT DRIVES COMMUNITIES

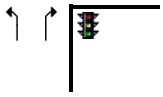


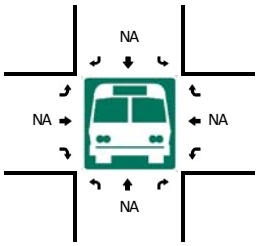












15-Min Count Period Beginning At	Moaniani St/H2 SB Off Ramp (Northbound)				Moaniani St/H2 SB Off Ramp (Southbound)				Ka Uka Blvd (Eastbound)				Ka Uka Blvd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	0	127	0	2	38	63	0	0	170	6	0	37	49	0	0	492	
7:15 AM	6	0	137	0	1	37	50	0	0	159	7	0	39	59	0	0	495	
7:30 AM	4	0	132	0	10	43	75	0	0	170	13	0	55	51	0	0	553	
7:45 AM	6	0	111	0	10	56	80	0	0	145	10	0	73	76	0	0	567	2107
8:00 AM	2	0	105	0	2	59	72	0	0	139	10	0	61	65	0	0	515	2130
8:15 AM	6	0	102	0	4	57	56	0	0	99	11	0	69	74	0	0	478	2113
8:30 AM	9	0	112	0	0	50	51	0	0	123	15	0	59	48	0	0	467	2027
8:45 AM	7	0	94	0	3	51	47	0	0	130	13	0	61	66	0	0	472	1932

Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	24	0	444	0	40	224	320	0	0	580	40	0	292	304	0	0	2268
Heavy Trucks	4	0	20		0	12	0		0	40	0		20	20	0		116
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Railroad																	
Stopped Buses																	

Comments:

Report generated on 2/22/2019 2:54 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

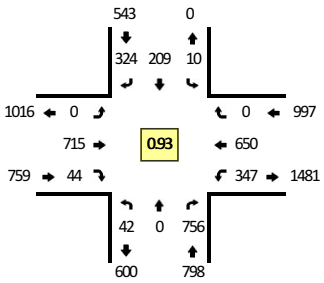
Type of peak hour being reported: User-Defined

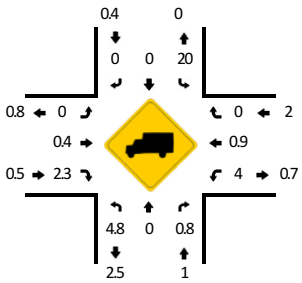
Method for determining peak hour: Total Entering Volume

LOCATION: Moaniani St/H2 SB Off Ramp -- Ka Uka Blvd
CITY/STATE: Waipahu, HI

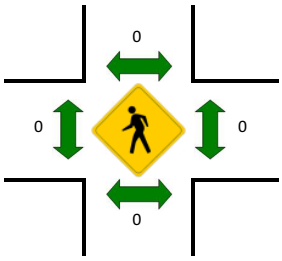
QC JOB #: 14901908
DATE: Tue, Feb 19 2019

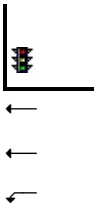
Peak-Hour: 4:30 PM -- 5:30 PM
Peak 15-Min: 5:00 PM -- 5:15 PM

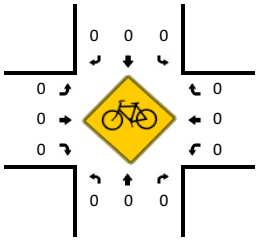


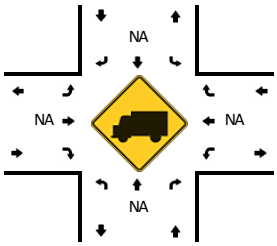


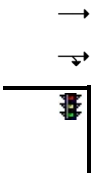
Quality Counts
DATA THAT DRIVES COMMUNITIES

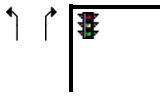


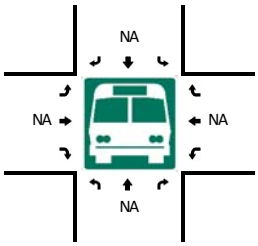












15-Min Count Period Beginning At	Moaniani St/H2 SB Off Ramp (Northbound)				Moaniani St/H2 SB Off Ramp (Southbound)				Ka Uka Blvd (Eastbound)				Ka Uka Blvd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	12	0	169	0	2	60	83	0	0	181	12	0	97	163	0	0	779	
4:15 PM	9	0	192	0	8	75	68	0	0	105	8	0	104	162	0	0	731	
4:30 PM	12	0	180	0	2	42	95	0	0	177	11	0	91	145	0	0	755	
4:45 PM	9	0	180	0	4	60	81	0	0	150	9	0	80	152	0	0	725	2990
5:00 PM	8	0	194	0	3	42	74	0	0	216	14	0	86	200	0	0	837	3048
5:15 PM	13	0	202	0	1	65	74	0	0	172	10	0	90	153	0	0	780	3097
5:30 PM	6	0	181	0	5	50	63	0	0	140	9	0	110	168	0	0	732	3074
5:45 PM	8	0	156	0	3	74	74	0	0	110	9	0	104	167	0	0	705	3054

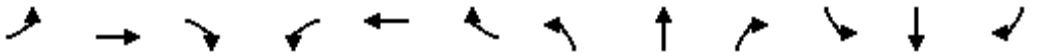
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	
All Vehicles	32	0	776	0	12	168	296	0	0	864	56	0	344	800	0	0	3348
Heavy Trucks	0	0	4		0	0	0		0	4	0		16	8	0		32
Pedestrians		0				0				0				0			0
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0
Railroad																	
Stopped Buses																	

Comments:

Report generated on 2/22/2019 2:55 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

Attachment B: Level of Service Analysis Worksheets



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	626	41	233	257	0	19	0	495	24	199	283
Future Volume (veh/h)	0	626	41	233	257	0	19	0	495	24	199	283
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1841	1841	1841	1796	0	1737	0	1811	1856	1856	1870
Adj Flow Rate, veh/h	0	666	40	248	273	0	20	0	56	26	212	61
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	0	4	4	4	7	0	11	0	6	3	3	2
Cap, veh/h	0	1103	66	323	2088	0	0	0	0	39	315	304
Arrive On Green	0.00	0.33	0.33	0.18	0.61	0.00	0.00	0.00	0.00	0.19	0.19	0.19
Sat Flow, veh/h	0	3444	201	1753	3503	0		0		202	1644	1585
Grp Volume(v), veh/h	0	347	359	248	273	0		0.0		238	0	61
Grp Sat Flow(s),veh/h/ln	0	1749	1805	1753	1706	0				1845	0	1585
Q Serve(g_s), s	0.0	7.6	7.6	6.2	1.5	0.0				5.5	0.0	1.5
Cycle Q Clear(g_c), s	0.0	7.6	7.6	6.2	1.5	0.0				5.5	0.0	1.5
Prop In Lane	0.00		0.11	1.00		0.00				0.11		1.00
Lane Grp Cap(c), veh/h	0	575	594	323	2088	0				354	0	304
V/C Ratio(X)	0.00	0.60	0.60	0.77	0.13	0.00				0.67	0.00	0.20
Avail Cap(c_a), veh/h	0	2119	2187	976	6371	0				1028	0	883
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	12.9	12.9	17.7	3.8	0.0				17.2	0.0	15.6
Incr Delay (d2), s/veh	0.0	1.0	1.0	3.8	0.0	0.0				2.2	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	2.7	2.8	2.6	0.3	0.0				2.3	0.0	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	13.9	13.9	21.6	3.8	0.0				19.4	0.0	15.9
LnGrp LOS	A	B	B	C	A	A				B	A	B
Approach Vol, veh/h		706			521						299	
Approach Delay, s/veh		13.9			12.2						18.7	
Approach LOS		B			B						B	

Timer - Assigned Phs		3	4		6		8					
Phs Duration (G+Y+Rc), s		12.9	19.6		13.3		32.5					
Change Period (Y+Rc), s		4.5	4.5		4.5		4.5					
Max Green Setting (Gmax), s		25.5	55.5		25.5		85.5					
Max Q Clear Time (g_c+I1), s		8.2	9.6		7.5		3.5					
Green Ext Time (p_c), s		0.7	5.4		1.5		2.1					

Intersection Summary	
HCM 6th Ctrl Delay	14.3
HCM 6th LOS	B

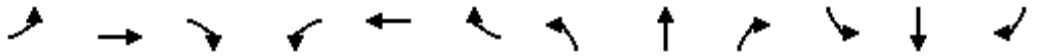
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	394	756	18	497	0	0	0	0	0	0	0
Future Vol, veh/h	0	394	756	18	497	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	94	94	94	94	92	94	92	94	92	92	92
Heavy Vehicles, %	2	3	5	2	5	2	2	2	2	2	2	2
Mvmt Flow	0	419	804	19	529	0	0	0	0	0	0	0

Major/Minor	Major1			Major2					Minor2		
Conflicting Flow All	-	0	-	419	0	0			986	986	265
Stage 1	-	-	-	-	-	-			567	567	-
Stage 2	-	-	-	-	-	-			419	419	-
Critical Hdwy	-	-	-	4.13	-	-			6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-			5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-			5.43	5.53	-
Follow-up Hdwy	-	-	-	2.219	-	-			3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	1138	-	0			259	247	734
Stage 1	0	-	0	-	-	0			532	506	-
Stage 2	0	-	0	-	-	0			663	589	-
Platoon blocked, %		-			-						
Mov Cap-1 Maneuver	-	-	-	1138	-	-			255	0	734
Mov Cap-2 Maneuver	-	-	-	-	-	-			255	0	-
Stage 1	-	-	-	-	-	-			532	0	-
Stage 2	-	-	-	-	-	-			652	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.3	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	SBLn1
Capacity (veh/h)	-	1138	-	-
HCM Lane V/C Ratio	-	0.017	-	-
HCM Control Delay (s)	-	8.2	-	0
HCM Lane LOS	-	A	-	A
HCM 95th %tile Q(veh)	-	0.1	-	-

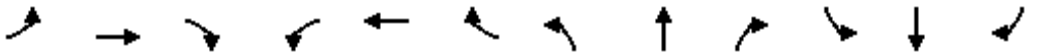


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	357	40	0	0	11	5	515	0	24	0	0	0
Future Volume (veh/h)	357	40	0	0	11	5	515	0	24	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1841	1870	0	0	1870	1870	1826	1870	1826			
Adj Flow Rate, veh/h	397	44	0	0	12	3	586	0	0			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90			
Percent Heavy Veh, %	4	2	0	0	2	2	5	2	5			
Cap, veh/h	771	695	0	0	1057	254	1039	559	0			
Arrive On Green	0.37	0.37	0.00	0.00	0.37	0.37	0.30	0.00	0.00			
Sat Flow, veh/h	1376	1870	0	0	2936	682	3478	1870	0			
Grp Volume(v), veh/h	397	44	0	0	7	8	586	0	0			
Grp Sat Flow(s),veh/h/ln	1376	1870	0	0	1777	1748	1739	1870	0			
Q Serve(g_s), s	7.0	0.4	0.0	0.0	0.1	0.1	3.9	0.0	0.0			
Cycle Q Clear(g_c), s	7.1	0.4	0.0	0.0	0.1	0.1	3.9	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.39	1.00		0.00			
Lane Grp Cap(c), veh/h	771	695	0	0	661	650	1039	559	0			
V/C Ratio(X)	0.51	0.06	0.00	0.00	0.01	0.01	0.56	0.00	0.00			
Avail Cap(c_a), veh/h	1544	1746	0	0	1658	1631	7064	3799	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	7.6	5.5	0.0	0.0	5.4	5.4	8.1	0.0	0.0			
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.3	0.1	0.0	0.0	0.0	0.0	1.0	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	8.2	5.6	0.0	0.0	5.4	5.4	8.6	0.0	0.0			
LnGrp LOS	A	A	A	A	A	A	A	A	A			
Approach Vol, veh/h		441			15			586				
Approach Delay, s/veh		7.9			5.4			8.6				
Approach LOS		A			A			A				
Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		12.7		14.7				14.7				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		55.5		25.5				25.5				
Max Q Clear Time (g_c+I1), s		5.9		9.1				2.1				
Green Ext Time (p_c), s		2.4		1.4				0.0				

Intersection Summary	
HCM 6th Ctrl Delay	8.2
HCM 6th LOS	A

Notes

User approved volume balancing among the lanes for turning movement.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	730	45	354	664	0	43	0	772	11	214	331
Future Volume (veh/h)	0	730	45	354	664	0	43	0	772	11	214	331
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1870	1870	1841	1870	0	1826	0	1870	1870	1870	1870
Adj Flow Rate, veh/h	0	785	45	381	714	0	46	0	281	12	230	62
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	2	2	4	2	0	5	0	2	2	2	2
Cap, veh/h	0	1240	71	405	2205	0	0	0	0	13	251	224
Arrive On Green	0.00	0.36	0.36	0.23	0.62	0.00	0.00	0.00	0.00	0.14	0.14	0.14
Sat Flow, veh/h	0	3510	196	1753	3647	0		0		93	1773	1585
Grp Volume(v), veh/h	0	408	422	381	714	0		0.0		242	0	62
Grp Sat Flow(s),veh/h/ln	0	1777	1835	1753	1777	0				1866	0	1585
Q Serve(g_s), s	0.0	32.3	32.3	36.3	16.2	0.0				21.8	0.0	5.9
Cycle Q Clear(g_c), s	0.0	32.3	32.3	36.3	16.2	0.0				21.8	0.0	5.9
Prop In Lane	0.00		0.11	1.00		0.00				0.05		1.00
Lane Grp Cap(c), veh/h	0	645	666	405	2205	0				264	0	224
V/C Ratio(X)	0.00	0.63	0.63	0.94	0.32	0.00				0.92	0.00	0.28
Avail Cap(c_a), veh/h	0	645	666	521	2205	0				280	0	238
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00				1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00				1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	44.8	44.8	64.2	15.3	0.0				72.0	0.0	65.2
Incr Delay (d2), s/veh	0.0	2.0	2.0	22.2	0.4	0.0				32.0	0.0	0.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	14.9	15.4	18.9	6.9	0.0				12.9	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	46.8	46.7	86.4	15.7	0.0				104.0	0.0	65.9
LnGrp LOS	A	D	D	F	B	A				F	A	E
Approach Vol, veh/h		830			1095						304	
Approach Delay, s/veh		46.8			40.3						96.3	
Approach LOS		D			D						F	

Timer - Assigned Phs		3	4		6		8					
Phs Duration (G+Y+Rc), s		43.8	66.2		28.5		110.0					
Change Period (Y+Rc), s		4.5	4.5		4.5		4.5					
Max Green Setting (Gmax), s		50.5	50.5		25.5		105.5					
Max Q Clear Time (g_c+I1), s		38.3	34.3		23.8		18.2					
Green Ext Time (p_c), s		1.0	5.1		0.3		6.4					

Intersection Summary												
HCM 6th Ctrl Delay		50.3										
HCM 6th LOS		D										

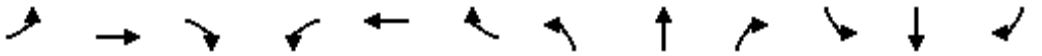
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	702	805	39	1029	0	0	0	0	0	0	0
Future Vol, veh/h	0	702	805	39	1029	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	93	93	93	93	92	93	92	93	92	92	92
Heavy Vehicles, %	2	2	2	8	2	2	2	2	2	2	2	2
Mvmt Flow	0	755	866	42	1106	0	0	0	0	0	0	0

Major/Minor	Major1			Major2					Minor2		
Conflicting Flow All	-	0	-	755	0	0			1945	1945	553
Stage 1	-	-	-	-	-	-			1190	1190	-
Stage 2	-	-	-	-	-	-			755	755	-
Critical Hdwy	-	-	-	4.22	-	-			6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-			5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-			5.43	5.53	-
Follow-up Hdwy	-	-	-	2.276	-	-			3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	821	-	0			64	64	478
Stage 1	0	-	0	-	-	0			252	260	-
Stage 2	0	-	0	-	-	0			463	416	-
Platoon blocked, %		-			-						
Mov Cap-1 Maneuver	-	-	-	821	-	-			61	0	478
Mov Cap-2 Maneuver	-	-	-	-	-	-			61	0	-
Stage 1	-	-	-	-	-	-			252	0	-
Stage 2	-	-	-	-	-	-			439	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.4	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	SBLn1
Capacity (veh/h)	-	821	-	-
HCM Lane V/C Ratio	-	0.051	-	-
HCM Control Delay (s)	-	9.6	-	0
HCM Lane LOS	-	A	-	A
HCM 95th %tile Q(veh)	-	0.2	-	-

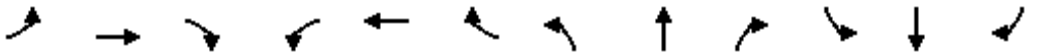


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	668	25	0	0	44	17	1027	4	25	0	0	0
Future Volume (veh/h)	668	25	0	0	44	17	1027	4	25	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1870	1841	0	0	1870	1870	1870	1870	1870			
Adj Flow Rate, veh/h	696	26	0	0	46	11	1096	0	0			
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96			
Percent Heavy Veh, %	2	4	0	0	2	2	2	2	2			
Cap, veh/h	755	989	0	0	1540	355	1460	767	0			
Arrive On Green	0.54	0.54	0.00	0.00	0.54	0.54	0.41	0.00	0.00			
Sat Flow, veh/h	1346	1841	0	0	2960	662	3563	1870	0			
Grp Volume(v), veh/h	696	26	0	0	28	29	1096	0	0			
Grp Sat Flow(s),veh/h/ln	1346	1841	0	0	1777	1751	1781	1870	0			
Q Serve(g_s), s	85.6	1.1	0.0	0.0	1.3	1.3	44.6	0.0	0.0			
Cycle Q Clear(g_c), s	87.0	1.1	0.0	0.0	1.3	1.3	44.6	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.38	1.00		0.00			
Lane Grp Cap(c), veh/h	755	989	0	0	954	941	1460	767	0			
V/C Ratio(X)	0.92	0.03	0.00	0.00	0.03	0.03	0.75	0.00	0.00			
Avail Cap(c_a), veh/h	828	1088	0	0	1050	1035	1460	767	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	39.0	18.5	0.0	0.0	18.5	18.5	42.7	0.0	0.0			
Incr Delay (d2), s/veh	14.8	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	31.3	0.5	0.0	0.0	0.5	0.6	20.7	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	53.8	18.5	0.0	0.0	18.5	18.5	46.3	0.0	0.0			
LnGrp LOS	D	B	A	A	B	B	D	A	A			
Approach Vol, veh/h		722			57			1096				
Approach Delay, s/veh		52.6			18.5			46.3				
Approach LOS		D			B			D				
Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		74.2		95.8				95.8				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		60.5		100.5				100.5				
Max Q Clear Time (g_c+I1), s		46.6		89.0				3.3				
Green Ext Time (p_c), s		4.1		2.3				0.4				

Intersection Summary	
HCM 6th Ctrl Delay	47.9
HCM 6th LOS	D

Notes

User approved volume balancing among the lanes for turning movement.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	970	50	240	420	0	20	0	500	30	200	360
Future Volume (veh/h)	0	970	50	240	420	0	20	0	500	30	200	360
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1841	1841	1841	1796	0	1737	0	1811	1870	1856	1870
Adj Flow Rate, veh/h	0	1032	48	255	447	0	21	0	0	32	213	59
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	0	4	4	4	7	0	11	0	6	2	3	2
Cap, veh/h	0	1282	60	369	1944	0	41	0		63	282	241
Arrive On Green	0.00	0.38	0.38	0.11	0.57	0.00	0.03	0.00	0.00	0.04	0.15	0.15
Sat Flow, veh/h	0	3495	158	3401	3503	0	1654	21		1781	1856	1585
Grp Volume(v), veh/h	0	530	550	255	447	0	21	34.9		32	213	59
Grp Sat Flow(s),veh/h/ln	0	1749	1812	1700	1706	0	1654	C		1781	1856	1585
Q Serve(g_s), s	0.0	14.5	14.5	3.8	3.5	0.0	0.7			0.9	5.9	1.7
Cycle Q Clear(g_c), s	0.0	14.5	14.5	3.8	3.5	0.0	0.7			0.9	5.9	1.7
Prop In Lane	0.00		0.09	1.00		0.00	1.00			1.00		1.00
Lane Grp Cap(c), veh/h	0	659	683	369	1944	0	41			63	282	241
V/C Ratio(X)	0.00	0.81	0.81	0.69	0.23	0.00	0.51			0.51	0.76	0.25
Avail Cap(c_a), veh/h	0	745	772	415	2160	0	376			913	373	318
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00	1.00			1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	14.9	14.9	22.9	5.7	0.0	25.6			25.2	21.6	19.9
Incr Delay (d2), s/veh	0.0	5.8	5.6	4.2	0.1	0.0	9.2			6.2	6.1	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.0	6.2	1.7	1.0	0.0	0.4			0.5	2.9	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	20.7	20.5	27.1	5.7	0.0	34.9			31.4	27.8	20.4
LnGrp LOS	A	C	C	C	A	A	C			C	C	C
Approach Vol, veh/h		1080			702						304	
Approach Delay, s/veh		20.6			13.5						26.7	
Approach LOS		C			B						C	

Timer - Assigned Phs	1		3	4	5	6		8				
Phs Duration (G+Y+Rc), s	6.4		10.3	24.6	5.8	12.6		34.8				
Change Period (Y+Rc), s	4.5		4.5	4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	27.3		6.5	22.7	12.1	10.7		33.7				
Max Q Clear Time (g_c+I1), s	2.9		5.8	16.5	2.7	7.9		5.5				
Green Ext Time (p_c), s	0.1		0.1	3.6	0.0	0.4		3.4				

Intersection Summary	
HCM 6th Ctrl Delay	19.2
HCM 6th LOS	B

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

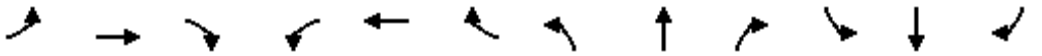
Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱↑	↰	↑↑						✣	
Traffic Vol, veh/h	0	470	1030	20	660	10	0	0	0	0	0	0
Future Vol, veh/h	0	470	1030	20	660	10	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	94	94	94	94	92	94	92	94	92	92	92
Heavy Vehicles, %	2	3	5	2	5	2	2	2	2	2	2	2
Mvmt Flow	0	500	1096	21	702	11	0	0	0	0	0	0

Major/Minor	Major1			Major2					Minor2		
Conflicting Flow All	-	0	-	500	0	0			1250	1250	357
Stage 1	-	-	-	-	-	-			750	750	-
Stage 2	-	-	-	-	-	-			500	500	-
Critical Hdwy	-	-	-	4.13	-	-			6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-			5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-			5.43	5.53	-
Follow-up Hdwy	-	-	-	2.219	-	-			3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	1062	-	-			177	172	640
Stage 1	0	-	0	-	-	-			428	418	-
Stage 2	0	-	0	-	-	-			608	542	-
Platoon blocked, %		-			-	-					
Mov Cap-1 Maneuver	-	-	-	1062	-	-			173	0	640
Mov Cap-2 Maneuver	-	-	-	-	-	-			173	0	-
Stage 1	-	-	-	-	-	-			428	0	-
Stage 2	-	-	-	-	-	-			596	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.2	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	-	1062	-	-	-
HCM Lane V/C Ratio	-	0.02	-	-	-
HCM Control Delay (s)	-	8.5	-	-	0
HCM Lane LOS	-	A	-	-	A
HCM 95th %tile Q(veh)	-	0.1	-	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	430	40	0	0	20	10	680	0	30	0	0	0
Future Volume (veh/h)	430	40	0	0	20	10	680	0	30	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1841	1870	0	0	1870	1870	1826	1870	1826			
Adj Flow Rate, veh/h	509	0	0	0	22	0	756	0	0			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90			
Percent Heavy Veh, %	4	2	0	0	2	2	5	2	5			
Cap, veh/h	806	430	0	0	98	0	1144	615	0			
Arrive On Green	0.23	0.00	0.00	0.00	0.03	0.00	0.33	0.00	0.00			
Sat Flow, veh/h	3506	1870	0	0	3741	0	3478	1870	0			
Grp Volume(v), veh/h	509	0	0	0	22	0	756	0	0			
Grp Sat Flow(s),veh/h/ln	1753	1870	0	0	1777	0	1739	1870	0			
Q Serve(g_s), s	4.3	0.0	0.0	0.0	0.2	0.0	6.1	0.0	0.0			
Cycle Q Clear(g_c), s	4.3	0.0	0.0	0.0	0.2	0.0	6.1	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.00	1.00		0.00			
Lane Grp Cap(c), veh/h	806	430	0	0	98	0	1144	615	0			
V/C Ratio(X)	0.63	0.00	0.00	0.00	0.22	0.00	0.66	0.00	0.00			
Avail Cap(c_a), veh/h	1558	831	0	0	544	0	2344	1261	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	11.3	0.0	0.0	0.0	15.5	0.0	9.4	0.0	0.0			
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.0	1.1	0.0	0.7	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.0	0.1	0.0	1.8	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.1	0.0	0.0	0.0	16.7	0.0	10.1	0.0	0.0			
LnGrp LOS	B	A	A	A	B	A	B	A	A			
Approach Vol, veh/h		509			22			756				
Approach Delay, s/veh		12.1			16.7			10.1				
Approach LOS		B			B			B				
Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		15.2		12.0				5.4				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		22.0		14.5				5.0				
Max Q Clear Time (g_c+I1), s		8.1		6.3				2.2				
Green Ext Time (p_c), s		2.7		1.3				0.0				
Intersection Summary												
HCM 6th Ctrl Delay			11.0									
HCM 6th LOS			B									

Notes

User approved volume balancing among the lanes for turning movement.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	1230	70	360	1090	0	50	0	780	20	220	480
Future Volume (veh/h)	0	1230	70	360	1090	0	50	0	780	20	220	480
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1870	1870	1841	1870	0	1826	0	1870	1604	1870	1870
Adj Flow Rate, veh/h	0	1323	73	387	1172	0	54	0	0	22	237	215
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	2	2	4	2	0	5	0	2	20	2	2
Cap, veh/h	0	1600	88	464	2318	0	71	0		36	301	256
Arrive On Green	0.00	0.47	0.47	0.14	0.65	0.00	0.04	0.00	0.00	0.02	0.16	0.16
Sat Flow, veh/h	0	3518	189	3401	3647	0	1739	54		1527	1870	1585
Grp Volume(v), veh/h	0	685	711	387	1172	0	54	59.6		22	237	215
Grp Sat Flow(s),veh/h/ln	0	1777	1836	1700	1777	0	1739	E		1527	1870	1585
Q Serve(g_s), s	0.0	30.9	31.1	10.2	15.8	0.0	2.8			1.3	11.2	12.2
Cycle Q Clear(g_c), s	0.0	30.9	31.1	10.2	15.8	0.0	2.8			1.3	11.2	12.2
Prop In Lane	0.00		0.10	1.00		0.00	1.00			1.00		1.00
Lane Grp Cap(c), veh/h	0	830	858	464	2318	0	71			36	301	256
V/C Ratio(X)	0.00	0.83	0.83	0.83	0.51	0.00	0.77			0.62	0.79	0.84
Avail Cap(c_a), veh/h	0	990	1023	534	2711	0	724			1000	354	300
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00	1.00			1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	21.4	21.4	38.9	8.3	0.0	43.9			44.7	37.2	37.6
Incr Delay (d2), s/veh	0.0	5.0	5.0	9.8	0.2	0.0	15.7			16.1	9.6	16.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	13.4	14.0	4.9	5.5	0.0	1.5			0.7	5.9	5.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	26.4	26.4	48.7	8.5	0.0	59.6			60.8	46.8	54.4
LnGrp LOS	A	C	C	D	A	A	E			E	D	D
Approach Vol, veh/h		1396			1559						474	
Approach Delay, s/veh		26.4			18.5						50.9	
Approach LOS		C			B						D	

Timer - Assigned Phs	1		3	4	5	6		8				
Phs Duration (G+Y+Rc), s	6.7		17.1	47.7	8.3	19.4		64.8				
Change Period (Y+Rc), s	4.5		4.5	4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	60.5		14.5	51.5	38.5	17.5		70.5				
Max Q Clear Time (g_c+I1), s	3.3		12.2	33.1	4.8	14.2		17.8				
Green Ext Time (p_c), s	0.1		0.4	10.1	0.1	0.7		12.8				

Intersection Summary	
HCM 6th Ctrl Delay	26.7
HCM 6th LOS	C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

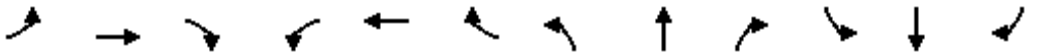
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↑↑	↰	↑↑						✣	
Traffic Vol, veh/h	0	850	1160	40	1450	0	0	0	0	0	0	0
Future Vol, veh/h	0	850	1160	40	1450	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	93	93	93	93	92	93	92	93	92	92	92
Heavy Vehicles, %	2	2	2	8	2	2	2	2	2	2	2	2
Mvmt Flow	0	914	1247	43	1559	0	0	0	0	0	0	0

Major/Minor	Major1			Major2			Minor2		
Conflicting Flow All	-	0	-	914	0	0	2559	2559	780
Stage 1	-	-	-	-	-	-	1645	1645	-
Stage 2	-	-	-	-	-	-	914	914	-
Critical Hdwy	-	-	-	4.22	-	-	6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-	5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.43	5.53	-
Follow-up Hdwy	-	-	-	2.276	-	-	3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	713	-	0	25	26	339
Stage 1	0	-	0	-	-	0	143	156	-
Stage 2	0	-	0	-	-	0	390	351	-
Platoon blocked, %		-			-				
Mov Cap-1 Maneuver	-	-	-	713	-	-	24	0	339
Mov Cap-2 Maneuver	-	-	-	-	-	-	24	0	-
Stage 1	-	-	-	-	-	-	143	0	-
Stage 2	-	-	-	-	-	-	367	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.3	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	SBLn1
Capacity (veh/h)	-	713	-	-
HCM Lane V/C Ratio	-	0.06	-	-
HCM Control Delay (s)	-	10.4	-	0
HCM Lane LOS	-	B	-	A
HCM 95th %tile Q(veh)	-	0.2	-	-



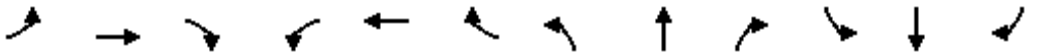
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	820	30	0	0	50	20	1450	10	30	0	0	0
Future Volume (veh/h)	820	30	0	0	50	20	1450	10	30	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1870	1841	0	0	1870	1870	1870	1870	1870			
Adj Flow Rate, veh/h	876	0	0	0	52	0	1545	0	0			
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96			
Percent Heavy Veh, %	2	4	0	0	2	2	2	2	2			
Cap, veh/h	1034	534	0	0	151	0	1789	939	0			
Arrive On Green	0.29	0.00	0.00	0.00	0.04	0.00	0.50	0.00	0.00			
Sat Flow, veh/h	3563	1841	0	0	3741	0	3563	1870	0			
Grp Volume(v), veh/h	876	0	0	0	52	0	1545	0	0			
Grp Sat Flow(s),veh/h/ln	1781	1841	0	0	1777	0	1781	1870	0			
Q Serve(g_s), s	18.9	0.0	0.0	0.0	1.2	0.0	31.1	0.0	0.0			
Cycle Q Clear(g_c), s	18.9	0.0	0.0	0.0	1.2	0.0	31.1	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.00	1.00		0.00			
Lane Grp Cap(c), veh/h	1034	534	0	0	151	0	1789	939	0			
V/C Ratio(X)	0.85	0.00	0.00	0.00	0.35	0.00	0.86	0.00	0.00			
Avail Cap(c_a), veh/h	1374	710	0	0	783	0	2486	1305	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	27.3	0.0	0.0	0.0	38.0	0.0	17.9	0.0	0.0			
Incr Delay (d2), s/veh	4.0	0.0	0.0	0.0	1.4	0.0	2.5	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	8.4	0.0	0.0	0.0	0.5	0.0	12.4	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.2	0.0	0.0	0.0	39.4	0.0	20.4	0.0	0.0			
LnGrp LOS	C	A	A	A	D	A	C	A	A			
Approach Vol, veh/h		876			52			1545				
Approach Delay, s/veh		31.2			39.4			20.4				
Approach LOS		C			D			C				

Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		45.5		28.2				8.0				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		57.0		31.5				18.0				
Max Q Clear Time (g_c+I1), s		33.1		20.9				3.2				
Green Ext Time (p_c), s		7.9		2.8				0.2				

Intersection Summary												
HCM 6th Ctrl Delay			24.6									
HCM 6th LOS			C									

Notes

User approved volume balancing among the lanes for turning movement.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	977	50	240	420	0	20	0	500	57	200	360
Future Volume (veh/h)	0	977	50	240	420	0	20	0	500	57	200	360
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1841	1841	1841	1796	0	1737	0	1811	1870	1856	1870
Adj Flow Rate, veh/h	0	1039	48	255	447	0	21	0	0	61	213	57
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	0	4	4	4	7	0	11	0	6	2	3	2
Cap, veh/h	0	1285	59	369	1946	0	41	0		99	281	240
Arrive On Green	0.00	0.38	0.38	0.11	0.57	0.00	0.03	0.00	0.00	0.06	0.15	0.15
Sat Flow, veh/h	0	3496	157	3401	3503	0	1654	21		1781	1856	1585
Grp Volume(v), veh/h	0	534	553	255	447	0	21	34.9		61	213	57
Grp Sat Flow(s),veh/h/ln	0	1749	1812	1700	1706	0	1654	C		1781	1856	1585
Q Serve(g_s), s	0.0	14.6	14.6	3.9	3.5	0.0	0.7			1.8	5.9	1.7
Cycle Q Clear(g_c), s	0.0	14.6	14.6	3.9	3.5	0.0	0.7			1.8	5.9	1.7
Prop In Lane	0.00		0.09	1.00		0.00	1.00			1.00		1.00
Lane Grp Cap(c), veh/h	0	660	684	369	1946	0	41			99	281	240
V/C Ratio(X)	0.00	0.81	0.81	0.69	0.23	0.00	0.51			0.61	0.76	0.24
Avail Cap(c_a), veh/h	0	744	771	414	2155	0	375			911	372	318
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00	1.00			1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	14.9	14.9	22.9	5.7	0.0	25.7			24.6	21.7	19.9
Incr Delay (d2), s/veh	0.0	6.0	5.8	4.2	0.1	0.0	9.2			6.0	6.2	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.2	6.3	1.7	1.0	0.0	0.4			0.9	2.9	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	20.9	20.7	27.2	5.7	0.0	34.9			30.7	27.9	20.4
LnGrp LOS	A	C	C	C	A	A	C			C	C	C
Approach Vol, veh/h		1087			702						331	
Approach Delay, s/veh		20.8			13.5						27.1	
Approach LOS		C			B						C	

Timer - Assigned Phs	1		3	4	5	6		8				
Phs Duration (G+Y+Rc), s	7.5		10.3	24.7	5.8	12.6		34.9				
Change Period (Y+Rc), s	4.5		4.5	4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	27.3		6.5	22.7	12.1	10.7		33.7				
Max Q Clear Time (g_c+I1), s	3.8		5.9	16.6	2.7	7.9		5.5				
Green Ext Time (p_c), s	0.1		0.1	3.6	0.0	0.4		3.4				

Intersection Summary												
HCM 6th Ctrl Delay			19.5									
HCM 6th LOS			B									

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

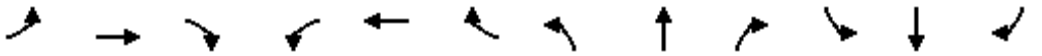
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	504	1030	30	660	10	0	0	0	0	0	0
Future Vol, veh/h	0	504	1030	30	660	10	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	94	94	94	94	92	94	92	94	92	92	92
Heavy Vehicles, %	2	3	5	2	5	2	2	2	2	2	2	2
Mvmt Flow	0	536	1096	32	702	11	0	0	0	0	0	0

Major/Minor	Major1			Major2					Minor2		
Conflicting Flow All	-	0	-	536	0	0			1308	1308	357
Stage 1	-	-	-	-	-	-			772	772	-
Stage 2	-	-	-	-	-	-			536	536	-
Critical Hdwy	-	-	-	4.13	-	-			6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-			5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-			5.43	5.53	-
Follow-up Hdwy	-	-	-	2.219	-	-			3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	1030	-	-			163	159	640
Stage 1	0	-	0	-	-	-			417	408	-
Stage 2	0	-	0	-	-	-			586	522	-
Platoon blocked, %		-			-	-					
Mov Cap-1 Maneuver	-	-	-	1030	-	-			158	0	640
Mov Cap-2 Maneuver	-	-	-	-	-	-			158	0	-
Stage 1	-	-	-	-	-	-			417	0	-
Stage 2	-	-	-	-	-	-			568	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.4	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	-	1030	-	-	-
HCM Lane V/C Ratio	-	0.031	-	-	-
HCM Control Delay (s)	-	8.6	-	-	0
HCM Lane LOS	-	A	-	-	A
HCM 95th %tile Q(veh)	-	0.1	-	-	-

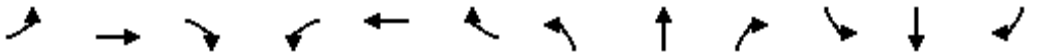


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	430	74	0	0	30	10	680	0	140	0	0	0
Future Volume (veh/h)	430	74	0	0	30	10	680	0	140	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1841	1870	0	0	1870	1870	1826	1870	1826			
Adj Flow Rate, veh/h	537	0	0	0	33	0	835	0	0			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90			
Percent Heavy Veh, %	4	2	0	0	2	2	5	2	5			
Cap, veh/h	814	434	0	0	139	0	1201	646	0			
Arrive On Green	0.23	0.00	0.00	0.00	0.04	0.00	0.35	0.00	0.00			
Sat Flow, veh/h	3506	1870	0	0	3741	0	3478	1870	0			
Grp Volume(v), veh/h	537	0	0	0	33	0	835	0	0			
Grp Sat Flow(s),veh/h/ln	1753	1870	0	0	1777	0	1739	1870	0			
Q Serve(g_s), s	4.9	0.0	0.0	0.0	0.3	0.0	7.3	0.0	0.0			
Cycle Q Clear(g_c), s	4.9	0.0	0.0	0.0	0.3	0.0	7.3	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.00	1.00		0.00			
Lane Grp Cap(c), veh/h	814	434	0	0	139	0	1201	646	0			
V/C Ratio(X)	0.66	0.00	0.00	0.00	0.24	0.00	0.70	0.00	0.00			
Avail Cap(c_a), veh/h	1443	770	0	0	504	0	2172	1168	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	12.3	0.0	0.0	0.0	16.4	0.0	9.9	0.0	0.0			
Incr Delay (d2), s/veh	0.9	0.0	0.0	0.0	0.9	0.0	0.7	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.6	0.0	0.0	0.0	0.1	0.0	2.2	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	13.2	0.0	0.0	0.0	17.3	0.0	10.7	0.0	0.0			
LnGrp LOS	B	A	A	A	B	A	B	A	A			
Approach Vol, veh/h		537			33			835				
Approach Delay, s/veh		13.2			17.3			10.7				
Approach LOS		B			B			B				
Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		16.7		12.7				5.9				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		22.0		14.5				5.0				
Max Q Clear Time (g_c+I1), s		9.3		6.9				2.3				
Green Ext Time (p_c), s		2.9		1.3				0.0				

Intersection Summary	
HCM 6th Ctrl Delay	11.8
HCM 6th LOS	B

Notes

User approved volume balancing among the lanes for turning movement.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	1230	70	360	1097	0	50	0	780	20	220	480
Future Volume (veh/h)	0	1230	70	360	1097	0	50	0	780	20	220	480
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1870	1870	1841	1870	0	1826	0	1870	1604	1870	1870
Adj Flow Rate, veh/h	0	1323	73	387	1180	0	54	0	0	22	237	216
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	2	2	4	2	0	5	0	2	20	2	2
Cap, veh/h	0	1599	88	464	2317	0	71	0		36	302	256
Arrive On Green	0.00	0.47	0.47	0.14	0.65	0.00	0.04	0.00	0.00	0.02	0.16	0.16
Sat Flow, veh/h	0	3518	189	3401	3647	0	1739	54		1527	1870	1585
Grp Volume(v), veh/h	0	685	711	387	1180	0	54	59.6		22	237	216
Grp Sat Flow(s),veh/h/ln	0	1777	1836	1700	1777	0	1739	E		1527	1870	1585
Q Serve(g_s), s	0.0	31.0	31.1	10.3	16.0	0.0	2.8			1.3	11.3	12.2
Cycle Q Clear(g_c), s	0.0	31.0	31.1	10.3	16.0	0.0	2.8			1.3	11.3	12.2
Prop In Lane	0.00		0.10	1.00		0.00	1.00			1.00		1.00
Lane Grp Cap(c), veh/h	0	830	857	464	2317	0	71			36	302	256
V/C Ratio(X)	0.00	0.83	0.83	0.83	0.51	0.00	0.77			0.62	0.78	0.84
Avail Cap(c_a), veh/h	0	989	1022	533	2708	0	724			999	354	300
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00	1.00			1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	21.4	21.4	38.9	8.4	0.0	44.0			44.8	37.2	37.6
Incr Delay (d2), s/veh	0.0	5.0	5.0	9.9	0.2	0.0	15.7			16.1	9.5	17.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	13.5	14.0	4.9	5.6	0.0	1.5			0.7	5.9	5.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	26.4	26.4	48.8	8.6	0.0	59.6			60.9	46.7	54.7
LnGrp LOS	A	C	C	D	A	A	E			E	D	D
Approach Vol, veh/h		1396			1567						475	
Approach Delay, s/veh		26.4			18.5						51.0	
Approach LOS		C			B						D	

Timer - Assigned Phs	1		3	4	5	6		8				
Phs Duration (G+Y+Rc), s	6.7		17.1	47.7	8.3	19.5		64.8				
Change Period (Y+Rc), s	4.5		4.5	4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	60.5		14.5	51.5	38.5	17.5		70.5				
Max Q Clear Time (g_c+I1), s	3.3		12.3	33.1	4.8	14.2		18.0				
Green Ext Time (p_c), s	0.1		0.4	10.1	0.1	0.7		13.0				

Intersection Summary	
HCM 6th Ctrl Delay	26.7
HCM 6th LOS	C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

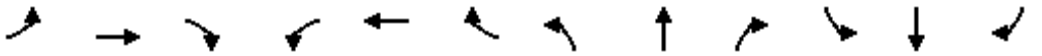
Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↑↑	↰	↑↑						✣	
Traffic Vol, veh/h	0	850	1160	150	1457	0	0	0	0	0	0	0
Future Vol, veh/h	0	850	1160	150	1457	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	93	93	93	93	92	93	92	93	92	92	92
Heavy Vehicles, %	2	2	2	8	2	2	2	2	2	2	2	2
Mvmt Flow	0	914	1247	161	1567	0	0	0	0	0	0	0

Major/Minor	Major1			Major2			Minor2		
Conflicting Flow All	-	0	-	914	0	0	2803	2803	784
Stage 1	-	-	-	-	-	-	1889	1889	-
Stage 2	-	-	-	-	-	-	914	914	-
Critical Hdwy	-	-	-	4.22	-	-	6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-	5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.43	5.53	-
Follow-up Hdwy	-	-	-	2.276	-	-	3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	713	-	0	17	18	337
Stage 1	0	-	0	-	-	0	105	118	-
Stage 2	0	-	0	-	-	0	390	351	-
Platoon blocked, %		-			-				
Mov Cap-1 Maneuver	-	-	-	713	-	-	13	0	337
Mov Cap-2 Maneuver	-	-	-	-	-	-	13	0	-
Stage 1	-	-	-	-	-	-	105	0	-
Stage 2	-	-	-	-	-	-	302	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	1.1	0
HCM LOS			A

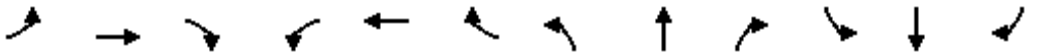
Minor Lane/Major Mvmt	EBT	WBL	WBT	SBLn1
Capacity (veh/h)	-	713	-	-
HCM Lane V/C Ratio	-	0.226	-	-
HCM Control Delay (s)	-	11.5	-	0
HCM Lane LOS	-	B	-	A
HCM 95th %tile Q(veh)	-	0.9	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	820	30	0	0	167	47	1450	10	40	0	0	0
Future Volume (veh/h)	820	30	0	0	167	47	1450	10	40	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1870	1841	0	0	1870	1870	1870	1870	1870			
Adj Flow Rate, veh/h	876	0	0	0	174	27	1555	0	0			
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96			
Percent Heavy Veh, %	2	4	0	0	2	2	2	2	2			
Cap, veh/h	999	516	0	0	262	40	1750	919	0			
Arrive On Green	0.28	0.00	0.00	0.00	0.08	0.08	0.49	0.00	0.00			
Sat Flow, veh/h	3563	1841	0	0	3184	472	3563	1870	0			
Grp Volume(v), veh/h	876	0	0	0	99	102	1555	0	0			
Grp Sat Flow(s),veh/h/ln	1781	1841	0	0	1777	1785	1781	1870	0			
Q Serve(g_s), s	22.0	0.0	0.0	0.0	5.1	5.2	37.0	0.0	0.0			
Cycle Q Clear(g_c), s	22.0	0.0	0.0	0.0	5.1	5.2	37.0	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.26	1.00		0.00			
Lane Grp Cap(c), veh/h	999	516	0	0	150	151	1750	919	0			
V/C Ratio(X)	0.88	0.00	0.00	0.00	0.66	0.68	0.89	0.00	0.00			
Avail Cap(c_a), veh/h	1194	617	0	0	340	342	2161	1135	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	32.3	0.0	0.0	0.0	41.7	41.8	21.6	0.0	0.0			
Incr Delay (d2), s/veh	6.7	0.0	0.0	0.0	4.8	5.2	4.2	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	10.3	0.0	0.0	0.0	2.4	2.5	15.7	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	38.9	0.0	0.0	0.0	46.5	46.9	25.8	0.0	0.0			
LnGrp LOS	D	A	A	A	D	D	C	A	A			
Approach Vol, veh/h		876			201			1555				
Approach Delay, s/veh		38.9			46.7			25.8				
Approach LOS		D			D			C				
Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		50.7		30.8				12.5				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		57.0		31.5				18.0				
Max Q Clear Time (g_c+I1), s		39.0		24.0				7.2				
Green Ext Time (p_c), s		7.1		2.3				0.8				
Intersection Summary												
HCM 6th Ctrl Delay			31.8									
HCM 6th LOS			C									

Notes

User approved volume balancing among the lanes for turning movement.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	971	50	240	420	0	20	0	500	31	200	360
Future Volume (veh/h)	0	971	50	240	420	0	20	0	500	31	200	360
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1841	1841	1841	1796	0	1737	0	1811	1870	1856	1870
Adj Flow Rate, veh/h	0	1033	48	255	447	0	21	0	0	33	213	59
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	0	4	4	4	7	0	11	0	6	2	3	2
Cap, veh/h	0	1282	60	369	1944	0	41	0		65	282	241
Arrive On Green	0.00	0.38	0.38	0.11	0.57	0.00	0.03	0.00	0.00	0.04	0.15	0.15
Sat Flow, veh/h	0	3495	158	3401	3503	0	1654	21		1781	1856	1585
Grp Volume(v), veh/h	0	531	550	255	447	0	21	34.9		33	213	59
Grp Sat Flow(s),veh/h/ln	0	1749	1812	1700	1706	0	1654	C		1781	1856	1585
Q Serve(g_s), s	0.0	14.5	14.5	3.8	3.5	0.0	0.7			1.0	5.9	1.7
Cycle Q Clear(g_c), s	0.0	14.5	14.5	3.8	3.5	0.0	0.7			1.0	5.9	1.7
Prop In Lane	0.00		0.09	1.00		0.00	1.00			1.00		1.00
Lane Grp Cap(c), veh/h	0	659	683	369	1944	0	41			65	282	241
V/C Ratio(X)	0.00	0.81	0.81	0.69	0.23	0.00	0.51			0.51	0.76	0.25
Avail Cap(c_a), veh/h	0	745	772	415	2159	0	376			913	373	318
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00	1.00			1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	14.9	14.9	22.9	5.7	0.0	25.6			25.2	21.6	19.9
Incr Delay (d2), s/veh	0.0	5.8	5.6	4.2	0.1	0.0	9.2			6.1	6.2	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	6.1	6.3	1.7	1.0	0.0	0.4			0.5	2.9	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	20.7	20.5	27.1	5.7	0.0	34.9			31.3	27.8	20.4
LnGrp LOS	A	C	C	C	A	A	C			C	C	C
Approach Vol, veh/h		1081			702						305	
Approach Delay, s/veh		20.6			13.5						26.8	
Approach LOS		C			B						C	

Timer - Assigned Phs	1		3	4	5	6		8				
Phs Duration (G+Y+Rc), s	6.4		10.3	24.6	5.8	12.6		34.8				
Change Period (Y+Rc), s	4.5		4.5	4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	27.3		6.5	22.7	12.1	10.7		33.7				
Max Q Clear Time (g_c+I1), s	3.0		5.8	16.5	2.7	7.9		5.5				
Green Ext Time (p_c), s	0.1		0.1	3.6	0.0	0.4		3.4				

Intersection Summary												
HCM 6th Ctrl Delay			19.3									
HCM 6th LOS			B									

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

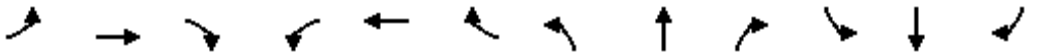
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱↑	↰	↑↑						↔	
Traffic Vol, veh/h	0	472	1030	25	660	10	0	0	0	0	0	0
Future Vol, veh/h	0	472	1030	25	660	10	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	94	94	94	94	92	94	92	94	92	92	92
Heavy Vehicles, %	2	3	5	2	5	2	2	2	2	2	2	2
Mvmt Flow	0	502	1096	27	702	11	0	0	0	0	0	0

Major/Minor	Major1			Major2					Minor2		
Conflicting Flow All	-	0	-	502	0	0			1264	1264	357
Stage 1	-	-	-	-	-	-			762	762	-
Stage 2	-	-	-	-	-	-			502	502	-
Critical Hdwy	-	-	-	4.13	-	-			6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-			5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-			5.43	5.53	-
Follow-up Hdwy	-	-	-	2.219	-	-			3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	1060	-	-			174	169	640
Stage 1	0	-	0	-	-	-			422	413	-
Stage 2	0	-	0	-	-	-			607	541	-
Platoon blocked, %		-			-	-					
Mov Cap-1 Maneuver	-	-	-	1060	-	-			170	0	640
Mov Cap-2 Maneuver	-	-	-	-	-	-			170	0	-
Stage 1	-	-	-	-	-	-			422	0	-
Stage 2	-	-	-	-	-	-			592	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.3	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	-	1060	-	-	-
HCM Lane V/C Ratio	-	0.025	-	-	-
HCM Control Delay (s)	-	8.5	-	-	0
HCM Lane LOS	-	A	-	-	A
HCM 95th %tile Q(veh)	-	0.1	-	-	-

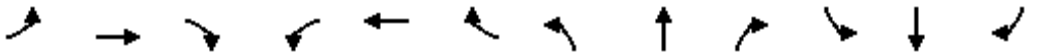


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	430	42	0	0	25	10	680	0	33	0	0	0
Future Volume (veh/h)	430	42	0	0	25	10	680	0	33	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1841	1870	0	0	1870	1870	1826	1870	1826			
Adj Flow Rate, veh/h	512	0	0	0	28	0	759	0	0			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90			
Percent Heavy Veh, %	4	2	0	0	2	2	5	2	5			
Cap, veh/h	805	429	0	0	122	0	1141	614	0			
Arrive On Green	0.23	0.00	0.00	0.00	0.03	0.00	0.33	0.00	0.00			
Sat Flow, veh/h	3506	1870	0	0	3741	0	3478	1870	0			
Grp Volume(v), veh/h	512	0	0	0	28	0	759	0	0			
Grp Sat Flow(s),veh/h/ln	1753	1870	0	0	1777	0	1739	1870	0			
Q Serve(g_s), s	4.4	0.0	0.0	0.0	0.3	0.0	6.2	0.0	0.0			
Cycle Q Clear(g_c), s	4.4	0.0	0.0	0.0	0.3	0.0	6.2	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.00	1.00		0.00			
Lane Grp Cap(c), veh/h	805	429	0	0	122	0	1141	614	0			
V/C Ratio(X)	0.64	0.00	0.00	0.00	0.23	0.00	0.66	0.00	0.00			
Avail Cap(c_a), veh/h	1536	819	0	0	537	0	2312	1243	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	11.5	0.0	0.0	0.0	15.6	0.0	9.6	0.0	0.0			
Incr Delay (d2), s/veh	0.8	0.0	0.0	0.0	0.9	0.0	0.7	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.0	0.1	0.0	1.8	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.3	0.0	0.0	0.0	16.5	0.0	10.2	0.0	0.0			
LnGrp LOS	B	A	A	A	B	A	B	A	A			
Approach Vol, veh/h		512			28			759				
Approach Delay, s/veh		12.3			16.5			10.2				
Approach LOS		B			B			B				
Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		15.4		12.1				5.6				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		22.0		14.5				5.0				
Max Q Clear Time (g_c+I1), s		8.2		6.4				2.3				
Green Ext Time (p_c), s		2.7		1.3				0.0				

Intersection Summary	
HCM 6th Ctrl Delay	11.2
HCM 6th LOS	B

Notes

User approved volume balancing among the lanes for turning movement.



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	1230	70	360	1091	0	50	0	780	20	220	480
Future Volume (veh/h)	0	1230	70	360	1091	0	50	0	780	20	220	480
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	0	1870	1870	1841	1870	0	1826	0	1870	1604	1870	1870
Adj Flow Rate, veh/h	0	1323	73	387	1173	0	54	0	0	22	237	215
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	0	2	2	4	2	0	5	0	2	20	2	2
Cap, veh/h	0	1600	88	464	2318	0	71	0		36	301	256
Arrive On Green	0.00	0.47	0.47	0.14	0.65	0.00	0.04	0.00	0.00	0.02	0.16	0.16
Sat Flow, veh/h	0	3518	189	3401	3647	0	1739	54		1527	1870	1585
Grp Volume(v), veh/h	0	685	711	387	1173	0	54	59.6		22	237	215
Grp Sat Flow(s),veh/h/ln	0	1777	1836	1700	1777	0	1739	E		1527	1870	1585
Q Serve(g_s), s	0.0	30.9	31.1	10.2	15.8	0.0	2.8			1.3	11.2	12.2
Cycle Q Clear(g_c), s	0.0	30.9	31.1	10.2	15.8	0.0	2.8			1.3	11.2	12.2
Prop In Lane	0.00		0.10	1.00		0.00	1.00			1.00		1.00
Lane Grp Cap(c), veh/h	0	830	858	464	2318	0	71			36	301	256
V/C Ratio(X)	0.00	0.83	0.83	0.83	0.51	0.00	0.77			0.62	0.79	0.84
Avail Cap(c_a), veh/h	0	990	1023	534	2711	0	724			1000	354	300
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00			1.00	1.00	1.00
Upstream Filter(I)	0.00	1.00	1.00	1.00	1.00	0.00	1.00			1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	21.4	21.4	38.9	8.3	0.0	43.9			44.7	37.2	37.6
Incr Delay (d2), s/veh	0.0	5.0	5.0	9.8	0.2	0.0	15.7			16.1	9.6	16.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	13.4	14.0	4.9	5.5	0.0	1.5			0.7	5.9	5.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	0.0	26.4	26.4	48.7	8.5	0.0	59.6			60.8	46.8	54.4
LnGrp LOS	A	C	C	D	A	A	E			E	D	D
Approach Vol, veh/h		1396			1560						474	
Approach Delay, s/veh		26.4			18.5						50.9	
Approach LOS		C			B						D	

Timer - Assigned Phs	1		3	4	5	6		8				
Phs Duration (G+Y+Rc), s	6.7		17.1	47.7	8.3	19.4		64.8				
Change Period (Y+Rc), s	4.5		4.5	4.5	4.5	4.5		4.5				
Max Green Setting (Gmax), s	60.5		14.5	51.5	38.5	17.5		70.5				
Max Q Clear Time (g_c+I1), s	3.3		12.2	33.1	4.8	14.2		17.8				
Green Ext Time (p_c), s	0.1		0.4	10.1	0.1	0.7		12.9				

Intersection Summary	
HCM 6th Ctrl Delay	26.7
HCM 6th LOS	C

Notes

Unsignalized Delay for [NBR] is excluded from calculations of the approach delay and intersection delay.

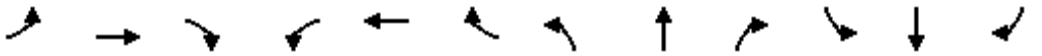
Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑	↱↑	↰	↑↑						↕	
Traffic Vol, veh/h	0	850	1160	43	1451	0	0	0	0	0	0	0
Future Vol, veh/h	0	850	1160	43	1451	0	0	0	0	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	Free	-	-	None	-	-	None	-	-	None
Storage Length	-	-	0	80	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	16974	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	93	93	93	93	92	93	92	93	92	92	92
Heavy Vehicles, %	2	2	2	8	2	2	2	2	2	2	2	2
Mvmt Flow	0	914	1247	46	1560	0	0	0	0	0	0	0

Major/Minor	Major1			Major2			Minor2		
Conflicting Flow All	-	0	-	914	0	0	2566	2566	780
Stage 1	-	-	-	-	-	-	1652	1652	-
Stage 2	-	-	-	-	-	-	914	914	-
Critical Hdwy	-	-	-	4.22	-	-	6.63	6.53	6.93
Critical Hdwy Stg 1	-	-	-	-	-	-	5.83	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.43	5.53	-
Follow-up Hdwy	-	-	-	2.276	-	-	3.519	4.019	3.319
Pot Cap-1 Maneuver	0	-	0	713	-	0	25	26	339
Stage 1	0	-	0	-	-	0	142	155	-
Stage 2	0	-	0	-	-	0	390	351	-
Platoon blocked, %		-			-				
Mov Cap-1 Maneuver	-	-	-	713	-	-	23	0	339
Mov Cap-2 Maneuver	-	-	-	-	-	-	23	0	-
Stage 1	-	-	-	-	-	-	142	0	-
Stage 2	-	-	-	-	-	-	365	0	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0.3	0
HCM LOS			A

Minor Lane/Major Mvmt	EBT	WBL	WBT	SBLn1
Capacity (veh/h)	-	713	-	-
HCM Lane V/C Ratio	-	0.065	-	-
HCM Control Delay (s)	-	10.4	-	0
HCM Lane LOS	-	B	-	A
HCM 95th %tile Q(veh)	-	0.2	-	-



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	820	30	0	0	54	21	1450	10	30	0	0	0
Future Volume (veh/h)	820	30	0	0	54	21	1450	10	30	0	0	0
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0			
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00			
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Work Zone On Approach		No			No			No				
Adj Sat Flow, veh/h/ln	1870	1841	0	0	1870	1870	1870	1870	1870			
Adj Flow Rate, veh/h	876	0	0	0	56	1	1545	0	0			
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96			
Percent Heavy Veh, %	2	4	0	0	2	2	2	2	2			
Cap, veh/h	1032	533	0	0	158	3	1787	938	0			
Arrive On Green	0.29	0.00	0.00	0.00	0.04	0.04	0.50	0.00	0.00			
Sat Flow, veh/h	3563	1841	0	0	3666	64	3563	1870	0			
Grp Volume(v), veh/h	876	0	0	0	28	29	1545	0	0			
Grp Sat Flow(s),veh/h/ln	1781	1841	0	0	1777	1859	1781	1870	0			
Q Serve(g_s), s	19.0	0.0	0.0	0.0	1.2	1.3	31.4	0.0	0.0			
Cycle Q Clear(g_c), s	19.0	0.0	0.0	0.0	1.2	1.3	31.4	0.0	0.0			
Prop In Lane	1.00		0.00	0.00		0.03	1.00		0.00			
Lane Grp Cap(c), veh/h	1032	533	0	0	79	82	1787	938	0			
V/C Ratio(X)	0.85	0.00	0.00	0.00	0.35	0.35	0.86	0.00	0.00			
Avail Cap(c_a), veh/h	1366	706	0	0	389	407	2472	1298	0			
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
Upstream Filter(I)	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00			
Uniform Delay (d), s/veh	27.5	0.0	0.0	0.0	38.1	38.1	18.0	0.0	0.0			
Incr Delay (d2), s/veh	4.0	0.0	0.0	0.0	2.7	2.6	2.5	0.0	0.0			
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
%ile BackOfQ(50%),veh/ln	8.5	0.0	0.0	0.0	0.6	0.6	12.5	0.0	0.0			
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.5	0.0	0.0	0.0	40.8	40.7	20.6	0.0	0.0			
LnGrp LOS	C	A	A	A	D	D	C	A	A			
Approach Vol, veh/h		876			57			1545				
Approach Delay, s/veh		31.5			40.7			20.6				
Approach LOS		C			D			C				

Timer - Assigned Phs		2		4				8				
Phs Duration (G+Y+Rc), s		45.7		28.3				8.1				
Change Period (Y+Rc), s		4.5		4.5				4.5				
Max Green Setting (Gmax), s		57.0		31.5				18.0				
Max Q Clear Time (g_c+I1), s		33.4		21.0				3.3				
Green Ext Time (p_c), s		7.9		2.8				0.2				

Intersection Summary												
HCM 6th Ctrl Delay			24.9									
HCM 6th LOS			C									

Notes

User approved volume balancing among the lanes for turning movement.

Waiawa Phase 2 Solar + Storage Project
Visual Simulations

Prepared for:

Waiawa Phase 2 Solar, LLC

August 2021

TETRA TECH

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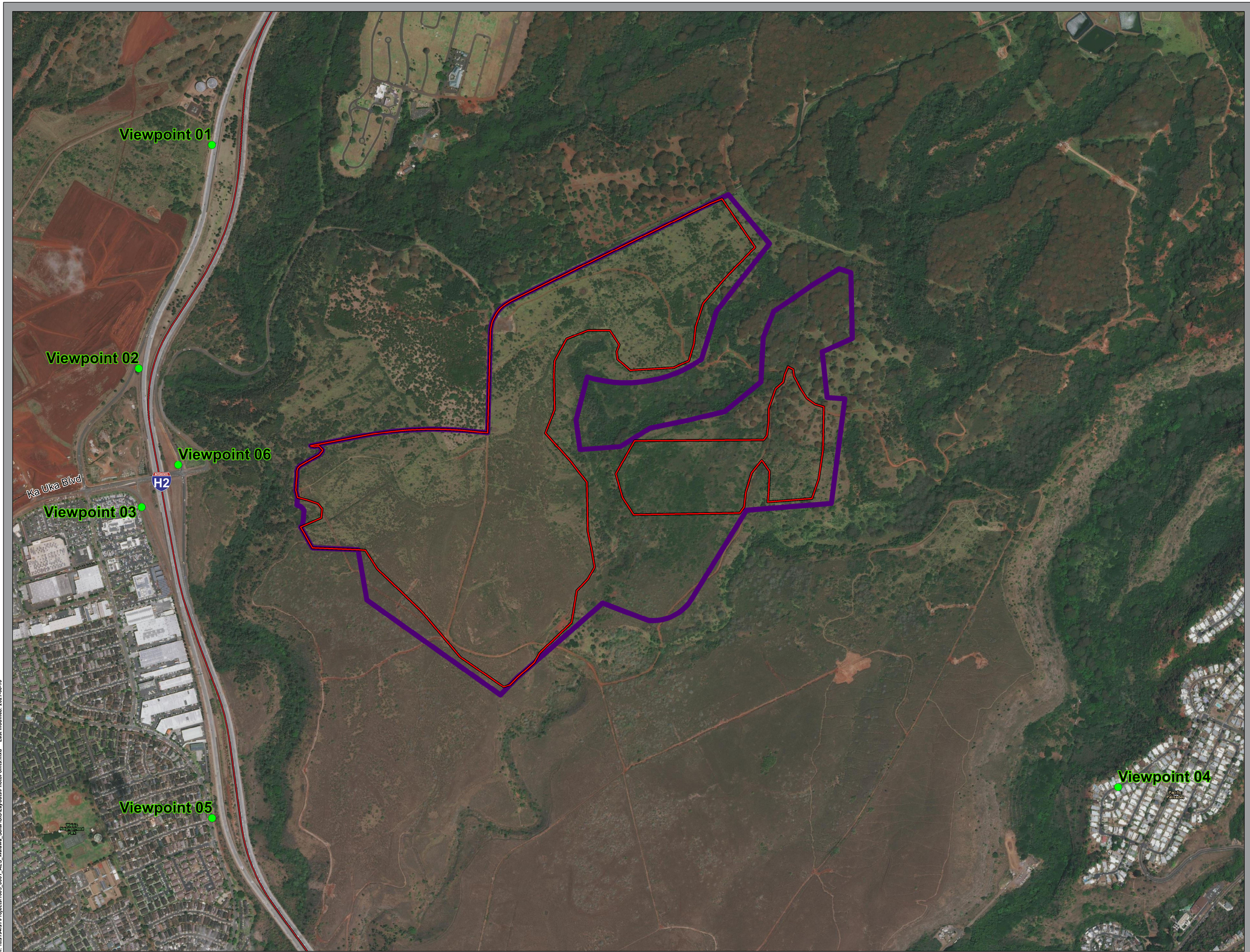
EXHIBIT "6"



Waiawa Phase 2 Solar + Storage Project

Figure 1
Viewpoint Locations

Oahu, HI
August 2021

Legend

- Project Area
- Viewpoint Location
- Fenced Solar Arrays

0 500 1,000 Feet

Scale is 1:6,200 when printed at 22x34"

NOT FOR CONSTRUCTION

TETRA TECH

Path: \\ttn194fs1\Projects\1005_0001_AES_Waiawa_Solar\GIS\Layouts\PhotoPoints.mxd Last modified: 2021-08-10

Existing Conditions

Simulated Conditions

Waiawa Phase 2 Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 01
H-2 South

VICINITY MAP

Photograph Information

Time of photograph: 1:15 p.m.
Date of photograph: 11/02/2020
Weather condition: Partly Cloudy
Viewing direction: Southeast
Latitude: 21.439293° N
Longitude: -157.994777° W
Photo Location: The photo was taken along Highway H-2 approximately .75 miles northwest of the Project.

Existing Conditions

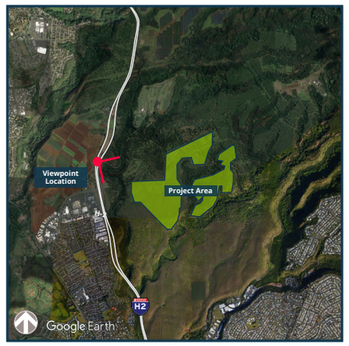
Simulated Conditions

Waiawa Phase 2 Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 02

Ka Uka Off-Ramp Southbound



VICINITY MAP

Photograph Information

Time of photograph: 2:15 p.m.
Date of photograph: 11/02/2020
Weather condition: Partly Cloudy
Viewing direction: Southeast
Latitude: 21.432306° N
Longitude:-157.997150° W
Photo Location: The photo was taken from the Ka Uka Off-Ramp Southbound approximately .4 miles northwest of the Project.

Existing Conditions

Simulated Conditions

Waiawa Phase 2 Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 03

H-2 On-Ramp Southbound

VICINITY MAP

Photograph Information

Time of photograph: 4:15 p.m.
Date of photograph: 10/31/2020
Weather condition: Partly Cloudy
Viewing direction: East
Latitude: 21.427992° N
Longitude: -157.997013° W
Photo Location: The photo was taken from the H-2 On-Ramp Southbound approximately 2000 feet west of the Project.

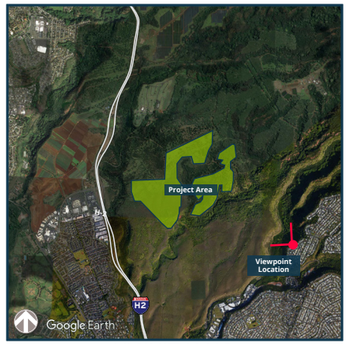
Waiawa Phase 2 Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 04
Aaniu Loop

Existing Conditions

Simulated Conditions



VICINITY MAP

Photograph Information

Time of photograph: 11:40 a.m.
Date of photograph: 10/31/2020
Weather condition: Partly Cloudy
Viewing direction: Northwest
Latitude: 21.419518° N
Longitude: -157.964432° W
Photo Location: The photo was taken along Aanui Loop approximately 1 mile southeast of the Project.

Existing Conditions

Simulated Conditions

Waiawa Phase 2 Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 05
Waipio Uka Street

VICINITY MAP

Photograph Information

Time of photograph: 3:35 p.m.
Date of photograph: 02/22/2021
Weather condition: Mostly Cloudy
Viewing direction: Northeast
Latitude: 21.419397° N
Longitude: -157.994592° W
Photo Location: The photo was taken along Waipio Uka Street approximately 3000 feet southwest of the Project.

Existing Conditions

Simulated Conditions

Waiawa Phase 2 Solar Plus Storage Project

PHOTO SIMULATION

Representative Viewpoint 06

Ka Uka Overpass

VICINITY MAP

Photograph Information

Time of photograph: 5:20 p.m.
Date of photograph: 02/22/2021
Weather condition: Partly Cloudy
Viewing direction: East
Latitude: 21.428965° N
Longitude: -157.995833° W
Photo Location: The photo was taken from the Ka Uka Overpass approximately 1600 feet west of the Project.

Glare Analysis Report for the Waiawa Phase 2 Solar Plus Storage Project

Oʻahu, Hawaiʻi

Prepared for:

Waiawa Phase 2 Solar, LLC

Prepared by:

Tetra Tech, Inc.

Revised August 2021

EXHIBIT "7"

Table of Contents

List of Tables

List of Attachments

Executive Summary

At the request of Waiawa Phase 2 Solar, LLC, Tetra Tech, Inc. (Tetra Tech) conducted a glare analysis of the proposed Waiawa Phase 2 Solar Plus Storage Project (Project). The analysis was conducted using the Solar Glare Hazard Analysis Tool (SGHAT) software through an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. A total of three glare analyses were conducted for the Project. Two of the analyses modeled the points of view from an average first- and second-floor structure, as well as those from a typical commuter car and commercial truck. These analyses included eleven representative observation points (OPs) and six segmented traffic routes from representative locations in proximal areas surrounding the Project. The results of the analyses indicate that the representative OPs and traffic routes would experience no glare as a result of the Project. The third analysis included sixteen final approach flight paths and two air traffic control tower (ATCT) associated with Wheeler Army Airfield (HHI), Daniel K. Inouye International Airport (HNL) and Kalaeloa Airport (JRF). Based on the results of the Federal Aviation Administration (FAA) Notice Criteria Tool (NCT), the Project is recommended to formally file with the FAA Obstruction Evaluation Group (OEG) due to its proximity to HNL, HHI and JRF. The analyses did not predict glare at the modeled two-mile final approach paths or the ATCT for any of the reviewed airports; however, formal filing to the FAA OEG is still recommended (with this analysis appended) in order to obtain an FAA "no effect" letter.

1.0 Introduction

The Project involves construction and operation of a solar photovoltaic and battery energy storage system on approximately 387 acres of Kamehameha Schools' Waiawa property, including tax map key (TMK) 9-6-004:024 (por.), 9-6-004:025, 9-6-004:026, 9-4-006:034, 9-4-006:035 (por.) 9-4-006:036 (por.), and 9-4-006:037 (por.). The Waiawa property is located north of Pearl City and east of the H-2 Freeway and Ka Uka Boulevard interchange. It is bordered by the Waiawa Correctional Facility and Mililani Memorial Park & Mortuary to the north, by Waiawa Stream to the south, and by Pānakauahi Gulch to the west. The H-2 Freeway is located just west of Pānakauahi Gulch. The area to the east consists of conservation land associated with the Koʻolau Mountains. Nearby communities include Pacific Palisades and Pearl City to the south (beyond Waiawa Stream), and Waipiʻo and Mililani to the west and north (beyond the H-2 Freeway). The land within and surrounding the Project area was historically used for sugarcane and pineapple cultivation, but agricultural operations ceased in 1983. The topography generally slopes in a southerly direction, with elevations ranging from approximately 650 feet above mean sea level (amsl) along the northeastern boundary to approximately 370 feet amsl along the southern edge of the Project area.

The Project involves construction and operation of an approximately 30-megawatt (MW) alternating current (AC)/60-MW direct current (DC) ground-mounted solar photovoltaic system coupled with a 240 MW-hour battery energy storage system, a substation, and related interconnection and ancillary facilities. A series of solar photovoltaic panels would be mounted on a racking system arranged in evenly-spaced rows throughout the Project area. The energy storage system would consist of containerized lithium-ion battery units distributed throughout the solar arrays. This equipment would connect via underground and overhead electrical wiring with a Project substation. The substation would be located near the existing Hawaiian Electric Company, Inc. (Hawaiian Electric) Waiau-Mililani and Wahiawa-Waimano 46-kilovolt (kV) sub-transmission lines and would include equipment to allow interconnection with the electrical grid; two 46 kV overhead lines would deliver power from the Project substation to the existing Waiau-Mililani and Wahiawa-Waimano 46 kV sub-transmission lines. The Project would be accessed via an existing gated entry off Waiawa Prison Road and would utilize a network of existing on-site access roads. Within the Project area, a series of new gravel access roads would be installed to accommodate construction vehicles and to allow ongoing access for operations and maintenance. The power generated by the Project would be sold to Hawaiian Electric under a new power purchase agreement. At the end of the Project's useful life, the Project equipment would be decommissioned and the land would be returned to substantially the same condition as existed prior to Project development.

As an industry standard, the term "glint and glare" analysis is typically used to describe an analysis of potential ocular impacts to defined receptors. As a point of clarification, ForgeSolar defines glint and glare in the following statement:

> *Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car.*

Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the slow relative movement of the sun, reflect sunlight for a longer duration.

Based on the ForgeSolar definitions of glint and glare and the stationary nature of the Project solar photovoltaic modules related to the sun, the potential reflectance from the Project modeled throughout this report will be referred to as glare.

Tetra Tech completed a glare analysis using the SGHAT software, developed by Sandia Laboratories, now hosted by ForgeSolar (as discussed further below). The SGHAT software is considered an industry-best practice and conservative model that effectively models the potential for glare at defined receptors from defined solar energy generating facilities. As discussed further below, the model is conservative in that it does not account for potential screening such as existing or proposed vegetation, topography outside of the defined areas, buildings, walls, or fences.

This report summarizes the glare analysis conducted based on the preliminary Project layout provided by Waiawa Phase 2 Solar, LLC dated March 1, 2021. Included as attachments are Figure 1: PV Array Areas, Figure 2: Receptors and Figure 3: Airport Receptors (Attachment A) and the glare analysis reports generated through the use of the ForgeSolar tool (Attachment B).

2.0 FAA Notice Criteria Consultation

The FAA developed Technical Guidance for Evaluating Selected Solar Technologies on Airports in 2010, in addition to FAA regulatory guidance under 78 FR 63276 Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (collectively referred to as FAA Guidance). The FAA Guidance recommends that glare analyses should be performed on a site-specific basis using the Sandia Laboratories SGHAT. This guidance applies to solar facilities located on federally-obligated airport property; it is not mandatory for a proposed solar installation that is not on an airport (and for which a Form 7460-1 is filed with FAA pursuant to CFR Title 14 Part 77.9, as discussed below), but is considered to be an industry best practice for solar facilities in general. The SGHAT is the standard for measuring potential ocular impact as a result of solar facilities (78 FR 63276).

According to 78 FR 63276, the FAA has determined that "glint and glare from solar energy systems could result in an ocular impact to pilots and/or air traffic control (ATC) facilities and compromise the safety of the air transportation system." The FAA has developed the following criteria for analysis of solar energy projects located on jurisdictional airports:

- No potential for glint or glare in the existing or planned ATCT cab; and
- No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two miles from 50 feet above the landing threshold using a standard three-degree glidepath.

The online FAA NCT reports whether a proposed structure is in proximity to a jurisdictional air navigation facility and if formal submission to the FAA OEG under CFR Title 14 Part 77.9 (Safe, Efficient Use, and Preservation of the Navigable Airspace) is recommended. The NCT also identifies final approach flight paths that may be considered vulnerable to a proposed structure's impact on navigation signal reception. The NCT was utilized to determine if the proposed Project is located within an FAA-identified impact area based on the Project boundaries and height above ground surface. The FAA NCT Report stated that a formal filing with the FAA OEG is recommended, and referenced Kahului Airport (OGG). Based on this information, this airport facility was included in the SGHAT analysis, as further discussed below.

3.0 Glare Analysis Method

The SGHAT is considered to be an industry best practice for analysis of glare related to solar energy generating facilities. Tetra Tech utilized the SGHAT technology as part of an online tool (GlareGauge) developed by Sandia National Laboratories and hosted by ForgeSolar. GlareGauge provides a quantitative assessment of the following:

- When and where glare has the potential to occur throughout the year for a defined solar array polygon; and
- Potential effects on the human eye at locations where glare is predicted.

The following statement was issued by Sandia Laboratories regarding the SGHAT technology:

> *Sandia developed SGHAT v. 3.0, a web-based tool and methodology to evaluate potential glint/glare associated with solar energy installations. The validated tool provides a quantified assessment of when and where glare will occur, as well as information about potential ocular impacts. The calculations and methods are based on analyses, test data, a database of different photovoltaic module surfaces (e.g. anti-reflective coating, texturing), and models developed over several years at Sandia. The results are presented in a simple easy-to-interpret plot that specifies when glare will occur throughout the year, with color indicating the potential ocular hazard (Sandia Laboratories, 2016).*

Note, however, that technology changes continue to occur to address issues such as reflectivity. The model, therefore, presents a conservative assessment based upon simplifying assumptions inherent in the model as well as industry improvements since the most recent update of such assumptions.

Based on the predicted retinal irradiance (intensity) and subtended angle (size/distance) of the glare source to receptor, the GlareGauge categorizes potential glare where it is predicted by the model to occur in accordance with three tiers of severity (ocular hazards) that are shown by different colors in the model output:

- Red glare: glare predicted with a potential for permanent eye damage (retinal burn)
- Yellow glare: glare predicted with a potential for temporary after-image
- Green glare: glare predicted with a low potential for temporary after-image

These categories of glare are calculated using a typical observer's blink response time, ocular transmission coefficient (the amount of radiation absorbed in the eye prior to reaching the retina), pupil diameter, and eye focal length (the distance between where rays intersect in the eye and the retina). As a point of comparison, direct viewing of the sun without a filter is considered to be on the border between yellow glare and red glare, while typical camera flashes are considered to be lower tier yellow glare (approximately 3 orders of magnitude less than direct viewing of the sun). Upon exposure to yellow glare, the observer may experience a temporary spot in their vision temporarily lasting after the exposure. Upon exposure to green glare, the observer may experience a bright reflection but typically no spot lasting after exposure.

4.0 Glare Analysis Inputs

The modules to be used for the proposed Project are smooth glass surface material with an anti-reflection coating (ARC), which are parameters selected in the glare analyses. Values associated with panel reflectivity and reflective scatter were not altered from the GlareGauge standard input averaged from various module reflectance profiles produced from module research concluded in 2016; therefore, as previously noted, the model does not incorporate further advances in anti-reflective coatings since that time.

Tetra Tech performed three separate glare analyses: the first two analyses included six proximal segmented vehicular traffic routes, as well as eleven observation points (OPs) for Analysis 1 and two OPs for Analysis 2. The vehicular route receptors and OPs were selected based on the preliminary viewshed analysis and resulting viewpoints used for visual simulations prepared by Tetra Tech; additional routes (Kunia Road, Waiawa Prison Road and H-1) and OPs (1, 2, 10, and 11) were included to provide a more comprehensive representation of areas surrounding the Project. Analysis 1 and 2 differ in the heights assumed for the OP and vehicular routes; Analysis 1 represents the point of view from an average first floor residential/commercial structure and typical commuter car, while Analysis 2 represents the point of view from an average second floor residential/ commercial structure and typical semi-tractor-trailer truck. Analysis 3 is focused on modeling the airport receptors referenced in the NCT results; it includes eight two-mile final approach flight paths and one ATCT associated with HNL, six two-mile final approach flight paths and one ATCT associated with JRF, and two two-mile final approach flight paths associated with HHI. In Analysis 3, a typical 30-degree maximum downward viewing angle and 50-degree maximum azimuthal viewing angle from the aircraft cockpit were included among other parameters presented in Table 2. For all three analyses, the Project Area consisted of nine separate "PV Array Areas", which are segmented polygons generally representative of the proposed Project layout dated March 1, 2021. Segmentation of the Project layout allows GlareGauge to more accurately represent potential ocular impacts as a result of the Project. The additional input features used in the analyses are summarized in Table 1 and Table 2.

Table 1. Glare Analyses Input Features

Analysis No.	Racking Type	Module Orientation[1]	Tracking Maximum[2] (degrees)	Resting Angle[3] (degrees)	Module Height[4] (feet)	OP Height[5] (feet)	Route Height[6] (feet)	ATCT	Flight Paths
1	Tracking	East-facing	±60	5	6.5	6	5	-	-
2	Tracking	East-facing	±60	5	6.5	16	9	-	-
3	Tracking	East-facing	±60	5	6.5	-	-	2	16

1. PV Array Areas modeled as single axis tracking modules from east-facing in the morning hours to west-facing in the evening hours.
2. The module tilt varies through the day as they track the sun, the maximum tracking angle tilt is ±60° east/west
3. Angle of rotation of panels when sun is outside tracking range. Used to model backtracking. Panels will revert to the position described by this rotation angle at all times when the sun is outside the rotation range defined by the tracking maximum.
4. Average module centroid height above ground surface.
5. Height of observation point receptor: 6 feet represents an average first floor residential/commercial point of view and 16 feet represents an average second floor residential/commercial point of view.
6. Height of vehicular route receptor: 5 feet represents typical commuter car height and 9 feet represents typical semi-tractor-trailer truck views.

Table 2. Analysis 3 Input Features

Flight Path/ ATCT Name	Associated Airport	True Direction (degrees)	Threshold Crossing Height (feet)	Glide Path[1] (degrees)	Height Above Ground (feet)
JRF RWY 11	Kalaeloa Airport	118	48	3	-
JRF RWY 22L	Kalaeloa Airport	235	32	3	-
JRF RWY 22R	Kalaeloa Airport	235	33	3	-
JRF RWY 29	Kalaeloa Airport	298	52	3	-
JRF RWY 4L	Kalaeloa Airport	55	35	3	-
JRF RWY 4R	Kalaeloa Airport	55	55	3	-
1-ATCT	Kahului Airfield	-	-	-	50[3]
HNL RWY 8L	Daniel K Inouye Intl Airport	89	71	3	-
HNL RWY 8R	Daniel K Inouye Intl Airport	90	96	3.25	-
HNL RWY 22L	Daniel K Inouye Intl Airport	233	80	3.44	-
HNL RWY 22R	Daniel K Inouye Intl Airport	233	50	3	-
HNL RWY 26L	Daniel K Inouye Intl Airport	270	75	3	-
HNL RWY 26R	Daniel K Inouye Intl Airport	270	65	3.25	-
HNL RWY 4L	Daniel K Inouye Intl Airport	53	50	3	-
HNL RWY 4R	Daniel K Inouye Intl Airport	53	71	3	-
2-ATCT	Daniel K Inouye Intl Airport	-	-	-	50[3]
HHI RWY 24	Wheeler Army Airfield	248	50	3	-
HHI RWY 6	Wheeler Army Airfield	68	50	3	-

1. Angle of descent along final approach flight path.

2. Unable to be confirmed based on public information. Default parameters in the SGHAT software which references the FAA criteria found in Section 2.0 were used.

3. Unable to be confirmed based on public information. A conservative height of 50 feet was used based on aerial photography and Google street views.

5.0 Glare Analysis Assumptions

The GlareGauge model is bound by conservative limitations. The following assumptions provide a level of conservatism to the GlareGauge model:

- The GlareGauge model simulates PV arrays as infinitesimally small modules within planar convex polygons exemplifying the tilt and orientation characteristics defined by the user. Gaps between modules, variable heights of the PV array within the polygons, and supporting structures are not considered in the analysis. Since the actual module rows will be separated by open space, this model assumption could result in indication of glare in locations where panels will not be located. In addition, the supporting structures are considered to have reflectivity values that are negligible relative to the module surfaces included in the model.
- The GlareGauge model utilizes a simplified model of backtracking which assumes panels instantaneously revert to the resting angle whenever the sun is outside the rotation range.
- The GlareGauge model assumes that the observation point receptor can view the entire PV array segment when predicting glare minutes. However, it may be that the receptor at the observation point may only be able to view a small portion (typically the most proximal edge) of the PV array segment. Therefore, the predicted glare minutes and intensity from a specific PV array to a specific observation point are conservative as the observer will likely not experience glare from the entire PV array segment at once.
- The GlareGauge model does not consider obstacles (either man-made or natural) between the defined PV arrays and the receptors such as vegetative screening (existing or planted), buildings, topography, etc. Where such features exist, they would screen views of the Project and, thus, minimize or eliminate glare from those locations.
- The GlareGauge model does not consider the potential effect of shading from existing topography between the sun and the Project outside of the defined areas.
- The direct normal irradiance (DNI) is defined as variable using a typical clear day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum of 1,000 Watts per square meter (W/m^2) at solar noon. The irradiance profile uses the coordinates from Google Maps and a sun position algorithm to scale the DNI throughout the year. The actual daily DNI would be affected by precipitation, cloud cover, atmospheric attenuation (radiation intensity affected by gaseous constituents), and other environmental factors not considered in the GlareGauge model. This may result in modeled predicted glare occurrences when in fact the glare is not actually occurring due to cloud cover, rain, or other atmospheric conditions.

Note that hazard zone boundaries shown in the Glare Hazard plots are an approximation; actual ocular impacts encompass a continuous, not discrete, spectrum.

6.0 Glare Analysis Results

Tetra Tech performed three separate glare analyses to provide a quantitative assessment of the potential for glare from the Project based on different receptor characteristics. The GlareGauge model's predicted results for the Project are summarized in the following sections partitioned according to the receptor parameters.

6.1 Analysis 1: First Story and Commuter Car View Results

Analysis 1 included eleven OPs at six feet above ground surface (typical first story receptor height) and six segmented vehicular traffic routes at five feet above ground surface (typical commuter vehicle receptor height). Table 3 represents the glare summary in annual minutes of glare for Analysis 1. Based on the SGHAT results, no glare of any type is predicted at the defined receptors.

Table 3. Analysis 1 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
OP 1	0	0	0
OP 2	0	0	0
OP 3	0	0	0
OP 4	0	0	0
OP 5	0	0	0
OP 6	0	0	0
OP 7	0	0	0
OP 8	0	0	0
OP 9	0	0	0
OP 10	0	0	0
OP 11	0	0	0
H-1	0	0	0
H-2-1	0	0	0
H-2-2	0	0	0
Kunia Rd	0	0	0
Waiawa Prison Rd	0	0	0
Waipio Uka Street	0	0	0

6.2 Analysis 2: Second Story and Tractor-Trailer View Results

Based on existing development patterns, Analysis 2 included two of the OPs at 16 feet above ground surface (typical second story receptor height) and all of the segmented vehicular traffic routes at nine feet above ground surface (typical tractor-trailer receptor height). Table 4 represents the glare summary in annual minutes of glare for Analysis 2. Similar to Analysis 1, no glare of any type is predicted at the defined receptors.

Table 4. Analysis 2 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
OP 1	0	0	0
OP 2	0	0	0
H-1	0	0	0
H-2-1	0	0	0
H-2-2	0	0	0
Kunia Rd	0	0	0
Waiawa Prison Rd	0	0	0
Waipio Uka Street	0	0	0

6.3 Analysis 3: Flight Path and ATCT Results

Analysis 3 included sixteen proximal two-mile final approach flight paths and two ATCT (as outlined in Table 2). The final approach flight paths that were modeled are located at the airports referenced in the NCT results: Kalaeloa Airport (JRF), Daniel K Inouye Intl Airport (HNL) and Wheeler Army Airport (HHI). Table 5 represents the glare summary in annual minutes of glare for Analysis 3.

Table 5. Analysis 3 Annual Minutes of Glare Summary

Receptor	Green Glare	Yellow Glare	Red Glare
JRF RWY 11	0	0	0
JRF RWY 22L	0	0	0
JRF RWY 22R	0	0	0
JRF RWY 29	0	0	0
JRF RWY 4L	0	0	0
JRF RWY 4R	0	0	0
1-ATCT	0	0	0
HNL RWY 8L	0	0	0
HNL RWY 8R	0	0	0
HNL RWY 22L	0	0	0
HNL RWY 22R	0	0	0
HNL RWY 26L	0	0	0
HNL RWY 26R	0	0	0
HNL RWY 4L	0	0	0
HNL RWY 4R	0	0	0
2-ATCT	0	0	0
HHI RWY 24	0	0	0
HHI RWY 6	0	0	0

7.0 Summary

The preliminary Project Area layout was modeled using GlareGauge to evaluate the potential extent of glare the Project may cause to receptors at eleven OPs and six segmented traffic routes representing proximal areas surrounding the Project, as well as sixteen proximal two-mile final approach flight paths and two ATCT associated with Kalaeloa Airport (JRF), Daniel K Inouye Intl Airport (HNL) and Wheeler Army Airport (HHI).

In order to better analyze the potential for glare as a result of sunlight reflectance from the Project and accommodate GlareGauge conservatisms noted in Section 4.0, nine solar array segments were modeled within the Project Area. Three separate glare analyses (Analysis 1, Analysis 2 and Analysis 3) were performed to provide a quantitative assessment of the potential for glare as a result of the Project, based on views from first- and second-story structures, commuter vehicles and semi-tractor-trailer trucks, and proximal two-mile final approach flight paths and ATCT at the airports referenced in the FAA NCT results. A summary of total glare predicted based on the analyses is presented in Table 6.

Table 6. Project Glare Summary

Analysis No.	OP Height (feet)	Route Height (feet)	Total Green Glare Predicted (annual minutes)[1]	Total Yellow Glare Predicted (annual minutes)	Total Red Glare Predicted (annual minutes)	Total Glare Predicted (annual minutes)	Total Potential Glare Percentage of Annual Daylight Hours[2]
1	6	5	0	0	0	0	0
2	16	9	0	0	0	0	0
3	50 (ATCT)	Variable (flight paths)	0	0	0	0	0

1. Total annual daylight minutes equal approximately 262,800.
2. Total annual daylight hours equal approximately 4,380.

Based on the SGHAT results, none of the modeled receptors (OPs, vehicular routes, and flight paths) are predicted to experience glare as a result of the Project. As previously noted, the GlareGauge model does not account for varying ambient conditions (i.e., cloudy days, precipitation); atmospheric attenuation; screening due to existing topography not located within the defined array layouts; or existing vegetation or structures (including fences or walls); nor does the tool allow proposed landscaping to be included; therefore, the predicted results are considered to be conservative.

As noted in Section 2.0, the FAA has developed the following criteria (78 FR 63276) for analysis of solar energy projects located on jurisdictional airports:

- No potential for glint or glare in the existing or planned ATCT cab; and
- No potential for glare or "low potential for after-image" along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved ALP

Based on the results of the FAA NCT, the Project is recommended to formally file with the FAA OEG due to its proximity to JRF, HNL, and HHI. Analysis 3 did not predict glare at any of the two-mile final approach paths of HHI; however, formal filing to the FAA OEG is still recommended with this analysis appended in order to obtain an FAA "no effect" letter.

8.0 References

FAA (Federal Aviation Administration), 2010a. Federal Aviation Administration. CFR Title 14 Part 77.9 Notice of Proposed Construction or Alteration Requiring Notice. 2010.

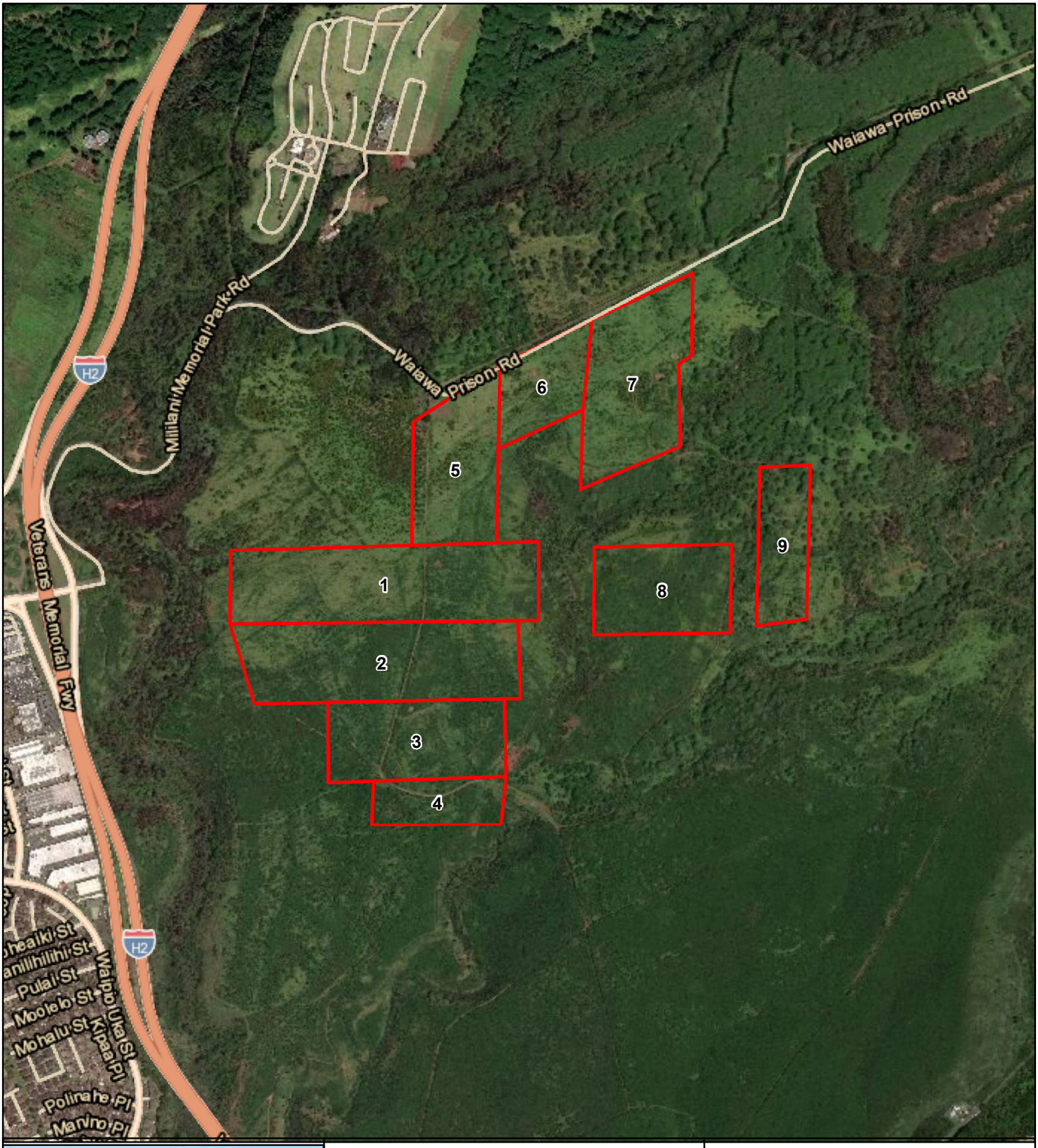
FAA, 2018. Technical Guidance for Evaluating Selected Solar Technologies on Airports. 2018.

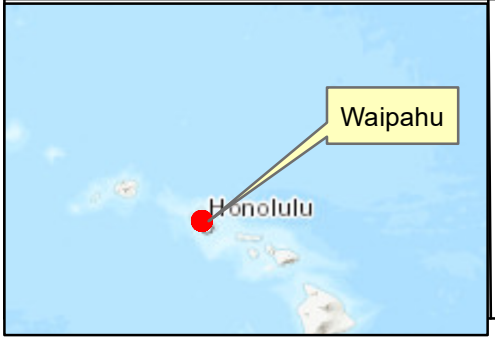
Ho et al. Sandia National Laboratories, Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual. March 2015.

Sandia Solar Glare Hazard Analysis Tool, GlareGauge hosted by ForgeSolar. Accessed online https://www.forgesolar.com/.

Sandia, 2016. Sandia National Laboratories, Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v. 3.0. December 6, 2016.

Attachment A. Figures





Legend

Project Layout (PV Array Areas)

*Locations are approximate

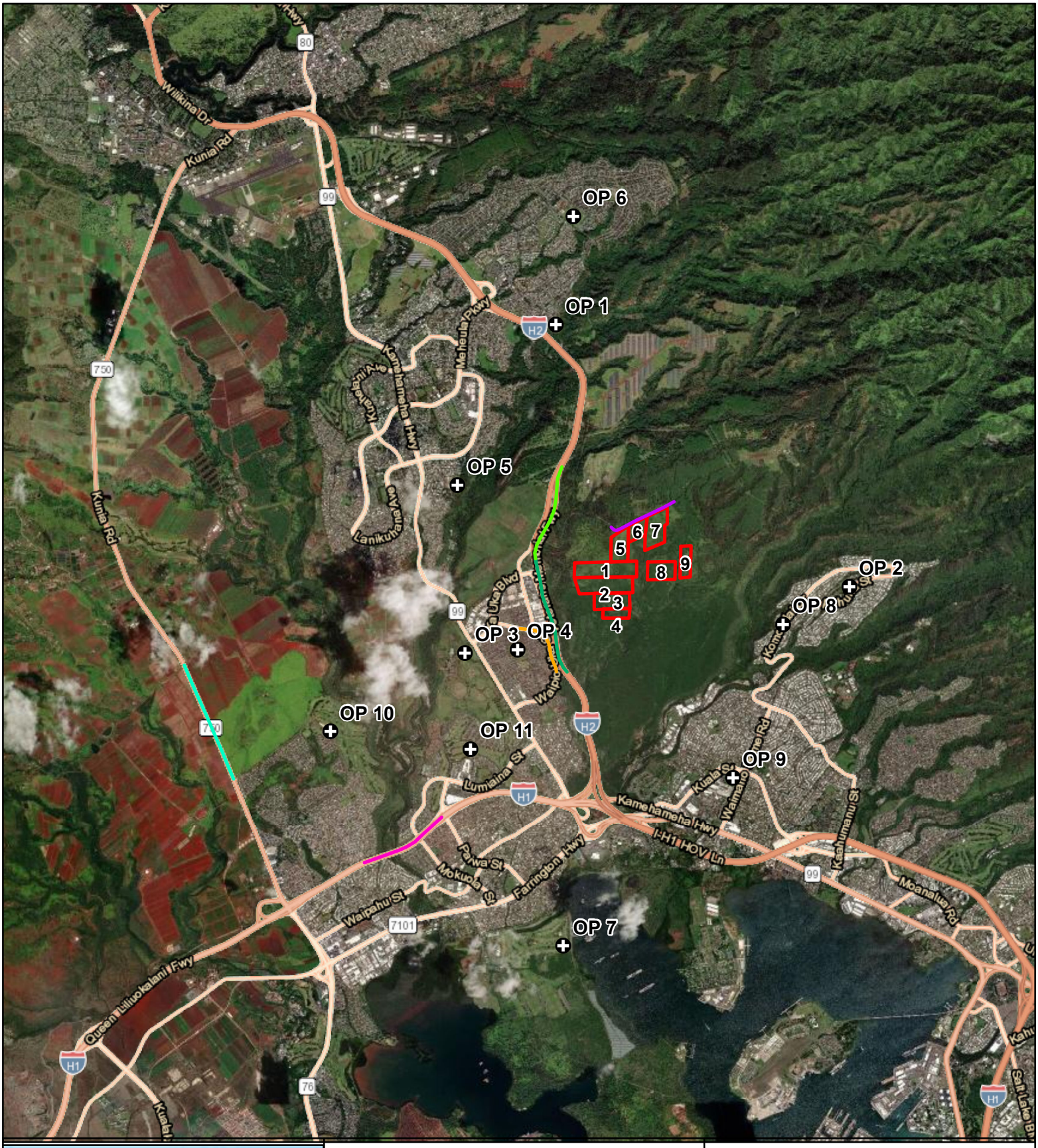
Approximate Scale:

0 750 1,500 3,000 Feet

TETRA TECH

Figure 1
PV Array Areas

Waiawa Solar
Waipahu, Hawaii


OP 6
OP 1
OP 5
OP 2
OP 8
OP 3
OP 4
OP 10
OP 11
OP 9
OP 7
1
2
3
4
5
6
7
8
9
Kunia Rd
Kamehameha Hwy
Waipio Uka St
Lumiaina St
Waipahu St
Farrington Hwy
Kamehameha Hwy
H-1 HOV Ln
Moanalua Rd
Queen Liliuokalani Fwy
Waipahu
Honolulu
Legend
Project Layout (PV Array Areas)
Observation Points
Waiawa Prison Rd
Waipo Uka Street
Kunia Rd
H-2-1
H-2-2
H-1
*Locations are approximate
Approximate Scale:
0
3,950
7,900
15,800
Feet
TETRA TECH
Figure 2
Receptors
Waiawa Solar
Waipahu, Hawaii

TETRA TECH

Figure 3
Airport Receptors

Waiawa Solar
Waipahu, Hawaii

Attachment B. ForgeSolar Glare Analysis Reports

FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **Waiawa Solar- 1st Floor 05122021**
Analysis conducted by Drew Timmis (drew.timmis@tetratech.com) at 22:18 on 12 May, 2021.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

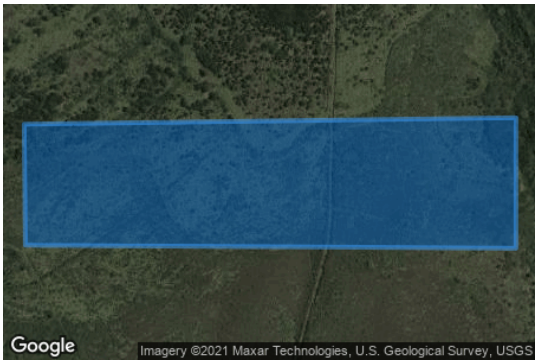
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 52279.6258

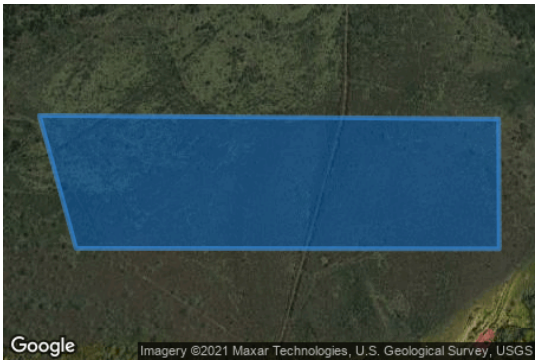
PV Array(s)

Name: PV array 1
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430224	-157.991114	470.90	7.60	478.50
2	21.430334	-157.982188	452.64	7.60	460.25
3	21.428136	-157.982188	435.01	7.60	442.61
4	21.428186	-157.991093	450.44	7.60	458.04

Name: PV array 2
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.428215	-157.991117	450.82	7.60	458.42
2	21.425978	-157.990452	448.72	7.60	456.32
3	21.425968	-157.983189	413.46	7.60	421.06
4	21.425968	-157.982770	406.96	7.60	414.56
5	21.428155	-157.982781	462.75	7.60	470.35

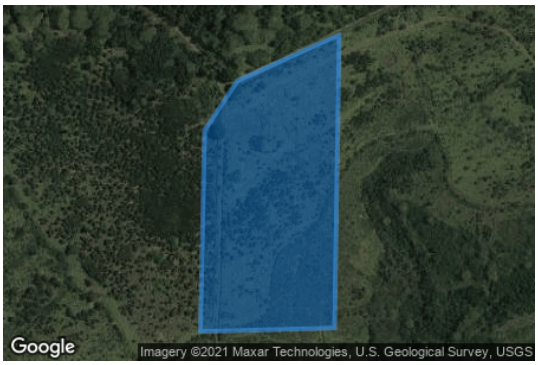
Name: PV array 3
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.1°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.425998	-157.988275	440.57	7.60	448.17
2	21.425998	-157.983232	414.33	7.60	421.93
3	21.423921	-157.983184	373.82	7.60	381.42
4	21.423811	-157.986987	399.74	7.60	407.34
5	21.423801	-157.988296	404.48	7.60	412.08

Name: PV array 4
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.423811	-157.986991	399.74	7.60	407.34
2	21.422608	-157.987066	383.12	7.60	390.72
3	21.422583	-157.983343	321.62	7.60	329.22
4	21.423921	-157.983193	373.88	7.60	381.48

Name: PV array 5
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.2°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430265	-157.985834	526.51	7.60	534.11
2	21.433651	-157.985759	538.01	7.60	545.61
3	21.434490	-157.985158	533.72	7.60	541.32
4	21.435259	-157.983313	546.32	7.60	553.92
5	21.430325	-157.983398	489.42	7.60	497.02

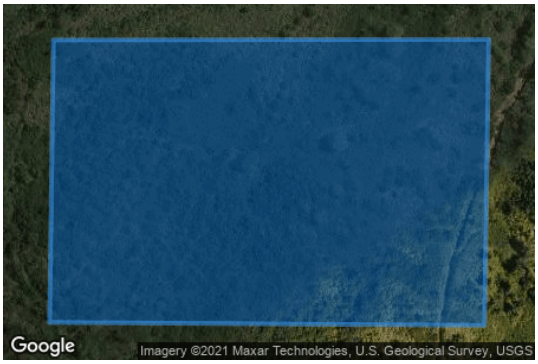
Name: PV array 6
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.435297	-157.983356	546.26	7.60	553.87
2	21.432881	-157.983356	527.38	7.60	534.98
3	21.433919	-157.980866	556.09	7.60	563.69
4	21.436536	-157.980609	601.80	7.60	609.40

Name: PV array 7
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.5°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.436556	-157.980609	602.18	7.60	609.78
2	21.437774	-157.977734	641.89	7.60	649.50
3	21.435457	-157.977734	623.66	7.60	631.26
4	21.435158	-157.978098	617.50	7.60	625.10
5	21.432920	-157.978077	552.18	7.60	559.78
6	21.431762	-157.980952	498.50	7.60	506.11
7	21.433919	-157.980888	555.50	7.60	563.10

Name: PV array 8
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.427785	-157.980621	417.87	7.60	425.47
2	21.427760	-157.976673	432.05	7.60	439.65
3	21.430167	-157.976635	521.52	7.60	529.12
4	21.430162	-157.980586	477.97	7.60	485.57

Name: PV array 9
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.432302	-157.975750	572.18	7.60	579.78
2	21.432332	-157.974344	602.38	7.60	609.98
3	21.428062	-157.974441	439.86	7.60	447.47
4	21.427957	-157.975932	404.81	7.60	412.41

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	21.462100	-157.993780	738.68	6.00
OP 2	2	21.426810	-157.951720	649.86	6.00
OP 3	3	21.417928	-158.006955	383.57	6.00
OP 4	4	21.418352	-157.999248	379.39	6.00
OP 5	5	21.440395	-158.007933	572.51	6.00
OP 6	6	21.476564	-157.991458	902.60	6.00
OP 7	7	21.378770	-157.992900	3.28	6.00
OP 8	8	21.421845	-157.961327	468.60	6.00
OP 9	9	21.401210	-157.968570	127.40	6.00
OP 10	10	21.407392	-158.025592	405.78	6.00
OP 11	11	21.405091	-158.006208	246.52	6.00

Route Receptor(s)

Name: H-1
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.390144	-158.020578	152.61	5.00	157.61
2	21.390599	-158.019151	131.82	5.00	136.82
3	21.391283	-158.017161	48.03	5.00	53.03
4	21.391575	-158.016028	137.65	5.00	142.65
5	21.392054	-158.015025	138.89	5.00	143.89
6	21.392514	-158.014269	139.31	5.00	144.31
7	21.393008	-158.013675	140.22	5.00	145.22
8	21.394017	-158.012565	140.04	5.00	145.04
9	21.395249	-158.011137	136.07	5.00	141.07
10	21.395918	-158.010359	139.94	5.00	144.94

Name: H-2-1
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.442348	-157.993267	593.02	5.00	598.02
2	21.441400	-157.993536	572.20	5.00	577.20
3	21.439362	-157.993729	548.35	5.00	553.35
4	21.438274	-157.993804	537.30	5.00	542.30
5	21.436646	-157.994201	523.77	5.00	528.77
6	21.435438	-157.994802	497.58	5.00	502.58
7	21.433660	-157.995907	501.87	5.00	506.87
8	21.432851	-157.996400	493.37	5.00	498.37
9	21.431912	-157.996701	483.21	5.00	488.21
10	21.430944	-157.996776	485.98	5.00	490.98

Name: H-2-2
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430914	-157.996787	486.24	5.00	491.24
2	21.429406	-157.996486	487.09	5.00	492.09
3	21.427718	-157.996121	454.46	5.00	459.46
4	21.426399	-157.995842	436.33	5.00	441.33
5	21.425176	-157.995547	403.18	5.00	408.18
6	21.424342	-157.995263	412.34	5.00	417.34
7	21.423333	-157.994850	405.62	5.00	410.62
8	21.422240	-157.994410	404.43	5.00	409.43
9	21.421605	-157.994163	399.87	5.00	404.87
10	21.420871	-157.993986	382.49	5.00	387.49
11	21.419663	-157.993799	368.91	5.00	373.91
12	21.418025	-157.993536	340.84	5.00	345.84
13	21.417111	-157.993294	339.17	5.00	344.17
14	21.416452	-157.992994	327.72	5.00	332.72

Name: Kunai Rd
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.416388	-158.047113	615.53	5.00	620.53
2	21.414146	-158.046056	595.80	5.00	600.80
3	21.411964	-158.045015	576.00	5.00	581.00
4	21.410081	-158.044130	560.61	5.00	565.61
5	21.408413	-158.043352	537.42	5.00	542.42
6	21.406325	-158.042398	515.09	5.00	520.09
7	21.404647	-158.041593	502.14	5.00	507.14
8	21.403089	-158.040869	491.81	5.00	496.81
9	21.401598	-158.040224	468.38	5.00	473.38

Name: Waipio Uka Street
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.421153	-157.997678	402.45	5.00	407.45
2	21.421023	-157.996895	398.68	5.00	403.68
3	21.420709	-157.996090	390.66	5.00	395.66
4	21.420214	-157.995474	386.36	5.00	391.36
5	21.419620	-157.995039	384.31	5.00	389.31
6	21.418971	-157.994749	380.21	5.00	385.21
7	21.418232	-157.994647	374.07	5.00	379.07
8	21.417642	-157.994535	369.87	5.00	374.87
9	21.416953	-157.994304	362.53	5.00	367.53
10	21.416344	-157.994009	358.47	5.00	363.47

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-
PV array 5	SA tracking	SA tracking	0	0	-
PV array 6	SA tracking	SA tracking	0	0	-
PV array 7	SA tracking	SA tracking	0	0	-
PV array 8	SA tracking	SA tracking	0	0	-
PV array 9	SA tracking	SA tracking	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare

0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare

0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare

0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare

0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 7

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare

0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 8

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 9

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0
OP 11	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 11

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **Waiawa Solar- 2nd Floor 05122021**
Analysis conducted by Drew Timmis (drew.timmis@tetratech.com) at 22:20 on 12 May, 2021.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

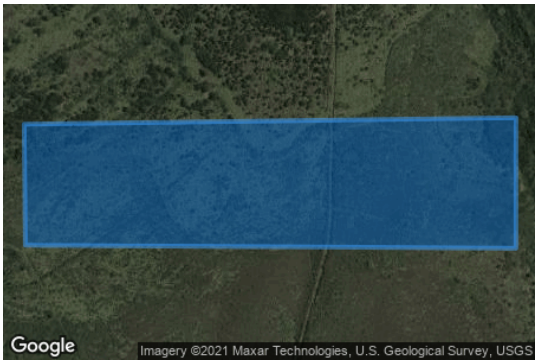
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 52280.6258

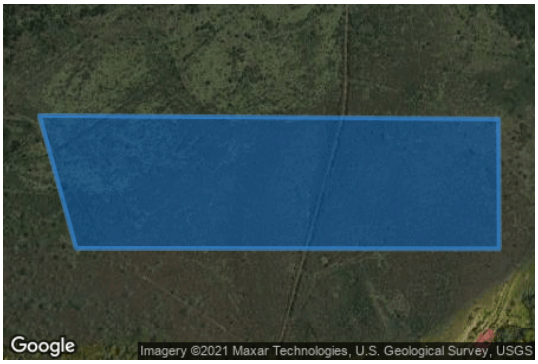
PV Array(s)

Name: PV array 1
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430224	-157.991114	470.90	7.60	478.50
2	21.430334	-157.982188	452.64	7.60	460.25
3	21.428136	-157.982188	435.01	7.60	442.61
4	21.428186	-157.991093	450.44	7.60	458.04

Name: PV array 2
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.428215	-157.991117	450.82	7.60	458.42
2	21.425978	-157.990452	448.72	7.60	456.32
3	21.425968	-157.983189	413.46	7.60	421.06
4	21.425968	-157.982770	406.96	7.60	414.56
5	21.428155	-157.982781	462.75	7.60	470.35

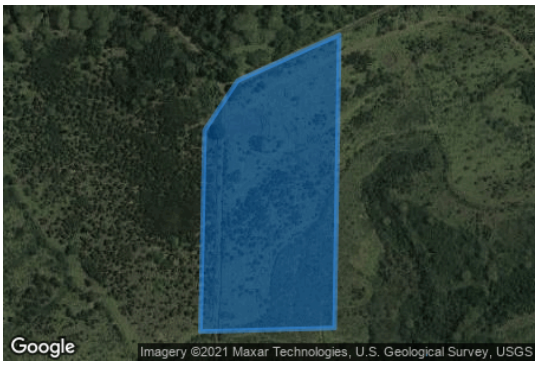
Name: PV array 3
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.1°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.425998	-157.988275	440.57	7.60	448.17
2	21.425998	-157.983232	414.33	7.60	421.93
3	21.423921	-157.983184	373.82	7.60	381.42
4	21.423811	-157.986987	399.74	7.60	407.34
5	21.423801	-157.988296	404.48	7.60	412.08

Name: PV array 4
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.423811	-157.986991	399.74	7.60	407.34
2	21.422608	-157.987066	383.12	7.60	390.72
3	21.422583	-157.983343	321.62	7.60	329.22
4	21.423921	-157.983193	373.88	7.60	381.48

Name: PV array 5
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.2°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430265	-157.985834	526.51	7.60	534.11
2	21.433651	-157.985759	538.01	7.60	545.61
3	21.434490	-157.985158	533.72	7.60	541.32
4	21.435259	-157.983313	546.32	7.60	553.92
5	21.430325	-157.983398	489.42	7.60	497.02

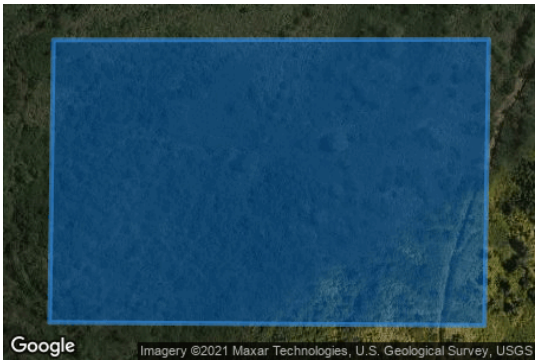
Name: PV array 6
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.435297	-157.983356	546.26	7.60	553.87
2	21.432881	-157.983356	527.38	7.60	534.98
3	21.433919	-157.980866	556.09	7.60	563.69
4	21.436536	-157.980609	601.80	7.60	609.40

Name: PV array 7
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.5°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.436556	-157.980609	602.18	7.60	609.78
2	21.437774	-157.977734	641.89	7.60	649.50
3	21.435457	-157.977734	623.66	7.60	631.26
4	21.435158	-157.978098	617.50	7.60	625.10
5	21.432920	-157.978077	552.18	7.60	559.78
6	21.431762	-157.980952	498.50	7.60	506.11
7	21.433919	-157.980888	555.50	7.60	563.10

Name: PV array 8
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.427785	-157.980621	417.87	7.60	425.47
2	21.427760	-157.976673	432.05	7.60	439.65
3	21.430167	-157.976635	521.52	7.60	529.12
4	21.430162	-157.980586	477.97	7.60	485.57

Name: PV array 9
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.432302	-157.975750	572.18	7.60	579.78
2	21.432332	-157.974344	602.38	7.60	609.98
3	21.428062	-157.974441	439.86	7.60	447.47
4	21.427957	-157.975932	404.81	7.60	412.41

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	21.462095	-157.993778	738.68	16.00
OP 2	2	21.426813	-157.951724	649.86	16.00

Route Receptor(s)

Name: H-1
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.390144	-158.020578	152.61	9.00	161.61
2	21.390599	-158.019151	131.82	9.00	140.82
3	21.391283	-158.017161	48.03	9.00	57.03
4	21.391575	-158.016028	137.65	9.00	146.65
5	21.392054	-158.015025	138.89	9.00	147.89
6	21.392514	-158.014269	139.31	9.00	148.31
7	21.393008	-158.013675	140.22	9.00	149.22
8	21.394017	-158.012565	140.04	9.00	149.04
9	21.395249	-158.011137	136.07	9.00	145.07
10	21.395918	-158.010359	139.94	9.00	148.94

Name: H-2-1
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.442348	-157.993267	593.02	9.00	602.02
2	21.441400	-157.993536	572.20	9.00	581.20
3	21.439362	-157.993729	548.35	9.00	557.35
4	21.438274	-157.993804	537.30	9.00	546.30
5	21.436646	-157.994201	523.77	9.00	532.77
6	21.435438	-157.994802	497.58	9.00	506.58
7	21.433660	-157.995907	501.87	9.00	510.87
8	21.432851	-157.996400	493.37	9.00	502.37
9	21.431912	-157.996701	483.21	9.00	492.21
10	21.430944	-157.996776	485.98	9.00	494.98

Name: H-2-2
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430914	-157.996787	486.24	9.00	495.24
2	21.429406	-157.996486	487.09	9.00	496.09
3	21.427718	-157.996121	454.46	9.00	463.46
4	21.426399	-157.995842	436.33	9.00	445.33
5	21.425176	-157.995547	403.18	9.00	412.18
6	21.424342	-157.995263	412.34	9.00	421.34
7	21.423333	-157.994850	405.62	9.00	414.62
8	21.422240	-157.994410	404.43	9.00	413.43
9	21.421605	-157.994163	399.87	9.00	408.87
10	21.420871	-157.993986	382.49	9.00	391.49
11	21.419663	-157.993799	368.91	9.00	377.91
12	21.418025	-157.993536	340.84	9.00	349.84
13	21.417111	-157.993294	339.17	9.00	348.17
14	21.416452	-157.992994	327.72	9.00	336.72

Name: Kunai Rd
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.416388	-158.047113	615.53	9.00	624.53
2	21.414146	-158.046056	595.80	9.00	604.80
3	21.411964	-158.045015	576.00	9.00	585.00
4	21.410081	-158.044130	560.61	9.00	569.61
5	21.408413	-158.043352	537.42	9.00	546.42
6	21.406325	-158.042398	515.09	9.00	524.09
7	21.404647	-158.041593	502.14	9.00	511.14
8	21.403089	-158.040869	491.81	9.00	500.81
9	21.401598	-158.040224	468.38	9.00	477.39

Name: Waipio Uka Street
Path type: Two-way
Observer view angle: 50.0°

Note: Route receptors are excluded from this FAA policy review. Use the 2-mile flight path receptor to simulate flight paths according to FAA guidelines.

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.421153	-157.997678	402.45	9.00	411.45
2	21.421023	-157.996895	398.68	9.00	407.68
3	21.420709	-157.996090	390.66	9.00	399.66
4	21.420214	-157.995474	386.36	9.00	395.36
5	21.419620	-157.995039	384.31	9.00	393.31
6	21.418971	-157.994749	380.21	9.00	389.22
7	21.418232	-157.994647	374.07	9.00	383.07
8	21.417642	-157.994535	369.87	9.00	378.87
9	21.416953	-157.994304	362.53	9.00	371.53
10	21.416344	-157.994009	358.47	9.00	367.47

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-
PV array 5	SA tracking	SA tracking	0	0	-
PV array 6	SA tracking	SA tracking	0	0	-
PV array 7	SA tracking	SA tracking	0	0	-
PV array 8	SA tracking	SA tracking	0	0	-
PV array 9	SA tracking	SA tracking	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare

0 minutes of green glare

Results for: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 7

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 8

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 9

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
H-1	0	0
H-2-1	0	0
H-2-2	0	0
Kunai Rd	0	0
Waipio Uka Street	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Route: H-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-1

0 minutes of yellow glare
0 minutes of green glare

Route: H-2-2

0 minutes of yellow glare
0 minutes of green glare

Route: Kunai Rd

0 minutes of yellow glare
0 minutes of green glare

Route: Waipio Uka Street

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

FORGESOLAR GLARE ANALYSIS

Project: **AES - Hawaii**
Site configuration: **Waiawa Solar- FAA 05122021**
Analysis conducted by Drew Timmis (drew.timmis@tetratech.com) at 22:22 on 12 May, 2021.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	PASS	Receptor(s) marked as ATCT do not receive glare

Default glare analysis parameters and observer eye characteristics (for reference only):

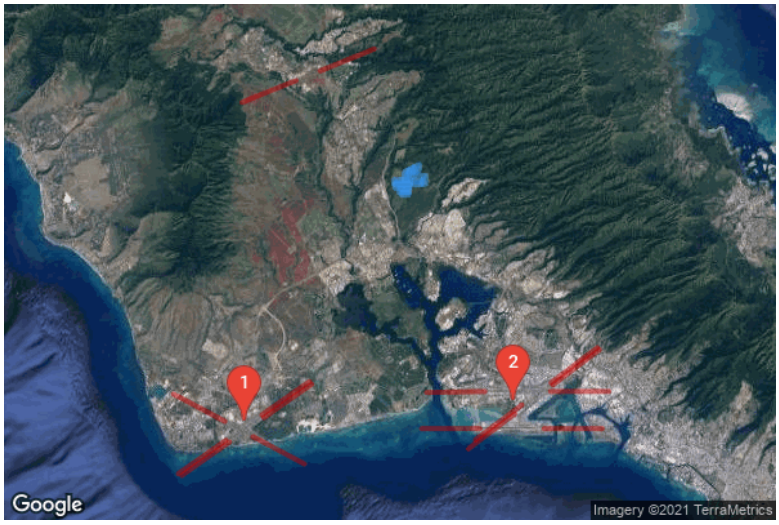
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

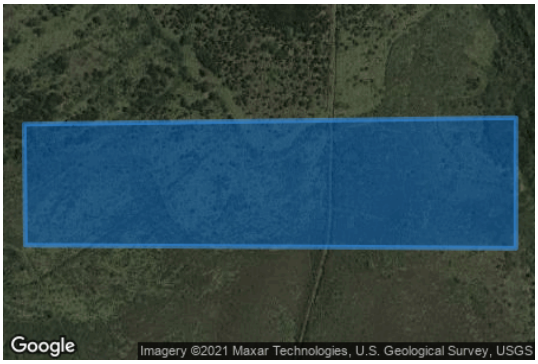
Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 52281.6258



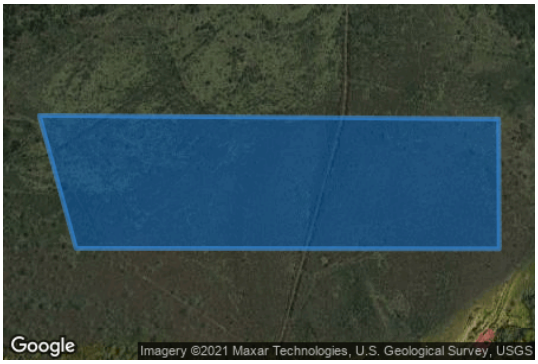
PV Array(s)

Name: PV array 1
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430224	-157.991114	470.90	7.60	478.50
2	21.430334	-157.982188	452.64	7.60	460.25
3	21.428136	-157.982188	435.01	7.60	442.61
4	21.428186	-157.991093	450.44	7.60	458.04

Name: PV array 2
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.428215	-157.991117	450.82	7.60	458.42
2	21.425978	-157.990452	448.72	7.60	456.32
3	21.425968	-157.983189	413.46	7.60	421.06
4	21.425968	-157.982770	406.96	7.60	414.56
5	21.428155	-157.982781	462.75	7.60	470.35

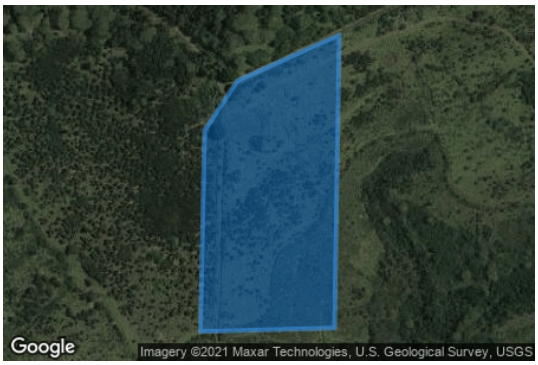
Name: PV array 3
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.1°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.425998	-157.988275	440.57	7.60	448.17
2	21.425998	-157.983232	414.33	7.60	421.93
3	21.423921	-157.983184	373.82	7.60	381.42
4	21.423811	-157.986987	399.74	7.60	407.34
5	21.423801	-157.988296	404.48	7.60	412.08

Name: PV array 4
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.423811	-157.986991	399.74	7.60	407.34
2	21.422608	-157.987066	383.12	7.60	390.72
3	21.422583	-157.983343	321.62	7.60	329.22
4	21.423921	-157.983193	373.88	7.60	381.48

Name: PV array 5
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.2°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.430265	-157.985834	526.51	7.60	534.11
2	21.433651	-157.985759	538.01	7.60	545.61
3	21.434490	-157.985158	533.72	7.60	541.32
4	21.435259	-157.983313	546.32	7.60	553.92
5	21.430325	-157.983398	489.42	7.60	497.02

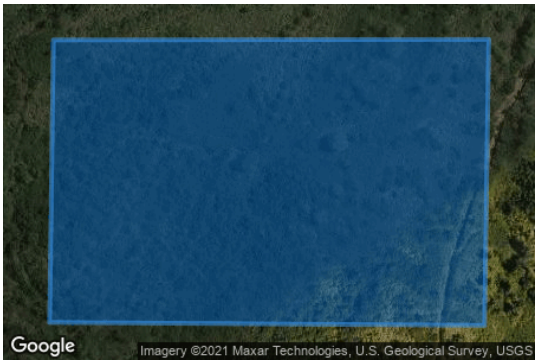
Name: PV array 6
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.435297	-157.983356	546.26	7.60	553.87
2	21.432881	-157.983356	527.38	7.60	534.98
3	21.433919	-157.980866	556.09	7.60	563.69
4	21.436536	-157.980609	601.80	7.60	609.40

Name: PV array 7
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.5°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.436556	-157.980609	602.18	7.60	609.78
2	21.437774	-157.977734	641.89	7.60	649.50
3	21.435457	-157.977734	623.66	7.60	631.26
4	21.435158	-157.978098	617.50	7.60	625.10
5	21.432920	-157.978077	552.18	7.60	559.78
6	21.431762	-157.980952	498.50	7.60	506.11
7	21.433919	-157.980888	555.50	7.60	563.10

Name: PV array 8
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.427785	-157.980621	417.87	7.60	425.47
2	21.427760	-157.976673	432.05	7.60	439.65
3	21.430167	-157.976635	521.52	7.60	529.12
4	21.430162	-157.980586	477.97	7.60	485.57

Name: PV array 9
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	21.432302	-157.975750	572.18	7.60	579.78
2	21.432332	-157.974344	602.38	7.60	609.98
3	21.428062	-157.974441	439.86	7.60	447.47
4	21.427957	-157.975932	404.81	7.60	412.41

Flight Path Receptor(s)

Name: HHI RWY 24
Description:
Threshold height: 50 ft
Direction: 248.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.484113	-158.030631	836.64	50.00	886.64
Two-mile	21.494944	-158.001788	964.84	475.25	1440.09

Name: HHI RWY 6
Description:
Threshold height: 50 ft
Direction: 68.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.479370	-158.043491	816.48	50.00	866.49
Two-mile	21.468539	-158.072332	1132.96	286.98	1419.94

Name: HNL RWY 22L
Description:
Threshold height: 80 ft
Direction: 233.0°
Glide slope: 3.44°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.328554	-157.906435	3.28	80.00	83.28
Two-mile	21.345954	-157.881617	98.20	619.90	718.10

Name: HNL RWY 22R
Description:
Threshold height: 50 ft
Direction: 233.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.329573	-157.907433	6.27	50.00	56.27
Two-mile	21.346973	-157.882615	113.38	496.35	609.72

Name: HNL RWY 26L
Description:
Threshold height: 75 ft
Direction: 270.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.306826	-157.911131	3.09	75.00	78.09
Two-mile	21.306831	-157.880060	8.33	623.22	631.55

Name: HNL RWY 26R
Description:
Threshold height: 65 ft
Direction: 270.0°
Glide slope: 3.25°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.325296	-157.907626	3.28	65.00	68.28
Two-mile	21.325296	-157.876552	19.06	648.90	667.96

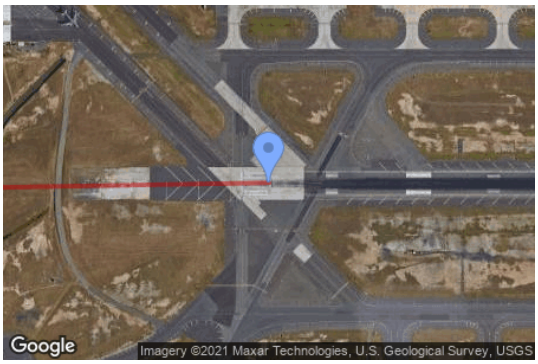
Name: HNL RWY 4L
Description:
Threshold height: 50 ft
Direction: 53.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.318621	-157.922942	6.56	50.00	56.56
Two-mile	21.301221	-157.947758	-24.99	635.01	610.02

Name: HNL RWY 4R
Description:
Threshold height: 71 ft
Direction: 53.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.314205	-157.926756	3.28	71.00	74.28
Two-mile	21.296805	-157.951571	-81.50	709.24	627.74

Name: HNL RWY 8L
Description:
Threshold height: 71 ft
Direction: 89.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.325283	-157.942766	9.84	71.00	80.85
Two-mile	21.324779	-157.973835	0.74	633.57	634.30

Name: HNL RWY 8R
Description:
Threshold height: 96 ft
Direction: 90.0°
Glide slope: 3.25°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.306846	-157.945382	3.15	96.00	99.15
Two-mile	21.306846	-157.976452	-12.58	711.40	698.83

Name: JRF RWY 11
Description:
Threshold height: 48 ft
Direction: 118.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.310468	-158.081505	29.45	48.00	77.45
Two-mile	21.324042	-158.108939	27.07	603.84	630.91

Name: JRF RWY 22L
Description:
Threshold height: 32 ft
Direction: 235.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.312267	-158.060633	26.25	32.00	58.25
Two-mile	21.328851	-158.035181	31.81	579.89	611.70

Name: JRF RWY 22R
Description:
Threshold height: 33 ft
Direction: 235.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.313659	-158.061716	29.53	33.00	62.53
Two-mile	21.330243	-158.036264	32.81	583.18	615.99

Name: JRF RWY 29
Description:
Threshold height: 52 ft
Direction: 298.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.302899	-158.066478	9.84	52.00	61.85
Two-mile	21.289326	-158.039045	-38.10	653.40	615.30

Name: JRF RWY 4L
Description:
Threshold height: 35 ft
Direction: 55.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.301071	-158.080871	13.12	35.00	48.13
Two-mile	21.284488	-158.106321	-24.51	626.09	601.58

Name: JRF RWY 4R
Description:
Threshold height: 55 ft
Direction: 55.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

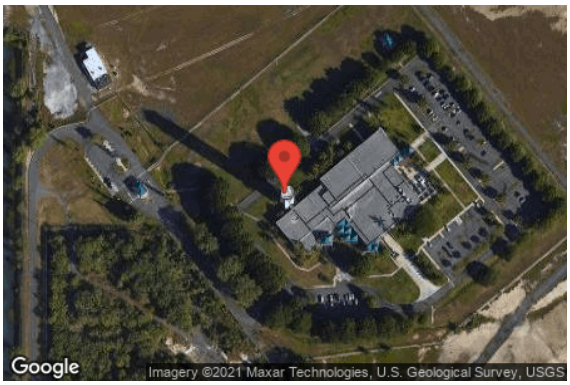
Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	21.300212	-158.078985	13.12	55.00	68.13
Two-mile	21.283628	-158.104435	-28.40	649.99	621.58

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	21.310378	-158.070904	29.53	50.00
2-ATCT	2	21.320948	-157.927233	6.93	50.00

Map image of 1-ATCT

Map image of 2-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-
PV array 5	SA tracking	SA tracking	0	0	-
PV array 6	SA tracking	SA tracking	0	0	-
PV array 7	SA tracking	SA tracking	0	0	-
PV array 8	SA tracking	SA tracking	0	0	-
PV array 9	SA tracking	SA tracking	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Results for: PV array 1

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare

0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 2

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare

0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 3

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 4

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare

0 minutes of green glare

Results for: PV array 5

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 6

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 7

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 8

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: PV array 9

Receptor	Green Glare (min)	Yellow Glare (min)
HHI RWY 24	0	0
HHI RWY 6	0	0
HNL RWY 22L	0	0
HNL RWY 22R	0	0
HNL RWY 26L	0	0
HNL RWY 26R	0	0
HNL RWY 4L	0	0
HNL RWY 4R	0	0
HNL RWY 8L	0	0
HNL RWY 8R	0	0
JRF RWY 11	0	0
JRF RWY 22L	0	0
JRF RWY 22R	0	0
JRF RWY 29	0	0
JRF RWY 4L	0	0
JRF RWY 4R	0	0
1-ATCT	0	0
2-ATCT	0	0

Flight Path: HHI RWY 24

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HHI RWY 6

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 26R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: HNL RWY 8R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 11

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 22R

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 29

0 minutes of yellow glare

0 minutes of green glare

Flight Path: JRF RWY 4L

0 minutes of yellow glare
0 minutes of green glare

Flight Path: JRF RWY 4R

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence may differ.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING
601 KAMOKILA BLVD, STE 555
KAPOLEI, HAWAII 96707

April 24, 2015

Chris Monahan, PhD, Principal
TCP Hawai'i LLC
333 Aoloa Street, #303
Kailua, HI 96734

LOG NO: 2014.04229
DOC NO: 1504GC15
Archaeology, Architecture

Dear Dr. Monahan:

SUBJECT: **Chapter 6E-42 Historic Preservation Review**
Archaeological Inventory Survey of 1,395 Acres of Kamehameha Schools' Lands
Waiawa and Waipi'o Ahupua'a, 'Ewa District, Island of O'ahu
TMK: (1) 9-4-006:034, 035, 036, 037; 9-6-004:024, 025, 026; 9-6-005:001

Thank-you for the opportunity to review the draft report titled *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* (Monahan, September 2014). We received this submittal on September 16, 2014; revised materials on January 10, 2015, and on March 23, 2015. SHPD requested an archaeological inventory survey be conducted due to the potential for proposed project plans to affect historic properties (June 12, 2014; Log No. 2014.02357, Doc. No. 1405GC14). The landowner, Kamehameha Schools (KS), proposes to develop a 50 megawatt solar facility on a portion of the property.

The archaeological inventory survey (AIS) provided surface coverage of the entire 1,395-acre project area which included two existing access roads and two proposed utility tie-ins. Subsurface testing consisted of a single hand-excavated unit placed to examine whether a small, dry-stacked terrace in Gulch C (Site 50-80-09-2273, Feature 21) was pre-Contact or plantation-era in age and association. Large-scale non-historic properties identified within the project area include recent earthen roads with low berms formed when the roads were graded or scraped; evidence of recent modification by civil engineers to control flooding of the landscape near two of the old reservoirs, Gulch C (Reservoir 3 on historic maps) and Gulch B (Reservoir 1-A on historic maps), and a long, heavily-built earthen berm in the northwest portion of the property, north of Gulch A, in an area of former workers' camp.

The AIS indicates that three previous archaeological surveys have included portions of the current project area (Barrera 1987, Goodman and Nees 1991, and Thurman et al. 2012). Portions of a data recovery project also extended into the current project area (Sinoto and Pantaleo 1994, 1995). Five historic properties (Sites 50-80-09-2262, 2270, 2271, 2272, and 2273) have been documented within or extending into the current project area. Of these, three were further documented during the current AIS (Sites 2270, 2271, and 2273); not further documented were Site 2262 (a small lithic scatter) and Site 2272 (WWII and later military concrete buildings and stock pile areas); Site 2262 was fully collected during the Goodman and Nees (1991) survey, and no evidence was found of possible Site 2272 features within the three areas previously identified in Figure 7 as having been used for military storage. Based on the current AIS documentation, Site 2270 is a network of roads and railroad right-of-ways consisting of 28 features, Site 2271 is the remains of workers' camps and other facilities represented by two extant features, and Site 2273 is an irrigation system consisting of 25 features. The most significant features of Site 2271–the Japanese cemetery (Feature 3) and the cannery (Feature 1)–were subject to data recovery work by Sinoto and Pantaleo (1994, 1995). No historic properties were newly identified during the current AIS.

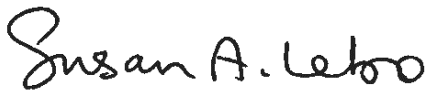
Pursuant to Hawaii Administrative Rule (HAR) §13-284-6, Site 2270 is assessed as significant under Criterion d for its informational value regarding geospatial location, extent, and character of the plantation roads and temporary railroad in Waiawa built around or just after the turn of the 19th/20th century. Site 2273 is assessed as significant under Criterion c for its distinctive construction method and Criterion d for its information value. Like Site 2270, Site 2273 provides important data on geospatial location, extent, and character of the plantation irrigation infrastructure in Waiawa Uka built by the Oahu Sugar Company and its association with the nearby Waiāhole Ditch System (upslope and *mauka* of the current project area). Site 2271 Feature 1 (structural remnants) is assessed as significant under Criterion d for its information content relative to plantation working conditions in the early to middle 20th century, while Site 2271 Feature 2 (camp debris) is assessed as not significant. Per HAR §13-284-7, the project effect determination is "effect, with proposed mitigation commitments." Of the three historic properties, no further work is recommended for Site 2270 and Site 2271 which are assessed as having yielded their informational and research value. The proposed mitigation is "*preservation of certain features of Site 2273*." The specific features are: (1) Feature 22, a large water-distribution and -retention basin of the plateau east of Gulch A, and one of the most formal structures in the project area; (2) a representative section of Feature 23, the cut basalt and mortar irrigation ditch leading into the Feature 22 basin; (3) Feature 19, a large dam-like retention structure in the west end of Gulch B; and (4) a representative section of Feature 14, Sub-feature 3, the cut basalt and mortar irrigation ditch draining into Gulch B and directly associated with the Feature 19 dam. We concur with the site significance assessments and the mitigation commitments.

The AIS report provides an excellent discussion of the project area, physical environs and cultural history background, previous investigations, the project methods and findings, and the site significance assessments and mitigation recommendations. The report meets the requirements of HAR §13-276-5. **It is accepted by SHPD**. Please send one hardcopy of the document, clearly marked FINAL, along with a copy of this review letter and a text-searchable PDF version on CD to the Kapolei SHPD office, attention SHPD Library.

As stipulated in HAR §13-284-7(e), when SHPD comments that the project will have an "effect, with agreed upon mitigation commitments," then detailed mitigation plans shall be developed for SHPD review and acceptance. Per HAR §13-284-8(a)(1)(A), the agreed-upon mitigation measure for this project is preservation of specific features of Site 2273. Pursuant to HAR §13-284-8(e)(5), we look forward to receiving an archaeological preservation plan that meets HAR §13-277.

Please contact Jessica Puff at (808) 692-8023 or at Jessica.L.Puff@hawaii.gov if you have any questions or concerns regarding architectural features. Please contact me at (808) 692-8019 or at Susan.A.Lebo@hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,



Susan A. Lebo, PhD
Oahu Lead Archaeologist
Acting Archaeology Branch Chief