

WHEREFORE, Petitioner respectfully prays that the Assistant Registrar of this Court be authorized and directed to endorse upon said Certificates of Title listed above the change of name of Petitioner from CASTLE & COOKE RESORTS, LLC to LANAI RESORTS, LLC.

DATED: Honolulu, Hawaii, September 25, 2012.

Petitioner: LANAI RESORTS, LLC  
By *Mark F. Ito*  
Mark F. Ito  
Its Attorney

STATE OF HAWAII )  
 ) ss.  
CITY AND COUNTY OF HONOLULU )

On this 25th day of September, 2012, in the State of Hawaii, before me personally appeared **MARK F. ITO**, to me personally known or proved to me on the basis of satisfactory evidence of her signature and identity to be the aforesaid persons, who, being by me duly sworn or affirmed, did say that such persons executed the foregoing instrument as the free act and deed of such persons, and if applicable, in the capacities shown, having been duly authorized to execute such instrument in such capacities.

I hereby certify that the instrument to which this notary acknowledgment is attached is entitled **PETITION FOR ORDER RE CHANGE OF NAME AND ORDER**, and  dated September 25, 2012 or  undated at the time of notarization. The entire instrument, including the notary acknowledgment page(s) and attachment(s), if any, consists of 7-pages.



*Michele P. Makainai*  
Print Name: Michele P. Makainai  
Notary Public, State of Hawaii  
My commission expires: 04/08/2016

PETITION FOR ORDER RE CHANGE OF NAME AND ORDER

ORDER

Upon the record herein and good cause appearing, the prayer of Petitioner in the foregoing Petition for Order re Change of Name is hereby granted, and the Assistant Registrar of this Court is authorized and directed to comply herewith.

DATED: Honolulu, Hawaii, this 27 day of SEP 27 2012, 2012

*for* KATHLEEN HANAWAHINE  
JUDGE OF THE LAND COURT OF THE STATE OF HAWAII  
REGISTRAR



PETITION FOR ORDER RE CHANGE OF NAME AND ORDER

9/17/2012 09:22:00  
5236030 RVCN  
www.BusinessRegistration.com

11:14:27 a.m. 09-14-2012 3/3

09/17/2012 09:22:00

FILED 09/14/2012 11:19 AM  
Business Registration Division  
DEPT. OF COMMERCE AND  
CONSUMER AFFAIRS  
State of Hawaii

STATE OF HAWAII  
DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS  
Business Registration Division  
335 Merchant Street  
Mailing Address: P.O. Box 40, Honolulu, Hawaii 96810  
Phone No. (808) 586-2727

FORM LLC-2  
7/2008

**ARTICLES OF AMENDMENT TO CHANGE LIMITED LIABILITY COMPANY NAME**  
(Section 639-604, Hawaii Revised Statutes)

6495 C5

PLEASE TYPE OR PRINT LEGIBLY IN BLACK INK

The undersigned, for the purpose of amending the Articles of Organization, do hereby certify as follows:

1. The present name of the limited liability company is:  
CASTLE & COOKE RESORTS, LLC
2. The name of the limited liability company is changed to:  
LANAI RESORTS, LLC
3. The amendment was adopted with the consent of all, or a lesser number of, the members of the limited liability company as authorized by the operating agreement.

We certify, under the penalties set forth in the Hawaii Uniform Limited Liability Company Act, that we have read the above statements, we are authorized to make this change, and that the statements are true and correct.

Signed this 14th day of September 2012

Lanai Island Holdings, LLC, its Member  
LIM Corporation, its Manager

PAUL T. MARRONELLI Vice President  
*Paul T. Marronelli*  
\_\_\_\_\_  
(Signature)

Instructions: Articles must be typewritten or printed in black ink, and must be legible. The articles must be signed and certified by at least one manager of a manager-managed company or by at least one member of a member-managed company. All signatures must be in black ink. Submit original articles together with the appropriate fee.

- Line 1. State the full name of the limited liability company prior to the change.
- Line 2. State the new name of the limited liability company. The company name must contain the words *Limited Liability Company*, or the abbreviation, *L.L.C.* or *LLC*.

Filing Fee: Filing fee (\$25.00) is not refundable. Make checks payable to DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS. Dishonored Check Fee \$25.00.

For any questions call (808) 586-2727. Neighbor Islands may call the following numbers followed by 6-2727 and the # sign: Kauai 274-3141; Maui 984-2400; Hawaii 974-4000; Lanai & Molokai 1-800-469-4644 (toll free).  
Fax: (808) 968-2733 Email Address: breg@dcca.hawaii.gov

NOTICE: THIS MATERIAL CAN BE MADE AVAILABLE FOR INDIVIDUALS WITH SPECIAL NEEDS. PLEASE CALL THE DIVISION SECRETARY, BUSINESS REGISTRATION DIVISION, DCCA, AT 586-2744, TO SUBMIT YOUR REQUEST.

ALL BUSINESS REGISTRATION FILINGS ARE OPEN TO PUBLIC INSPECTION. (SECTION 92F-11, HRS)

APPENDIX D  
PHOTOGRAPH LOG



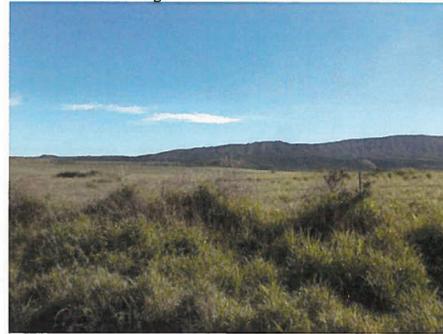
1. Site from south property border facing west, overview of the existing industrial area.



2. Site from the south property border at Miki Road facing northwest, overview of the existing industrial area.



3. Site from the south property border at Miki Road facing north.



4. Site from the south property border facing east.

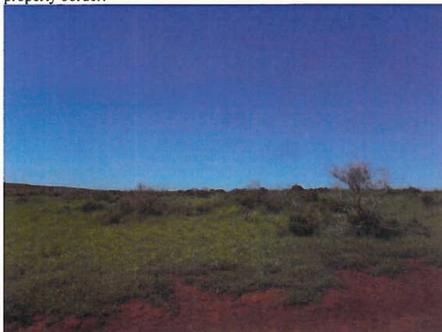
Lanai Resorts, LLC – Miki Basin – 200 Acre – Proposed Industrial Property, Lanai, HI	TRC Project Number - 215580	April 3, 2014
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5. Undeveloped land to the east beyond the Site from the east property border.



6. Undeveloped land to the north beyond the Site from the north property border.



7. Undeveloped land to the west beyond the Site from the west property border.



8. Undeveloped land to the northwest of the Site with the Lanai Airport beyond from the West property boundary.

Lanai Resorts, LLC – Miki Basin – 200 Acre – Proposed Industrial Property, Lanai, HI	TRC Project Number - 215580	April 3, 2014
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9. Undeveloped land to the south beyond the Site from the southwest property border.



10. Typical piping used for agricultural purposes located throughout the property.



11. Typical PVC pipe located throughout the property.



12. Adjoining metal scrapyard with workers actively removing debris.

Lanai Resorts, LLC – Miki Basin – 200 Acre – Proposed Industrial Property, Lanai, HI	TRC Project Number - 215580	April 3, 2014
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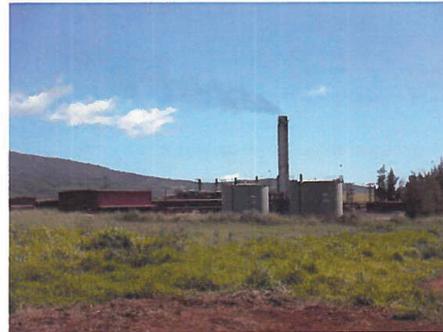
13. Segregated waste materials including batteries, tires and propane tanks located on the adjoining property.



14. Gasoline and oil without proper secondary containment located on the adjoining property. No evidence of spills or releases observed.



15. Overview of the storage warehouse adjoining the Site.

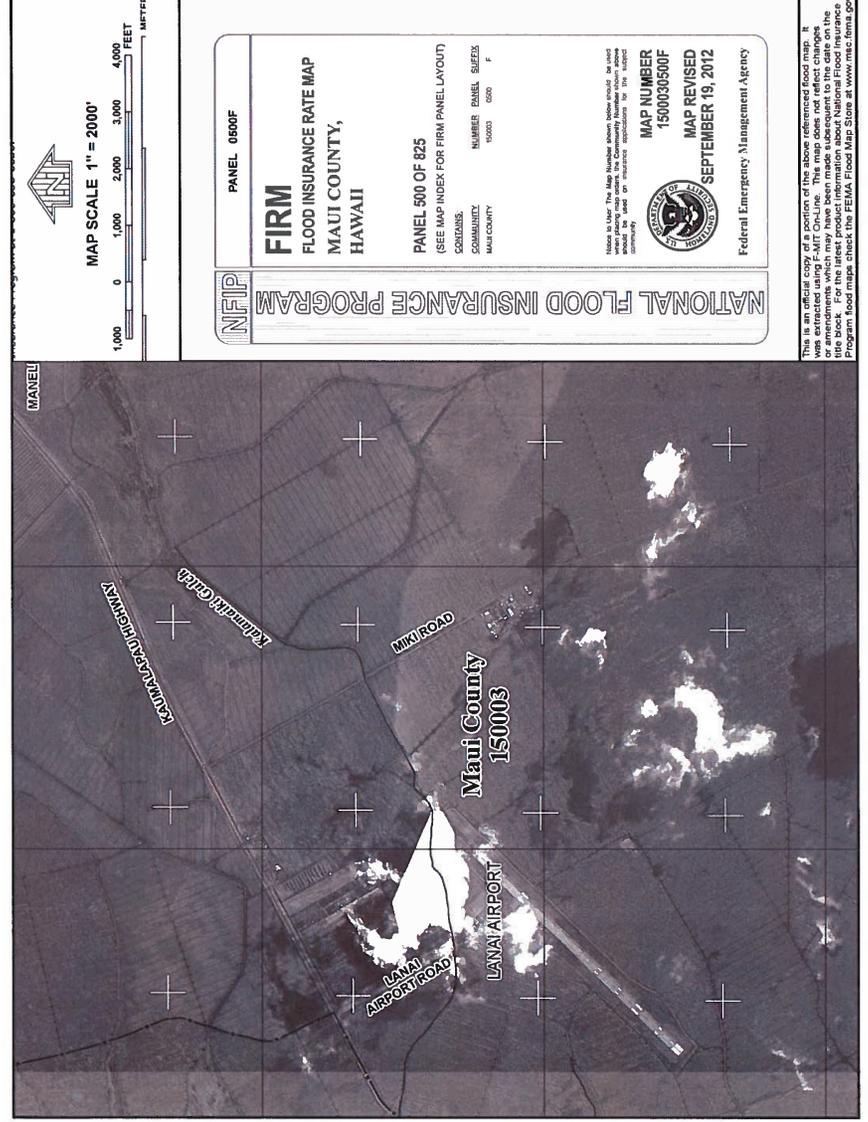


16. MECO power plant facility adjoining the Site.

Lanai Resorts, LLC – Miki Basin – 200 Acre – Proposed Industrial Property, Lanai, HI	TRC Project Number - 215580	April 3, 2014
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APPENDIX E

OTHER REFERENCE INFORMATION





**RONALD A. LANDOLT, CAC**

**EDUCATION**

B.A., Biology/Environmental Management, Concordia University, 2002

**PROFESSIONAL REGISTRATIONS/CERTIFICATIONS**

- State of California, Department of Occupational Safety and Health, Certified Asbestos Consultant, #10-4597
- State of California, Department of Public Health, Certified Lead Inspector/Assessor, #24276.
- State of Hawaii, Department of Health, Certified Asbestos Inspector, #HIASB-2677.

**AREAS OF EXPERTISE**

Mr. Ronald A. Landolt, CAC, has project management and technical experience in the following general areas:

- Client Development, Management and Interaction
- Write and Edit Technical Reports for Clients and Regulatory Agencies
- Soil and Groundwater Sampling and Remediation System Implementation
- Spill Prevention Control and Countermeasure (SPCC) Plan Management
- Stormwater Pollution Control Plan (SWPCP) Development & Management
- Indoor Air Quality and Microbial Assessments and Remediation Design
- Asbestos Surveys and Abatement Project Design
- AHERA Management Plan Review and Development
- Poly-Chlorinated Biphenyl and Mercury Investigations
- Stormwater Regulatory Compliance and Plan Development
- Phase I and Phase II Environmental Site Assessments and Audits
- Property Condition Assessments
- 3<sup>rd</sup> Party QAQC Inspections
- Construction Management and Loan Reviews

**REPRESENTATIVE EXPERIENCE**

Mr. Landolt has over 10 years of experience and progressive responsibility in environmental and engineering consulting. His qualifications include extensive hands-on planning, field investigation, design, permitting, cost estimating, project management, and client management. Mr. Landolt's background includes extensive service to public and private-sector clientele including Target, Rite Aid, Shorestein Realty Services, Deering Property Management, Beaverton School District, North Wasco County School District, Salem-Keizer School District, University of New Mexico, Clackamas Community College, Clatsop Community College, Columbia Gorge Community College, NW Natural Gas, Bank of America, Bechtel Corporation, CB Richard Ellis, FedEx Ground and UPS. He currently serves in the capacity of Project Manager for TRC with responsibility for the business development, proposal and contract document writing and review to initiate projects, track project status and input critical data associated with each project, monitor the work performed by field staff and subcontractors and analyze the data acquired to determine further action with respect to regulatory compliance or industry standards while maintaining strict deadlines.

APPENDIX F

TRC STAFF AND ENVIRONMENTAL PROFESSIONAL  
QUALIFICATIONS/RESUMES



Mr. Landolt is also responsible for management of financial budgets set forth in the specific contract documents from initial development, tracking labor and additional costs through the project until contract completion and final invoicing.

**Millennium Bulk Terminals, Hazardous Materials Assessments – Longview, Washington (Project Manager: Present)**

Lead project manager and client manager responsible for the hazardous materials inspection (asbestos, lead, PCB's, PAH's, Fluoride and Mercury), abatement oversight and regulatory compliance for the re-development of the Millennium Bulk Terminals facility. Responsibilities included initial cost proposals and contracts, scope of work development, organization with the Client and contractors as well as sample collection, staff management and oversight.

**Holly Street Power Plant, Pre-Demolition Asbestos Abatement Management – Austin, Texas (Asbestos Abatement Manager: March – August 2012)**

On-site abatement organization and oversight of the asbestos abatement activities associated with the demolition of the Holly Street Power Plant in Austin, TX. Mr. Landolt was responsible for the management of the abatement activities being conducted in conjunction with the active demolition of the plant as well as providing direct project updates and other correspondence to the client and their representatives on a daily basis.

**Target Distribution Center, SPCC Plan Development and Audits – Albany, Oregon (Project Manager: 2008 – 2011).**

Project Manager responsible for the development of the facilities revised SPCC plan in order to ensure regulatory conformance as well as the subsequent facility audits to confirm compliance with the SPCC plan. Responsibilities included development of the SPCC plan for regulatory compliance and annual Audit of the facility. Mr. Landolt was also involved in client management and communication throughout the duration of the project.

**FedEx Ground, SPCC Audits – Portland, Oregon (Project Manager: 2007 – 2010).**

Project Manager responsible for the audit of the FedEx Ground facilities SPCC plan and conformance to the regulatory requirements. Responsibilities included review of the SPCC plan for regulatory compliance and annual Audit of the facility. Mr. Landolt was also involved in client management and communication throughout the duration of the project.

**FedEx Ground, Environmental Site Investigation – Troutdale, Oregon (Project Manager: 2009 – 2010).**

Development and implementation of a large scale contract and scope of work on a 78-acre site to be used as a shipping facility. The site was previously occupied by an aluminum factory and is listed as a former Superfund site. Responsibilities included developing the scope of work, working with a team to perform the initial Phase I Environmental Site Assessment, management of surveying and excavating subcontractors, performing a detailed subsurface investigation and associated report. Mr. Landolt was also involved in client management and communication throughout the duration of the project.



**Coca-Cola Bottling Company, Due Diligence Environmental Investigations – Omak, Washington (Project Scientist and Project Manager: 2004 – 2011)**

Subsurface investigation where responsibilities included scheduling, ordering drilling supplies, supervision of outside contractors, collect and field screen soil samples, log soil borings according to the Unified Soils Classification System, monitoring well re-development, groundwater monitoring, data interpretation and report preparation as well as remediation system design, implementation and submittal of Voluntary Cleanup Program Application to Washington DOE, and regulatory compliance discussions with Washington DOE.

**Conoco Phillips, Soil and Groundwater Sampling – Oregon, Washington and Arizona (Project Geologist: 2004-2008 and Project Manager: 2008 – 2011)**

Project Geologist and Project Manager responsible for conducting soil and groundwater sampling activities for various retail fueling stations throughout Oregon, Washington and Arizona. Mr. Landolt has also been responsible for the on-site safety compliance associated with soil and groundwater sampling activities for Conoco Phillips as well as collaborating with other consultants, contractors and laboratories to ensure proper sample collection and procedures were followed in accordance with all applicable regulations.

**Teroro Golden Eagle Oil Refining Terminal, Groundwater Remediation Well System Sampling – Concord, California (Project Manager: 2008 – 2010)**

Lead on-site Project Manager for bi-annual sampling of over 300 monitoring wells located throughout a 1,000-acre oil refining terminal. Responsibilities included daily scheduling, permit acquisition, staff coordination, data compilation and management. Mr. Landolt was also responsible for collaborating with other consultants, contractors and laboratories to ensure proper sample collection and procedures were followed.

**Various Clients, Phase I Environmental Site Assessments – Oregon, Washington, California, Idaho, Arizona and New Mexico (Project Manager: 2001 – Present)**

Performs, reviews and manages ASTM Phase I ESAs as an Environmental Professional for various clients including industrial properties, commercial/retail properties, residential properties, and vacant parcels of land. Responsibilities included proposal and budget preparation, proposal review, client interaction, record review, site reconnaissance, interviews, report preparation, limited sampling, report review and submittals.

**Various Clients, Property Condition Assessments – Oregon, Washington, California, Idaho, Colorado, Wyoming, Utah, Nevada, Arizona, New Mexico and Massachusetts (Project Manager: 2005 – Present)**

Performs and manages ASTM PCA's for various clients including high-rise buildings, hotel properties, industrial properties, commercial properties, retail properties and multi-family residential facilities. Responsibilities included proposal and budget preparation, proposal review, client interaction, record review, site reconnaissance, interviews, report preparation, report review and submittals.



Ronald A. Landolt, CAC

**Various Clients, Indoor Air Quality Assessments and Microbial Sampling – Oregon, Washington, California, Idaho and New Mexico (Project Scientist and Project Manager: 2001 – Present)**

Conducted pre- and post-remediation sampling for viable and non-viable spores in commercial, retail and residential properties. Responsibilities include budget and proposal preparation, project coordination, collection of both viable and non-viable spore sampling, bulk sampling, swab sampling, data interpretation, report preparation, and client interaction.

**Clatsop Community College, Hazardous Materials Inspection and Management – Astoria, Oregon (Project Manager and Client Manager: 2009 – Present)**

Lead project manager and client manager responsible for the hazardous materials inspection (asbestos, lead, PCB's and Mercury), abatement oversight and regulatory compliance for the Jerome Campus Redevelopment Project. Responsibilities included initial cost proposals and contracts, scope of work development, organization with the Project Manager, general contractor and abatement contractors as well as staff management and oversight.

**Beaverton School District, Building Science Services – Beaverton, Oregon (Project Manager: 2002-2007, Client Manager: 2007 – Present)**

Project Manager responsible for the oversight of bond and non-bond related asbestos services including: asbestos surveys, development of abatement project designs, abatement oversight, clearance sampling, project completion reports as well as 6-month surveillances, 3-year re-inspections and other AHERA management activities. Lead client manager for ensuring proper investigation, remediation and best management practices compliance during District wide indoor air quality and microbial projects. Responsibilities included initial cost proposals and contracts, scope of work development, organization with District Facilities Specialist and remediation contractors as well as staff management and oversight. Mr. Landolt is also responsible for conducting direct client management and review in conjunction with each project.

**Salem-Keizer School District, Asbestos Management – Salem, Oregon (Client Manager: 2009 – 2011)**

Lead client manager for ensuring regulatory compliance during substantial asbestos abatement projects in conjunction with a District wide 252-million dollar redevelopment bond. Responsibilities included initial cost proposals and contracts, scope of work development, organization with project management teams and general contractors as well as staff management and oversight. Mr. Landolt was also responsible for conducting direct client management and regulatory review in conjunction with each project.

**Falls City School District, Asbestos Program Management – Falls City, Oregon (Client Manager: 2011 – Present)**

Lead client manager for updating the District's AHREA program, ensuring regulatory compliance. Responsibilities included initial cost proposals and contracts, scope of work development, as well as AHERA sampling, report writing and Management Plan development. Mr. Landolt is also responsible for conducting direct client management and training to ensure proper regulatory compliance needs are implemented.



Ronald A. Landolt, CAC

**North Wasco County School District, Asbestos Program Management – The Dalles, Oregon (Client Manager: 2009 – Present)**

Lead client manager for assisting the District with the management of their AHREA program, ensuring regulatory compliance. Responsibilities included initial cost proposals and contracts, scope of work development, as well as AHERA sampling, report writing, abatement project design, abatement oversight and re-inspections.

**Bank of America, Asbestos Inspections and Program Development – Western United States (Project Manager: 2005 – 2010)**

Assistant project manager for the development of standardized sampling methods and report templates for an asbestos survey portfolio consisting of full interior and exterior surveys of over 350 banks throughout California. Mr. Landolt was also the primary project manager for this client in Oregon, with experience managing over 100 local asbestos and indoor air quality projects.

**Rite Aid Corporation, Asbestos & Concrete Vapor Emissions – Western United States (Client Manager: 2007 – Present)**

Primary Client manager for Rite Aid Corporation. The scope of work consists of providing standardized asbestos surveys with concrete moisture testing of the floors as well. Responsibilities included proposal and budget development, project management, distribution of projects to various other offices as well as client management and communication.

**Confidential Luxury Hotel/Resort, Asbestos and Microbial Assessment – Kapalua, Maui, Hawaii (Assistant Project Manager: March – September 2007)**

On-site inspection and remediation oversight of a large scale renovation project in Maui, Hawaii. The resort property consisted of a 550-room hotel, and two unattached restaurant buildings that were scheduled for complete renovation. Responsibilities included assisting with the initial asbestos and microbial inspection, as well as being the lead on-site Project Manager overseeing the microbial remediation. Mr. Landolt was also responsible for providing direct project updates and other correspondence to the client on a regular basis.

**Beaverton School District, Storm Water System Management – Beaverton, Oregon (Project Manager: 2006 – Present)**

Project Manager responsible for the District's Storm Water Pollution Control Program. Conducted sampling events, site inspections and updated facility storm water pollution control plans (SWPCP) in coordination with applicable regulations. Responsible for working with regulators to ensure compliance with proper storage and handling of hazardous materials.

**Milgard Windows and Doors, Storm Water System Management – Tualatin, Oregon (Project Manager: 2010 – Present)**

Project Manager responsible for the development of the industrial facilities Storm Water Pollution Control Plan. Conducted sampling events, site inspections and issued action plans in coordination with applicable regulations and the facilities 1200-Z industrial stormwater permit. Also responsible for working with regulators to ensure compliance with proper sampling strategies, as well as the storage and handling of hazardous materials.



Ronald A. Landolt, CAC

#### SPECIALIZED TRAINING

- EPA AHERA-Accredited Building Inspector, Management Planner, Project Designer, and Contractor Supervisor
- OSHA 10-Hour Construction Safety Training
- 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER)
- OSHA Confined Space Training
- NIOSH 582 Trained Microscopist
- First Aid/CPR Certified (Not current)
- DOT & IATA Department of Transportation's Hazardous Materials' Regulations Certification
- Washington Department of Ecology Dangerous Waste Management Training
- Hazardous/Toxic Waste Management Training
- 16-Hour Microbial Investigations, Assessments and Remediation Training



#### Kacey N. Swindle

##### EDUCATION

B.A., Biology, Hendrix College, 2006  
A.A., Education, Central Baptist College, 2003

##### PROFESSIONAL REGISTRATIONS/CERTIFICATIONS

EPA/AHERA (HIASB-3378) Accredited Asbestos Inspector - Hawaii  
EPA/AHERA (HIASB-3378) Accredited Asbestos Contractor/Supervisor - Hawaii  
EPA/AHERA (HIASB-3378) Accredited Asbestos Project Monitor – Hawaii  
EPA (PB-0509) Certified Lead Inspector – Hawaii  
NIOSH 582 Equivalent Sampling and Evaluating Airborne Asbestos Dust

##### AREAS OF EXPERTISE

Ms. Kacey N. Swindle has technical experience in the following general areas:

- Environmental Assessments and Audits
- Site Remediation Design and Implementation
- Asbestos Surveys
- Microbial Investigations
- Lead Based Paint Inspections
- OSHA Compliance

##### REPRESENTATIVE EXPERIENCE

Ms. Swindle's responsibilities include large and small scale asbestos and lead (Pb) inspections for private, public, commercial and governmental agencies, air monitoring and compliance certification. Ms. Swindle is a certified lead inspector, AHERA inspector, contractor / supervisor, and project monitor.

In addition to asbestos and lead consulting, Ms. Swindle is also proficient in industrial hygiene air monitoring exposure and evaluations, including OSHA compliance and safety program development, as well as indoor air quality studies. Ms. Swindle has performed microbial investigations on multi-family residential and commercial structures. The investigations have encompassed microbial sampling, moisture mapping, project design, and coordination with company senior-level scientists (Ph.D.s, C.I.H.s). Ms. Swindle also performs microbial remediation oversight and post-remediation sampling. She is knowledgeable of construction practices, means, and methods. Ms. Swindle has performed Phase I Environmental Site Assessments including conducting site visits and generating reports.

ASBESTOS ASSESSMENTS**Kyo-Ya, Ltd., Princess Kaiulani Hotel and Retail Spaces Asbestos Surveys - Honolulu, Hawaii (2013 - 2014)**

Performed asbestos inspections prior to proposed renovation activities. The investigation included sample collection, analysis, square footage estimates and friability status to determine if the materials pose a health risk to workers and the general public. Written reports were issued to the client detailing laboratory findings with regulatory recommendations including health risk assessment.

**Hawaii Pacific University, Aloha Tower Marketplace Asbestos/Lead Paint Surveys - Honolulu, Hawaii (2013 - 2014)**

Performed asbestos/lead paint inspections prior to proposed renovation activities. The investigation included sample collection, analysis, square footage estimates and friability status to determine if the materials pose a health risk to workers and the general public. Written reports were issued to the client detailing laboratory findings with regulatory recommendations including health risk assessment.

**General Growth Properties, Sears Asbestos/Lead Paint Surveys and Abatement Oversight - Honolulu, Hawaii (2012 - 2013)**

Performed asbestos/lead paint inspections and asbestos abatement oversight during demolition activities. The investigation included sample collection, analysis, square footage estimates and friability status to determine if the materials pose a health risk to workers and the general public. Written reports were issued to the client detailing laboratory findings with regulatory recommendations including health risk assessment. Oversight activities included daily asbestos air monitoring, clearance inspections and waste disposal characterizations and laboratory data interpretation to ensure that human health was protected.

**Kyo-Ya, Ltd., Moana Surfrider Hotel Asbestos Surveys - Honolulu, Hawaii (2012 - 2013)**

Performed asbestos inspections and asbestos remediation oversight of during renovation activities. The investigation included sample collection, analysis, square footage estimates and friability status to determine if the materials pose a health risk to workers and the general public. Written reports were issued to the client detailing laboratory findings with regulatory recommendations including health risk assessment. Oversight activities included daily asbestos air monitoring, clearance inspections and waste disposal characterizations and laboratory data interpretation to ensure that human health was protected.

**Kyo-Ya, Ltd., Sheraton Waikiki Hotel Asbestos/Lead Paint Surveys - Honolulu, Hawaii (2011 - 2013)**

Performed asbestos/lead paint inspections and asbestos remediation oversight during renovation activities. The investigation included sample collection, analysis, square footage estimates and friability status to determine if the materials pose a health risk to workers and the general public. Written reports were issued to the client detailing laboratory findings with regulatory recommendations including health risk assessment. Oversight activities included daily asbestos air monitoring, clearance inspections and waste disposal characterizations and laboratory data interpretation to ensure that human health was protected.

**Hilton Hawaiian Village, LLC., Hilton Hawaiian Village Asbestos/Lead Paint Surveys - Honolulu, Hawaii (2011 - 2013)**

Performed asbestos/lead paint inspections and asbestos remediation oversight during renovation activities. The investigation included sample collection, analysis, square footage estimates and friability status to determine if the materials pose a health risk to workers and the general public. Written reports were issued to the client detailing laboratory findings with regulatory recommendations including health risk assessment. Oversight activities included daily asbestos air monitoring, clearance inspections and waste disposal characterizations and laboratory data interpretation to ensure that human health was protected.

LEAD BASED PAINT ASSESSMENTS**Ala Wai Townhouse AOA, Ala Wai Townhouse Lead Based Paint Inspection - Honolulu, Hawaii (2012)**

Performed a lead based paint inspection of the above referenced residential building consisting of one hundred (100) similar dwellings as defined by the State of Hawaii, Environmental Protection Agency (EPA) and United States Department of Housing and Urban Development. A written report was issued to the client detailing findings with regulatory recommendations.

PHASE I ENVIRONMENTAL SITE ASSESSMENTS**Lanai Resorts, LLC, Phase I Environmental Site Assessments – Lanai City, Hawaii (Present).**

Performed Phase I Environmental Site Assessments for the development of various properties within Lanai City, HI. Responsibilities included assisting in the site investigations and report generation.

**DEFINITION OF ENVIRONMENTAL PROFESSIONAL AND RELEVANT EXPERIENCE THERETO PURSUANT TO 40 CFR 312**

(1) a person who possesses sufficient specific education, training, and experience necessary to exercise professional judgment to develop opinions and conclusions regarding conditions indicative of releases or threatened releases (see §312.1(c)) on, at, in, or to a property, sufficient to meet the objectives and performance factors in §312.20(e) and (f).

(2) Such a person must: (i) hold a current Professional Engineer's or Professional Geologist's license or registration from a state, tribe, or U.S. territory (or the Commonwealth of Puerto Rico) and have the equivalent of three (3) years of full-time relevant experience; or (ii) be licensed or certified by the federal government, a state, tribe, or U.S. territory (or the Commonwealth of Puerto Rico) to perform environmental inquiries as defined in §312.21 and have the equivalent of three (3) years of full-time *relevant experience*; or (iii) have a Baccalaureate or higher degree from an accredited institution of higher education in a discipline of engineering or science and the equivalent of five (5) years of full-time relevant experience; or (iv) have the equivalent of ten (10) years of full-time relevant experience.

(3) An environmental professional should remain current in his or her field through participation in continuing education or other activities.

(4) The definition of environmental professional provided above does not preempt state professional licensing or registration requirements such as those for a professional geologist, engineer, or site remediation professional. Before commencing work, a person should determine the applicability of state professional licensing or registration laws to the activities to be undertaken as part of the inquiry identified in §312.21(b).

(5) A person who does not qualify as an environmental professional under the foregoing definition may assist in the conduct of all appropriate inquiries in accordance with this part if such person is under the supervision or responsible charge of a person meeting the definition of an environmental professional provided above when conducting such activities.

*Relevant experience*, as used in the definition of environmental professional in this section, means: participation in the performance of all appropriate inquiries investigations, environmental site assessments, or other site investigations that may include environmental analyses, investigations, and remediation which involve the understanding of surface and subsurface environmental conditions and the processes used to evaluate these conditions and for which professional judgment was used to develop opinions regarding conditions indicative of releases or threatened releases (see §312.1(c)) to the Site. TRC personnel resume(s) are included in **Appendix F**.

I declare that, to the best of my professional knowledge and belief, I meet the definition of environmental professional as defined in §312.10 of 40 CFR 312.

I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject property. I have developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312.

Signature of  
Environmental  
Professional:



Date: 04/03/14

APPENDIX G

ENVIRONMENTAL PROFESSIONAL STATEMENT



**ECONOMIC,  
POPULATION AND  
FISCAL IMPACTS  
REPORT**

**APPENDIX**

**F**

***MIKI BASIN INDUSTRIAL PARK:***  
***• SOCIO-ECONOMIC CONDITIONS***  
***• ECONOMIC, POPULATION AND FISCAL IMPACTS***

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***MIKI BASIN INDUSTRIAL PARK:***  
***• SOCIO-ECONOMIC CONDITIONS***  
***• ECONOMIC, POPULATION AND FISCAL IMPACTS***

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*PREPARED FOR:*  
**Pūlama Lāna'i**

*PREPARED BY:*  
**Plasch Econ Pacific LLC**

**September 2021**

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## EXECUTIVE SUMMARY

### 1. PLANNED DEVELOPMENT

Miki Basin Industrial Park (the **Project** or **Miki 200**) is a proposed master-planned development on a 200-acre site located in the Miki Basin area on the island of Lānaʻi, Hawaiʻi. The project will include approximately 100 acres of light industrial and 100 acres of heavy industrial zoned lands.

Following approval, most Project development is expected to occur over a period of about 10 years, but development could require more or less time, depending on the pace of future economic and population growth, market conditions and lot leases.

By 2030, the use of industrial land at Miki 200 is projected to be as follows:

	<u>Acres</u>
— Committed	
• Infrastructure	20.0
• Renewable energy	127.0
• Concrete/rock-crushing facility	14.5
• Asphalt plant	12.5
— Typical industrial activities	7.6
— Vacant (projected development after 2030)	<u>18.4</u>
— <b>Total</b>	<b>200.0</b>

As indicated, about 18.4 acres will accommodate the demand for industrial land beyond 2030. More importantly, this acreage will provide land approved for development and may have major infrastructure in order to take immediate advantage of any new economic opportunities which may arise, thereby diversifying Lānaʻi's economy.

### 2. EMPLOYMENT BENEFITS

#### a. Construction and Related Employment

During the Project's initial 10-year development period, construction employment is expected to average about 19 jobs per year. Indirect employment related to Project development is expected to average about 29 jobs per year. Thus, total direct-plus-indirect employment associated with Project development activities will average about 48 jobs per year. The actual job count will fluctuate over time, depending on the pace of construction.

#### b. Operating Employment, 2030

Onsite operating employment is expected to grow to about 60 new jobs by 2030. These jobs will include entry-level positions to highly skilled professionals.

### 3. FISCAL BENEFITS

#### a. County

Project development activity is expected to have a negligible impact on County finances inasmuch as the developer will provide or pay its fair-share of support infrastructure (interior roads, water distribution, sewers, drainage, etc.).

At full development, the Project is expected to generate net income to the County of approximately \$380,000 per year. Net revenues are positive largely because of the property taxes.

Inasmuch as the Miki 200 is expected to be developed in conjunction with forecasted population growth for Lānaʻi, the County is not expected to realize significant additional increases in expenditures as a direct result of the Project.

#### b. State

Unlike the County, the State derives substantial net revenues from development activity. Over the initial 10-year construction period, the State will net about \$5.6 million from construction and related economic activities associated with the Project, or an average of about \$560,000 million per year.

At full development, the Project is expected to generate net income to the State of about \$670,000 per year. The positive return to the State reflects the various taxes on economic activities associated with Miki 200. As with County services, additional State expenditures are not anticipated to be required to support operations of the Project.

**MIKI BASIN INDUSTRIAL PARK:  
• SOCIO-ECONOMIC CONDITIONS  
• ECONOMIC, POPULATION, AND FISCAL IMPACTS**

**PART I: INTRODUCTION AND PROPOSED PROJECT**

**I. INTRODUCTION**

**a. Content and Purpose**

Miki Basin Industrial Park (the **Project** or **Miki 200**) is a proposed master-planned development on a 200-acre site located in the Miki Basin area on the island of Lānaʻi, Hawaiʻi.

This report addresses (1) the socio-economic conditions on Lānaʻi, and (2) the economic, population and fiscal impacts of the Project. The purpose is to provide the community, State of Hawaiʻi (**State**) officials and County of Maui (**County**) officials with relevant information about planned development and operations.

Socio-economic conditions includes information about the population, housing, incomes, education, economic activities, employment and labor force on Lānaʻi.

Economic impacts cover expenditures and sales, profits, employment and payroll related to (1) construction and related activities, and (2) operations of the Project.

Population impacts cover the number of residents supported by jobs created by the development and operations, and the number of homes required to house these residents.

Fiscal impacts address the impact of the Project on State and County revenues and expenditures.

**b. Methodology**

Socio-Economic Conditions

Demographic, social, household and economic characteristics of the population were obtained from the 2010 census by the U.S. Census Bureau, and from the American Community Survey (“ACS”). The ACS is an ongoing survey that provides up-to-date information about the nation’s population. The ACS includes questions that were not included in the 2010 decennial census (but, historically, were included in the 2000 census). The most up-to-date available data from the ACS are five-year estimates from 2015-2019.

Economic and Fiscal Impacts

*Multipliers*

The proposed development and operations are translated into economic and fiscal impacts based on a number of multipliers (for example, indirect sales as a percentage of direct sales, construction jobs per \$1 million in expenditures, indirect jobs per direct jobs, and tax rates). These multipliers reflect the professional judgment of the consultant, and were based on information from the following sources: U.S. Census data; the *State of Hawaiʻi Data Book*; *The Hawaiʻi State Input-Output Study: 2012 Benchmark Report (I-O Model)*; employment and labor rates from the Hawaiʻi Department of Labor and Industrial Relations (**DLIR**); State and County tax rates.

Direct and Indirect Impacts

“**Direct**” economic impacts (gross sales, employment, payroll, etc.) are the immediate effects of a change in a particular sector of the economy (e.g., construction activity). Traditionally, “indirect” impacts are changes in other sectors of the economy that are caused by the direct impacts (e.g., transportation of building supplies), but exclude impacts related to the purchase of goods and services by employees and their families (**household spending**). Traditionally, “induced” impacts are changes in the economy that are caused by the household spending by those who are affected by the direct and indirect changes in the economy. In this report, “**indirect**” economic impacts are redefined broadly to include both the traditional indirect economic impacts and the induced economic impacts.

2019 Dollars

For the economic and fiscal impacts (Part III), dollar amounts are expressed in terms of 2019 purchasing power and market conditions. The year 2019 was used because it is the last year of “normal” economic conditions before COVID-19. Values, prices, costs and dollar amounts for prior years are adjusted for inflation to 2019 dollars based on the Honolulu Consumer Price Index (CPI) for Urban Consumers. Dollar amounts after 2019 are not increased to account for inflation, appreciation in property values, changes in labor rates, changes in building costs, or other changes in market conditions. However, fiscal impacts are based on current tax rates (i.e., August 2021 rates).

Accuracy of Estimates

Much of the analysis contained in this report is quantitative in nature, where numbers are used to help communicate anticipated impacts. However, these numbers should not be interpreted as precise predictions. Rather, they represent the best estimates of what is

expected to occur based on available information about planned development and operations, market conditions, and tax rates.

### c. Organization of the Report

The report is divided into three Parts:

- Part I: Introduction and Proposed Project
- Part II: Socio-Economic Conditions
- Part III: Economic, Population and Fiscal Impacts

All Figures in this report are embedded in the text, while all tables are at the end. Socio-economic conditions for Lānaʻi and the County are presented in Tables II-1 and II-2. Economic, population and fiscal impacts are presented in Tables III-1 to III-5. In these tables, the quantities appearing in **bold** highlight the more significant impacts.

### d. Economic Consultant

The analysis was conducted by Plasch Econ Pacific LLC (**PEP**), a Hawaiʻi-based economic-consulting firm specializing in economic development, land and housing economics, feasibility studies, valuations, market analysis, public policy analysis, and the economic and fiscal impacts of projects.

## 2. PROJECT OVERVIEW

### a. Project Location

The Miki 200 will be centrally located on a 200-acre site in Miki Basin on the island of Lānaʻi, about 1 mile east of the Lānaʻi Airport terminal, 2.7 miles southwest of Lānaʻi City, and 3.7 miles east of Kaunalapau Harbor (Figures I-1 and I-2). The Tax Map Key (TMK) for the Project area is (2)4-9-002:061(por).

As shown in Figure I-3, the Project will abut (1) the Hawaiian Electric Company/Maui Electric Co. (**HECO**) power plant, and (2) the “Existing Industrial Condominium” (referred to as **Miki 20** since it is a 20-acre project in the Miki Basin).

### b. Project Description

Consistent with the Lānaʻi Community Plan, Miki 200 will include 100 acres designated Light Industrial and 100 acres designated Heavy Industrial. It will be Lānaʻi’s first large-scale industrial park. Lot sizes may range from less than a half-acre to 20 acres or more. Also, rental space may be available in industrial buildings if built. Infrastructure may include internal roads, water, power, sewers, drainage, etc.

Miki 200 will provide space for the relocation and/or expansion of existing industrial activities on Lānaʻi, land and warehouses for storing goods and equipment, and land and buildings to accommodate industrial activities new to Lānaʻi. Regarding the last point, it is important to have industrial land readily available and approved for development in order to take immediate advantage of any new economic opportunities which may arise.

### c. Development Period

Following approval, most Project development is expected to occur over a period of about 10 years, but development could require more time, depending on the pace of future economic and population growth, market conditions and lot leases. About 9% of the land is expected to be developed after 2030.

### d. Land Classifications and Required Approvals

Current land classifications of the Project Area and proposed changes are as follows:

- State Districts
  - Current: Agricultural
  - Proposed: Urban
- County Designations
  - Lānaʻi Community Plan
    - + Current: Light and Heavy Industrial
    - + Proposed: No change
  - Maui County Zoning
    - + Current: Agricultural
    - + Proposed: Light and Heavy Industrial

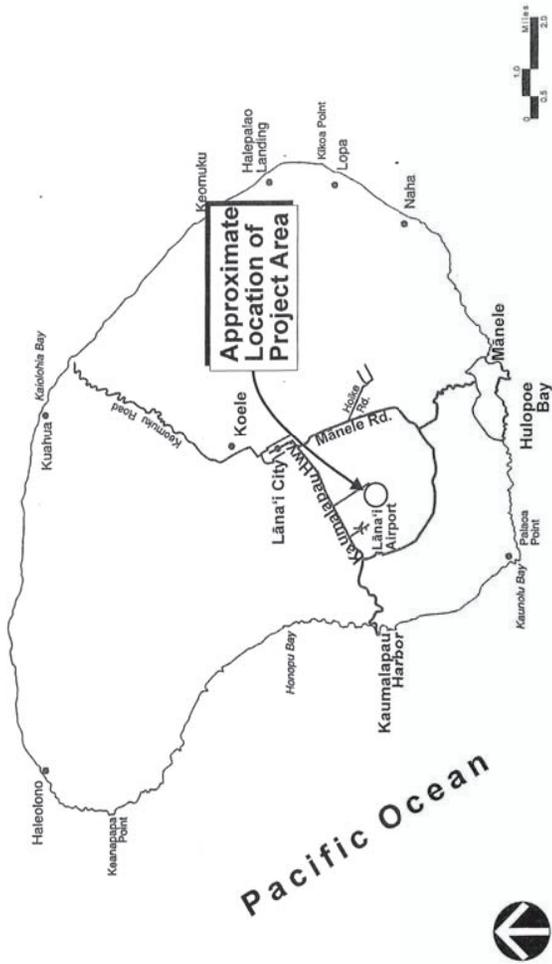


Figure I-1. Project Location, Lānaʻi

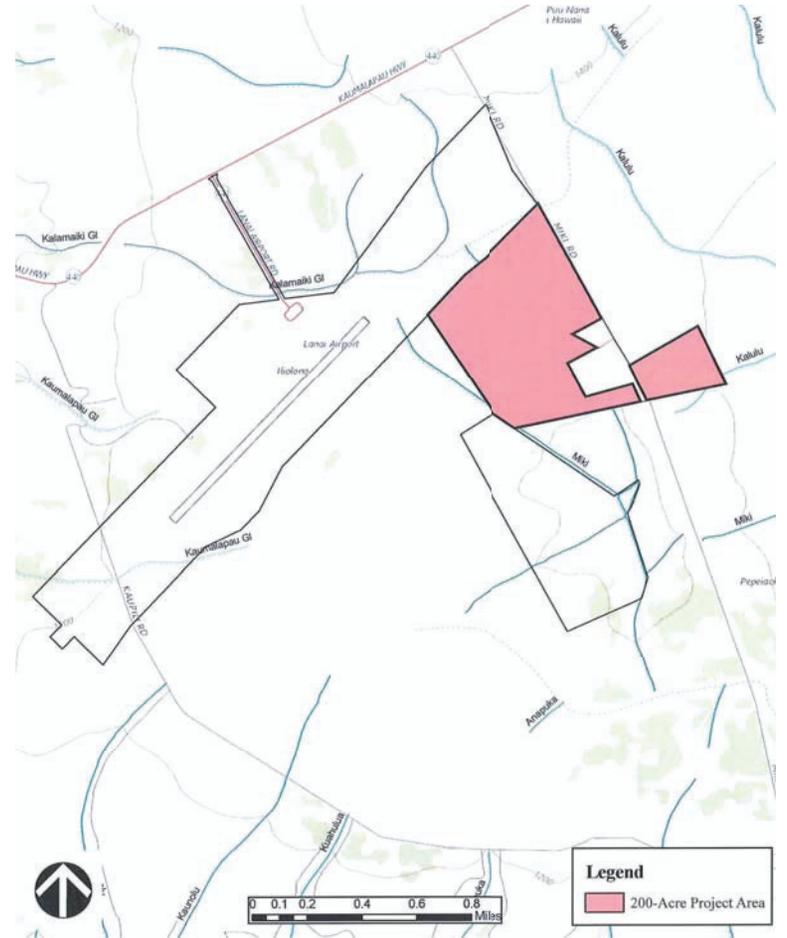


Figure I-2. Project Location, Miki Basin



time or permanently in the County, and exclude visitors and part-time residents (i.e., those who live most of the time in a primary home located elsewhere).

Throughout most of the decade, the U.S. Census Bureau's five-year population estimate for Lānaʻi ranged from approximately 3,100 to 3,500 residents. However, in 2018 and 2019, the five-year estimate dipped below 3,000 residents. As noted above, the 2015-2019 five-year estimate was 2,730 people, which represents a 12.9% decrease from the 2010 population of 3,135 residents. Meanwhile, the population for the County as a whole has increased by 7.2% since 2010 (Table II-1).

The Lānaʻi Community Plan, which was updated and approved by the Maui County Council in 2016, originally projected that an additional 885 residents will live on the island by the year 2030, for a total population of 4,020 (based on the County's Land Use Forecast produced in December 2012). The Lānaʻi Community Plan did note that increased economic activity and development plans on the island may result in the population growing beyond the original forecast of up to 6,000 residents.

Between 2015 and 2019, Asian residents comprised a higher proportion of the Lānaʻi population compared to the County as a whole: 53.4% of residents were estimated to be Asians compared to 29.3% for the County (Table II-1).

The resident profile of Lānaʻi is older than that of the County as a whole. The median age on Lānaʻi was about 49.0 years old between 2015 and 2019 compared to 41.2 years for the County.

#### **b. Households**

The average household size on Lānaʻi is estimated to be 2.31 people per household between 2015 and 2019—a decrease from 2.71 people per household in 2010 (Table II-1). On average, households on Lānaʻi are smaller than households for the County —3.00 people per household.

Approximately 59.8% of the households were estimated to be homeowners. Also, an estimated 63.1% of the households were family households.

#### **c. Housing**

Between 2015 and 2019, Lānaʻi had an estimated 1,549 housing units (Table II-1). This figure includes resort/residential units that were used as second homes, or were available for visitors, or were vacant. Approximately 23.8% of housing units were vacant, compared to 25.5% for the County.

Most residents live in Lānaʻi City in single family homes of less than 1,500 square feet on lots of about 6,000 square feet or less (Google Maps). According to the County tax records, many of the homes on Lānaʻi were built before 1940.

#### **d. Income and Education**

The mean household income on Lānaʻi between 2015 and 2019 was estimated at \$73,484, 39.8% lower than the County as a whole (Table II-2). Correspondingly, Lānaʻi had a lower per-capita income.

A slightly lower proportion of residents on Lānaʻi completed some secondary education compared to the County as a whole. An estimated 50.7% of Lānaʻi residents attended some college or received a higher education degree, compared to 60.8% of the residents for the County. About 67.2% of the households spoke only English at home, while 31.5% spoke Asian and Pacific Island languages.

### **3. ECONOMIC ROLE OF SHIPPING**

Inasmuch as Lānaʻi is a small island with a small population and a small economy, few consumer and business goods are produced on the island. Instead, most goods must be imported by barge or airfreight from Honolulu. Barge service is weekly, but the service is canceled occasionally due to kona storms. Airfreight is available daily, but the capacity is low and the shipping rates are higher than the barge rates.

### **4. IMPLICATIONS FOR INDUSTRIAL ACTIVITIES ON LĀNAʻI**

Economic development is needed on Lānaʻi in order to provide jobs and increase incomes for the residents. As mentioned above, the average household income on Lānaʻi is 39.8% lower than the County-wide average.

For both residents and businesses, Lānaʻi needs more storage space than other communities of similar size because most goods must be imported, and shipping is infrequent and occasionally unreliable. And for most residents, home storage is limited by the relatively small lots and homes.

### PART III: ECONOMIC, POPULATION AND FISCAL IMPACTS

#### 1. PLANNED DEVELOPMENT

The development plans for Miki 200 are summarized in Table III-1.

##### a. Zoning and Land Use

###### Zoning (proposed)

As indicated previously, Miki 200 will include 100 acres designated Light Industrial and 100 acres designated Heavy Industrial, which is consistent with the Lānaʻi Community Plan (Table III, Section 1.a).

###### Land Use, 2030

As mentioned in Subsection 1.2.b, Miki 200 will be Lānaʻi's first large-scale industrial park. Lot sizes may range from less than a half-acre to 20 acres or more. Also, rental space may be available in industrial buildings, if built.

###### *Committed Industrial Uses*

About 174 acres are committed for infrastructure and industrial activities, including:

— Infrastructure: about 20 acres

Internal roads, drainage areas and common areas are expected to require about 20 acres (10%) of the Project area.

— Renewable Energy: about 127 acres

HECO has requested proposals for a 17.5 megawatt (**MW**) photo voltaic system on Lānaʻi plus a 70 MW-hour (**MWh**) battery energy storage system (**PV+BESS**). To help meet the need for renewable energy on Lānaʻi, Pūlama Lānaʻi plans to allocate 127 acres at Miki 200 for renewable energy. The acreage is based on the energy facility being developed at the Pacific Missile Range Facility (**PMRF**) on Kauaʻi (14 MW/70MWh PV+BESS).

— Concrete/Rock Crushing Facility: about 14.5 acres

Pūlama Lānaʻi's concrete recycling and rock- crushing facility uses equipment to crush concrete and rocks into various sizes and types of aggregate to construct roadways, sidewalks, etc., and for backfill throughout the island for construction projects.

The facility and equipment are mobile, and are temporarily located on 1.6 acres at Miki 20. Miki 200 will provide a permanent base for the operation, water for washing equipment and controlling dust, and a central location for serving the island. Most of the acreage for the relocated operation will be used for stockpiling (1) various types of material to be crushed and (2) various grades of aggregate. These stockpiles will provide an ample and ready supply of aggregate when needed.

After the relocation of operations to Miki 200, the 1.6 acres now used at Miki 20 will come available for other industrial activities.

— Asphalt Plant: about 12.5 acres

Pūlama Lānaʻi's asphalt plant is a hot-mix batch plant that services both the community and Pūlama Lānaʻi. The asphaltic concrete produced from this plant supplies material required to pave new roads, and to repair and repave existing ones.

This mobile facility will be relocated from its current temporary site near Kaunalapau Harbor to Miki 200 in order to provide a permanent base of operations in a central location for serving the island. The current location near the harbor will be used for stockpiling supplies.

###### *Typical Industrial Activities by 2030*

“**Typical industrial activities**” are defined to include those industrial activities typically found in Hawaiʻi (such as manufacturing, warehouses, base yards, etc.), but excluding those activities listed in the previous section (i.e., PV+BESS, concrete/rock-crushing facilities, and asphalt plants).

A partial list of industrial activities that could or are likely to develop at Miki 200 include the following:

- Vehicle rentals (cars, 4-wheel drive vehicles, trucks, etc.)
- Vehicle maintenance and repair (engines, transmissions, tires, body, etc.)
- Car wash
- All-terrain vehicle sales, maintenance, repair, etc.
- Small-boat supplies, maintenance and repair (including fishing gear)
- Commercial laundry services for residents
- Base yards and storage for construction trucks, equipment and supplies (lumber, bricks, cement, pipes, roofing, sheetrock, etc.)
- A base of operations for home maintenance, repairs and services (roofing, electrical, plumbing, appliances, cleaning services, pools, etc.)

- A base of operations for maintaining and repairing office equipment (computers, printers, wifi networks, etc.)
- Self-storage space for household goods, records, business supplies, etc.
- Shops and crafts (metal, woodcrafts, taxidermy, lei hulu, etc.)
- Fruit and vegetable processing, possibly with a shared commercial kitchen
- Veterinarian services and pet supplies at a fixed location
- A gym featuring exercise and therapy equipment
- A fixed location for a slaughtering facility and cold storage for hunted animals (i.e., axis deer and mouflon sheep)
- Laboratories (medical, environmental, etc.)
- Shared office facilities for business at Miki 200

The market assessment for Miki 200 forecasts that about 7.6 acres will be used for “typical industrial activities” by 2030.

#### *Industrial Activities After 2030*

About 18.4 acres at Miki 200 will accommodate the demand for industrial land beyond 2030. More importantly, this acreage will provide industrial land approved for development and may have major infrastructure in order to take immediate advantage of any new economic opportunities which may arise, thereby diversifying Lāna‘i’s economy. This acreage will also be available to accommodate “typical industrial activities” before 2030 in the event that the pent-up demand is greater than estimated.

#### Fully Improved and Partially Improved Lots

Improved lots will be offered for lease, with the lots having access to internal roads, water, power, sewers, the drainage system, etc. However, the lots planned for renewable energy, the concrete/rock crushing facilities and the asphalt plant will be partially improved given the nature of these activities. These lots, which will cover about 154 acres, will require less road development, less water or no water, less power or no power, less waste-water disposal or no disposal, etc.

#### **b. Building Space**

As mentioned above, estimated 7.6 acres will be used for “typical industrial activities” by 2030. This acreage may accommodate about 114,000 sq. ft. of building space (Table III-1, Section 1.b). It is anticipated that some of this space may be occupied by businesses relocating from home operations in Lāna‘i City.

## **2. ECONOMIC IMPACTS OF DEVELOPMENT ACTIVITIES**

The development of the Project may involve the following activities: (1) grading and other work to prepare the site for development; (2) construction of internal roads, a water delivery system, a sewer system, drainage systems, utilities systems, etc.; (3) rental of lots to component developers; and (4) construction of buildings. Table III-2 summarizes the direct and indirect economic impacts of these development activities. The material in this table gives the development period, construction expenditures, indirect sales generated by the construction activity, profits, and employment and payroll.

### **a. Development Period**

As mentioned previously, most Project development is expected to occur over a period of about 10 years (Table III-2, Section 4.a). Given the current economy and population, along with projected growth, significant demand for industrial space is expected during this period. However, development could require more time, depending on future market conditions, lot leases, and the construction of buildings.

### **b. Construction Expenditures and Related Sales**

Over the 10-year development period, total construction expenditures for the Project are estimated at about \$78.8 million (Table III-2, Section 2.b). This translates into average construction expenditures of about \$7.9 million per year. In practice, construction expenditures will vary from year to year. Infrastructure costs normally occur in the early years of development as the backbone infrastructure is installed. Construction expenditures associated with possible buildings and other improvements will be made over time as the lots are leased and developed.

In addition to construction, other development expenditures will be incurred for planning, permitting, design, financing, marketing, and sales commissions.

In addition to construction expenditures, development activities will generate indirect sales associated with supplying goods and services to construction companies and to the families of construction workers. In turn, the companies supplying goods and services, and the families of their employees, will purchase goods and services from other companies, and so on. These indirect sales will include sales by companies supplying building materials (cement, steel, lumber, roofing materials, plumbing equipment, electrical equipment, hardware supplies, lighting, flooring, etc.); rent out construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Indirect sales also include sales by grocery stores, drug stores, restaurants, service stations, beauty salons, medical providers, accountants, attorneys, insurance agents, etc.

Based on State economic multipliers, these indirect sales are expected to average about \$5.0 million per year, of which about \$3.0 million per year will be on the island of Lāna‘i and about \$2.0 million on O‘ahu (Table III-2, Section 2.b).

Construction expenditures plus indirect sales related to construction are expected to average about \$12.9 million per year. About \$9.6 million per year will be subject to the State 4% excise tax on final sales, while about \$3.3 million per year will be subject to the 0.5% excise tax on intermediate sales. Depending upon market conditions, development and sales in some years may be much higher or lower than the average.

**c. Profits**

Profits on construction expenditures and related sales are estimated to average about \$1.7 million per year (Table III-2, Section 2.c). These profits will accrue to the various construction companies and subcontractors, and to the various companies that sell goods and services to those companies and the families deriving income from the construction activity.

**d. Employment**

During the Project's 10-year development period, construction employment is expected to average about 19 jobs per year (Table III-2, Section 2.e). These jobs will include supervisors, heavy-equipment operators (grading, roads, water mains, sewer lines, etc.), cement workers to lay foundations, metal workers, carpenters, plumbers, electricians, roofers, glass and window installers, cabinet makers, carpet and tile layers, painters, equipment installers, interior decorators, landscapers, etc. Other jobs related to construction will include architects, civil engineers, draftsmen, government inspectors, etc. These jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, management, and professional positions.

As with indirect sales, development activities will generate indirect jobs associated with supplying goods and services to construction companies and to the families of construction workers. In turn, the companies supplying goods and services, and the families of their employees, will purchase goods and services from other companies, and so on. Indirect jobs will include those at companies supplying building materials (cement, steel, lumber, roofing materials, plumbing equipment, electrical equipment, hardware supplies, lighting, flooring, etc.); rent construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Other indirect jobs will include those involved with supplying goods and services to employees and their families: grocery workers, store clerks, restaurant workers, service-station workers, beauty technicians, barbers, bankers, pharmacists, veterinarians, computer technicians, medical workers, accountant attorneys, etc. The jobs will range over a variety of skill levels, including entry-level, semi-skilled, skilled, and management positions.

Based on State employment multipliers, indirect employment related to Project development is expected to average about 29 jobs per year.

Thus, total direct-plus-indirect employment associated with Project development activities will average about 48 jobs per year.

**e. Payroll**

Development activities are expected to generate a total payroll of about \$3.0 million per year for the Project, of which nearly \$1.7 million will be for construction workers, and nearly \$1.4 million for indirect employment (Table III-2, Section 2.f). These estimates are based on the average number of direct and indirect jobs multiplied by average wages as reported by the DLIR.

Wages are expected to average about \$87,800 per year for construction jobs and about \$47,000 for indirect jobs.

**f. Sources of Construction Workers**

The construction labor force on the island of Lānaʻi is limited. As such, it is assumed that a mix of on-island and off-island construction workers will fill the various jobs generated by the proposed development. In the past, construction workers have commuted to Lānaʻi to fill the labor requirements of building projects.

**3. ECONOMIC IMPACTS OF OPERATIONS, 2030**

Table III-3 summarizes economic impacts of operations at Miki 200 in 2030.

**a. Economic Activities**

As mentioned previously, industrial activities at Miki 200 by 2030 will include the renewable energy facility (ie., PV+BESS), the concrete/rock-crushing facility, the asphalt plant, and "typical industrial activities."

The PV system is expected to generate about 35,800 MWh per year of energy, which is based on HECO's request for proposals.

The concrete/rock-crushing facility and the asphalt plant will be relocated from elsewhere on Lānaʻi, so are not new activities to the island. These operations are owned by Palama Lānaʻi, and generate little or no revenues.

"Typical industrial activities" are expected to use about 114,000 sq. ft. of space at Miki 200 by 2030. About about 23,700 sq. ft. of this space may be used for self-storage facilities (based on the market assessment for Miki 200).

Some of the companies at Miki 200 are expected to be businesses that will relocate from home operations in Lānaʻi City. The space required to accommodate these existing business is estimated at 17,700 sq. ft. based on 5% of the households on Lānaʻi × an average of 300 sq. ft. per household. Thus, the net increase in "typical industrial activities" is projected to be about 96,300 sq. ft., including about 23,700 sq. ft. used for self-storage facilities.

**b. Revenues**

By 2030, new economic activities at Miki 200 are expected to generate about \$17.1 million per year in revenues (Table III-3, Section 3.b).

**c. Rental Income**

Rental income is expected to reach nearly \$1.7 million per year, including (1) rent from the renewable energy facility and (2) rents from the industrial space within buildings (Table III-3, Section 3.c). However, the rental income does not include land rents for those lots having buildings.

**d. Profits**

Corresponding new profits will amount to about \$1.6 million per year by 2030 (Table III, Section 3.d).

**e. Employment**

The industrial activities at Miki 200 will generate about 60 new jobs by 2030 (Table III-3, Section 3.e). Most of these new jobs will be provided by “typical industrial activities.” Also, about 8 additional employees will be hired for concrete/rock-crushing and asphalt operations.

The industrial jobs at Miki 200 will range over a variety of skill levels, including entry-level, semi-skilled, skilled, highly skilled professionals, and management positions.

**f. Payroll**

By 2030, total payroll for the new jobs is estimated at about \$2.8 million per year (Table III-3, Section 3.f).

**g. Sources of Skilled Workers**

As Miki 200 will be developed over a number of years, skilled workers will be recruited from various schools, companies, and other organizations in Hawai‘i and on the mainland. The jobs will appeal to skilled workers who want to apply their training and skills in order to remain in Hawai‘i or return to Hawai‘i.

Programs to increase the supply of professionals and skilled workers are the responsibility of the various universities, colleges, and technical schools.

**h. Supported Population and Housing**

New jobs at Miki 200 will support approximately 120 residents in 50 homes by 2030 (Table III, Section 3.g).

**4. IMPACTS ON COUNTY REVENUES AND EXPENDITURES**

The impact of the Project on County finances is shown in Table III-4. This table summarizes: (1) revenues and expenditures related to development activities, and (2) revenues and expenditures related to operations in 2030.

**a. Development Activities**

The County derives negligible tax revenues from development activity.

Regarding County expenditures to support the Project, they also are expected to be negligible. As with other major projects in the County, the developer and builders will provide or finance their fair shares of infrastructure and facilities to support the Project. This may include interior roads, interior water distribution, sewers, drainage systems, etc. Also, construction activities require few onsite services from the County. Furthermore, construction companies will provide their own security, sanitation, transportation, etc.

As a result, Project development activity will result in a negligible impact on County finances during the development period.

**b. Operations, 2030**

By 2030, Miki 200 will generate additional property tax revenues to the County of about \$380,000 per year (Table III-4, Section 4.b). Nominal revenues from other taxes and user fees will be generated but are not estimated.

Inasmuch as the Miki 200 is expected to be developed in conjunction with forecasted population growth for Lāna‘i, the County is not expected to realize significant additional increases in expenditures as a direct result of the project. Thus, the Project is projected to generate about \$380,000 per year in net revenues to the County.

**5. IMPACTS ON STATE REVENUES AND EXPENDITURES**

The impact of the Project on State finances is shown in Table III-5. This table summarizes: (1) revenues and expenditures related to development activities, and (2) revenues and expenditures related to operations in 2030.

**a. Development Activities**

Unlike the County, the State derives substantial revenues from development activity. Over the initial 10-year development period, Project development activities are expected to generate about \$5.6 million in revenues for the State, for an average of about \$560,000 per year (Table III-5, Section 5.a). Most of the revenues will be derived from (1) excise taxes and (2) corporate and personal income taxes.

State expenditures to support Project development activities are expected to be negligible. Infrastructure and facilities to support the Project are primarily a County responsibility, with most of the fair share provided or financed by the developer. Also, Construction activities will require few onsite services from the State. Furthermore, most required services will be provided by construction companies.

Over the initial 10-year development period, the State will net about \$5.6 million from development activities associated with the Project, for an average of about \$560,000 per year.

**b. Operations, 2030**

By 2030, Miki 200 will generate increased revenues to the State of about \$670,000 per year (Table III-5, Section 5.b). State revenues will include excise taxes, corporate and personal income taxes. Nominal revenues from other taxes and user fees will be generated but are not estimated.

Additional State expenditures are not anticipated to be required to support operations of the Project.

Thus, the Project is projected to generate about \$670,000 per year in net revenues to the State by 2030.

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**PART II TABLES:  
SOCIO-ECONOMIC CONDITIONS**

**Table II-1. Demographic Characteristics, County of Maui  
and Island of Lana'i: 2010 and 2015-2019 Estimates**

Item	County of Maui			Lana'i		
	2010	2015-2019	Change	2010	2015-2019	Change
<b>Population (residents)</b>	154,834	165,979	7.2%	3,135	2,730	-12.9%
Male	77,587	82,633	6.5%	1,600	1,396	-12.8%
Female	77,247	83,346	7.9%	1,535	1,334	-13.1%
<b><u>Distribution</u></b>						
Male	50.1%	49.8%		51.0%	51.1%	
Female	49.9%	50.2%		49.0%	48.9%	
<b>Population by Age</b>						
Pre-school Age, 4 and Under	10,020	9,907	-1.1%	235	124	-47.2%
School Age, 5 to 19	29,117	29,706	2.0%	621	366	-41.1%
Working Age, 20 to 64	95,894	97,271	1.4%	1,805	1,546	-14.3%
Retirement Age, 65 and Over	19,803	29,095	46.9%	474	694	46.4%
<b><u>Distribution</u></b>						
Pre-school Age, 4 and Under	6.5%	6.0%		7.5%	4.5%	
School Age, 5 to 17	18.8%	17.9%		19.8%	13.4%	
Working Age, 18 to 64	61.9%	58.6%		57.6%	56.6%	
Retirement Age, 65 and Over	12.8%	17.5%		15.1%	25.4%	
<b>Median Age</b>	39.6	41.20	4.0%	38.6	49.00	26.9%
<b>Ethnicity</b>						
White alone	53,336	58,891	10.4%	460	488	6.1%
Black or African American alone	870	845	-2.9%	5	0	-100.0%
American Indian and Alaska Native alone	603	424	-29.7%	2	0	-100.0%
Asian alone	44,595	48,579	8.9%	1,745	1,459	-16.4%
Native Hawaiian and Other Pacific Islander alone	16,051	18,093	12.7%	205	186	-9.3%
Some Other Race alone	3,051	2,865	-6.1%	5	52	940.0%
Two or More Races	36,328	36,282	-0.1%	713	545	-23.6%
<b><u>Distribution</u></b>						
White alone	34.4%	35.5%		14.7%	17.9%	
Black or African American alone	0.6%	0.5%		0.2%	0.0%	
American Indian and Alaska Native alone	0.4%	0.3%		0.1%	0.0%	
Asian alone	28.8%	29.3%		55.7%	53.4%	
Native Hawaiian and Other Pacific Islander alone	10.4%	10.9%		6.5%	6.8%	
Some Other Race alone	2.0%	1.7%		0.2%	1.9%	
Two or More Races	23.5%	21.9%		22.7%	20.0%	

Table II-1. Demographic Characteristics, County of Maui  
and Island of Lana'i: 2010 and 2015–2019 Estimates  
(continued)

Item	County of Maui			Lana 'i		
	2010	2015-2019	Change	2010	2015-2019	Change
<b>Households</b>	53,886	54,479	1.1%	1,158	1,181	2.0%
<b>Average Size</b>	2.82	3.00	6.4%	2.71	2.31	-14.8%
<b>Tenure</b>						
Homeowners	30,055	33,232	10.6%	591	706	19.5%
Renters	23,831	21,247	-10.8%	567	475	-16.2%
<b>Distribution</b>						
Homeowners	55.8%	61.0%		51.0%	59.8%	
Renters	44.2%	39.0%		49.0%	40.2%	
<b>Household Type</b>						
Family Household	35,498	38,249	7.7%	788	745	-5.5%
Non-family Household	18,388	16,230	-11.7%	370	436	17.8%
<b>Distribution</b>						
Family Household	65.9%	70.2%		68.0%	63.1%	
Non-family Household	34.1%	29.8%		32.0%	36.9%	
<b>Housing Units</b>	70,379	73,169	4.0%	1,545	1,549	0.3%
Occupied	53,886	54,479	1.1%	1,158	1,181	2.0%
Vacant	16,493	18,690	13.3%	387	368	-4.9%
For seasonal, recreational, or occasional use	9,956	n/a		108	n/a	
<b>Distribution</b>						
Occupied	76.6%	74.5%		75.0%	76.2%	
Vacant	23.4%	25.5%		25.0%	23.8%	
For seasonal, recreational, or occasional use	14.1%	n/a		7.0%	n/a	

Sources:

U.S. Census Bureau. Decennial Census. 2010.

U.S. Census Bureau. American Community Survey 5 Year Estimate, 2015-2019.

Table II-2. Income and Education, County of Maui  
and Island of Lana'i: 2010–2014 and 2015–2019 Estimates

Item	County of Maui			Lana 'i		
	2010-2014	2015-2019	Change	2010-2014	2015-2019	Change
<b>Income</b>						
Mean Household Income	\$84,035	\$102,759	22.3%	\$67,475	\$73,484	8.9%
Per Capita Income	\$29,499	\$35,241	19.5%	\$23,262	\$33,052	42.1%
<b>Educational Attainment, 25 Years and Older</b>						
Less than 9th Grade	4,393	4,416	0.5%	146	219	50.0%
Grades 9 to 12, No Diploma	6,007	5,057	-15.8%	158	128	-19.0%
High School Graduate, No College	34,941	36,912	5.6%	896	723	-19.3%
Some College, No Degree	27,200	27,584	1.4%	505	408	-19.2%
Associate Degree	9,854	12,029	22.1%	170	229	34.7%
College, Bachelor's Degree	19,374	21,366	10.3%	367	334	-9.0%
Graduate or Professional Degree	9,000	10,753	19.5%	170	136	-20.0%
Total Population, Age 25 and Older	110,769	118,117	6.6%	2,412	2,177	-9.7%
<b>Distribution</b>						
Less than 9th Grade	4.0%	3.7%		6.1%	10.1%	
Grades 9 to 12, No Diploma	5.4%	4.3%		6.6%	5.9%	
High School Graduate, No College	31.5%	31.3%		37.1%	33.2%	
Some College, No Degree	24.6%	23.4%		20.9%	18.7%	
Associate Degree	8.9%	10.2%		7.0%	10.5%	
College, Bachelor's Degree	17.5%	18.1%		15.2%	15.3%	
Graduate or Professional Degree	8.1%	9.1%		7.0%	6.2%	
<b>Language Spoken at Home (Household)</b>						
English Only	117,369	120,418	2.6%	2,299	1,751	-23.8%
Spanish	2,768	5,896	113.0%	-	33	0.0%
Other Indo-European	2,483	1,647	-33.7%	1	1	0.0%
Asian and Pacific Island languages	25,882	27,466	6.1%	967	821	-15.1%
Others	234	645	175.6%	-	-	0.0%
<b>Distribution</b>						
English Only	78.9%	77.2%		70.4%	67.2%	
Spanish	1.9%	3.8%		0.0%	1.3%	
Other Indo-European	1.7%	1.1%		0.0%	0.0%	
Asian and Pacific Island languages	17.4%	17.6%		29.6%	31.5%	
Others	0.2%	0.4%		0.0%	0.0%	

Sources:

U.S. Census Bureau. American Community Survey 5 Year Estimate, 2010-2014.

**PART III TABLES:  
ECONOMIC, POPULATION AND FISCAL IMPACTS**

**Table III-1. Planned Development**

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
<b>1.a. ZONING AND LAND USE</b>			
<b>Zoning (proposed)</b>			
Light Industrial	Pulama Lanai	100.0	acres
Heavy Industrial		100.0	acres
<b>Total Industrial</b>		<b>200.0</b>	<b>acres</b>
<b>Land Use, 2030</b>			
Infrastructure	Pulama Lanai	20.0	acres
Renewable Energy	Pulama Lanai	127.0	acres
Concrete/Rock-Crushing Facility	Pulama Lanai	14.5	acres
Asphalt Plant	Pulama Lanai	12.5	acres
Typical Industrial Activities	Market Assessment	7.6	acres
Vacant (to be developed after 2030)	Market Assessment	18.4	acres
<b>Total Use</b>		<b>200.0</b>	<b>acres</b>
<b>Fully Improved and Partially Improved Areas</b>			
Full Improvements	residual	46.0	acres
Partial Improvements	Renewable energy, concrete/rock-crushing facility and asphalt plant	154.0	acres
<b>Total</b>		<b>200.0</b>	<b>acres</b>
<b>1.b. BUILDING SQUARE FOOTAGE</b>			
Typical Industrial Activities	15,000 sq ft per acre	<b>114,000</b>	<b>sq. ft.</b>

**Table III-2. Economic Impacts of Development Activities**

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
<b>2.a. DEVELOPMENT PERIOD</b>			
Duration of Construction (for most development)		10	years
<b>2.b. CONSTRUCTION AND RELATED EXPENDITURES</b>			
<b>Construction Costs</b>			
Sitework, Infrastructure and Utilities			
Full Improvements	\$ 200,000 per acre	\$ 9,200,000	
Partial Improvements	\$ 20,000 per acre	\$ 3,080,000	
Renewable Energy	17.5 MW \$ 2.5 million/MW	\$ 43,750,000	
Relocation Costs, Crushing Facilities		n.e.	
Relocation Costs, Asphalt Plant		n.e.	
Buildings	\$200 per sq. ft.	\$ 22,800,000	
<b>Total Construction and Related Expenditures</b>		<b>\$ 78,830,000</b>	
<b>Construction Expenditures, Annual Average</b>		<b>\$ 7,883,000</b>	<b>per year</b>
Hawaii	55%	\$ 4,335,700	per year
Imports	45%	\$ 3,547,400	per year
<b>Indirect Sales, Annual Average</b>	1.15 of Hawaii exp.	<b>\$ 4,986,055</b>	<b>per year</b>
Lanai	60%	\$ 2,991,600	per year
Oahu	40%	\$ 1,994,455	per year
<b>Total Direct and Indirect Sales, Annual Average</b>		<b>\$ 12,869,055</b>	<b>per year</b>
<b>Other Development Costs [1]</b>		<b>n.e.</b>	
<b>Final Sales (taxed at 4%)</b>			
Construction Expenditures	above	\$ 7,883,000	per year
Consumption	55% of payroll	\$ 1,667,160	per year
<b>Total Final Sales</b>		<b>\$ 9,550,160</b>	<b>per year</b>
<b>Intermediate Sales (taxed at 0.5%)</b>			
Indirect Sales Related to Construction	Section 4.c	\$ 4,986,055	per year
Less Consumption	above	\$ (1,667,160)	
<b>Total Intermediate Sales</b>		<b>\$ 3,318,895</b>	<b>per year</b>
<b>2.c. PROFITS</b>			
Profits on Total Expenditures & Sales	10.0%	\$ 1,286,906	per year
Risk Premium for Construction	5.0%	\$ 394,200	per year
<b>Total Profit from Construction &amp; Related Activity</b>		<b>\$ 1,681,106</b>	<b>per year</b>
<b>2.d. EMPLOYMENT (on-site &amp; off-site)</b>			
Construction Jobs	4.31 x sales/\$1 mil	19	jobs/year
Indirect Jobs Generated by Construction	1.55 x direct jobs x	29	jobs/year
<b>Total Employment</b>		<b>48</b>	<b>jobs/year</b>
<b>2.e. PAYROLL</b>			
Construction Payroll	\$ 87,800 per job	\$ 1,668,200	per year
Payroll for Indirect Employment	\$ 47,000 per job	\$ 1,363,000	per year
<b>Total Payroll</b>		<b>\$ 3,031,200</b>	<b>per year</b>

[1] Before realizing profits, developers must pay a number of development-related costs in addition to construction costs. These "Other Development Costs" include planning, permitting, design, financing, marketing, and sales commissions.

**Table III-3. Economic Impacts of Operations, 2030**

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
<b>3.a. ECONOMIC ACTIVITIES</b>			
<b>On Site</b>			
Renewable Energy	HECO	35,800	MWh/yr
Concrete/Rock-Crushing Facility	Table III-1, Section 1.a	14.5	acres
Asphalt Plant	Table III-1, Section 1.a	12.5	acres
Typical Industrial Activities	Table III-1, Section 1.b	114,000	sq. ft.
Typical Industrial Activities, Excluding Self-Storage	derived	90,300	sq. ft.
Self-Storage	Market Assessment	23,700	sq. ft.
<b>Relocated Activities</b>			
Concrete/Rock-Crushing Facility	Pulama Lanai	14.5	acres
Asphalt Plant	Pulama Lanai	12.5	acres
Typical Industrial Activities, Excluding Self-Storage	5% of households 1,181 households 300 sq. ft per household	17,700	sq. ft.
<b>New To Lanai</b>			
Renewable Energy		35,800	MWh/yr
Typical Industrial Activities		96,300	sq. ft.
Typical Industrial Activities, Excluding Self-Storage	residual	72,600	sq. ft.
Self-Storage	Market Assessment	23,700	sq. ft.
<b>3.b. REVENUES</b>			
<b>Revenues, On-Site Activities</b>			
Renewable Energy	\$ 0.10 per kWh	\$ 3,580,000	per year
Concrete/Rock-Crushing Facility	Pulama Lanai	\$ -	per year
Asphalt Plant	Pulama Lanai	\$ -	per year
Typical Industrial Activities, Excluding Self-Storage	\$ 150 per sq. ft.	\$ 13,545,000	per year
Self-Storage	(included with rents)	\$ -	per year
<b>Total Revenues, On-Site Activities</b>		<b>\$ 17,125,000</b>	<b>per year</b>
<b>New Revenues</b>			
Renewable Energy	\$ 0.10 per kWh	\$ 3,580,000	per year
Concrete/Rock-Crushing Facility		\$ -	per year
Asphalt Plant		\$ -	per year
Typical Industrial Activities, Excluding Self-Storage	\$ 150 per sq. ft.	\$ 10,890,000	per year
Self-Storage	included with rents	\$ -	per year
<b>Total New Revenues</b>		<b>\$ 14,470,000</b>	<b>per year</b>
<b>3.c. RENTAL INCOME</b>			
Renewable Energy	\$ 3,000 per acre	\$ 381,000	per year
Concrete/Rock-Crushing Facility	Pulama Lanai	\$ -	per year
Asphalt Plant	Pulama Lanai	\$ -	per year
Typical Industrial Activities			
<b>Land Rent</b>		n.e.	per year
<b>Space Rent</b>			
Typical Industrial Activities, Excluding Self-Storage	\$ 10 per sq. ft. 50% rented	\$ 451,500	per year
Self-Storage	\$ 35 per sq. ft.	\$ 829,500	per year
<b>Total Rents</b>		<b>\$ 1,662,000</b>	<b>per year</b>

**Table III-3. Economic Impacts of Operations, 2030**

(Values in 2019 dollars)  
(continued)

Item	Source or Multiplier	Amount	Units
<b>3.d. PROFITS</b>			
<b>Profits, On-site Activities</b>			
From Operations	10% of revenues	\$ 1,712,500	per year
From Rents	10% of rents	\$ 166,200	per year
<b>Total Profits, On-Site Activities</b>		<b>\$ 1,878,700</b>	<b>per year</b>
<b>New Profits</b>			
From Operations	10% of revenues	\$ 1,447,000	per year
From Rents	10% of rents	\$ 166,200	per year
<b>Total New Profits</b>		<b>\$ 1,613,200</b>	<b>per year</b>
<b>3.e. EMPLOYMENT</b>			
<b>Employment, On Site</b>			
Renewable Energy	PEP	2	jobs
Concrete/Rock-Crushing Facility + Asphalt Plant	Pulama Lanai	25	jobs
Typical Industrial Activities	1,500 sf per job	60	jobs
Self-Storage	PEP	2	jobs
<b>Total Jobs, On Site</b>		<b>89</b>	<b>jobs</b>
<b>New Employment</b>			
Renewable Energy	PEP	2	jobs
Concrete/Rock-Crushing Facility + Asphalt Plant	Pulama Lanai	8	jobs
Typical Industrial Activities	1,500 sf per job	48	jobs
Self-Storage	PEP	2	jobs
<b>Total New Jobs</b>		<b>60</b>	<b>jobs</b>
<b>3.f. PAYROLL</b>			
<b>Payroll for On-site Jobs</b>			
Renewable Energy	\$ 60,000 per job	\$ 120,000	per year
Concrete/Rock-Crushing Facility+ Asphalt Plant	\$ 56,000 per job	\$ 1,400,000	per year
Typical Industrial Activities	\$ 45,000 per job	\$ 2,700,000	per year
Self-Storage	\$ 35,000 per job	\$ 70,000	per year
<b>Total Payroll, On Site</b>		<b>\$ 4,290,000</b>	<b>per year</b>
<b>Payroll for New Jobs</b>			
Renewable Energy	\$ 60,000 per job	\$ 120,000	per year
Concrete/Rock-Crushing Facility+ Asphalt Plant	\$ 56,000 per job	\$ 448,000	per year
Typical Industrial Activities	\$ 45,000 per job	\$ 2,160,000	per year
Self-Storage	\$ 35,000 per job	\$ 70,000	per year
<b>Total Payroll for New Jobs</b>		<b>\$ 2,798,000</b>	<b>per year</b>
<b>3.g. SUPPORTED POPULATION AND HOUSING</b>			
Total New Employment	Section 3.e	60	jobs
Supported Population	1.97 residents per new job	120	residents
Housing for Supported Population	2.31 resident per home	50	homes

**Table III-4. Impacts on County Revenues and Expenditures**

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
<b>4.a. DEVELOPMENT ACTIVITIES</b>			
Revenues, Cumulative		n.e.	see text
Expenditures, Cumulative [1]		n.e.	see text
<b>Net Revenues, Cumulative</b>		n.e.	see text
<b>4.b. OPERATIONS, 2030</b>			
<b>Tax and Expenditure Base</b>			
<b>Taxable Property Value</b>			
Land	\$ 150,000 per acre	\$ 30,000,000	
Buildings	Table III-2, Section 2.b	\$ 22,800,000	
<b>Total Property Value</b>		<b>\$ 52,800,000</b>	
<b>Revenues, Annual</b>			
<b>Property Taxes</b>			
Property Tax Revenue	\$ 7.20 per \$1,000	\$ 380,160	per year
Less Current Taxes	County of Maui	\$ (490)	per year
<b>New Property Taxes</b>		<b>\$ 379,670</b>	<b>per year</b>
<b>Expenditures, Annual</b>			
<b>Net Revenues, Annual</b>		<b>\$ 379,670</b>	<b>per year</b>

[1] Infrastructure will be built by Pulama Lanai.

**Table III-5. Impacts on State Revenues and Expenditures**

(Values in 2019 dollars)

Item	Source or Multiplier	Amount	Units
<b>5.a. DEVELOPMENT ACTIVITIES</b>			
<b>Tax and Expenditure Base</b>			
Duration (for most development)	Table III-2, Section 2.a	10	years
Final Sales	Table III-2, Section 2.b	\$ 9,550,160	per year
Intermediate Sales	Table III-2, Section 2.b	\$ 3,318,895	per year
Profits	Table III-2, Section 2.c	\$ 1,681,106	per year
Payroll	Table III-2, Section 2.e	\$ 3,031,200	per year
<b>Revenues, Average Annual</b>			
Excise Tax on:			
Final Sales	4.0% of sales and property sales	\$ 382,000	per year
Intermediate Sales	0.5% of sales	\$ 16,600	per year
Corporate Income Taxes	1.0% of profits	\$ 16,800	per year
Personal Income Taxes	4.8% of income	\$ 145,500	per year
<b>Total Revenues</b>		<b>\$ 560,900</b>	<b>per year</b>
<b>Revenues, Cumulative</b>		<b>\$ 5,609,000</b>	
<b>Expenditures, Cumulative</b>		n.e.	see text
<b>Net Revenues, Cumulative</b>		<b>\$ 5,609,000</b>	
<b>5.b. OPERATIONS, 2030</b>			
<b>Tax and Expenditure Base</b>			
Sales Revenues, New			
Final Sales (Typical industrial activities)	Table III-3, Section 3.b	\$ 10,890,000	per year
Intermediate Sales (energy)	Table III-3, Section 3.b	\$ 3,580,000	per year
Rental Income	Table III-3, Section 3.c	\$ 1,662,000	per year
Profits, New	Table III-3, Section 3.d	\$ 1,613,200	per year
Payroll, New	Table III-3, Section 3.f	\$ 2,798,000	per year
<b>New Revenues, Annual</b>			
Excise Tax on:			
Final Sales	4.0% of sales final sales	\$ 435,600	per year
Intermediate Sales	0.5% of sales intermediate sales	\$ 17,900	per year
Rents	4.0% of rents	\$ 66,480	per year
Corporate Income Tax	1.0% of profit	\$ 16,130	per year
Personal Income Tax	4.8% of income	\$ 134,300	per year
<b>Total New Revenues</b>		<b>\$ 670,410</b>	<b>per year</b>
<b>Expenditures, Annual</b>		n.e.	see text
<b>Net Revenues, Annual</b>		<b>\$ 670,410</b>	<b>per year</b>

**TRAFFIC IMPACT  
ANALYSIS REPORT**



**APPENDIX**

---

**TRAFFIC IMPACT ANALYSIS REPORT  
MIKI BASIN INDUSTRIAL PARK  
LANAI CITY, LANAI, HAWAII**

**DRAFT FINAL**

June 3, 2021

Prepared for:  
Pulama Lanai  
1311 Fraser Avenue  
Lanai City, HI 96763



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---

**TRAFFIC IMPACT ANALYSIS REPORT  
MIKI BASIN INDUSTRIAL PARK  
Lanai City, Lanai, Hawaii**

**DRAFT FINAL**

Prepared for

**Pulama Lanai  
1311 Fraser Avenue  
Lanai City, HI 96763**

Prepared by  
**Austin, Tsutsumi & Associates, Inc.**  
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June 3, 2021

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- C. LEVEL OF SERVICE CALCULATIONS
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**TRAFFIC IMPACT ANALYSIS REPORT**

**Miki Basin Industrial Park**

**Lanai City, Lanai, Hawaii**

**1. INTRODUCTION**

This report documents the findings of a traffic study conducted by Austin, Tsutsumi, and Associates, Inc. (ATA) to evaluate the traffic impacts resulting from the proposed Miki Basin Industrial Park (hereinafter referred to as the "Project") located in Lanai, Hawaii.

**1.1 Project Description**

The Project proposes to construct a 200-acre industrial park located south of Lanai Airport within a portion of a large parcel (TMK No. (2) 4-9-002:061). The current site plan proposes to include the following:

- Relocated Concrete Crushing Facility and Asphalt Plant (27 acres)
- Renewable Energy Projects (127 acres)
- New Industrial Uses (26 acres)
- Infrastructure (20 acres)

Access to the Project will be provided via Miki Road. It is our understanding that if approved, the 200-acre industrial park will develop over a 20-year period with the concrete crushing facility, asphalt plant and renewable energy projects completed in the first 10 years and the remaining industrial uses completed in the following 10 years. Thus, full build-out of the Project is anticipated by year 2040.

See Figure 1.1 for Project Location. See Figure 1.2 for the Project site plan.

**1.2 Study Methodology**

This study will address the following:

- Assess existing traffic operating conditions during the weekday AM and PM peak hours of traffic within the study area.
- Traffic Projections for Base Year 2040 (without the Project).

- Estimate the vehicular trips that will be generated by the Project.
- Traffic projections for the Project for Future Year 2040 (with Project).
- Recommendations for roadway improvements or other mitigative measures, as appropriate, to reduce or eliminate the adverse impacts resulting from traffic generated by the Project.

### 1.3 Analysis Methodology

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The *Highway Capacity Manual (HCM)*, 6<sup>th</sup> Edition, includes methods for calculating volume to capacity ratios, delays, and corresponding LOS that were used in this study. See Appendix A for LOS Criteria.

Analyses for the study intersections were performed using the traffic analysis software Synchro, which is able to prepare reports based on the methodologies described in the HCM. These reports contain control delay results as based on intersection lane geometry, signal timing, and hourly traffic volumes. Based on the vehicular delay at each intersection, a LOS is assigned to each approach and intersection movement as a qualitative measure of performance. These results, as confirmed or refined by field observations, constitute the technical analysis that will form the basis of the recommendations outlined in this report.

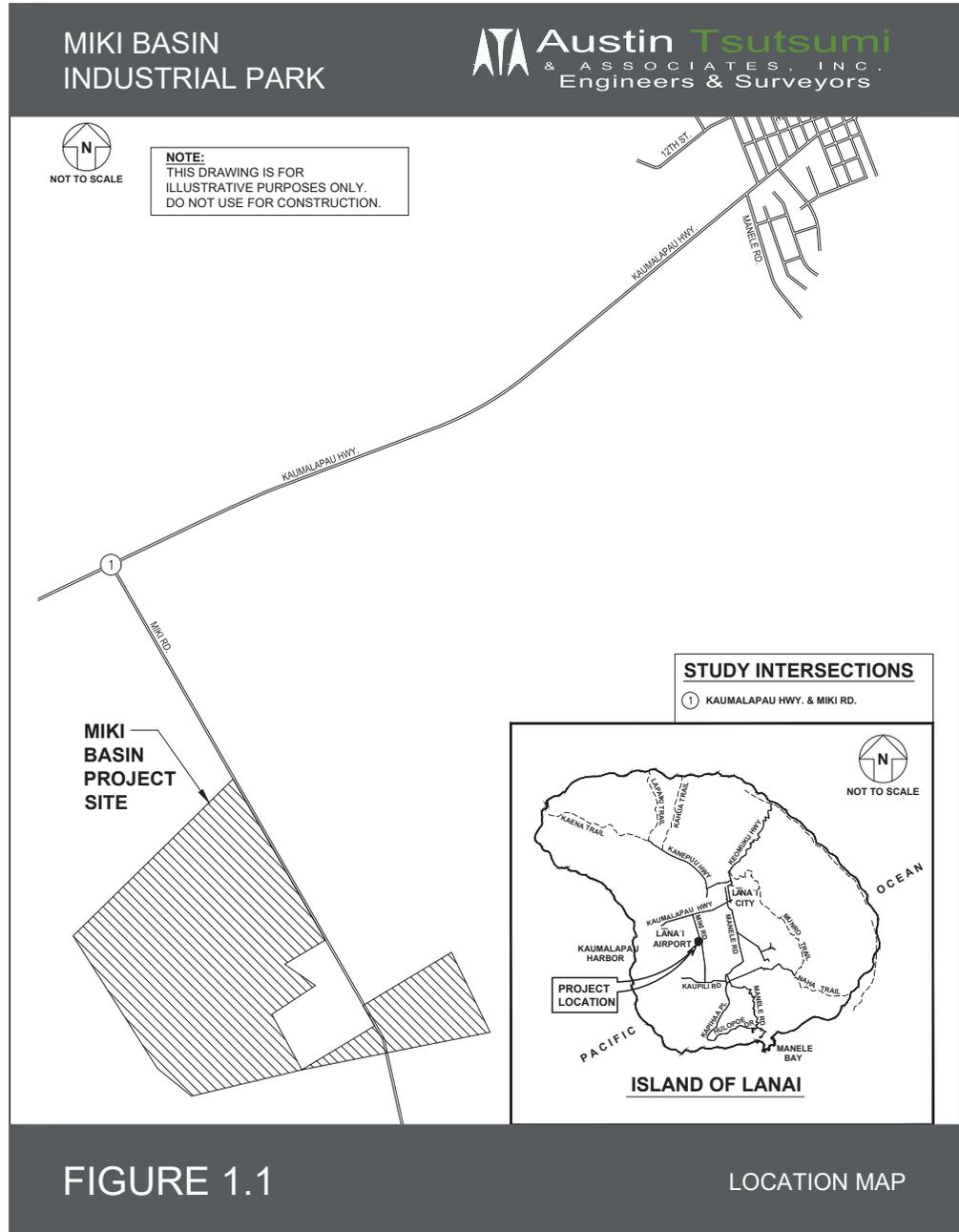
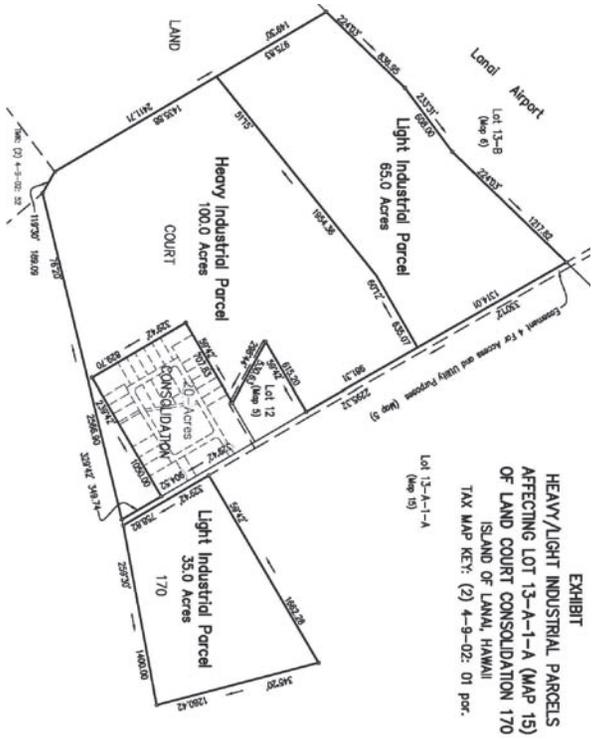


FIGURE 1.1

LOCATION MAP



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NOT TO SCALE

MIKI BASIN INDUSTRIAL PARK



2. EXISTING CONDITIONS

2.1 Roadway System

The following are brief descriptions of the existing roadways studied within the vicinity of the Project:

Kaunalapau Highway is generally an east-west, two-way, two-lane state-owned roadway that runs perpendicular to Miki Road. This roadway begins to the west at the Fuel Depot and terminates to the east at its intersection with Lanai Avenue/Queens Street. The speed limit along Kaunalapau Highway is 45 miles per hour (mph) near Miki Road.

Miki Road is generally a north-south, two-way privately owned roadway that begins to the north at its intersection with Kaunalapau Highway and extends approximately 2.95 miles to the south – primarily through undeveloped land. The roadway is only approximately 13-15 feet wide, and therefore requires vehicles to pull off to the unpaved shoulder when encountering approaching vehicles traveling in the opposite direction.

2.2 Existing Traffic Volumes

Due to the prolonged disruptions to both residential and visitor traffic in the Hawaii region as a result of the impacts of the COVID-19 pandemic, collecting new traffic count data at this time would be atypical. Previously collected data in conjunction with available traffic volume data from the Hawaii Department of Transportation (HDOT) were instead used to estimate the existing 2020 traffic volumes at the study intersections. Observations of existing conditions in the study area were also not conducted as part of this study as a result of the atypical traffic conditions. Available traffic count data and adjustments made to estimate existing 2020 traffic volumes are described in the following sections.

2.2.1 Kaunalapau Highway/Miki Road Count Data

12-hour traffic count data was taken between 6:00 AM and 6:00 PM at the Kaunalapau Highway/Miki Road intersection between Wednesday, October 24, 2018 and Friday, October 26, 2018. The Wednesday AM and PM peak hours were the heaviest days in terms of traffic generation, and were therefore used as the basis for the intersection analyses contained within this report. The AM and PM hours of traffic were determined to be 6:30-7:30 AM and 1:00-2:00 PM, respectively. Traffic count data is provided in Appendix A.

2.2.2 Traffic Count Adjustments

Because Kaunalapau Highway serves as the major east-west arterial on Lanai connecting Kaunalapau Harbor, Lanai Airport and Lanai City, the 2018 traffic counts along the highway were adjusted to reflect growth between 2018 and 2020. HDOT traffic volume data collected between 2016 and 2019 along Kaunalapau Highway between Lanai Airport Road and Miki Road were used to determine historical growth along the roadway. The HDOT annual average daily traffic (AADT) are included in Appendix A and summarized in Table 2.1 below.

Based on the HDOT traffic counts, volumes have increased every year along Kaunalapau Highway between 2016 and 2019. However, the annual growth has varied from year to year. Therefore, the average annual growth of 9.7% between 2016 and 2019 was applied to 2018 volumes to estimate existing 2020 volumes.

**Table 2.1: HDOT AADT Traffic Volumes**

Kaumalapau Highway - West of Miki Road				
Year	EB	WB	Total	Growth
2019	541	543	1084	8.0%
2018	502	502	1004	18.0%
2017	426	425	851	3.2%
2016	413	412	825	
<b>Average</b>	<b>471</b>	<b>471</b>	<b>941</b>	<b>9.7%</b>

## 2.3 Existing Observations and Analysis

### 2.3.1 Intersection Analysis

The Kaumalapau Highway/Miki Road intersection currently operates with all movements at LOS B or better during the AM and PM peak hours of traffic. No significant delays or queuing were previously observed during the 2018 data collection at the intersection during either peak hour of traffic. See Figure 2.1 and Table 4.2 for traffic volumes and levels of service. LOS worksheets are provided in Appendix C.

# MIKI BASIN INDUSTRIAL PARK



DATE OF COUNTS:  
WEDNESDAY, OCTOBER 24, 2018 TO  
FRIDAY, OCTOBER 26, 2018

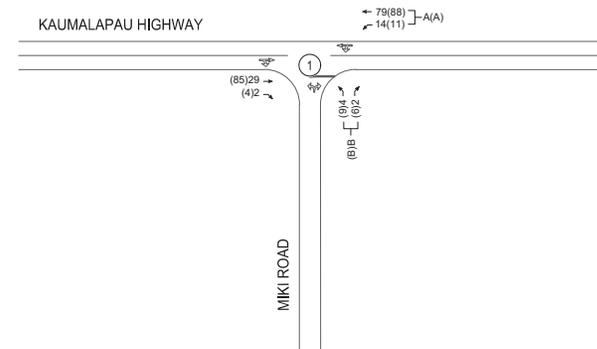
AM PEAK HOUR:  
6:30 AM - 7:30 AM

PM PEAK HOUR:  
1:00 PM - 2:00 PM



## LEGEND

- ##(##) - AM(PM) VEHICLE VOLUMES
- X(X) - AM(PM) LOS
- (X) - UNSIGNALIZED INTERSECTION X



### NOTES:

1. THIS DRAWING IS FOR ILLUSTRATIVE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.
2. THE WEDNESDAY, OCTOBER 24, 2018 AM PEAK HOUR AND THE FRIDAY, OCTOBER 26, 2018 PM PEAK HOUR WERE THE HEAVIEST IN TERMS OF TRAFFIC GENERATION AND REFLECT THE AM PEAK HOUR AND PM PEAK HOUR, RESPECTIVELY.
3. KAUMALAPAU HIGHWAY VOLUMES WERE ADJUSTED BASED ON HISTORIC HDOT TRAFFIC VOLUMES TO REFLECT 2020 CONDITIONS.

**FIGURE 2.1**

EXISTING LANE CONFIGURATION,  
VOLUMES AND LOS

### 3. BASE YEAR 2040 TRAFFIC CONDITIONS

The Year 2040 was selected to reflect the Project completion year. The Base Year 2040 scenario represents the traffic conditions within the study area without the Project. Traffic projections were formulated by applying a defacto growth rate to the existing 2020 traffic count volumes as well as trips generated by known future developments in the vicinity of the Project.

#### 3.1 Growth Rate

As of 2010, the population on the island of Lanai was about 3,100 residents. According to the Lanai Community Plan Update published by the County of Maui Planning Department in December 2013, the anticipated growth of Lanai's economy may require its population to nearly double in size to about 6,000 residents. This planning document was published as a guide for decision making and implementation through 2030. In order for Lanai's population to reach 6,000 by year 2030, the island would experience an average growth rate of approximately 4.7 percent per year. Therefore, this growth rate was applied along Kaunalapau Highway to represent the anticipated growth by year 2030.

The Population and Economic Projections for the State of Hawaii to 2045, published by the Hawaii Department of Business, Economic Development, and Tourism (DBEDT) in June 2018, was used to estimate the anticipated growth of Lanai's population between year 2030 and year 2040. According to DBEDT population forecasts, the population growth rate will decrease to less than 1.0 percent per year between 2025 and 2045. To be conservative, an average growth rate of 1.0 percent per year was applied along Kaunalapau Highway to represent the anticipated growth between year 2030 and year 2040.

#### 3.2 Background Projects

The following background project was added to Base Year 2040 projections.

1. Miki Basin Heavy Industrial Area – 14-acre expansion to the existing 6 acres of the Miki Industrial Complex. The project is anticipated to generate a total of 43(43) trips per hour during the AM and PM peak hours of traffic, respectively. All trips are expected to pass through the Kaunalapau Highway/Miki Road intersection. The background project is shown in Figure 3.1.

#### 3.3 Planned Roadway Projects

The Lanai Community Plan Update identified two proposed private roadway connections near the Project site. One roadway will travel parallel to Miki Road, east of the Project site connecting Kaunalapau Highway and Manele Road. The other roadway will travel between Miki Road and the proposed road, described in the previous sentence. To be conservative, it is assumed that these proposed private roadways will not provide access to the Project site, which would require all Project traffic to travel along Miki Road.

#### 3.4 Base Year 2040 Analysis

Under Base Year 2040 conditions, the study intersection is forecast to operate similarly to existing conditions with all intersection movements expected to operate at LOS B or better during the AM and PM peak hours of traffic. See Figure 3.2 and Table 4.2 for traffic volumes and LOS. LOS worksheets are provided in Appendix C.

## MIKI BASIN INDUSTRIAL PARK

**ATA** Austin Tsutsumi  
& ASSOCIATES, INC.  
Engineers & Surveyors

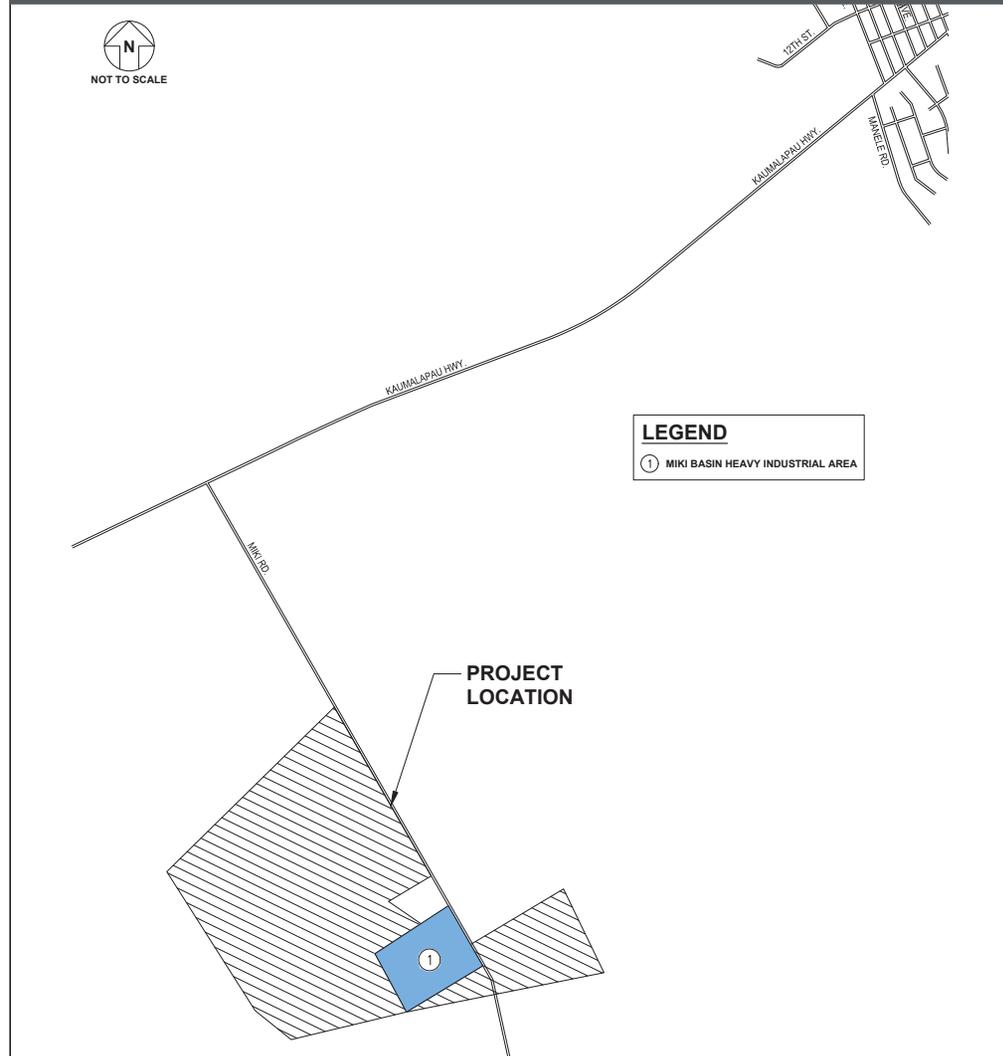


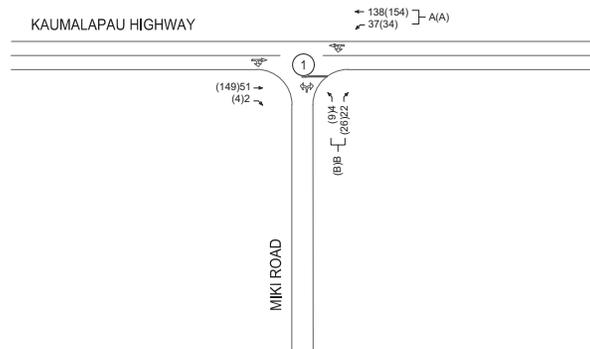
FIGURE 3.1

BACKGROUND PROJECTS

MIKI BASIN  
INDUSTRIAL PARK



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**LEGEND**

- ##(##) - AM(PM) VEHICLE VOLUMES
- X(X) - AM(PM) LOS
- (X) - UNSIGNALIZED INTERSECTION X

FIGURE 3.2

BASE YEAR 2040 LANE CONFIGURATION,  
VOLUMES AND LOS

**4. FUTURE YEAR 2040 TRAFFIC CONDITIONS**

The Future Year 2040 scenario represents the traffic conditions within the Project study area with the full build-out of the Project.

**4.1 Project Description**

The Project proposes to construct a 200-acre industrial park located south of Lanai Airport within a portion of a large parcel (TMK No. (2) 4-9-002:061). The current site plan proposes to include the following:

- Relocated Concrete Crushing Facility and Asphalt Plant (27 acres)
- Renewable Energy Projects (127 acres)
- New Industrial Uses (26 acres)
- Infrastructure (20 acres)

It is assumed that at least two driveway access points to the Project site will be provided along Miki Road. As shown in Figure 4.1, Project Driveway 1 provides access to the light and heavy industrial areas west of Miki Road and Project Driveway 2 provides access to the light industrial area east of Miki Road. For the purposes of this analysis Project Driveway 2 was assumed to align with the existing driveway west of Miki Road. However, it is important to note that a final decision on the location or number of Project driveways has not been made.

**4.2 Travel Demand Estimations**

**4.2.1 Trip Generation**

Trip generation for the proposed Project was estimated based on the anticipated land uses planned for the site. Currently, the known land uses include a concrete crushing facility, asphalt plant and a photovoltaic plus battery energy storage system. The remainder of the Project will be allocated for new industrial uses, which may include, but not be limited to, a slaughter house, warehouse space for cold storage, laboratory/testing facilities, product development, automotive services, a multi-media facility and an animal hospital.

The concrete crushing facility and asphalt plant are existing land uses that will be relocated to the Project site. Based on the current employment and operations at the facilities, it is anticipated that the uses will conservatively generate a total of 35(35) trips during the AM and PM peak hours of traffic. The photovoltaic plus battery energy storage system will be a new land use. Trips generated by the site will be primarily from employees performing normal operation and maintenance activities. It is anticipated that the photovoltaic plus battery energy storage system will have a maximum of 10 employees and is estimated to generate 10(10) trips during the AM and PM peak hours during operation.

Because the new industrial uses have not been finalized yet, general trip generation rates were applied to the remaining 26 acres. The Institute of Transportation Engineers (ITE) publishes trip rates, *Trip Generation Manual, 10<sup>th</sup> Edition*, based upon historical data from similar land uses. These trip rates/formulae and their associated directional distributions were used to estimate the increase in the number of vehicular trips generated by the new industrial uses. The rate selected was based on the potential facilities that may be constructed within the 26-acre new

industrial uses portion of the Project site. Table 4.1 shows the projected traffic generated by the Project during the AM and PM peak hours.

Table 4.1: Project Trip Generation

Land Use	Independent Variable	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Enter (vph)	Exit (vph)	Total (vph)	Enter (vph)	Exit (vph)	Total (vph)
Concrete Crushing Facility & Asphalt Plant	27 Acres	35	0	35	0	35	35
Photovoltaic + Battery Energy Storage System	127 Acres	10	0	10	0	10	10
New Industrial Uses (ITE Code 140 - Manufacturing)	26 Acres	104	12	116	51	67	118
<b>Total</b>		<b>149</b>	<b>12</b>	<b>161</b>	<b>51</b>	<b>112</b>	<b>163</b>

The Project is anticipated to generate 161 trips during the AM peak hour of traffic and 163 trips during the PM peak hour of traffic.

#### 4.2.2 Trip Distribution & Assignment

Approximately 75 percent of the trips were assumed to originate from and be destined towards the east and the remaining 25 percent of the trips were assumed to originate from and be destined towards the west. Figure 4.1 illustrates the Project-generated trip distribution.

As mentioned above, it was assumed that two driveways to the Project site would be provided – one east and one west of Miki Road. The trips were distributed between the two driveways based on the proportion of Project area located on each side of Miki Road.

#### 4.3 Future Year 2040 Analysis

Upon completion of the Project, all intersection movements are forecast to operate at LOS B or better during the AM and PM peak hours of traffic. Miki Road is privately-owned; the levels of service for the proposed uses on such are acceptable and not significant. A westbound left-turn deceleration lane is recommended and is discussed further in section 4.3.2.

See Figure 4.2 and Table 4.2 for traffic volumes and LOS. LOS worksheets are provided in Appendix C.

#### 4.3.1 Signal Warrant Analysis

Although a full traffic signal warrant analysis was not performed as part of this report, the Kaunalapau Highway/Miki Road intersection is not anticipated to warrant a traffic signal by Year 2040 with the Project. Refer to Appendix D for signal warrant analysis.

#### 4.3.2 Left-turn Lane Warrant

##### Westbound Left-Turn Lane

At the time of this writing, the A Policy on Geometric Design of Highways and Streets (“Green Book”, 2011) was the most recent version adopted by the Hawaii Department of Transportation. Based upon the following chart from NCHRP Report 279, which is referenced by the Green Book, a westbound left-turn lane is not warranted but is close to warranting at this intersection for Future Year 2040 with the Project. The westbound left-turn percentages are roughly 52 and 32 percent, respectively for the AM and PM peak hours of traffic as plotted below in Figure 4.3.

Although not warranted, given the proximity of the left-turn lane warranting as well as the understanding that the industrial park will serve a large number of heavy vehicles, a left-turn lane is recommended at the intersection.

#### 4.3.3 Intersection Geometry

The current intersection geometry provides a single, approximately 13-foot wide bi-directional lane at its southern Miki Road approach, which is inadequate to accommodate vehicles traveling side-by-side. As a result of the significant anticipated increase in travel demand, large design vehicle (lowboy with crane), and the 45 mph posted speed along Kaunalapau Highway in the vicinity of Miki Road, widening to two lanes is recommended between the Project site and Kaunalapau Highway with intersection geometries capable of accommodating turning movements by the design vehicle.

Table 4.2: Existing, Base Year 2040, and Future Year 2040 LOS

	Existing Conditions						Base Year 2040						Future Year 2040					
	AM			PM			AM			PM			AM			PM		
	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS	HCM Delay	v/c Ratio	LOS
<b>Kaunalapau Highway/Miki Road</b>																		
NB LT/RT	10.3	0.01	B	10.4	0.01	B	11.2	0.01	B	12.2	0.02	B	10.2	0.06	B	11.8	0.23	B
WB LT	7.3	0.01	A	7.5	0.01	A	7.4	0.03	A	7.7	0.03	A	7.7	0.11	A	7.8	0.06	A
<b>Miki Road/Project Driveway 1</b>																		
NB LT/TH	n/a						n/a						0.0	0.00	A	0.0	0.00	A
EB LT/TH	n/a						n/a						10.1	0.02	B	10.5	0.13	B
<b>Miki Road/Project Driveway 2</b>																		
EB LT/TH/RT	n/a						n/a						0.0	0.00	A	0.0	0.00	A
WB LT/TH/RT	n/a						n/a						0.0	0.00	A	0.0	0.00	A

MIKI BASIN  
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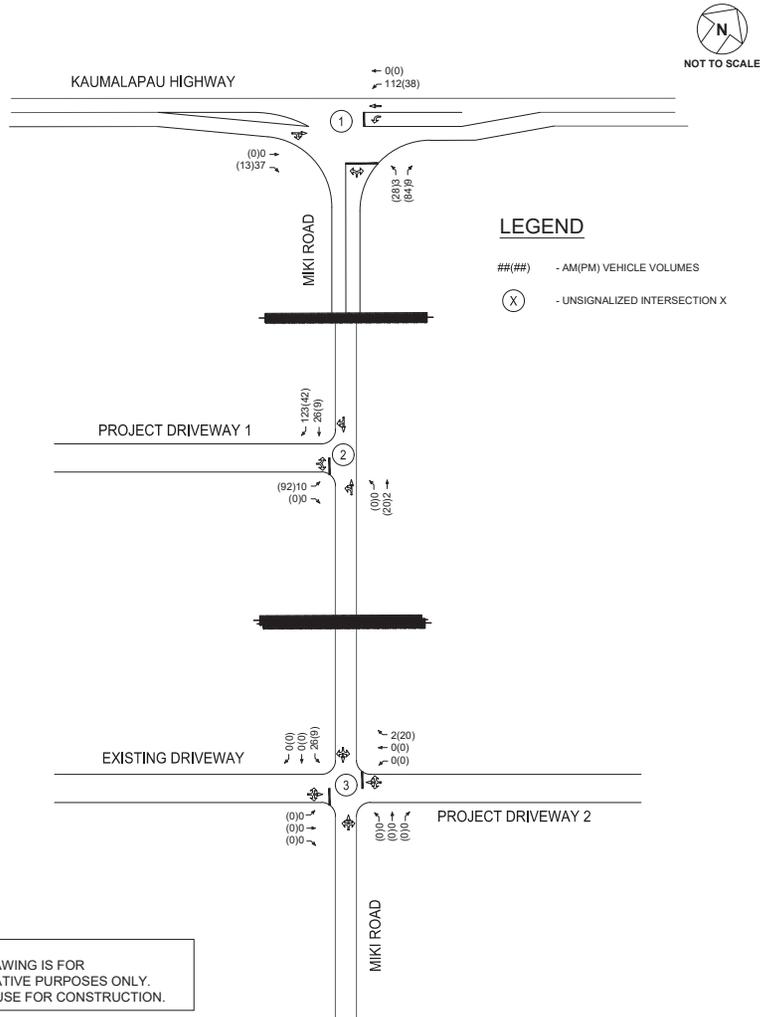


FIGURE 4.1

PROJECT-GENERATED TRIPS

MIKI BASIN  
INDUSTRIAL PARK

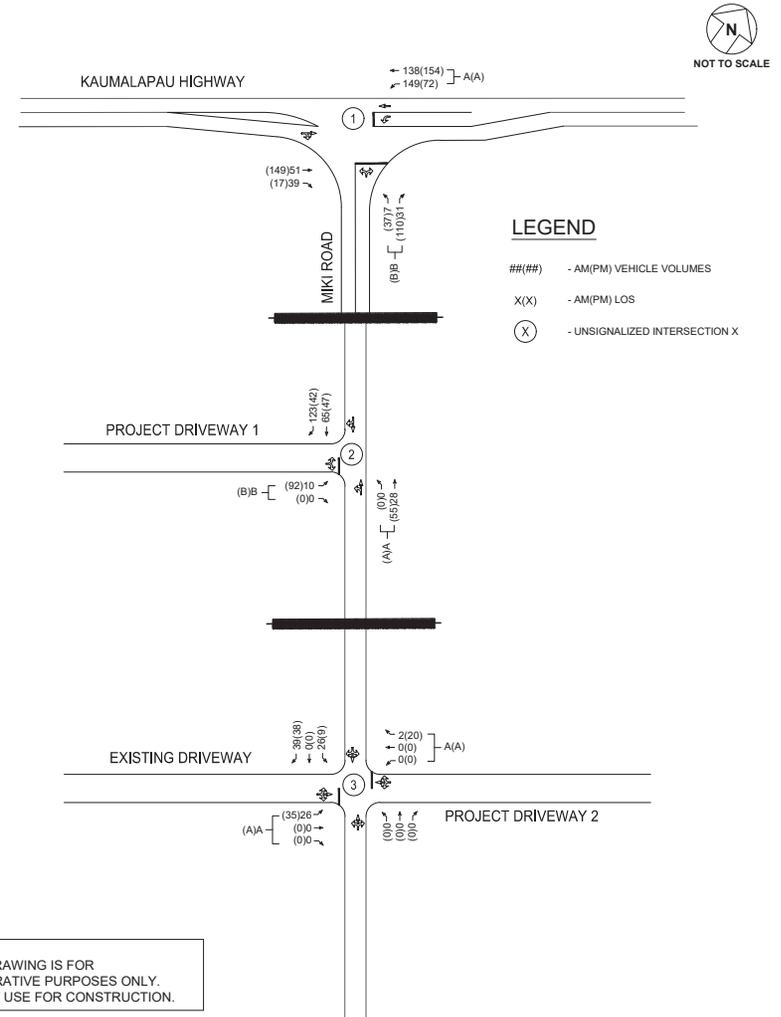
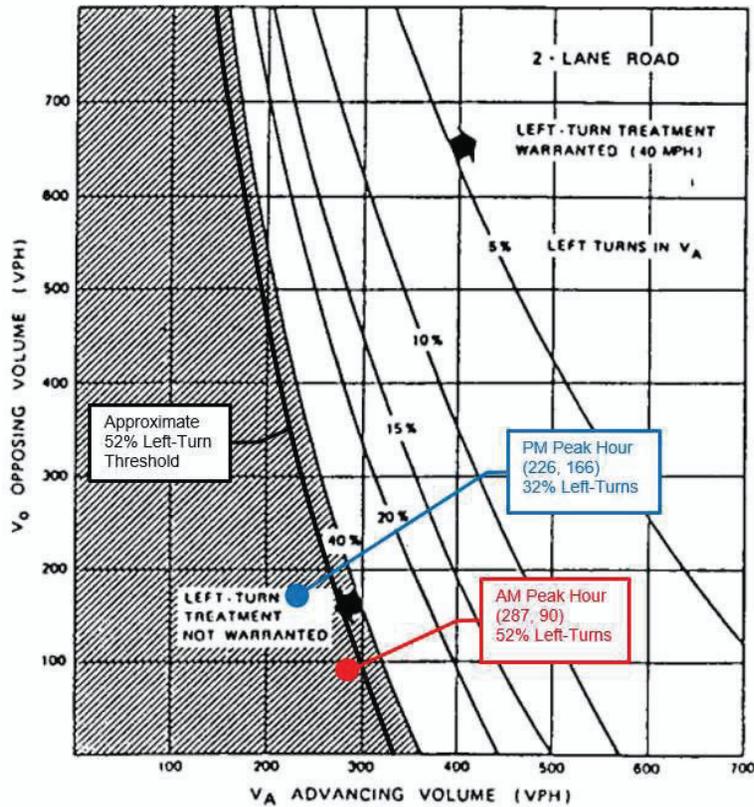


FIGURE 4.2

FUTURE YEAR 2040 LANE CONFIGURATION,  
VOLUMES AND LOS

Figure 4.3: Left-Turn Warrant (NCHRP 279)



## 5. CONCLUSIONS AND RECOMMENDATIONS

The Project proposes to construct a 200-acre industrial park along Miki Road, south of Lanai Airport. The Project is anticipated to generate approximately 161(163) trips during the AM(PM) peak hours of traffic by its 2040 estimated completion.

Upon completion of the Project, all intersection movements are forecast to operate at LOS B or better during the AM and PM peak hours of traffic.

The following geometric modifications are recommended when warranted:

- Widen Miki Road between its intersection with Kaunalapau Highway to the Project Driveway(s). Miki Road is currently estimated to be 13 feet wide, and should be widened to accommodate the design vehicle (lowboy with crane) and full side-by-side bidirectional travel with intersection geometries capable of accommodating turning movements.
- Provide an exclusive westbound left-turn deceleration lane.

## 6. REFERENCES

1. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets, 2011.
2. Austin, Tsutsumi and Associates, Inc., Traffic Assessment for Miki Basin Heavy Industrial Area, 2013.
3. County of Maui Planning Department, Lanai Community Plan Update, 2013.
4. Institute of Transportation Engineers, Trip Generation, 10th Edition, 2017.
5. Neuman, Timothy R., NCHRP 279 – Intersection Channelization Design Guide, 1985.
6. State of Hawaii Department of Business, Economic Development and Tourism, Population and Economic Projections for the State of Hawaii to 2045, 2018.
7. Transportation Research Board, Highway Capacity Manual, 6<sup>th</sup> Edition.

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# APPENDICES

---

**APPENDIX A**  
LEVEL OF SERVICE CRITERIA

**APPENDIX A – LEVEL OF SERVICE (LOS) CRITERIA**

**VEHICULAR LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS (HCM 6<sup>th</sup> Edition)**

Level of service for vehicles at signalized intersections is directly related to delay values and is assigned on that basis. Level of Service is a measure of the acceptability of delay values to motorists at a given intersection. The criteria are given in the table below.

Level-of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec./veh.)
A	< 10.0
B	>10.0 and ≤ 20.0
C	>20.0 and ≤ 35.0
D	>35.0 and ≤ 55.0
E	>55.0 and ≤ 80.0
F	> 80.0

Delay is a complex measure, and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group or approach in question.

**VEHICULAR LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS (HCM 6<sup>th</sup> Edition)**

The level of service criteria for vehicles at unsignalized intersections is defined as the average control delay, in seconds per vehicle.

LOS delay threshold values are lower for two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections than those of signalized intersections. This is because more vehicles pass through signalized intersections, and therefore, drivers expect and tolerate greater delays. While the criteria for level of service for TWSC and AWSC intersections are the same, procedures to calculate the average total delay may differ.

Level of Service Criteria for Two-Way Stop-Controlled Intersections

Level of Service	Average Control Delay (sec/veh)
A	≤ 10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	> 50

**APPENDIX B**  
TRAFFIC COUNT DATA

Miki Road, Kaumalapau Highway								
Start Time	KAUMALAPAU HWY EASTBOUND		KAUMALAPAU HWY WESTBOUND		MIKI RD NORTHBOUND		Int. Total	
	Thru	Right	Left	Thru	Left	Right		
6:00	1	0	3	15	0	0	19	
6:15	3	2	3	12	0	0	20	
6:30	1	0	5	18	0	0	24	
6:45	11	1	3	22	0	0	37	
7:00	8	1	3	9	2	0	23	
7:15	4	0	3	17	2	2	28	
7:30	4	1	1	13	0	1	20	
7:45	6	2	1	9	1	3	22	
8:00	3	0	3	15	2	0	23	
8:15	9	0	1	10	2	2	24	
8:30	11	2	1	13	0	2	29	
8:45	5	2	3	12	2	0	24	
9:00	18	2	2	6	2	0	30	
9:15	9	1	0	9	1	2	22	
9:30	10	0	2	9	1	5	27	
9:45	13	0	0	11	0	0	24	
10:00	13	0	4	18	1	1	37	
10:15	16	0	0	19	0	4	39	
10:30	7	2	3	22	0	1	35	
10:45	20	1	2	14	1	5	43	
11:00	25	1	2	14	2	0	44	
11:15	17	1	1	9	1	5	34	
11:30	29	1	0	5	0	2	37	
11:45	14	2	2	18	1	2	39	
12:00	12	1	4	17	1	4	39	
12:15	11	0	4	14	1	1	31	
12:30	9	1	2	10	3	4	29	
12:45	11	3	2	20	0	3	39	
13:00	17	0	4	22	1	3	47	
13:15	21	0	4	17	2	1	45	
13:30	14	1	0	18	4	1	38	
13:45	19	3	3	16	2	1	44	
14:00	20	2	3	19	1	2	47	
14:15	16	2	3	14	1	3	39	
14:30	17	2	3	12	2	2	38	
14:45	21	2	2	9	2	1	37	
15:00	25	2	1	11	3	2	44	
15:15	7	3	0	4	1	4	19	
15:30	24	1	2	3	0	4	34	
15:45	8	0	2	8	1	3	22	
16:00	14	1	1	9	0	2	27	
16:15	10	1	6	5	1	4	27	
16:30	7	0	0	5	0	3	15	
16:45	9	0	0	2	1	3	15	
17:00	7	0	0	5	3	1	16	
17:15	6	0	0	3	0	1	10	
17:30	3	0	0	8	0	1	12	
17:45	2	1	0	8	0	0	11	
<b>24-Oct</b>	<b>567</b>	<b>48</b>	<b>94</b>	<b>578</b>	<b>51</b>	<b>91</b>	<b>1429</b>	

AM Peak Hour

PM Peak Hour

Miki Road Kaumalapau Highway								
Start Time	KAUMALAPAU HWY EASTBOUND		KAUMALAPAU HWY WESTBOUND		MIKI RD NORTHBOUND		Int. Total	
	Thru	Right	Left	Thru	Left	Right		
6:00	0	0	2	6	0	0	8	80
6:15	5	0	2	10	0	0	17	85
6:30	2	0	5	23	0	0	30	91
6:45	4	0	6	15	0	0	25	85
7:00	2	0	3	3	1	4	13	90
7:15	5	0	2	14	1	1	23	103
7:30	3	1	4	15	0	1	24	108
7:45	5	0	5	15	1	4	30	126
8:00	10	0	2	10	1	3	26	125
8:15	6	1	2	13	2	4	28	134
8:30	15	1	2	21	0	3	42	143
8:45	8	2	2	14	0	3	29	143
9:00	15	1	0	17	1	1	35	144
9:15	8	1	5	21	0	2	37	145
9:30	22	1	1	15	0	3	42	135
9:45	10	2	4	11	0	3	30	126
10:00	15	0	2	12	2	5	36	120
10:15	12	1	2	9	1	2	27	107
10:30	12	1	2	13	0	5	33	119
10:45	7	2	1	11	1	2	24	125
11:00	8	1	2	10	0	2	23	132
11:15	20	1	4	11	2	1	39	141
11:30	19	0	2	14	0	4	39	130
11:45	17	0	1	10	0	3	31	123
12:00	12	0	6	11	0	3	32	124
12:15	12	0	3	9	0	4	28	117
12:30	10	0	3	15	1	3	32	124
12:45	8	0	2	17	0	5	32	123
13:00	8	0	3	12	0	2	25	117
13:15	14	1	1	19	0	0	35	137
13:30	11	1	3	11	2	3	31	138
13:45	7	1	3	11	0	4	26	132
14:00	19	1	3	18	0	4	45	151
14:15	17	0	5	9	1	4	36	144
14:30	8	0	0	14	0	3	25	139
14:45	22	1	5	15	2	0	45	155
15:00	22	2	1	9	0	4	38	143
15:15	13	1	2	14	0	1	31	127
15:30	20	2	1	9	1	8	41	111
15:45	20	0	1	11	0	1	33	90
16:00	9	0	2	5	1	5	22	77
16:15	10	0	1	3	0	1	15	70
16:30	6	1	2	10	0	1	20	64
16:45	11	0	0	4	0	5	20	54
17:00	7	0	0	5	1	2	15	44
17:15	3	0	0	5	1	0	9	
17:30	4	1	0	5	0	0	10	
17:45	4	0	2	4	0	0	10	
<b>25-Oct</b>	<b>507</b>	<b>28</b>	<b>112</b>	<b>558</b>	<b>23</b>	<b>119</b>	<b>1347</b>	

Miki Road Kaumalapau Highway								
Start Time	KAUMALAPAU HWY EASTBOUND		KAUMALAPAU HWY WESTBOUND		MIKI RD NORTHBOUND		Int. Total	
	Thru	Right	Left	Thru	Left	Right		
6:00	1	0	0	3	0	0	4	63
6:15	0	0	0	15	0	0	15	76
6:30	1	0	3	20	0	0	24	79
6:45	2	0	5	10	0	3	20	84
7:00	6	0	2	9	0	0	17	87
7:15	2	1	3	11	1	0	18	97
7:30	9	3	1	11	4	1	29	106
7:45	4	0	4	12	0	3	23	105
8:00	10	1	1	9	0	6	27	125
8:15	9	1	2	10	3	2	27	132
8:30	5	1	2	20	0	0	28	141
8:45	11	2	3	21	2	4	43	146
9:00	8	0	2	20	1	3	34	145
9:15	13	0	4	17	0	2	36	148
9:30	14	1	4	12	0	2	33	139
9:45	27	2	2	7	1	3	42	141
10:00	17	1	1	13	2	3	37	136
10:15	10	0	2	12	1	2	27	130
10:30	13	0	0	15	0	7	35	141
10:45	15	1	4	16	0	1	37	134
11:00	12	3	1	13	0	2	31	125
11:15	22	0	2	9	1	4	38	122
11:30	16	0	0	7	0	5	28	111
11:45	10	0	2	12	1	3	28	113
12:00	9	0	2	15	0	2	28	114
12:15	16	0	2	7	0	2	27	127
12:30	10	0	4	15	0	1	30	123
12:45	8	0	3	12	5	1	29	113
13:00	13	3	3	20	0	2	41	113
13:15	10	1	2	9	0	1	23	107
13:30	5	0	2	12	0	1	20	106
13:45	14	0	1	10	2	2	29	115
14:00	13	2	5	13	0	2	35	114
14:15	10	1	0	7	0	4	22	108
14:30	16	0	3	7	1	2	29	123
14:45	8	0	11	8	0	1	28	154
15:00	14	0	4	8	0	3	29	147
15:15	14	0	1	18	0	4	37	136
15:30	30	0	1	20	0	9	60	118
15:45	7	1	1	9	0	3	21	68
16:00	10	0	0	5	1	2	18	56
16:15	8	0	0	10	1	0	19	44
16:30	5	1	1	3	0	0	10	39
16:45	3	0	3	3	0	0	9	43
17:00	1	1	0	2	0	2	6	44
17:15	4	0	0	4	0	6	14	
17:30	7	0	0	5	1	1	14	
17:45	7	0	0	3	0	0	10	
<b>26-Oct</b>	<b>479</b>	<b>27</b>	<b>99</b>	<b>529</b>	<b>28</b>	<b>107</b>	<b>1269</b>	

**APPENDIX C**  
LEVEL OF SERVICE CALCULATIONS

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**APPENDIX C**  
LEVEL OF SERVICE CALCULATIONS

- Existing Conditions
-

HCM 6th TWSC  
1: Miki Road & Kaumalapau Highway

Miki Basin 200-Acre Industrial Subdivision  
01/27/2021

Intersection						
Int Delay, s/veh	1.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Vol, veh/h	29	2	14	79	4	2
Future Vol, veh/h	29	2	14	79	4	2
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	74	74	74	74	74	74
Heavy Vehicles, %	10	55	4	8	55	20
Mvmt Flow	39	3	19	107	5	3

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	43	0	187
Stage 1	-	-	-	-	42
Stage 2	-	-	-	-	145
Critical Hdwy	-	-	4.14	-	6.95
Critical Hdwy Stg 1	-	-	-	-	5.95
Critical Hdwy Stg 2	-	-	-	-	5.95
Follow-up Hdwy	-	-	2.236	-	3.995
Pot Cap-1 Maneuver	-	-	1553	-	695
Stage 1	-	-	-	-	860
Stage 2	-	-	-	-	768
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1552	-	685
Mov Cap-2 Maneuver	-	-	-	-	685
Stage 1	-	-	-	-	859
Stage 2	-	-	-	-	758

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	10.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	685	-	-	1552	-
HCM Lane V/C Ratio	0.008	-	-	0.012	-
HCM Control Delay (s)	10.3	-	-	7.3	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

HCM 6th TWSC  
1: Miki Road & Kaumalapau Highway

Miki Basin 200-Acre Industrial Subdivision  
01/27/2021

Intersection						
Int Delay, s/veh	0.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔		↔		↔	
Traffic Vol, veh/h	85	4	11	88	9	6
Future Vol, veh/h	85	4	11	88	9	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	11	56	7	10	46	11
Mvmt Flow	91	4	12	95	10	6

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	95	0	212
Stage 1	-	-	-	-	93
Stage 2	-	-	-	-	119
Critical Hdwy	-	-	4.17	-	6.86
Critical Hdwy Stg 1	-	-	-	-	5.86
Critical Hdwy Stg 2	-	-	-	-	5.86
Follow-up Hdwy	-	-	2.263	-	3.914
Pot Cap-1 Maneuver	-	-	1468	-	688
Stage 1	-	-	-	-	831
Stage 2	-	-	-	-	808
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1468	-	682
Mov Cap-2 Maneuver	-	-	-	-	682
Stage 1	-	-	-	-	831
Stage 2	-	-	-	-	801

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	10.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	682	-	-	1468	-
HCM Lane V/C Ratio	0.014	-	-	0.008	-
HCM Control Delay (s)	10.4	-	-	7.5	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

**APPENDIX C**  
LEVEL OF SERVICE CALCULATIONS

- Base Year 2040 without Project Conditions

HCM 6th TWSC  
1: Miki Road & Kaumalapau Highway

Miki Basin 200-Acre Industrial Subdivision  
06/02/2021

Intersection						
Int Delay, s/veh	1.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	
Traffic Vol, veh/h	51	2	37	138	4	22
Future Vol, veh/h	51	2	37	138	4	22
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	10	55	4	8	55	20
Mvmt Flow	55	2	40	150	4	24
Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	58	0	287	-
Stage 1	-	-	-	-	57	-
Stage 2	-	-	-	-	230	-
Critical Hdwy	-	-	4.14	-	6.95	-
Critical Hdwy Stg 1	-	-	-	-	5.95	-
Critical Hdwy Stg 2	-	-	-	-	5.95	-
Follow-up Hdwy	-	-	2.236	-	3.995	-
Pot Cap-1 Maneuver	-	-	1533	-	605	0
Stage 1	-	-	-	-	846	0
Stage 2	-	-	-	-	698	0
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1532	-	587	-
Mov Cap-2 Maneuver	-	-	-	-	587	-
Stage 1	-	-	-	-	845	-
Stage 2	-	-	-	-	678	-
Approach	EB	WB	NB			
HCM Control Delay, s	0	1.6	11.2			
HCM LOS			B			
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	587	-	-	1532	-	
HCM Lane V/C Ratio	0.007	-	-	0.026	-	
HCM Control Delay (s)	11.2	-	-	7.4	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0	-	-	0.1	-	

Intersection						
Int Delay, s/veh	1.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	↔
Traffic Vol, veh/h	149	4	34	154	9	26
Future Vol, veh/h	149	4	34	154	9	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	11	56	7	10	46	11
Mvmt Flow	160	4	37	166	10	28

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	164	0	402
Stage 1	-	-	-	-	162
Stage 2	-	-	-	-	240
Critical Hdwy	-	-	4.17	-	6.86
Critical Hdwy Stg 1	-	-	-	-	5.86
Critical Hdwy Stg 2	-	-	-	-	5.86
Follow-up Hdwy	-	-	2.263	-	3.914
Pot Cap-1 Maneuver	-	-	1385	-	528
Stage 1	-	-	-	-	771
Stage 2	-	-	-	-	707
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1385	-	513
Mov Cap-2 Maneuver	-	-	-	-	513
Stage 1	-	-	-	-	771
Stage 2	-	-	-	-	686

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	12.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	513	-	-	1385	-
HCM Lane V/C Ratio	0.019	-	-	0.026	-
HCM Control Delay (s)	12.2	-	-	7.7	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.1	-

**APPENDIX C**  
LEVEL OF SERVICE CALCULATIONS

- Future Year 2040 with Project Conditions

HCM 6th TWSC  
1: Miki Road & Kaumalapau Highway

Miki Basin 200-Acre Industrial Subdivision  
06/02/2021

Intersection						
Int Delay, s/veh	3.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↗		↖	↗	↖	↗
Traffic Vol, veh/h	51	39	149	138	7	31
Future Vol, veh/h	51	39	149	138	7	31
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	900	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	10	55	4	8	55	20
Mvmt Flow	55	42	162	150	8	34

Major/Minor	Major1	Major2	Minor1	Minor2
Conflicting Flow All	0	0	98	0
Stage 1	-	-	-	77
Stage 2	-	-	-	474
Critical Hdwy	-	-	4.14	-
Critical Hdwy Stg 1	-	-	-	5.95
Critical Hdwy Stg 2	-	-	-	5.95
Follow-up Hdwy	-	-	2.236	-
Pot Cap-1 Maneuver	-	-	1483	-
Stage 1	-	-	-	828
Stage 2	-	-	-	529
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	1482	-
Mov Cap-2 Maneuver	-	-	-	370
Stage 1	-	-	-	827
Stage 2	-	-	-	471

Approach	EB	WB	NB
HCM Control Delay, s	0	4	10.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	730	-	-	1482	-
HCM Lane V/C Ratio	0.057	-	-	0.109	-
HCM Control Delay (s)	10.2	-	-	7.7	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.4	-

HCM 6th TWSC  
2: Miki Road & Project Driveway 1

Miki Basin 200-Acre Industrial Subdivision  
06/02/2021

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖			↗	↖	↗
Traffic Vol, veh/h	10	0	0	28	65	123
Future Vol, veh/h	10	0	0	28	65	123
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	50	50	50	50	50	50
Mvmt Flow	11	0	0	30	71	134

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	168	138	205
Stage 1	138	-	-
Stage 2	30	-	-
Critical Hdwy	6.9	6.7	4.6
Critical Hdwy Stg 1	5.9	-	-
Critical Hdwy Stg 2	5.9	-	-
Follow-up Hdwy	3.95	3.75	2.65
Pot Cap-1 Maneuver	723	797	1126
Stage 1	783	-	-
Stage 2	882	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	723	797	1126
Mov Cap-2 Maneuver	723	-	-
Stage 1	783	-	-
Stage 2	882	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.1	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1126	-	723	-	-
HCM Lane V/C Ratio	-	-	0.015	-	-
HCM Control Delay (s)	0	-	10.1	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

HCM 6th TWSC Miki Basin 200-Acre Industrial Subdivision  
 3: Miki Road & Miki Industrial Complex Driveway/Project Driveway 2 06/02/2021

Intersection												
Int Delay, s/veh	0											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	26	0	0	0	0	2	0	0	0	26	0	39
Future Vol, veh/h	26	0	0	0	0	2	0	0	0	26	0	39
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	50	50	50	50	50	50	50	50	50	50	50	50
Mvmt Flow	28	0	0	0	0	2	0	0	0	28	0	42

Major/Minor	Minor2	Minor1	Major1	Major2
Conflicting Flow All	78	77	21	77
Stage 1	77	77	-	0
Stage 2	1	0	-	77
Critical Hdwy	7.6	7	6.7	7.6
Critical Hdwy Stg 1	6.6	6	-	6.6
Critical Hdwy Stg 2	6.6	6	-	6.6
Follow-up Hdwy	3.95	4.45	3.75	3.95
Pot Cap-1 Maneuver	807	730	933	808
Stage 1	825	746	-	-
Stage 2	910	-	-	825
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	730	933	808
Mov Cap-2 Maneuver	-	730	-	808
Stage 1	825	746	-	-
Stage 2	910	-	-	825

Approach	EB	WB	NB	SB
HCM Control Delay, s			0	
HCM LOS	-	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1308	-	-	-	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-	-	-	-
HCM Control Delay (s)	0	-	-	-	-	-	-	-
HCM Lane LOS	A	-	-	-	-	-	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-	-	-	-

HCM 6th TWSC Miki Basin 200-Acre Industrial Subdivision  
 1: Miki Road & Kaumalapau Highway 06/02/2021

Intersection						
Int Delay, s/veh	4.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕		↕	↕	↕	↕
Traffic Vol, veh/h	149	17	72	154	37	110
Future Vol, veh/h	149	17	72	154	37	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	900	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	11	56	7	10	46	11
Mvmt Flow	160	18	77	166	40	118

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	178
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.17
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.263
Pot Cap-1 Maneuver	-	-	1368
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	1368
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2.5	11.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	690	-	-	1368	-
HCM Lane V/C Ratio	0.229	-	-	0.057	-
HCM Control Delay (s)	11.8	-	-	7.8	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.9	-	-	0.2	-

HCM 6th TWSC  
2: Miki Road & Project Driveway 1

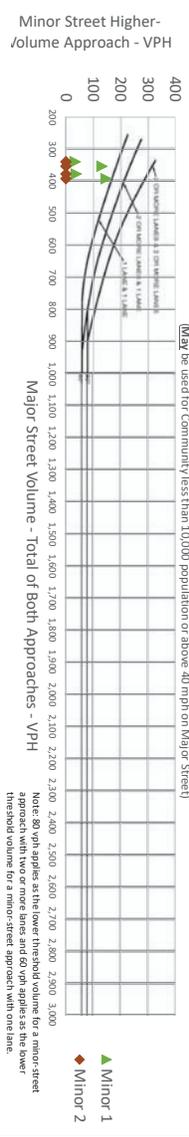
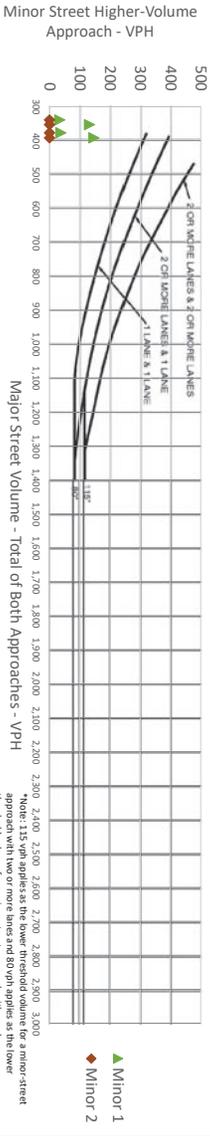
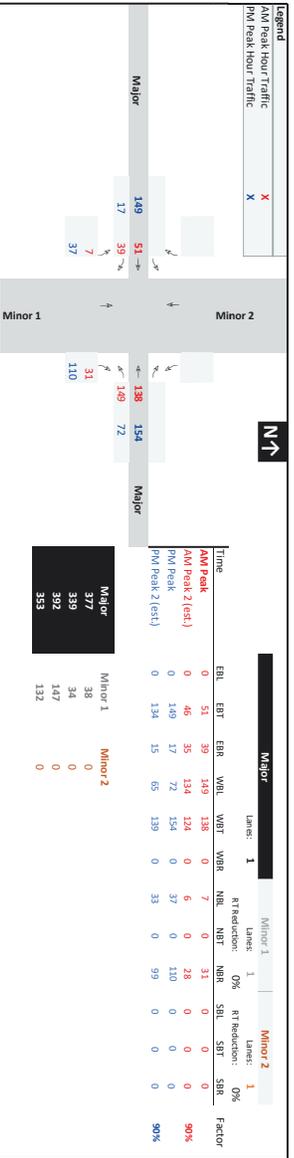
Miki Basin 200-Acre Industrial Subdivision  
06/02/2021

Intersection						
Int Delay, s/veh	4.1					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔			↕	↕	
Traffic Vol, veh/h	92	0	0	55	47	42
Future Vol, veh/h	92	0	0	55	47	42
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	50	50	50	50	50	50
Mvmt Flow	100	0	0	60	51	46
Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	134	74	97	0	-	0
Stage 1	74	-	-	-	-	-
Stage 2	60	-	-	-	-	-
Critical Hdwy	6.9	6.7	4.6	-	-	-
Critical Hdwy Stg 1	5.9	-	-	-	-	-
Critical Hdwy Stg 2	5.9	-	-	-	-	-
Follow-up Hdwy	3.95	3.75	2.65	-	-	-
Pot Cap-1 Maneuver	758	869	1243	-	-	-
Stage 1	841	-	-	-	-	-
Stage 2	854	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	758	869	1243	-	-	-
Mov Cap-2 Maneuver	758	-	-	-	-	-
Stage 1	841	-	-	-	-	-
Stage 2	854	-	-	-	-	-
Approach	EB	NB	SB			
HCM Control Delay, s	10.5	0	0			
HCM LOS	B					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1243	-	758	-	-	
HCM Lane V/C Ratio	-	-	0.132	-	-	
HCM Control Delay (s)	0	-	10.5	-	-	
HCM Lane LOS	A	-	B	-	-	
HCM 95th %tile Q(veh)	0	-	0.5	-	-	

HCM 6th TWSC  
3: Miki Road & Miki Industrial Complex Driveway/Project Driveway 2

Miki Basin 200-Acre Industrial Subdivision  
06/02/2021

Intersection												
Int Delay, s/veh	0											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	35	0	0	0	0	20	0	0	0	9	0	38
Future Vol, veh/h	35	0	0	0	0	20	0	0	0	9	0	38
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	50	50	50	50	50	50	50	50	50	50	50	50
Mvmt Flow	38	0	0	0	0	22	0	0	0	10	0	41
Major/Minor	Minor2	Minor1	Major1	Major2								
Conflicting Flow All	52	41	21	41	61	0	41	0	0	0	0	0
Stage 1	41	41	-	0	0	-	-	-	-	-	-	-
Stage 2	11	0	-	41	61	-	-	-	-	-	-	-
Critical Hdwy	7.6	7	6.7	7.6	7	6.7	4.6	-	-	4.6	-	-
Critical Hdwy Stg 1	6.6	6	-	6.6	6	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.6	6	-	6.6	6	-	-	-	-	-	-	-
Follow-up Hdwy	3.95	4.45	3.75	3.95	4.45	3.75	2.65	-	-	2.65	-	-
Pot Cap-1 Maneuver	840	766	933	855	746	-	1309	-	-	-	-	-
Stage 1	865	775	-	-	-	-	-	-	-	-	-	-
Stage 2	899	-	-	865	759	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	766	933	855	746	-	1309	-	-	-	-	-
Mov Cap-2 Maneuver	-	766	-	855	746	-	-	-	-	-	-	-
Stage 1	-	865	775	-	-	-	-	-	-	-	-	-
Stage 2	-	899	-	865	759	-	-	-	-	-	-	-
Approach	EB	WB	NB	SB								
HCM Control Delay, s			0									
HCM LOS	-	-										
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1309	-	-	-	-	-	-	-				
HCM Lane V/C Ratio	-	-	-	-	-	-	-	-				
HCM Control Delay (s)	0	-	-	-	-	-	-	-				
HCM Lane LOS	A	-	-	-	-	-	-	-				
HCM 95th %tile Q(veh)	0	-	-	-	-	-	-	-				



Kauntdapau Highway & Miki Road  
Austin, Tsutsumi, and Associates, Inc.  
Future Year 2040 4-Hour Signal Warrant Approximation  
FIGURE D.1

## APPENDIX D SIGNAL WARRANT



**WATER MASTER PLAN**

**APPENDIX**

**H-1**

**PŪLAMA LĀNA'I MIKI BASIN  
200 ACRE INDUSTRIAL PARK**

**TMK: 4-9-002:061  
(Portion)**

**Lāna'i, Hawai'i**

**WATER MASTER PLAN**

**Prepared By:** Akinaka & Associates, Ltd.  
1100 Alakea Street, Suite 1800  
Honolulu, Hawaii 96813

**Date:** October 2021

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- X. APPENDICES**

1. **Appendix A1: Water Calculations**
2. **Appendix A2: Water Calculations – Adjusted PRV**
3. **Appendix B: 0% Design Construction Costs**

**X. REFERENCES (Not attached)**

1. County of Water Supply, Department of Water Supply, Water System Standards, dated 2002.
2. County of Water Supply, Department of Water Supply, Lānaʻi Island Water Use and Development Plan, dated 2011.

**I. INTRODUCTION**

The Water Master Plan for Pūlama Lānaʻi Miki Basin 200-Acre Industrial Park provides the basic information for the design of the water distribution system for the Miki Basin 200-Acre Industrial Park (Industrial Park) based on zoning requirements. The purpose of this master plan is to analyze the condition of the existing water distribution system and provide a plan for the new projected water demands as part of the Environmental Assessment (EA) submission required to complete the Land Use Commission (LUC) rezoning process.

The Industrial Park consists of approximately 200 acres of agricultural zoned lands. Pūlama Lānaʻi is in the process of rezoning the area for light and heavy industrial lands. The project area (Industrial Park) is located directly south of Lānaʻi Airport within the Pālāwai Irrigation Grid (See **Exhibit 1: Location Map**). The majority of Miki Basin is currently undeveloped with the exception of the Maui Electric Company (MECO) Miki Basin diesel generating facility and substation and a portion of the 20-acre approved subdivision which is currently used by Pūlama Lānaʻi for mobile concrete batch plant (CBP), Pūlama Lānaʻi warehouses and by other commercial industrial tenants uses (e.g., Hawaii Gas, Maui Disposal, etc.). Pūlama Lānaʻi has submitted a Special Use Permit to the County of Maui Planning Department for the relocation of the interim industrial uses. The 200-acres of the proposed Industrial Park do not include the MECO facility and the 20-acre subdivision.

**II. EXECUTIVE SUMMARY**

Water for Miki Basin is currently provided by the Mānele Bay Water System (Public Water System 238) which is owned, operated, and maintained by the Lānaʻi Water Company. The system, sourced by Wells No. 2 (State Well No. 5-4953-001) and 4 (State Well No. 5-4952-002), currently services Mānele, Hulopoʻe and the Pālāwai Irrigation Grid. Water from the wells is either stored in the existing 0.5 million gallon (MG) Hiʻi Tank or 1.0 MG concrete Hiʻi Reservoir or fed directly into the distribution system depending on need. The existing Mānele Bay Water System (PWS 238) consists of 10-inch, 12-inch and 16-inch transmission mains. The Mānele Bay Water System (PWS 238) is interconnected with the Lānaʻi City Water System (Public Water System 237). During emergencies, the Lānaʻi City Water System (PWS 237) can be connected to the Mānele Bay Water System (PWS 238) by opening a valve.

The existing average daily water usage of the Mānele Bay Water System (PWS 238) is currently estimated at 433,000 gallons per day (gpd).

In accordance with the Water System Standards (WSS), available source capacity is governed by the well with the smallest pumping unit. Well No. 2 has an existing maximum pump capacity of 500 gallons per minute (gpm). Well No. 4 has a maximum pump capacity of 900 gpm. Since Well No. 2 currently has the smaller pump capacity, available source capacity for the Mānele Bay Water System (PWS 238) is governed by Well No. 2, which has a maximum day pumping capacity of 480,000 gpd and is equivalent to an average day pumping capacity of 320,000 gpd. Once this capacity is used/committed, the construction of a new well will be required. According to the 2011 Lānaʻi Water Use and Development Plan, Well No. 2 can be outfitted with a pump with a capacity of up to 1,200 gpm. However, based upon analysis of a pump test of the well in October 2015, we do not recommend increasing the current pump capacity.

Proposed water use for the full buildout of the Industrial Park is based on the existing demands on the Mānele Bay Water System (PWS 238) and potential development plans. The potential development plans that are contemplated in the Industrial Park include an asphalt plant, CBP, renewable energy projects, infrastructure, and new industrial uses.

The Industrial Park's incremental or new estimated water demand on Mānele Bay Water System (PWS 238) is 159,625 gpd. The estimated water demand on Mānele Bay Water System (PWS 238) for the full buildout of the Industrial Park is 163,125 gpd.

The projected average day demand for the Mānele Bay Water System (PWS 238), including full buildout of the Industrial Park and existing demands serviced by the Mānele Bay Water System (PWS 238), is 592,625 gpd. The pie chart in Section 4 (**Figure B**) provides a visual summary of the percentages of existing, new or incremental water demands on the Mānele Bay Water System (PWS 238). After evaluating the full buildout of the project, the Mānele Bay Water System (PWS 238), does not have adequate well-pump capacity (source). There is enough storage to support the full buildout with the existing tank and reservoir. Although the transmission mains do meet WSS for fire flow protection, the existing Mānele Bay Water System (PWS 238) does not meet the WSS in other aspects. There is an existing pressure reducing valve (PRV) that has an outflow limit that could be lowered. If a booster pump could be added to the system, the PRV can be set lower, and the booster could pump the water from nodes J-4 to J-5 through pipe P-6 so that there can be enough pressure to distribute water uphill (See **Exhibit 6: Proposed Mānele Bay Water System (Public Water System 238) Improvements Nodal Map**).

The following improvements will be required to support full buildout of the Industrial Park (See **Exhibit 5: Existing Mānele Bay Water System (Public Water System 238)**):

- The existing water PRV could be lowered to at least acquire an outflow of 55 pounds per square inch (psi) to reach the best possible pressures for the distribution main. If there are cavitation issues, a new PRV should be installed that has an anti-cavitation trim.
- Drilling a new source or multiple sources to obtain an additional total minimum pump capacity of 426 gpm.
- While Lānaʻi Water Company has replaced and has abandoned sections of the Pālāwai Irrigation Grid, there remains sections that are in need of repair, replacement or possible abandonment. Since the condition and use of these pipes are unknown, those pipes were excluded from this evaluation. A conditional assessment and analysis for those pipes should be conducted separately, but from the water calculations in this water master plan (See **Appendix A1 & A2**), existing pipes will need to be assessed and potentially replaced at high pressures.
- Construction costs of offsite improvements can be revised based off of the condition assessment for the existing pipes and the existing PRV.

### III. EXISTING WATER SUPPLY AND DISTRIBUTION SYSTEM

Water for Miki Basin is currently serviced by the Mānele Bay Water System (PWS 238) which is owned, operated and maintained by Lānaʻi Water Company (See **Exhibit 2: Existing Mānele Bay Water System (Public Water System 238)**). Mānele Bay Water System (PWS 238) services Mānele, Hulopoʻe and the Pālāwai Irrigation Grid.

#### 1. SOURCE

Water is provided by Wells No. 2 (State Well No. 5-4953-001) and 4 (State Well No. 5-4952-002) and either stored in the existing 0.5 MG Hiʻi Tank or 1.0 MG concrete Hiʻi Reservoir or fed into the tank, then into the distribution system depending on need.

- a. Well No. 2 has a pump capacity of 500 gpm or an average day

capacity of 320,000 gpd based on an operating time of 16 hours. According to the 2011 Lānaʻi Water Use and Development Plan, Well No. 2 can be outfitted with a pump with a capacity of up to 1,200 gpm. However, based upon analysis of a pump test of the well in October 2015, we do not recommend increasing the current pump capacity.

- b. Well No. 4 has a pump capacity of 900 gpm or an average day capacity of 576,000 gpd.
- c. The existing average daily water usage from Mānele Bay Water System (PWS 238) is currently estimated at 433,000 gpd.
- d. WSS requires sources to be able to meet maximum day demand with an operating time of 16 hours, assuming that the largest pumping unit is down. Since Well No. 4 has the larger pump capacity of the two wells, available source capacity for the system is governed by Well No. 2. The incremental estimated water demand for the full buildout of the Miki 200 project (excluding existing water use) is 159,625 gpd.
- e. Lānaʻi has a sustainable yield of 6 million gallons per day (MGD), with 3 MGD allocated to both the Leeward and Windward aquifer sector areas. The majority of the pumping wells are located in the Leeward Aquifer. According to the Lānaʻi Water Company Periodic Water Report, the current moving average pumping is 1.53 MGD.

## 2. STORAGE

- a. 500,000 gallon Hiʻi Tank (Spillway Elevation = 1823ʻ)  
Serves as the water distribution storage tank for Mānele, Hulopoʻe and the Pālāwai Irrigation Grid.
- b. 1,000,000 gallon Hiʻi Reservoir (Spillway Elevation = 1823ʻ)  
Primarily serves as storage for the two well water sources to supply water into the distribution system

## 3. TRANSMISSION

- a. A 12-inch transmission main transports water from the 1,000,000 gallon Hiʻi Reservoir to the 500,000 gallon Hiʻi Tank and into the

Mānele Bay Water System (PWS 238). The 12-inch main splits at a junction to serve both Mānele and Pālāwai Irrigation Grid.

- b. To Mānele and Hulopoʻe – From the junction, the 12-inch line feeds into three pressure breaker storage tanks that service Mānele.
- c. To Pālāwai Irrigation Grid – From the junction, the waterline upsizes to a 16-inch main that delivers water to the Pālāwai Irrigation Grid area. The existing 12-inch Pālāwai PRV downstream of the junction reduces the pressure in the waterline to 95 psi.

## 4. CONNECTION TO OTHER WATER SYSTEMS

- a. The Mānele Bay Water System (PWS 238) is interconnected with the Lānaʻi City Water System (PWS 237). During emergencies, the Lānaʻi City System (PWS 237) can be connected to the Mānele Bay Water System (PWS 238) by opening a valve.

## IV. LAND USE

Pūlama Lānaʻi is in the process of rezoning approximately 200 acres of land from LUC agricultural to urban, which will include both light and heavy industrial uses.

The Industrial Park project is in the entitlement phase. Proposed water use for the full build out of the Industrial Park is based on the existing demands on the Mānele Bay Water System (PWS 238) and potential development plans. The potential development plans that are contemplated in the Industrial Park include an asphalt plant, CBP, renewable energy projects, infrastructure, and new industrial uses.

The asphalt plant and the CBP are being relocated to the Industrial Park. Although the relocation of the asphalt plant is not anticipated to create any additional water demand on for the entire island, the relocation will shift the existing demand from Lānaʻi City (PWS 237) to Mānele Bay Water System (PWS 238).

The renewable energy projects and infrastructure do not consider any new or incremental water demands on Mānele Bay Water System (PWS 238). The only “new” or “incremental” water demands for the Industrial Park include the new industrial uses and a minor increase for the CBP. The estimated water demand for new industrial uses is determined by the guidelines set in the WSS, which contemplates 6,000 gpd, per acre.

The Industrial Park's incremental or new estimated water demand on Mānele Bay Water System (PWS 238) is 159,625 gpd. The estimated water demand on Mānele Bay Water System (PWS 238) for the full build out of the Industrial Park is 163,125 gpd. The table below (**Figure A**) provides a summary for convenience.

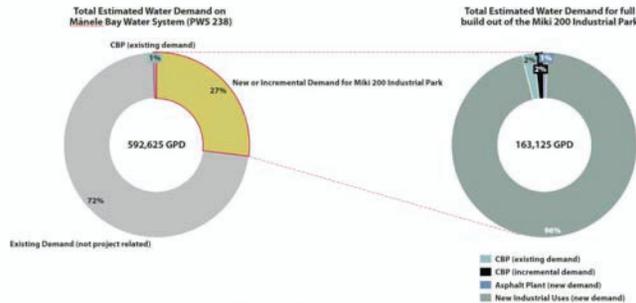
**Figure A**

Description	Acres	Existing water demand on Mānele Bay Water System (PWS 238) (GPD)	New or incremental water demand on Mānele Bay Water System (PWS 238) (GPD)	Full Build Out of Industrial Park water demand on Mānele Bay Water System (PWS 238) (GPD)
CBP	14.5	3,500	2,625	6,125
Asphalt Plant	12.5	-	1,000	1,000
Renewable Energy Projects	127.0	-	-	-
New Industrial Uses	26.0	-	156,000	156,000
Infrastructure	20.0	-	-	-
<b>Total</b>	<b>200.0</b>	<b>3,500</b>	<b>159,625</b>	<b>163,125</b>

The projected average day demand for the Mānele Bay Water System (PWS 238), including full build out of the Industrial Park and existing demands serviced by the Mānele Bay Water System (PWS 238), is 592,625 gpd. The pie chart (**Figure B**) below provides a visual summary of the percentages of existing, new or incremental water demands on the Mānele Bay Water System (PWS 238).

**Figure B**

AT FULL BUILD OUT, THE PROJECT IS ONLY 28% OF THE TOTAL ESTIMATED DEMAND ON PWS 238



~5% of the incremental or new demand for the Māki 200 project will come online within the first five years. The remaining ~96% is not contemplated until later in the development timeline.

**V. SAFE DRINKING WATER SYSTEM DESIGN CRITERIA**

As outlined in the County of Maui WSS, the following criteria are used in determining the minimum requirements for the safe drinking water system.

**1. CONSUMPTION GUIDELINES**

- a. The average demand for industrial land uses for planning purposes is 6,000 gpd / acre.

**2. DEMAND FACTORS**

- a. Maximum Daily Demand = 1.5 x Average Day
- b. Peak Hour Demand = 3.0 x Average Day

**3. FIRE FLOW REQUIREMENTS**

- a. Light Industrial = 2,000 gpm for 2 hour duration
- b. Heavy Industrial = 2,500 gpm for 2 hour duration

**4. PIPELINE SIZING**

- a. Maximum daily flow plus fire flow with a residual pressure of 20 psi at critical fire hydrant.
- b. Peak hour flow with a minimum residual pressure of 40 psi.
- c. In determining the carrying capacity of the mains, the "C" values to be applied are:

Size	"C"
4" & 6"	100
8" & 12"	110
16" & 20"	120

- d. The maximum velocity in transmission mains (without fire flow) is 20 feet per second. The maximum velocity in distribution mains with fire flow shall be 10 feet per second.

- e. Maximum static or pumping pressure, whichever is greater, shall not exceed 125 psi.
- f. Ductile iron pipe is required by County of Maui WSS and is recommended for this project. The design pressures for ductile iron pipe are as follows:
  - i. Maximum design working pressure = 250 psi
  - ii. Maximum desirable working pressure = 125 psi
  - iii. Maximum expected working pressure = 150 psi
- g. The working pressure for distribution mains servicing residences:
  - i. Maximum = 125 psi
  - ii. Minimum = 40 psi
- h. In-line Pālāwai's for distribution mains are required where pressure exceeds 125 psi.
- i. Cleanouts are required at the end of all transmission and distribution waterlines.
- j. Sampling spigots: For collection of water samples to determine water quality at dead ends of pipeline.

**5. RESERVOIR CAPACITY**

- a. Meet maximum day consumption. Reservoir fills at the beginning of the 24-hour period with no source input to the reservoir.
- b. Meet maximum day consumption plus fire flow for duration of fire. Reservoir ¾-full, with credit for incoming flow from pumps.
- c. Minimum reservoir size shall be 100,000 gallons.
- d. Where there are two or more reservoir serving the same system, the design shall be made on the basis of combined protection by all facilities available.

**6. PUMP CAPACITY**

- a. Meet maximum day demand with an operating time of 16 hours simultaneously with maximum fire flow required independent of the reservoir. The standby unit may be used to determine the total flow required.
- b. Meet maximum day demand during the duration of the fire plus fire demand less ¾ of reservoir storage.
- c. Meet maximum day demand with an operating time of 16 hours with the largest pumping unit considered out of service.

**VI. INDUSTRIAL PARK WATER DEMAND**

1. The Industrial Park's incremental or new estimated water demand on Mānele Bay Water System (PWS 238) is 159,625 gpd.
2. The estimated water demand on Mānele Bay Water System (PWS 238) for the full build out of the Industrial Park is 163,125 gpd.
3. The projected average day demand for the Mānele Bay Water System (PWS 238), including full build out of the Industrial Park and existing demands serviced by the Mānele Bay Water System (PWS 238), is 592,625 gpd. (See **Exhibit 3: Existing and Projected Water Flow Summation, Exhibit 4: Water Demand Map for Mānele Bay Water System (PWS 238)**).
4. The existing system does not meet the WSS criteria for pipe sizing based on the maximum static pressure shall not exceed 125 psi. The system does meet the WSS criteria to have a maximum of 2,000 gpm for Fire Flow plus Maximum Daily flow for Light Industry and 2,500 gpm for Fire Flow plus Maximum Daily flow for Heavy Industry with a maximum velocity of 10 feet per second for Light and Heavy Industrial Uses. The system also meets the criteria for the Peak Hour flow with a minimum residual pressure of 20 psi.
5. **Exhibit 5: Existing Mānele Bay Water System (PWS 238) Nodal Map** shows the overall water system facilities and nodal map.

**VII. PROPOSED SAFE DRINKING WATER SYSTEM (BASED ON LAND USE/ZONING)**

1. **WATER SOURCE**

- a. In accordance with the WSS, available source capacity is governed by the well with the smallest pumping unit. Well No. 2 has an existing pump capacity of 500 gpm. Well No. 4 has a pump capacity of 900 gpm. Since Well No. 2 has the smaller pump capacity, available source capacity for the Mānele Bay Water System (PWS 238) is governed by Well No. 2, which has an average day pumping capacity of 320,000 gpd, which is equivalent to a maximum day pumping capacity of 480,000 gpd. The current average daily water usage of the Mānele Bay Water System (PWS 238) is 433,000 gpd. The full build out of the Industrial Park is anticipated to add an incremental demand of 159,625 gpd to the Mānele Bay Water System (PWS 238), resulting in a total demand of 163,125 gpd for the Industrial Park on the Mānele Bay Water System (PWS 238). Since there are no definite plans to utilize the full amount of water in these estimations, the actual water use may be lower than anticipated.

b. Well Pump Sizing - Mānele Bay Water System (PWS 238)

- i. Existing PWS 238 average day capacity = 320,000 gpd  
Existing PWS 238 maximum day capacity = 480,000 gpd
  - ii. PWS 238 with Full Buildout of Industrial Park average day demand = 592,625 gpd  
PWS 238 with Full Buildout of Industrial Park maximum day demand = 888,937 gpd
  - iii. Additional average day capacity required = 272,625 gpd  
Additional maximum day capacity required = 408,937 gpd
- $408,937 \text{ gallons} / 16 \text{ hours} / 60 \text{ min} = 426 \text{ gpm}$   
 $\text{Additional required pump capacity} = 426 \text{ gpm}$
- Full Buildout of the Industrial Park will require increasing the existing well pump, the development of a new well, or multiple wells with an additional total minimum total capacity of 426 gpm.

b. Source Options

The Lāna'i Water Use and Development Plan (WUDP) discusses the following options for development of to meet future water demand requirements:

- i. Drilling a new source or multiple sources to obtain a total minimum pump capacity of 426 gpm.
- ii. Installing a permanent interconnection with the Lāna'i City System. This will require a separate analysis for possible interconnection.
- iii. Well 7 is currently in the permitting process for another project in Lāna'i City to bring online (See **Exhibit 2: Existing Mānele Bay Water System (PWS 238)**). Recommissioning the well will provide reliability for both the Lāna'i City system and the Irrigation Grid.

2. **RESERVOIR CAPACITY**

- a. Case A: Meet maximum day demand in 24-hours  
Capacity required = 888,937 gallons

Case B: Meet maximum day + fire flow, reservoir ¾ full  
 Max day rate = 888,937 gpd  
 Fire flow = 2,500 gpm  
 Smallest pump capacity = 500 gpm

Max day rate + fire flow – smallest pump for 120 minutes  
 = 888,937 gpd + 2,500 gpm x 120 min  
 = 1,188,937 gallons

Size required = 1,188,937 gallons \* 1.25 = 1,486,171 gallons

Case B governs:

Minimum Reservoir Capacity = 1,486,171 gallons

Existing Reservoir Capacity = 1,500,000 gallons

**Therefore, existing reservoir capacity is adequate for full buildout.**

3. **TRANSMISSION/DISTRIBUTION MAINS**

- a. Offsite Improvements
  - i. Option 1. The existing water PRV could be lowered to at least acquire an outflow of 55 psi to reach the best possible pressures for the distribution main. If there are

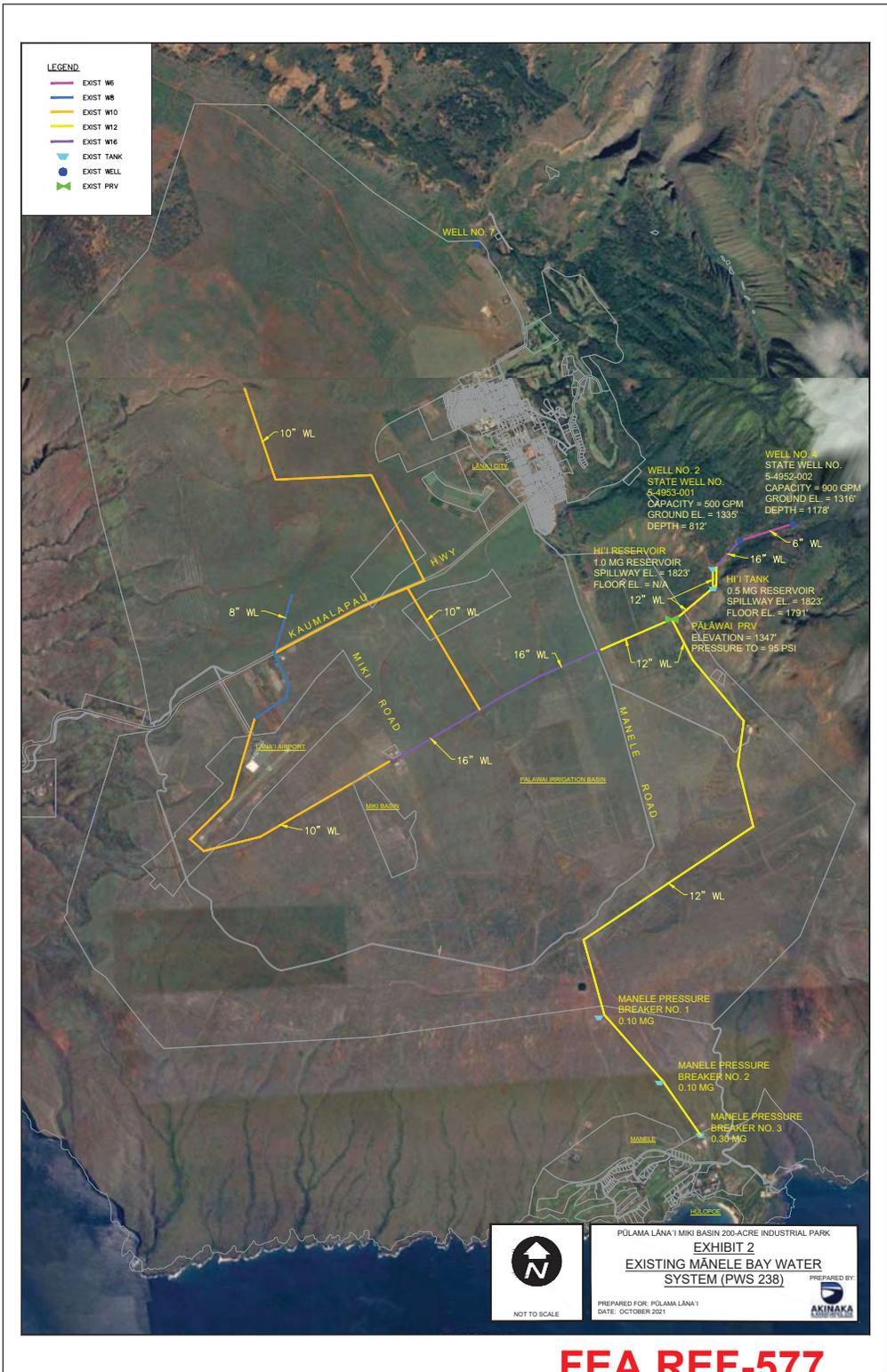
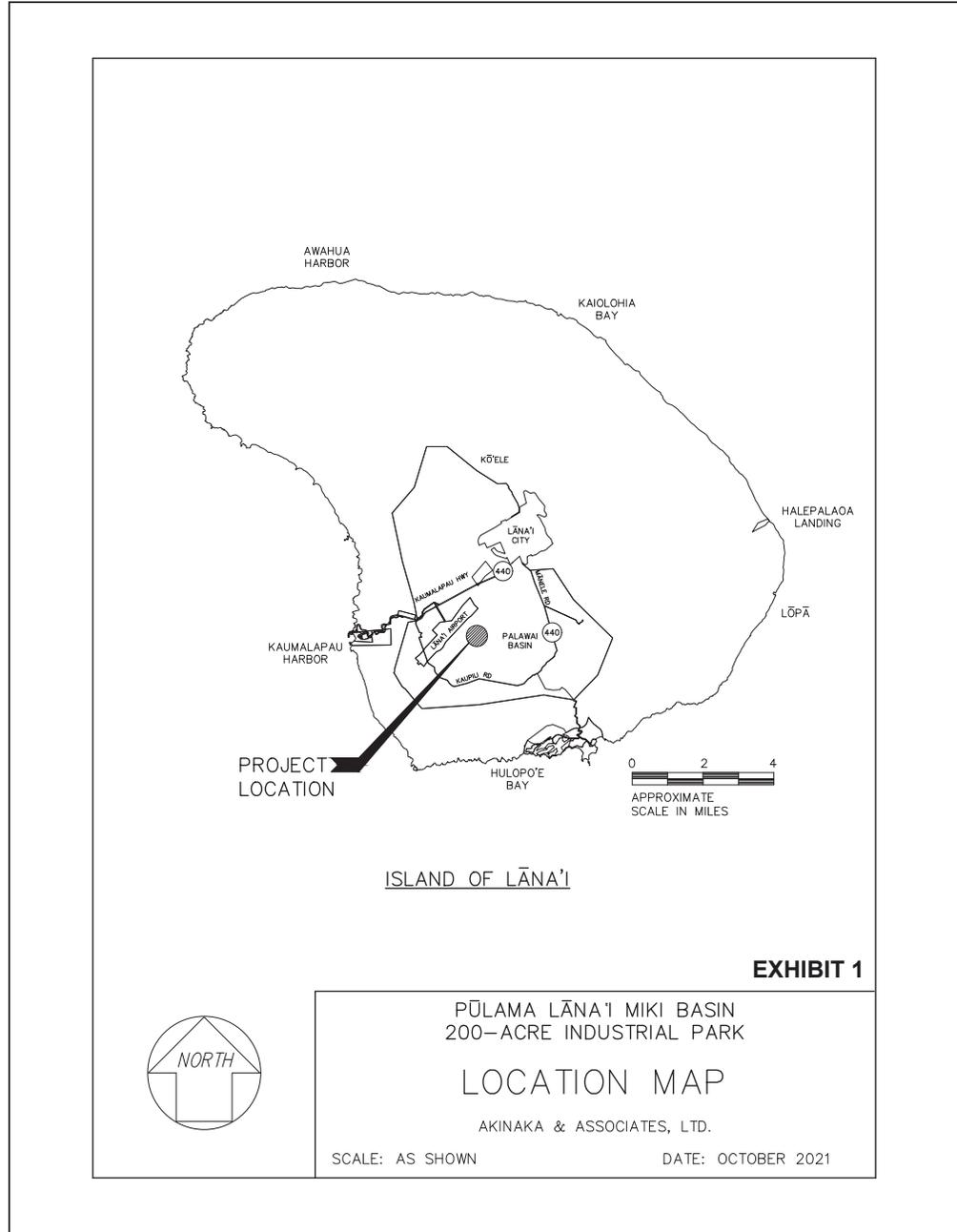
cavitation issues, a new PRV should be installed that has an anti-cavitation trim.

- ii. Option 2. While Lānaʻi Water Company has replaced and has abandoned sections of the Pālāwai Irrigation Grid, there remains sections that are potentially in need of repair, replacement, or possible abandonment. Since the condition and use of these pipes are unknown, those pipes were excluded from this evaluation. A conditional assessment and analysis for those pipes should be conducted separately, but from the water calculations in this water master plan (see **Appendix A1 & A2**), existing pipes will need to be assessed and potentially replaced at high pressures.

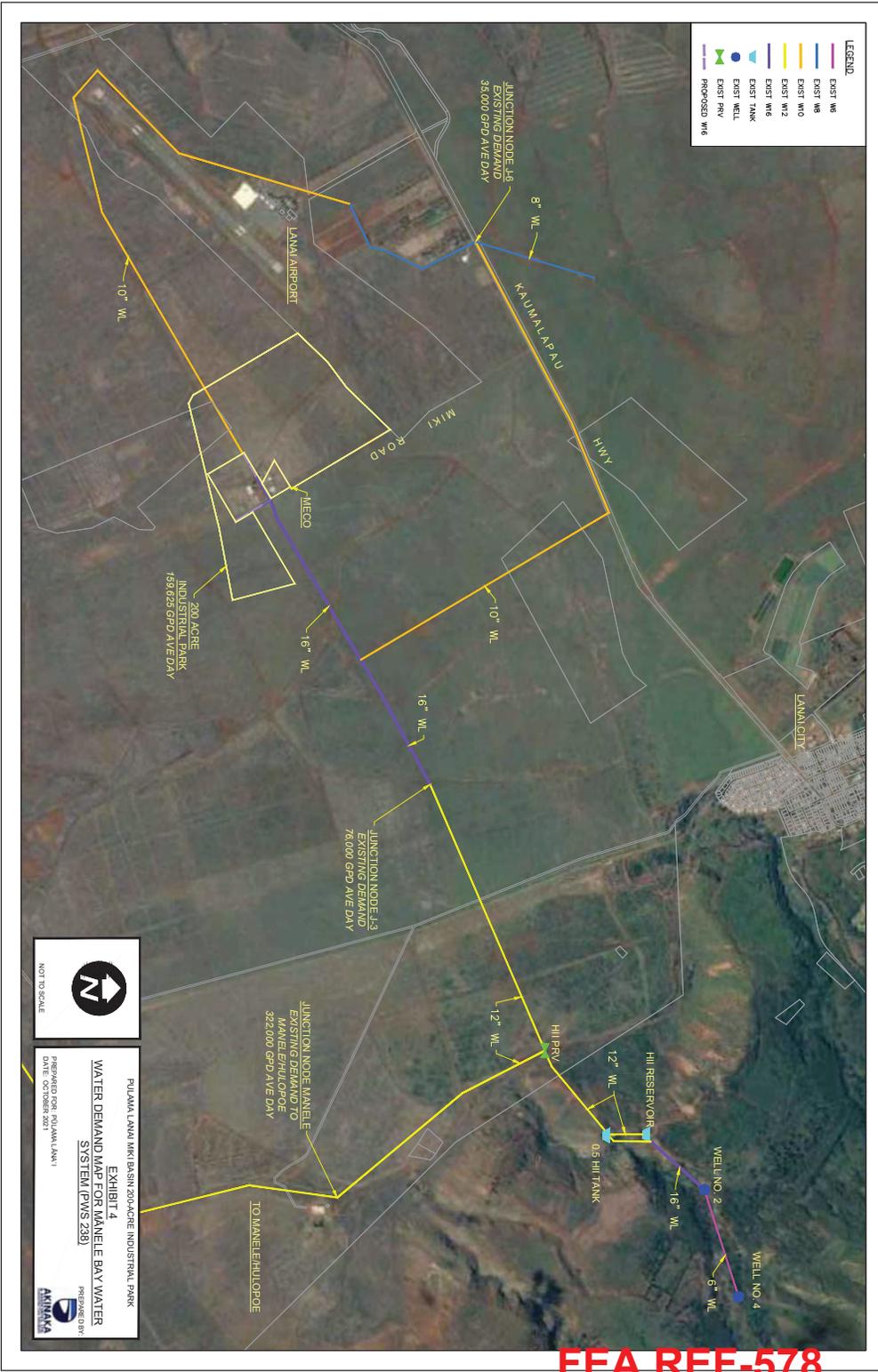
#### **VII. COST CONSIDERATIONS**

Budgetary cost for the water improvements is provided in Appendix B.

# **EXHIBITS**

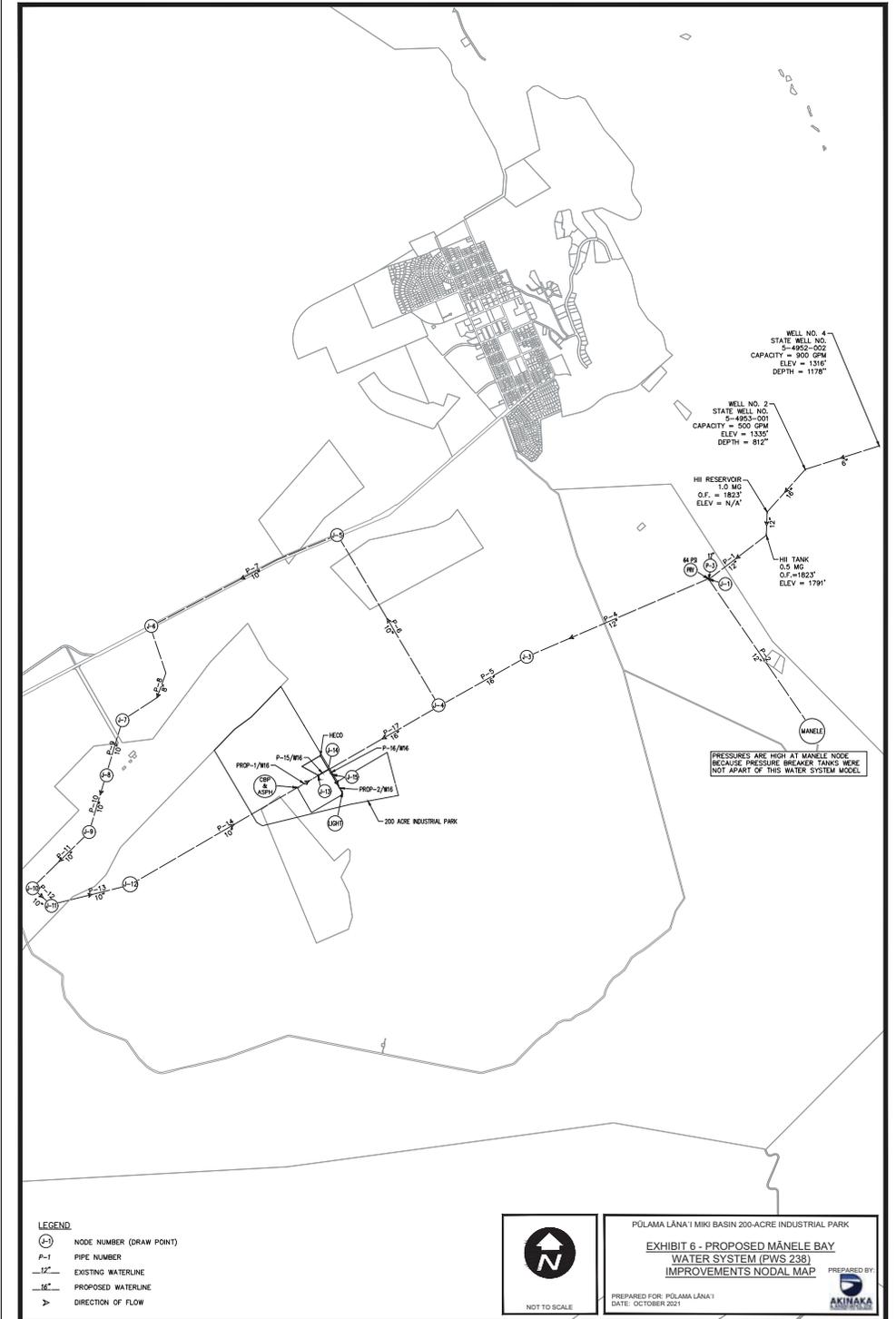
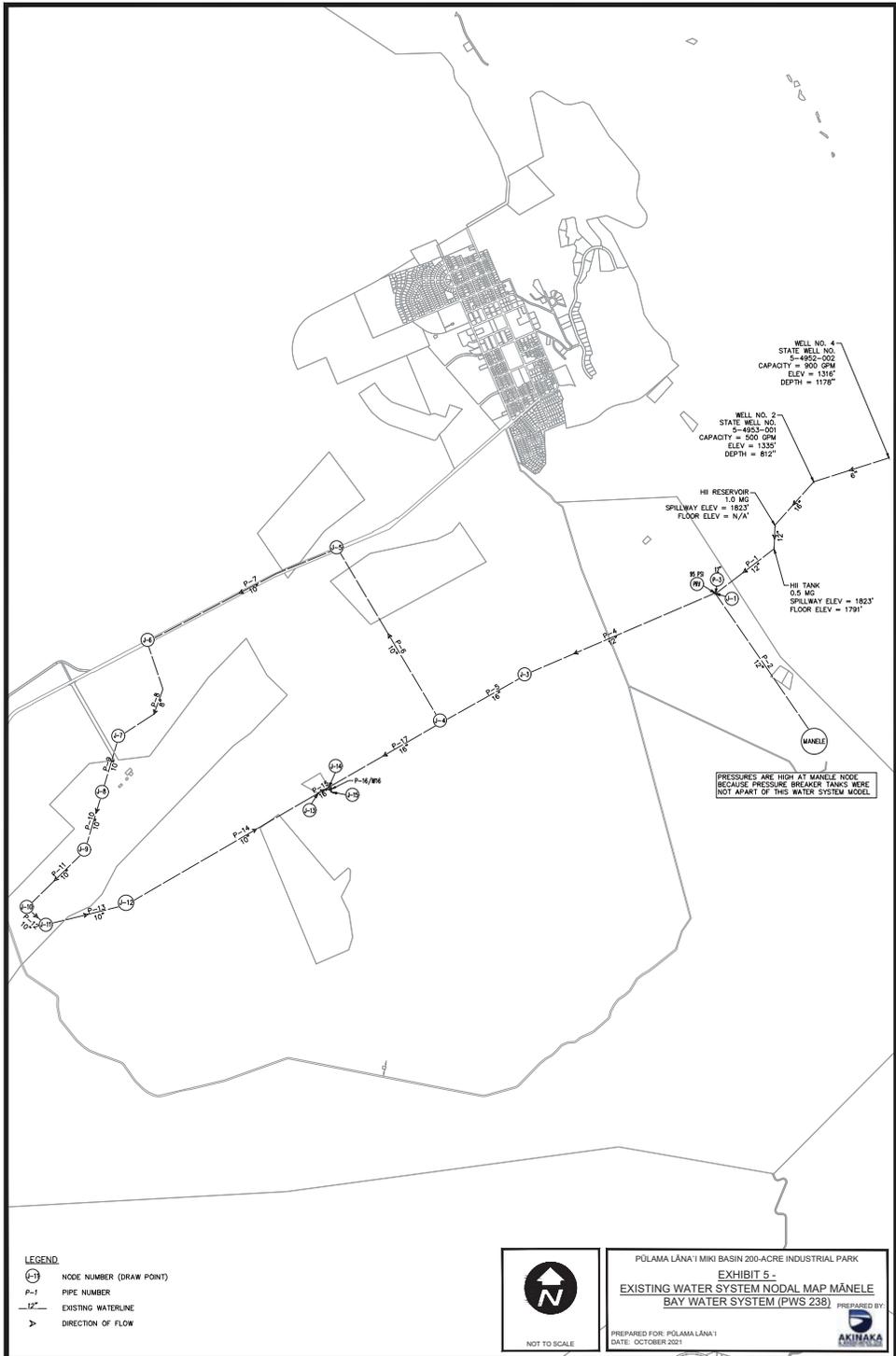


**FEA REF-577**



**EXHIBIT 3: EXISTING AND PROJECTED WATER FLOW SUMMATION**  
**PULAMA LAVA IMIKI BASIN 200 ACRE INDUSTRIAL PARK**  
**OCTOBER 2021**

Point No	Description	Land Use	Proposed Area (ac)	Avg Daily Demand (gal/ac)	Avg Daily Rate (GPD)	Max Day Rate (GPD)	Peak Hour Rate (GPD)	Avg Day Rate (GPM)	Max Day Rate (GPM)	Peak Hour Rate (GPM)
MANELE	Exist Demand		-	-	322,000.00	483,000.00	966,000.00	223.61	335.42	670.83
J-3	Exist Demand		-	-	76,000.00	114,000.00	228,000.00	52.78	79.17	158.33
J-6	Exist Demand		-	-	35,000.00	52,500.00	105,000.00	24.00	36.00	72.00
CBP & ASPH	Concrete Crushing Facility	CBP & Toilet Facility	14.50	-	2,625.00	3,937.50	7,875.00	1.82	2.73	5.47
LIGHT	Other Industrial Uses	Light Industrial	26.00	6,000.00	156,000.00	234,000.00	468,000.00	108.33	162.50	325.00
CBP & ASPH	Asphalt Plant	Asphalt Process	12.50	-	1,000.00	1,500.00	3,000.00	0.69	1.04	2.08
	Renewable Energy Projects		127.00	-	-	-	-	-	-	-
	Infrastructure		200.00	-	-	-	-	-	-	-
	<b>Total</b>		<b>200.00</b>	<b>-</b>	<b>592,625.00</b>	<b>888,937.50</b>	<b>1,777,875.00</b>	<b>411.24</b>	<b>616.86</b>	<b>1,233.72</b>



**PULAMA LĀMAI WĪNI BASIN**  
**200 ACRE INDUSTRIAL PARK**  
**EXISTING PIPES & PRV @ 95 PSI - STATIC**

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-1	2098.00	T-1	J-1	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-2	5145.00	J-1	MANNELE	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	0.00	0.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	0.00	0.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-13	238.00	J-12	J-11	10.00	Ductile Iron	110.00	0.00	0.00	0.00
P-14	6275.00	J-12	J-13	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-15	361.00	J-13	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	0.00	0.00	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
J-1	1347.17	1818.00	204.00	0.00
J-3	1345.73	1566.82	96.00	0.00
J-4	1134.61	1566.82	187.00	0.00
J-5	1350.00	1566.82	94.00	0.00
J-6	1339.00	1566.82	99.00	0.00
J-7	1301.00	1566.82	115.00	0.00
J-8	1287.75	1566.82	121.00	0.00
J-9	1249.00	1566.82	138.00	0.00
J-10	1207.00	1566.82	156.00	0.00
J-11	1223.00	1566.82	124.00	0.00
J-12	1281.00	1566.82	149.00	0.00
J-13	1224.41	1566.82	148.00	0.00
J-14	1221.15	1566.82	150.00	0.00
J-15	1221.91	1566.82	149.00	0.00
MANNELE	1128.00	1818.00	299.00	0.00

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (gpm)	Percent Full (%)
HIT TANK	1791.00	1812.00	1818.00	1823.00	0.50	26.00	0.00	54.50

# APPENDIX A1

## Water Calculations

PŪLAMA LĀNA'I MIKI BASIN 200 ACRE INDUSTRIAL PARK EXISTING PIPES & PRV @ 95 PSI : MAX DAY															
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)		Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	616.86	1.75	0.00		CBP & ASPH	1230.00	1564.46	145.00	3.77
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00		J-1	1347.17	1809.47	200.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	281.44	0.80	0.00		J-3	1345.73	1564.87	95.00	79.17
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	281.44	0.80	0.00		J-4	1134.61	1564.57	186.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	202.27	0.32	0.00		J-5	1350.00	1564.50	93.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	27.95	0.11	0.00		J-6	1339.00	1564.44	98.00	36.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	27.95	0.11	0.00		J-7	1301.00	1564.45	114.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	8.05	0.05	0.00		J-8	1287.75	1564.45	120.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	8.05	0.03	0.00		J-9	1249.00	1564.45	136.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	8.05	0.03	0.00		J-10	1207.00	1564.45	155.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	8.05	0.03	0.00		J-11	1223.00	1564.45	148.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	8.05	0.03	0.00		J-12	1281.00	1564.46	123.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	8.05	0.03	0.00		J-13	1236.46	1564.46	142.00	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	8.05	0.03	0.00		J-14	1239.00	1564.46	141.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	11.82	0.02	0.00		J-15	1250.00	1564.46	136.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00		LIGHT	1255.00	1564.45	134.00	162.50
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	174.32	0.28	0.00		MANELE	1128.00	1799.62	291.00	335.42
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	11.82	0.02	0.00						
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00						

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	616.86	54.50

PŪLAMA LĀNA'I MIKI BASIN 200 ACRE INDUSTRIAL PARK EXISTING PIPES & PRV @ 95 PSI : PEAK HOUR															
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)		Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	1233.71	3.50	0.01		CBP & ASPH	1230.00	1558.30	142.00	7.55
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	670.83	1.90	0.00		J-1	1347.17	1787.22	190.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	562.88	1.60	0.00		J-3	1345.73	1559.76	93.00	158.33
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	562.88	1.60	0.00		J-4	1134.61	1558.67	183.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	404.55	0.65	0.00		J-5	1350.00	1558.44	90.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	55.89	0.23	0.00		J-6	1339.00	1558.20	95.00	72.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	55.89	0.23	0.00		J-7	1301.00	1558.24	111.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	16.11	0.10	0.00		J-8	1287.75	1558.25	117.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	16.11	0.07	0.00		J-9	1249.00	1558.25	134.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	16.11	0.07	0.00		J-10	1207.00	1558.26	152.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	16.11	0.07	0.00		J-11	1223.00	1558.27	145.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	16.11	0.07	0.00		J-12	1281.00	1558.28	120.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	16.11	0.07	0.00		J-13	1236.46	1558.30	139.00	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	16.11	0.07	0.00		J-14	1239.00	1558.30	138.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	23.66	0.04	0.00		J-15	1250.00	1558.28	133.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	325.00	0.52	0.00		LIGHT	1255.00	1558.24	131.00	325.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	348.66	0.56	0.00		MANELE	1128.00	1751.64	270.00	670.83
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	23.66	0.04	0.00						
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	325.00	0.52	0.00						

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hi'i Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	1233.71	54.50

PŪLAMA LĀNA'I MIKI BASIN 200 ACRE INDUSTRIAL PARK EXISTING PIPES & PRV @ 95 PSI : MAX DAY FLOW + FIRE FLOW @ CONCRETE CRUSHING FACILITY & ASPHALT PLANT														
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss (ft/ft)	Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	3116.86	8.84	0.03	CBP & ASPH	1230.00	1375.82	63.00	2503.77
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00	J-1	1347.17	1646.73	130.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2781.44	7.89	0.02	J-3	1345.73	1430.61	37.00	79.17
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2781.44	7.89	0.02	J-4	1134.61	1394.11	112.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2702.27	4.31	0.01	J-5	1350.00	1390.55	18.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	245.17	1.00	0.00	J-6	1339.00	1386.81	21.00	36.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	245.17	1.00	0.00	J-7	1301.00	1382.43	35.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-209.17	1.34	0.00	J-8	1287.75	1381.70	41.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-209.17	0.85	0.00	J-9	1249.00	1380.78	57.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-209.17	0.85	0.00	J-10	1207.00	1379.72	75.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-209.17	0.85	0.00	J-11	1223.00	1379.39	68.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-209.17	0.85	0.00	J-12	1281.00	1378.30	42.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-209.17	0.85	0.00	J-13	1236.46	1378.91	62.00	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-209.17	0.85	0.00	J-14	1239.00	1380.13	61.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	2294.60	3.66	0.00	J-15	1250.00	1380.12	56.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00	LIGHT	1255.00	1380.11	54.00	162.50
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2457.10	3.92	0.00	MANELE	1128.00	1636.88	220.00	335.42
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	2294.60	3.66	0.00					
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00					

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hifi Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	3116.86	54.50

PŪLAMA LĀNA'I MIKI BASIN 200 ACRE INDUSTRIAL PARK EXISTING PIPES & PRV @ 95 PSI : MAX DAY FLOW + FIRE FLOW @ LIGHT INDUSTRIAL PARCEL														
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss (ft/ft)	Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	2616.86	7.42	0.02	CBP & ASPH	1230.00	1437.75	90.00	3.77
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00	J-1	1347.17	1694.11	150.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2281.44	6.47	0.02	J-3	1345.73	1472.46	55.00	79.17
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2281.44	6.47	0.02	J-4	1134.61	1447.46	135.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2202.27	3.51	0.00	J-5	1350.00	1445.44	41.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	180.84	0.74	0.00	J-6	1339.00	1443.31	45.00	36.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	180.84	0.74	0.00	J-7	1301.00	1441.09	61.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-144.84	0.92	0.00	J-8	1287.75	1440.73	66.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-144.84	0.59	0.00	J-9	1249.00	1440.26	83.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-144.84	0.59	0.00	J-10	1207.00	1439.72	101.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-144.84	0.59	0.00	J-11	1223.00	1439.55	94.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-144.84	0.59	0.00	J-12	1281.00	1439.00	68.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-144.84	0.59	0.00	J-13	1236.46	1437.73	87.00	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-144.84	0.59	0.00	J-14	1239.00	1437.72	86.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	-141.07	0.23	0.00	J-15	1250.00	1437.21	81.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	2162.50	3.45	0.00	LIGHT	1255.00	1435.82	78.00	2162.50
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2021.43	3.23	0.00	MANELE	1128.00	1684.25	241.00	335.42
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	-141.07	0.23	0.00					
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	2162.50	3.45	0.00					

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hifi Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	2616.86	54.50

PULAMA LĀMAI WAIKI BASIN  
200 ACRE INDUSTRIAL PARK  
PROPOSED PRV @ 55 PSI - STATIC

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2098.00	T-1	J-1	12.00	Ductile Iron	110.00	0.00	0.00	0.00	1230.00	1474.34	106.00	0.00
P-2	5145.00	J-1	MANILE	12.00	Ductile Iron	110.00	0.00	0.00	0.00	1347.17	1818.00	204.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	0.00	0.00	0.00	1345.73	1474.34	56.00	0.00
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	0.00	0.00	0.00	1350.00	1474.34	54.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	0.00	0.00	0.00	1399.00	1474.34	59.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1301.00	1474.34	75.00	0.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1287.75	1474.34	81.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	0.00	0.00	0.00	1249.00	1474.34	97.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1207.00	1474.34	116.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1223.00	1474.34	109.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1281.00	1474.34	84.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1236.46	1474.34	103.00	0.00
P-13	2388.00	J-12	J-11	10.00	Ductile Iron	110.00	0.00	0.00	0.00	1259.00	1474.34	102.00	0.00
P-14	5359.00	CBP	J-12	16.00	Ductile Iron	120.00	0.00	0.00	0.00	1255.00	1474.34	97.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	0.00	0.00	0.00	1255.00	1474.34	97.00	0.00
P-16	170.00	J-14	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00	1255.00	1474.34	97.00	0.00
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	0.00	0.00	0.00	1128.00	1818.00	299.00	0.00
PROP-1	916.00	J-13	CBP	16.00	Ductile Iron	120.00	0.00	0.00	0.00				
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	0.00	0.00	0.00				

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
H/I Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	0.00	54.50

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP	1230.00	1474.34	106.00	0.00
J-1	1347.17	1818.00	204.00	0.00
J-3	1345.73	1474.34	56.00	0.00
J-4	1134.61	1474.34	147.00	0.00
J-5	1350.00	1474.34	54.00	0.00
J-6	1399.00	1474.34	59.00	0.00
J-7	1301.00	1474.34	75.00	0.00
J-8	1287.75	1474.34	81.00	0.00
J-9	1249.00	1474.34	97.00	0.00
J-10	1207.00	1474.34	116.00	0.00
J-11	1223.00	1474.34	109.00	0.00
J-12	1281.00	1474.34	84.00	0.00
J-13	1236.46	1474.34	103.00	0.00
J-14	1259.00	1474.34	102.00	0.00
J-15	1255.00	1474.34	97.00	0.00
MANILE	1128.00	1818.00	299.00	0.00

# APPENDIX A2

## Water Calculations – Adjusted PRV

PŪLAMA LĀNA'Ī MIKI BASIN 200 ACRE INDUSTRIAL PARK PROPOSED PRV @ 55 PSI : MAX DAY										
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	616.86	1.75	0.00	
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00	
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	281.44	0.80	0.00	
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	281.44	0.80	0.00	
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	202.27	0.32	0.00	
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	27.95	0.11	0.00	
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	27.95	0.11	0.00	
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	8.05	0.05	0.00	
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	8.05	0.03	0.00	
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	8.05	0.03	0.00	
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	8.05	0.03	0.00	
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	8.05	0.03	0.00	
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	8.05	0.03	0.00	
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	8.05	0.03	0.00	
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	11.82	0.02	0.00	
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00	
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	174.32	0.28	0.00	
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	11.82	0.02	0.00	
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00	

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1471.98	105.00	3.77
J-1	1347.17	1809.47	200.00	0.00
J-3	1345.73	1472.38	55.00	79.17
J-4	1134.61	1472.08	146.00	0.00
J-5	1350.00	1472.02	53.00	0.00
J-6	1339.00	1471.95	58.00	36.00
J-7	1301.00	1471.96	74.00	0.00
J-8	1287.75	1471.96	80.00	0.00
J-9	1249.00	1471.96	96.00	0.00
J-10	1207.00	1471.97	115.00	0.00
J-11	1223.00	1471.97	108.00	0.00
J-12	1281.00	1471.97	83.00	0.00
J-13	1236.46	1471.98	102.00	0.00
J-14	1239.00	1471.98	101.00	0.00
J-15	1250.00	1471.97	96.00	0.00
LIGHT	1255.00	1471.96	94.00	162.50
MANELE	1128.00	1799.62	291.00	335.42

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hifi Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	616.86	54.50

PŪLAMA LĀNA'Ī MIKI BASIN 200 ACRE INDUSTRIAL PARK PROPOSED PRV @ 55 PSI : PEAK HOUR										
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	1233.71	3.50	0.01	
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	670.83	1.90	0.00	
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	562.88	1.60	0.00	
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	562.88	1.60	0.00	
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	404.55	0.65	0.00	
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	55.89	0.23	0.00	
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	55.89	0.23	0.00	
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	16.11	0.10	0.00	
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	16.11	0.07	0.00	
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	16.11	0.07	0.00	
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	16.11	0.07	0.00	
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	16.11	0.07	0.00	
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	16.11	0.07	0.00	
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	16.11	0.07	0.00	
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	23.66	0.04	0.00	
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	325.00	0.52	0.00	
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	348.66	0.56	0.00	
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	23.66	0.04	0.00	
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	325.00	0.52	0.00	

Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
CBP & ASPH	1230.00	1465.81	102.00	7.55
J-1	1347.17	1787.22	190.00	0.00
J-3	1345.73	1467.27	53.00	158.33
J-4	1134.61	1466.19	143.00	0.00
J-5	1350.00	1465.96	50.00	0.00
J-6	1339.00	1465.72	55.00	72.00
J-7	1301.00	1465.75	71.00	0.00
J-8	1287.75	1465.76	77.00	0.00
J-9	1249.00	1465.77	94.00	0.00
J-10	1207.00	1465.78	112.00	0.00
J-11	1223.00	1465.78	105.00	0.00
J-12	1281.00	1465.79	80.00	0.00
J-13	1236.46	1465.81	99.00	0.00
J-14	1239.00	1465.81	98.00	0.00
J-15	1250.00	1465.80	93.00	0.00
LIGHT	1255.00	1465.76	91.00	325.00
MANELE	1128.00	1751.64	270.00	670.83

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hifi Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	1233.71	54.50

PŪLAMA LĀNA'Ī MIKI BASIN 200 ACRE INDUSTRIAL PARK PROPOSED PRV @ 55 PSI : MAX DAY FLOW + FIRE FLOW @ CONCRETE CRUSHING FACILITY & ASPHALT PLANT															
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss (ft/ft)		Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	3116.86	8.84	0.03		CBP & ASPH	1230.00	1283.34	23.00	2503.77
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00		J-1	1347.17	1646.73	130.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2781.44	7.89	0.02		J-3	1345.73	1338.13	-3.00	79.17
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2781.44	7.89	0.02		J-4	1134.61	1301.62	72.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2702.27	4.31	0.01		J-5	1350.00	1298.06	-22.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	245.17	1.00	0.00		J-6	1339.00	1294.32	-19.00	36.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	245.17	1.00	0.00		J-7	1301.00	1289.94	-5.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-209.17	1.34	0.00		J-8	1287.75	1289.22	1.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-209.17	0.85	0.00		J-9	1249.00	1288.30	17.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-209.17	0.85	0.00		J-10	1207.00	1287.23	35.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-209.17	0.85	0.00		J-11	1223.00	1286.90	28.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-209.17	0.85	0.00		J-12	1281.00	1285.82	2.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-209.17	0.85	0.00		J-13	1236.46	1286.42	22.00	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-209.17	0.85	0.00		J-14	1239.00	1287.64	21.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	2294.60	3.66	0.00		J-15	1250.00	1287.64	16.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	162.50	0.26	0.00		LIGHT	1255.00	1287.62	14.00	162.50
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2457.10	3.92	0.00		MANELE	1128.00	1636.88	220.00	335.42
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	2294.60	3.66	0.00						
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	162.50	0.26	0.00						

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hifi Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	3143.50	54.50

PŪLAMA LĀNA'Ī MIKI BASIN 200 ACRE INDUSTRIAL PARK PROPOSED PRV @ 55 PSI : MAX DAY FLOW + FIRE FLOW @ LIGHT INDUSTRIAL PARCEL															
Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Headloss (ft/ft)		Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)	Demand (gpm)
P-1	2088.00	T-1	J-1	12.00	Ductile Iron	110.00	2616.86	7.42	0.02		CBP & ASPH	1230.00	1345.26	50.00	3.77
P-2	5145.00	J-1	MANELE	12.00	Ductile Iron	110.00	335.42	0.95	0.00		J-1	1347.17	1694.11	150.00	0.00
P-3	11.00	J-1	PRV	12.00	Ductile Iron	110.00	2281.44	6.47	0.02		J-3	1345.73	1379.97	15.00	79.17
P-4	5931.00	PRV	J-3	12.00	Ductile Iron	110.00	2281.44	6.47	0.02		J-4	1134.61	1354.98	95.00	0.00
P-5	2675.00	J-3	J-4	16.00	Ductile Iron	120.00	2202.27	3.51	0.00		J-5	1350.00	1352.95	1.00	0.00
P-6	5732.00	J-4	J-5	10.00	Ductile Iron	110.00	180.84	0.74	0.00		J-6	1339.00	1350.83	5.00	36.00
P-7	6012.00	J-5	J-6	10.00	Ductile Iron	110.00	180.84	0.74	0.00		J-7	1301.00	1348.61	21.00	0.00
P-8	3194.00	J-7	J-6	8.00	Ductile Iron	110.00	-144.84	0.92	0.00		J-8	1287.75	1348.24	26.00	0.00
P-9	1561.00	J-8	J-7	10.00	Ductile Iron	110.00	-144.84	0.59	0.00		J-9	1249.00	1347.77	43.00	0.00
P-10	1989.00	J-9	J-8	10.00	Ductile Iron	110.00	-144.84	0.59	0.00		J-10	1207.00	1347.24	61.00	0.00
P-11	2294.00	J-10	J-9	10.00	Ductile Iron	110.00	-144.84	0.59	0.00		J-11	1223.00	1347.07	54.00	0.00
P-12	723.00	J-11	J-10	10.00	Ductile Iron	110.00	-144.84	0.59	0.00		J-12	1281.00	1346.52	28.00	0.00
P-13	2338.00	J-12	J-11	10.00	Ductile Iron	110.00	-144.84	0.59	0.00		J-13	1236.46	1345.24	47.00	0.00
P-14	5359.00	CBP & ASPH	J-12	10.00	Ductile Iron	110.00	-144.84	0.59	0.00		J-14	1239.00	1345.24	46.00	0.00
P-15	361.00	J-14	J-13	16.00	Ductile Iron	120.00	-141.07	0.23	0.00		J-15	1250.00	1344.73	41.00	0.00
P-16	170.00	J-14	J-15	16.00	Ductile Iron	120.00	2162.50	3.45	0.00		LIGHT	1255.00	1343.33	38.00	2162.50
P-17	3654.00	J-4	J-14	16.00	Ductile Iron	120.00	2021.43	3.23	0.00		MANELE	1128.00	1684.25	241.00	335.42
PROP-1	916.00	J-13	CBP & ASPH	16.00	Ductile Iron	120.00	-141.07	0.23	0.00						
PROP-2	461.00	J-15	LIGHT	16.00	Ductile Iron	120.00	2162.50	3.45	0.00						

Label	Elevation (Base) (ft)	Elevation (Min) (ft)	Hydraulic Grade (ft)	Elevation (Max) (ft)	Volume (MG)	Diameter (ft)	Flow (Out) (gpm)	Percent Full (%)
Hifi Tank	1791.00	1812.00	1818.00	1823.00	0.50	26.00	2643.50	54.50

# APPENDIX B

## 0% Design Construction Costs

PULAMA LANAI MIKI BASIN - OCTOBER 2021 200 ACRE INDUSTRIAL PARK 0% DESIGN CONSTRUCTION COSTS FOR PROPOSED WATER IMPROVEMENTS				
ITEM	APPROX QTY	UNIT	UNIT PRICE	AMOUNT
<b>OFFSITE IMPROVEMENTS</b>				
<b>New Well:</b>				
Well Studies, including environmental and hydrologic studies for siting exploratory well		Lump Sum	Lump Sum	\$ 250,000.00
Exploratory Well, including siting, drilling and testing	1	Each	Each	\$ 1,000,000.00
Well Construction, including reaming of exploratory well, drilling, installation of casing and pump installation	1	Each	Each	\$ 2,300,000.00
<b>PRV Replacement:</b>				
Replacement and installation of 12" Cla-val Model 90-01 Pressure Reducing Valve with Anti-Cavitation SST Trim and 150lb Flanged End connections, epoxy coated, opening speed control, valve position indicator and gauges	1	Each	Each	\$ 55,000.00
*TOTAL OFFSITE IMPROVEMENTS AND CONTINGENCY (20%)				\$ 4,326,000.00
*Not included in this estimate is the piping cost from a new well to the existing piping and/or existing tank or reservoir. Once the new well is sited, an estimate can be provided based on the distance.				
<b>ONSITE IMPROVEMENTS</b>				
16-inch water line along Miki Road within the parcel, including trench excavation, cushion and backfill, fittings and connections to existing water lines	450	LF	\$ 200.00	\$ 90,000.00
16-inch water line along Road A, including trench excavation, cushion and backfill, fittings and connections to existing water lines	1,050	LF	\$ 200.00	\$ 210,000.00
CONTINGENCY (20%)				\$ 60,000.00
TOTAL ONSITE IMPROVEMENTS				\$ 360,000.00



**NEW WELL SUPPLY  
ALTERNATIVES FOR  
THE MANELE BAY  
WATER SYSTEM,  
PUBLIC WATER  
SYSTEM NO. 238**

**APPENDIX  
H-2**

New Well Supply Alternatives  
for the Manele Bay Water System,  
Public Water System No. 238

*Prepared for:*

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Revised October 2021  
August 2021

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## Introduction

Pulama Lanai proposes to develop a 200-acre industrial subdivision in Miki Basin. The subdivision site is next to the airport and in the service area of the Manele Bay System, identified as Public Water System (PWS) No. 238. At present, PWS No. 238 is supplied by Well 2 (State No. 4953-001) and by Well 4 (State No. 4952-002). The October 2021 Water Master Plan prepared by Akinaka & Associates, Ltd. determined that the pumping capacities of these two wells are not sufficient to supply current users and the proposed industrial subdivision. Although there is connection between the Lanai City (PWS No. 237) and Manele Bay systems, it is just a back-up for emergencies. The Akinaka report concluded that new well supply for the Manele Bay System of at least 426 gallons per minute (GPM) capacity will be required. This report evaluates alternatives to provide this new well supply.

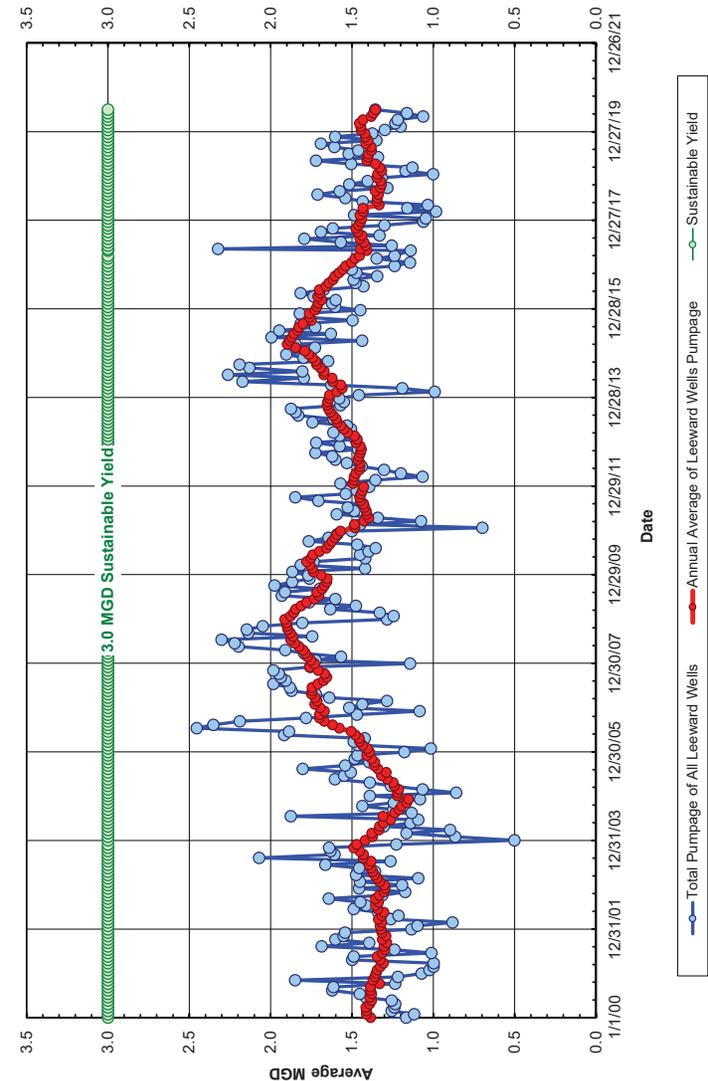
## Basic Considerations in the Identification of Well Development Alternatives

Available Supply in the Leeward Aquifer System. As a practical matter of geography, a new well for PWS No. 238 would be located in the Leeward Aquifer System (No. 50102). The Commission on Water Resource Management (CWRM) has set the sustainable yield for this Aquifer at 3.0 million gallons per day (MGD). All of the presently active wells, with the single exception of Well 6 (State No. 5054-002), are located in and are pumping from the Leeward Aquifer system. Figure 1 depicts the combined pumpage of these wells over the last 20 years in comparison to the 3.0 MGD sustainable yield limit. The sustainable yield is expressed as the moving annual average. That average is shown as the bold red line on Figure 1. It reached a peak of 1.9 MGD in December 2008 and again in March 2015 and has been less than 1.5 MGD since early 2017. Based on this data, it can be concluded that the planned addition of Well 7 (State No. 5055-001) in PWS No. 237 and a new well in PWS No. 238 to supply the Miki industrial subdivision can both be readily accommodated within the Leeward Aquifer System's 3.0 MGD sustainable yield.

Well Installed Pumping Capacity Versus its Long-Term Sustainable Supply. Without exception, the following aspects of well performance apply to all presently active and planned pumping wells. First, all of these wells tap into separate high-level groundwater compartments. No two wells draw from the same groundwater compartment. Second, the long-term sustainable supply of each of these compartments is less than the well's installed pump capacity if the pump were to be operated continuously. Third, based on the available storage in each of these groundwater compartments, the well pumps can be operated for extended periods in excess of the compartment's long-term sustainable supply as long as the pumping is then cut back to allow recharge to recover the depletion in storage. Fourth and finally, the long-term sustainable supply of a compartment can only be accurately determined by the response of its water level to pumping over an extended period. As such, determination of the long-term sustainable supply of any well must rely on the available pumping and water level data in Anderson & Kelly (1985) from the start of use of the wells in the 1950s through 1984 and on the Lanai Water Company's Periodic Water Reports for the pumping and water level data since that time. Up through December 1988, pumpage and water levels were reported as monthly amounts. Starting in January 1988, reporting has been at 28-day intervals.

Sustainable Supplies of Wells 2 and 4, the Current Sources of Supply for PWS No. 238. Wells 2 and 4 were drilled in 1946 and 1950, respectively. Anderson & Kelly (1985) provides pumpage and water level data starting in 1948 for Well 2 and in 1950 for Well 4. For Well 2 up to July 2012, the pump was located on the floor of the inclined access tunnel to Shaft 3 at an elevation of about 1505 feet. A decision was then made to shut down use of Shaft 3 and the cart used for access up and down the inclined shaft

Figure 1. Combined Pumpage of Wells in the Leeward High Level Aquifer from January 2000 to June 2020



and move the pump for Well 2 to the ground surface at the location where the well was originally drilled at an elevation of 1905 feet.

As a new pump for Well 2 would be required for this change, a pump test of the well was run in October 2015 to determine the appropriate capacity of the new pump. At an average pumping rate of 904 GPM, the drawdown was substantial and did not stabilize by the end of the 61-hour test (Figure 2). Based on the results of this test, a 500 GPM capacity pump was selected and installed. The well was put back into service in December 2017. Its use since then has averaged about 0.20 MGD with only a modest impact on its water level (Figure 3). Based on this record, the well's long-term sustainable supply appears to be about 0.3 MGD. It should be noted that the 2011 Water Use and Development Plan for Lanai states that Well 2 could be outfitted with a pump of up to 1200 GPM capacity. If this was actually the case, the lease expensive alternative for new supply would simply be to remove the 500 GPM pump now in the well and replace it with one of at least 426 GPM capacity. Very clearly based on the October 2015 pump test results, this is not a viable option. However, some discussion of pump capacity to provide some perspective is warranted:

- The basis for the reported capacity of up to 1200 GPM in the Water Use and Development Plant is not known.
- CWRM records prior to the conversion of the well to a 500 GPM pump listed its pump capacity as 1400 GPM.
- There is no way the well itself could sustain a 1400 GPM rate. It would drop the water level precipitously and begin sucking air in a matter of minutes.
- The 1400 GPM listed pump capacity in the CWRM records is likely to be the capacity of the booster pump in the pump room of Shaft 3. It pumped the combined delivery from Well 2 and Shaft 3 up the inclined shaft and on to the Hii storage tank.

Well 4 is outfitted with a 900 GPM (1.3 MGD) pump. Particularly in the post-plantation period, this well has been far and away the most productive of any on Lanai. Based on its performance in this period, its long-term sustainable supply is estimated to be about 0.7 MGD (Figure 4). That puts the combined long-term sustainable supply of Wells 2 and 4 at approximately 1.0 MGD. In contrast, their combined use since Well 2 was put back into service in December 2017 has typically been between 0.4 and 0.5 MGD (Figure 5).

#### Evaluation of Alternatives for New Well Development for Public Water System No. 238

The October 2021 Water Master Plan by Akinaka & Associates, Ltd. determined that new well pumping capacity of at least 426 GPM would need to be installed to supply the full build out and occupancy of the proposed industrial subdivision as well as ongoing uses and commitments. Three alternative well sites have been evaluated to provide that supply. They are: a new well at the site of Lanai Well 5; a new well directly inland of Well 2 and drilled into the groundwater compartment tapped by Shaft 3; and a new well to the northwest of Well 2 and above Hii Flats. Figure 6 shows these three locations. The site for a new well at Well 5 would be about 25 feet from the existing well. The site for a new well drilled into the groundwater tapped by Shaft 3 would be about 400 feet upgradient from Well 2. The third alternative, labeled "Possible Well Site" on Figure 6, is about 2000 feet northwest of Well 2 and at the upper end of a former pineapple field.

Figure 2  
Drawdown as a Function of Duration of Pumping  
During the October 21 to 24, 2015 Pump Test of Lanai Well 2 (Log Scale of Time)

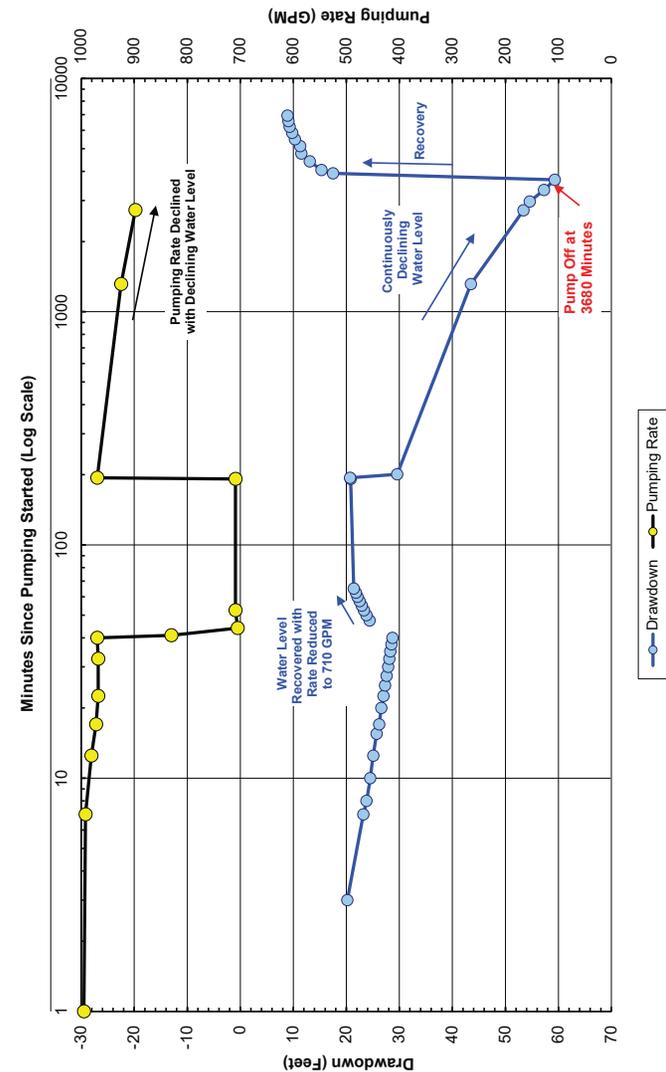


Figure 3  
Pumpage and Water Level Response in Well 2 from December 2017 through August 2021

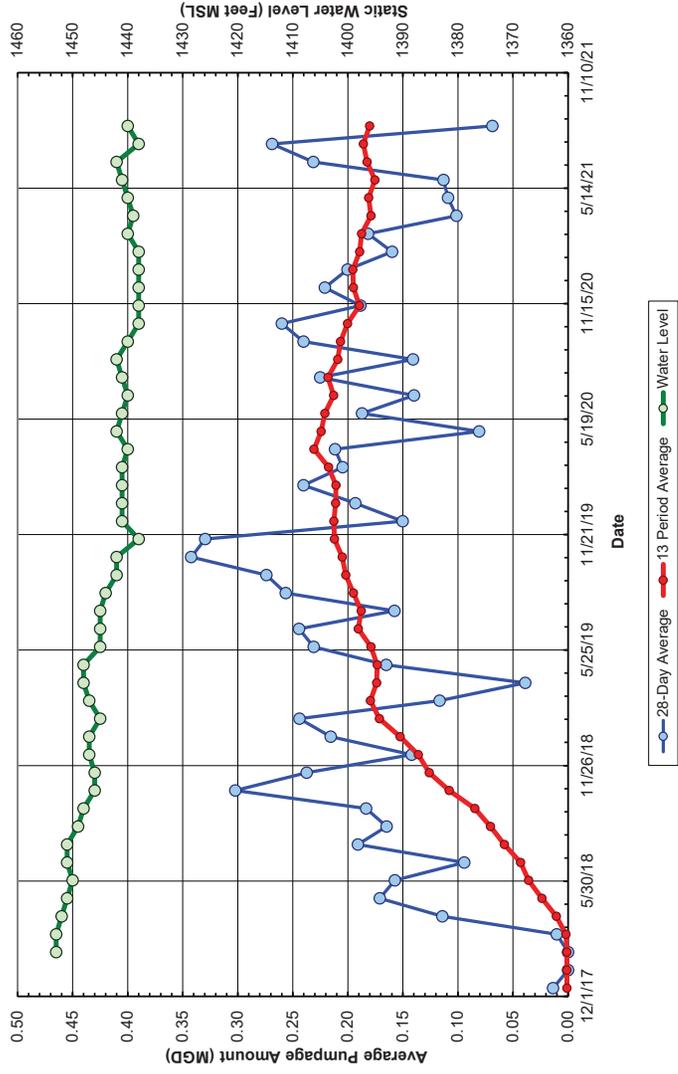


Figure 4  
Pumpage and Water Level Response in Well 4 in the Post-Plantation Period

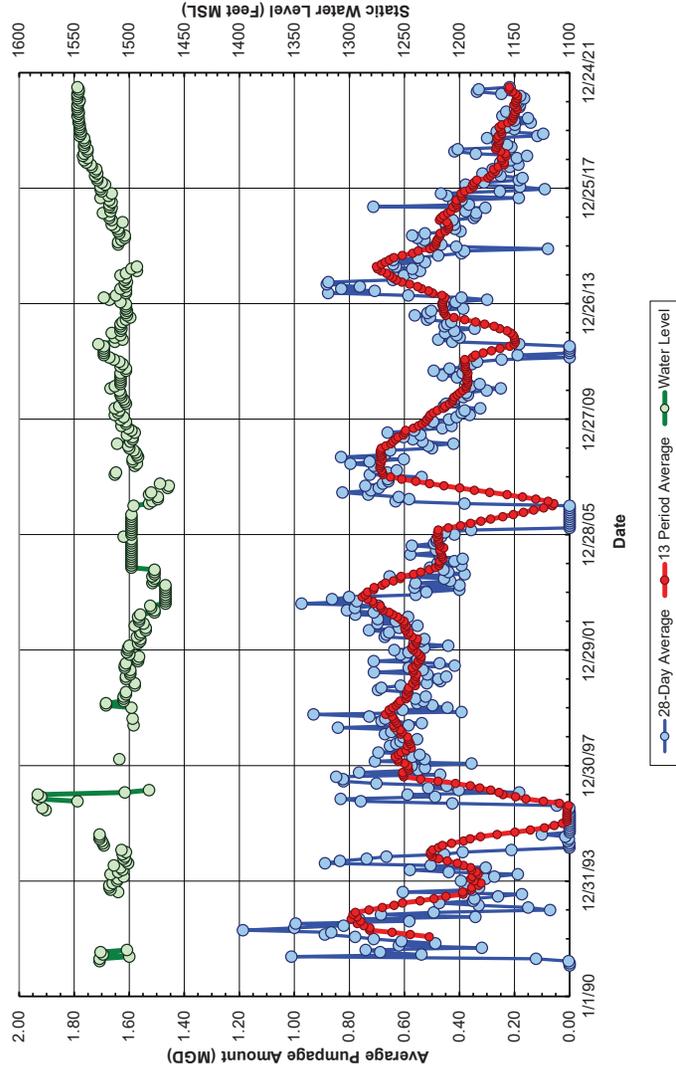
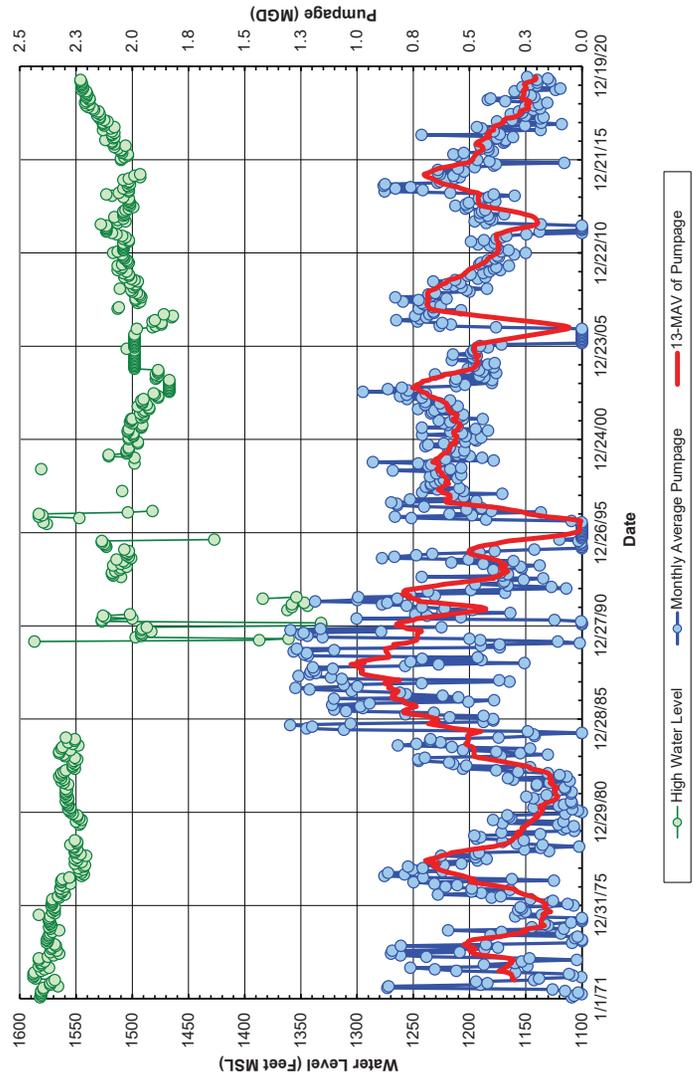


Figure 5  
Water Levels and Pumpage of Lanai Well 4 Since January 1971



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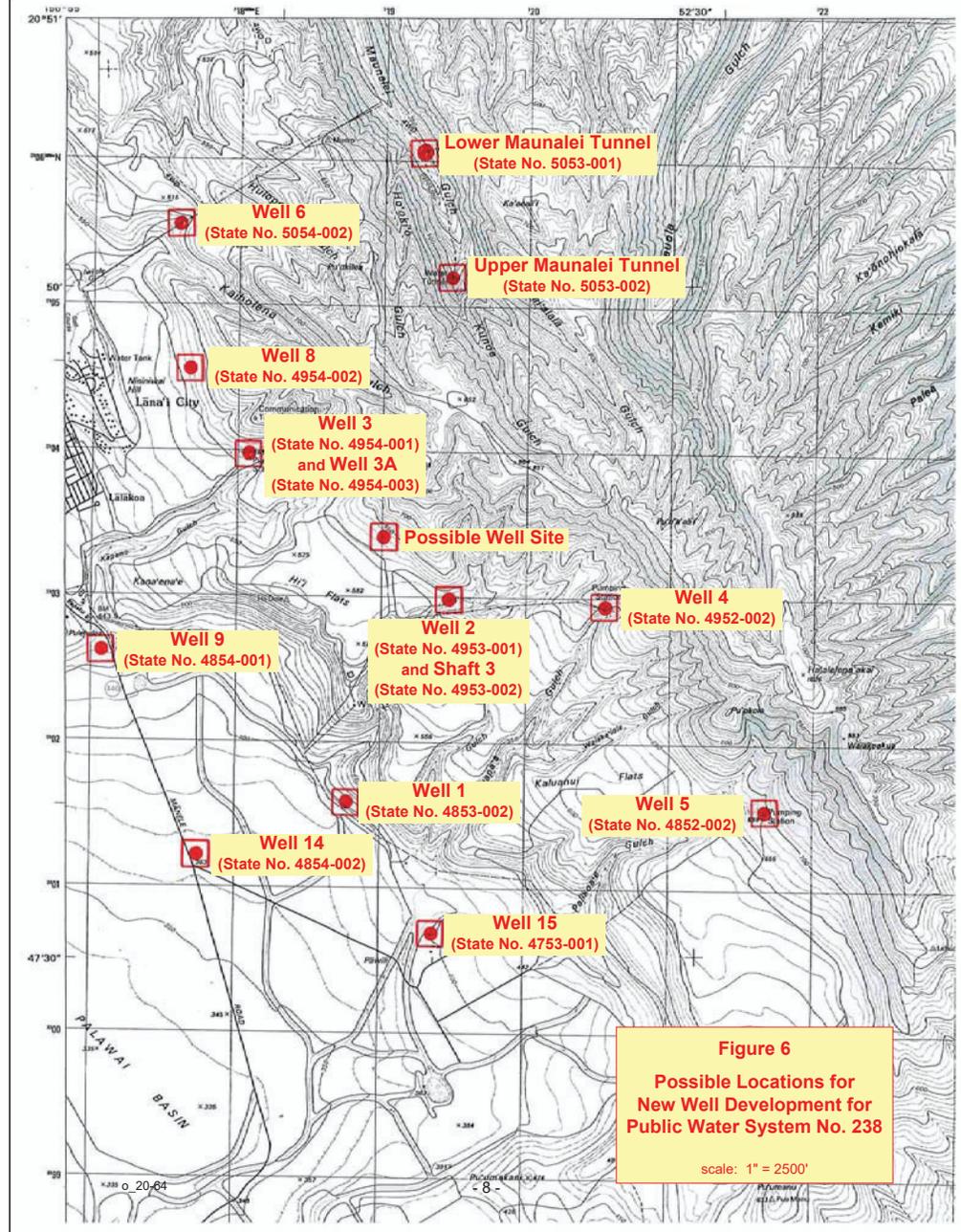


Figure 6  
Possible Locations for  
New Well Development for  
Public Water System No. 238  
scale: 1" = 2500'