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County of Hawai'i
PLANNING DEPARTMENT

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July 18, 2022

Mary Alice Evans, Director
Office of Planning and Sustainable Development
Environmental Review Program
235 S. Beretania Street, Room 702
Honolulu, Hawaii 96813

Dear Ms. Evans,

SUBJECT: **Publication of the Environmental Impact Statement Prep Notice (EISPN) for the Proposed Puna Geothermal Venture Repower Project**
Applicant: **Puna Geothermal Venture**
Location: **Pāhoa, Puna District, Island of Hawai'i, State of Hawai'i**
TMK(s): **(3) 1-4-001:001; (3) 1-4-001:002; (3) 1-4-001:019**

With this letter, the County of Hawai'i Planning Department determines that an Environmental Impact Statement is required, in accordance with Hawai'i Administrative Rules Section 11-200.1-23(a). We hereby transmit this EISPN determination for the Puna Geothermal Venture Repower Project, located in the Puna District, on Hawai'i Island, for publication in the next edition of "The Environmental Notice" on July 23, 2022.

If there are any questions regarding this letter, please contact April Surprenant at (808) 961-8288 or via email at planning@hawaiicounty.gov.

Sincerely,

ZENDO KERN
Planning Director

From: webmaster@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Monday, July 18, 2022 11:29:42 AM

Action Name

Puna Geothermal Venture Repower Project

Type of Document/Determination

Environmental impact statement preparation notice (EISPN)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds

Judicial district

Puna, Hawai‘i

Tax Map Key(s) (TMK(s))

(3) 1-4-001: 001, 002, and 019

Action type

Applicant

Other required permits and approvals

Building Permit (County), Grading Permit (County)

Discretionary consent required

DOH noncovered source permit (for Phase 2, upgrades to 60 MW)

Approving agency

County of Hawaii Planning Department

Agency contact name

April Surprenant

Agency contact email (for info about the action)

planning@hawaiicounty.gov

Email address or URL for receiving comments

planning@hawaiicounty.gov

Agency contact phone

(808) 961-8288

Agency address

101 Pauahi Street
Suite 3
Hilo, Hawaii 96720
United States
Map It

Public Scoping Meeting information
August 17/5:00-8:00pm Pahoa Community Center
Accepting authority
County of Hawaii Planning Department
Applicant
Puna Geothermal Venture
Applicant contact name
Mike Kaleikini
Applicant contact email
mkaleikini@ormat.com
Applicant contact phone
(808) 369-9094
Applicant address
P.O. Box 30 Pahoa, Hawaii 96778 United States Map It
Was this submittal prepared by a consultant?
Yes
Consultant
Stantec Consulting Services Inc.
Consultant contact name
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michele.lefebvre@stantec.com
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(808) 494-2039
Consultant address
P.O. Box 191 Hilo, Hawaii 96721 United States Map It
Action summary
Puna Geothermal Venture is currently authorized for and operating a geothermal power plant in the Puna District and proposes to replace the current 12 operating power-generating units with up to four energy converters. The project would increase the production of renewable energy at the existing facility (within the current site fence line) using new, more efficient units on a smaller land footprint compared to the existing units. The project would increase power production from 38 to 46 megawatts in Phase 1 and

further increase production to 60 megawatts in Phase 2. The overall property size would remain the same. Most of the existing infrastructure and buildings would remain for the Project including administration buildings, the control room, maintenance areas, well pads, and the gathering system. The proposed new units would continue to safely supply reliable power from renewable geothermal resources with more efficient and quieter equipment.

Attached documents (signed agency letter & EA/EIS)

- PGV_EISPN_draft_07182022.pdf
- PD_EISPN_Cover_Letter_to_OPSD_07182022.pdf

Action location map

- PGV_Parcels.zip

Authorized individual

Michele Lefebvre

Authorization

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.

Puna Geothermal Venture Repower Project
Environmental Impact Statement Preparation Notice

Prepared for: County of Hawai‘i Planning Department

July 2022

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Project Information Summary

Project Name:	Geothermal Repower Project
Applicant:	Puna Geothermal Venture P.O. Box 30 Pāhoa, HI 96778 Contact: Mike Kaleikini Phone: 808-369-9094 Email: mkaleikini@ormat.com
Accepting Authority:	County of Hawaii Planning Department Aupuni Center 101 Pauahi Street, Suite 3 Hilo, HI 96720 Phone: 808-961-8288
Planning Consultant:	Stantec Consulting Services Inc. P.O. Box 191 Hilo, HI 96721 Contact: Michele Lefebvre Phone: 808-494-2039 Email: michele.lefebvre@stantec.com
Location:	14-3860 Kapoho-Pāhoa Road Pāhoa, HI 96778
District:	Puna
Tax Map Keys:	(3) 1-4-001: 001, 002, and 019
Land Area:	815 acres
Recorded Fee Owner	Kapoho Land & Development Co. Ltd
Existing Use:	Portions include Puna Geothermal Venture facility, and portions undeveloped
State Land Use District:	State Land Use Agricultural District
Lava Flow Hazard Zone	LF1
Special Management Area:	Not within the Special Management Area
Zoning:	A-10a (Agricultural District, minimum building site of 10 acres)
Flood Zone Designation:	Zone X
Proposed Action:	See Section 2.0
Chapter 343, HRS Trigger(s):	Under a recent new interpretation of statutory definitions of “land” by the PUC, the heat extracted from the geothermal fluid beneath the site, a resource to which the State of Hawai`i claims title, is state “land,” so the Project’s continued use of the geothermal resource triggers environmental review. (1) Propose the use of state or county lands or the use of state or county funds
Agencies to be Consulted:	See Section 5.0

List of Acronyms and Abbreviations

AAQS	Ambient Air Quality Standards
ARPPA	Amended and Restated Power Purchase Agreement
BLNR	Board of Land and Natural Resources
BOP	Balance of Plant
CDA	Hawai‘i Civil Defense Agency
CDP	Census Designated Place
CFR	Code of Federal Regulations
CIA	Cultural Impact Assessment
CO	Carbon monoxide
CO_2	Carbon dioxide
DBEDT	Department of Business, Economic Development & Tourism
DOH	Hawai‘i Department of Health
EA	Environmental Assessment
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EPA	Environmental Protection Agency
ERC	Hawai‘i Emergency Response Commission
ERP	Emergency Response Plan
ERSF	Emergency Steam Release Facility
GHG	Greenhouse gas
GRP	Geothermal Resource Permit
H_2	Hydrogen gas
H_2S	Hydrogen sulfide
HAPs	Hazardous air pollutants
HAR	Hawaii Administrative Rules
Hawaiian Electric	Hawaiian Electric Company
HCEI	Hawaii Clean Energy Initiative
HELCO	Hawaiian Electric Light Company, Inc.
Hg	Mercury
HRS	Hawaii Revised Statute
ITLU	Integrated two level unit
kph	kilo-pounds per hour
kV	Kilovolt
LERZ	Lower East Rift Zone
MW	Megawatts
N_2	Nitrogen gas
NAAQS	National Ambient Air Quality Standards
NCG	Non-Condensable Gas
NOx	Nitrogen oxides
OEC	Ormat energy converter
OPSD	Office of Planning and Sustainable Development
Ormat	Ormat Technologies, Inc.
PGV	Puna Geothermal Venture
PPA	Power Purchase Agreement
PUC	Public Utilities Commission
Rn	Radon
RPS	Renewable Portfolio Standard
SO_2	Sulfur dioxide
TSP	Total suspended particulates
U.S.	United States
UIC	Underground Injection Control

USGS	U.S. Geological Survey
VRMU	Vapor Recovery Maintenance Unit
VRU	Vapor Recovery Unit

1.0 Introduction

1.1 Project Introduction and Overview

Puna Geothermal Venture (PGV), a subsidiary of Ormat Technologies, Inc. (Ormat), is currently authorized for and operating a geothermal power plant in the Puna District on Hawai'i Island and proposes to replace the current 12 operating power-generating units with up to four upgraded power-generating units (Project). The proposed Project would be constructed within the current PGV facility site fence line, would have a smaller footprint of disturbance than the current units, and would increase power production from 38 to 46 megawatts (MW) in Phase 1 and further increase production to 60 MW in Phase 2. The location of the facility as well as existing and proposed Project features are shown on Figures 1 through 3. The site is located on private property and is leased by PGV.

Why this Environmental Impact Statement is Being Prepared: History of PGV's Power Purchase Agreements

To generate the proposed increase in power, PGV needs approval from the Public Utilities Commission (PUC) of the Amended and Restated Power Purchase Agreement (ARPPA) consistent with the State of Hawai'i Public Utilities Law (Chapter 269, Hawai'i Revised Statutes [HRS]). This section provides the context of the approved Power Purchase Agreements (PPAs) for the Project.

According to the original PPA (signed on March 24, 1986), PGV agreed to provide a capacity of 25 MW of energy on-peak, and 22 MW off-peak, to Hawaiian Electric Light Company, Inc. (HELCO)[1], the utility company which serves Hawai'i Island. In August 1987, although there was no statutory trigger, an Environmental Impact Statement (EIS) for the now operating power plant was voluntarily prepared by PGV in accordance with Chapter 343, HRS (commonly referred to as HEPA) and the Hawai'i Administrative Rules (HAR) in effect at the time and submitted to the County of Hawai'i Planning Department. In November 1987, the EIS was published and the Hawai'i County Planning Commission approved the original Geothermal Resource Permit (GRP) for the geothermal power plant in 1987.

PGV came online in 1993 with a generating capacity of 25 MW and expanded to 30 MW in 1995, without adding any new equipment or drilling additional geothermal wells. The additional 5 MW was produced only by the increased use of steam. An additional 8 MW were added in an Expansion PPA in 2012, which allowed PGV to provide a total of 38 MW to HELCO. New generating equipment was added at that time, but no additional geothermal wells were required because the equipment used to generate the additional 8 MW was designed to utilize the hot fluid (or brine) from the existing geothermal resource.

PGV continued providing renewable geothermal energy to HELCO which distributed the energy around Hawai'i Island until 2018. In May 2018, approaching lava from the 2018 eruption of Kīlauea on the Lower East Rift Zone (LERZ) inundated the main access road to the power plant, the wellheads of two geothermal wells, the substation of the complex, and an adjacent warehouse that stored a drilling rig. PGV restored the damaged access and facilities and on November 5, 2020, electricity production partially resumed. PGV continued the geothermal field recovery work to increase the production of energy since then and as of early 2022, PGV currently produces approximately 25.7 MW.

Since the previous PPA's term was set to expire on December 31, 2027, PGV proposed to upgrade to more efficient equipment and make associated improvements to the original facility. PGV and HELCO reached an agreement on the ARPPA which would combine the two existing PPAs into one PPA, repower the existing plant using the same amount of geothermal resource, extend the term until 2052, increase capacity of the geothermal plant to 46 MW, and delink pricing for energy from oil costs with no escalation. The ARPPA was filed within the PUC on December 31, 2019, for its review and approval (Docket No. 2019-0333).

[1] Hawaiian Electric Company is the parent company of HELCO.

The PUC suspended the docket reviewing the ARPPA on March 31, 2021, pending Ormat's submittal of a Supplemental EIS pursuant to Chapter 343, HRS and Chapter 11-200.1, HAR, however, the PUC declined to be the accepting authority for any environmental review and deferred such authority to another undetermined agency that would serve as the accepting authority for the environmental review.

In letters dated November 2, 2021, and March 22, 2022, the State of Hawai'i Office of Planning and Sustainable Development (OPSD) responded to PGV's request to designate an approving agency for the environmental review. The OPSD designated the County of Hawai'i Planning Department as the approving agency for the Project for any environmental review that is required. The County of Hawai'i Planning Department was selected as a permissible approving agency under HRS Section 343-5 because the Proposed Action will occur on Hawai'i island, the Planning Department is capable of overseeing the Chapter 343 process, has the greatest expertise or access to information, and has the greatest participation because it would be issuing ministerial permits, such as a Grading and Grubbing Permit, for the Project.

On November 5, 2021, in Order No. 38063 following OPSD's designation, the PUC lifted the suspension of the docket and stated it would proceed with its review of the ARPPA concurrently with Hawai'i County's environmental review. In response to these events, the County of Hawai'i Planning Department determined that an EIS was the appropriate level of environmental review for the Project to satisfy the PUC's request for environmental review and to assure a comprehensive understanding of the environmental aspects of the proposed Project. On March 16, 2022, the PUC approved the ARPPA (Decision and Order No. 38276) with conditions that the "HEPA review" be complete prior to the commencement of Project construction.

The EIS will be prepared in accordance with Chapter 343, HRS and Chapter 11-200.1 HAR. The Project covered by the EIS proposes to upgrade equipment and associated infrastructure. Under a recent new interpretation of statutory definitions of "land" by the PUC, the heat extracted from the geothermal fluid beneath the site, a resource to which the State of Hawai`i claims title, is state "land," so the Project's use of the geothermal resource triggers environmental review. The property is held in private title and no state or county funds are proposed to be used for the Project.

1.2 Proposed Action

The Project is an upgrade to an existing facility. PGV operates the first commercial geothermal power plant and associated geothermal wellfield in the State of Hawai'i. Current production of electric power at PGV includes production wells, injection wells, a steam plant, a brine plant, and associated infrastructure. The Project would replace existing geothermal energy converters with more efficient energy converters using the same geothermal energy source. The increase in power production during Phase 1 would be 8 MW (from 38 MW to 46 MW), or an approximately 21 percent increase. The overall property size would remain 815 acres. Most of the existing infrastructure and buildings would remain for the Project including administration buildings, the control room, maintenance areas, well pads, and the gathering system. As part of the Project, the existing 12 steam and brine energy converters would be replaced with three new energy converters in Phase 1 (and one (1) additional converter in Phase 2) at a new location on the site (**Figure 3**). The amount of power generated in Phase 1 matches the amount approved in the ARPPA. PGV would need to further amend the agreement prior to implementing Phase 2 which would increase power generation to 60 MW (30 percent increase from 46 MW).

The Project would also install new piping and reduce existing steel structures, piping, mechanical components, and associated flange connections (associated with the replacement of the currently operating equipment).

1.3 Project Background and Purpose

The Project would increase the production of renewable energy at the existing facility (within the current site fence line) using new geothermal power-generating units on a smaller land footprint compared to the existing units.

Hawai‘i’s Current Energy Mix

The current energy mix for Hawai‘i consists of both fossil fuels and various sources of renewable energy. Hawaiian Electric Company (which provides electricity for 95 percent of residents of the state on Oahu, Maui, Molokai, Lanai, and Hawai‘i Island) tracks its sales of renewable energy (Hawaiian Electric 2022a). The exact mix of renewables produced in Hawai‘i is a product of complex and in-flux considerations of fossil fuel prices, renewable energy technologies, renewable energy regulations and policies, consumption patterns, a grid adapting to distributed generation, environmental impacts, perceptions of different energy production by residents, and investor interest. In this context, it is useful to briefly consider a comparison of energy production in the State, the position of geothermal energy relative to the current renewable energy policies and goals, and the role of geothermal energy in the local production and consumption of electricity.

Hawai‘i’s geographic isolation has historically required Hawai’i to import fuel resources to meet its energy needs for electricity as well as land, sea, and air transportation. In 2021, approximately 80 percent of Hawai‘i’s energy was met by imported petroleum (which is consistent with figures from previous years), making Hawai‘i the most petroleum-dependent state in the nation. Since there are no local sources of fossil fuel, the state is dependent on imported petroleum for both transportation and electricity generation. This dependence on imported petroleum for generating electricity and the isolated island grids contribute to Hawai‘i having the highest average electricity retail price of any state, and nearly triple the United States (U.S.) average rate (U.S. Energy Information Administration 2022). With the current dramatic rises in fossil fuel prices, electricity costs for island residents is predicted to increase an additional 20 percent (Hawaii Tribune-Herald 2022).

In 2017, greenhouse gas (GHG) emissions from the energy sector accounted for 86 percent of Hawai‘i’s total GHG emissions. Of the 86 percent generated by the energy sector, stationary combustion facilities (e.g., electric power plants, petroleum refineries and fugitive emissions from petroleum refineries, and industrial facilities) generated the second most GHG emissions after transportation at 46 percent (HSEO 2022a).

In addition to petroleum and imported resources, Hawai‘i utilizes renewable resources to produce electricity throughout the state, including solar power, onshore wind resources, biomass, hydropower, geothermal, and other developing hydro-related technologies.

Hawai‘i Renewable Energy Goals and Policies

The Hawai‘i Clean Energy Initiative (HCEI) was established to reduce the state’s dependence on imported petroleum for energy production and locally produce more clean energy. The HCEI was launched in 2008 when a Memorandum of Understanding was signed between the state and the U.S. Department of Energy and developed a framework of statutes and regulations to establish renewable energy goals and policy. The original goal was for Hawai‘i to meet 70 percent of its total energy needs through clean sources by 2030.

HCEI’s renewable energy and energy efficiency targets, which have been codified into law, drive Hawai‘i’s clean energy policy agenda. Other policy actions include regulatory reform to tax policy and clean energy financing. The state exceeded the HCEI original target to achieve a 2015 renewable portfolio standard (RPS) of 15 percent, and in 2018 the state was generating 27 percent of its electricity sales from clean energy sources (HCEI 2018). In May 2015, the state set its goals higher and the adopted an RPS of 100 percent by 2045 with interim targets of 30 percent by 2020 (which was met, reaching 35 percent), 40 percent by 2030, and 70 percent by 2040. HCEI identified the following objectives to help meet that goal:

- Define the new infrastructure needed for a clean energy economy;
- Foster and demonstrate innovation in the use of clean energy technologies, creative financing, and public policy to accelerate the transition to clean energy;
- Create economic opportunity by developing and diversifying Hawai‘i’s economy;

- Establish an open-source learning model that supports other island communities with similar goals; and
- Build a workforce with new skills that form the foundation of an energy-independent Hawai‘i (HCEI 2022).

Additionally, Hawaiian Electric has committed to helping to achieve the state's goals of increasing Hawai‘i's use of clean energy and reducing dependency on imported oil, with a goal to cut carbon emissions from power generation by 70 percent by 2030 (from 2005 levels) and to achieve net zero or net negative carbon emissions (i.e., if there are any emissions, they will be captured or offset) by 2045. The key elements to meet this goal include the shutting down of the state's last coal plant on Oahu in 2022, adding rooftop solar systems, retiring at least six fossil-fueled generating units and reducing the use of other fossil fuel units as new renewable resources come online, adding community-based renewable energy, using more grid-scale and customer-owned energy storage, expanding geothermal resources, and creating customer incentives to change patterns of energy use (Hawaiian Electric 2021a).

State Renewable Energy Production

In 2021, Hawaiian Electric Company (Hawaiian Electric) reported the percentage of renewable energy generated in the state was 38 percent (for a total of 468,039 customers) (Hawaiian Electric 2021b). The island of Kaua‘i is powered by a utility cooperative owned by Kaua‘i energy users (the Kaua‘i Island Utility Cooperative), which achieved 67 percent renewable energy generation in 2020 (HSEO 2022b).

In 2021, Hawaiian Electric reported the following breakdown of renewable power generation facts:

- For its 307,378 customers, Oahu generated **32.8 percent** of its energy through renewable resources (with a peak of 69.8 percent on March 17, 2021);

- For its 87,357 customers, Hawaii Island generated **60 percent** of its energy through renewable resources (with a peak of 87 percent on July 1, 2021);

- For its 73,304 customers on Maui, Molokai, and Lanai, Maui County generated **50.2 percent** of its energy through renewable resources (with a peak of 76.3 percent on September 26, 2021) (Hawaiian Electric 2021b).

The 2021 percentage of 38 percent of electricity sales from renewable resources in the state was an increase from 34.8 percent in 2020, and 28.4 percent in 2019 (Hawaiian Electric 2022b).

Hawai‘i Island Renewable Energy Production

Hawai‘i Island currently has the highest percent of energy among Hawaiian Electric powered islands generated by renewable resources in the state[2]. The mix of firms and resources that generated power in 2021 are included in **Table 1-1** below, and include oil (40 percent) and renewables (60 percent) including sources from geothermal, hydroelectricity, wind, and solar.

Table 1-1 Power Generation on Hawaii Island in 2021

Type of Source	Source Name	Amount Generated (Megawatts)
Firm Generation[1]		
Hawaiian Electric Plants (Oil)	Keahole	77.6
	Puna	36.7
	Kanoelehua	21.0

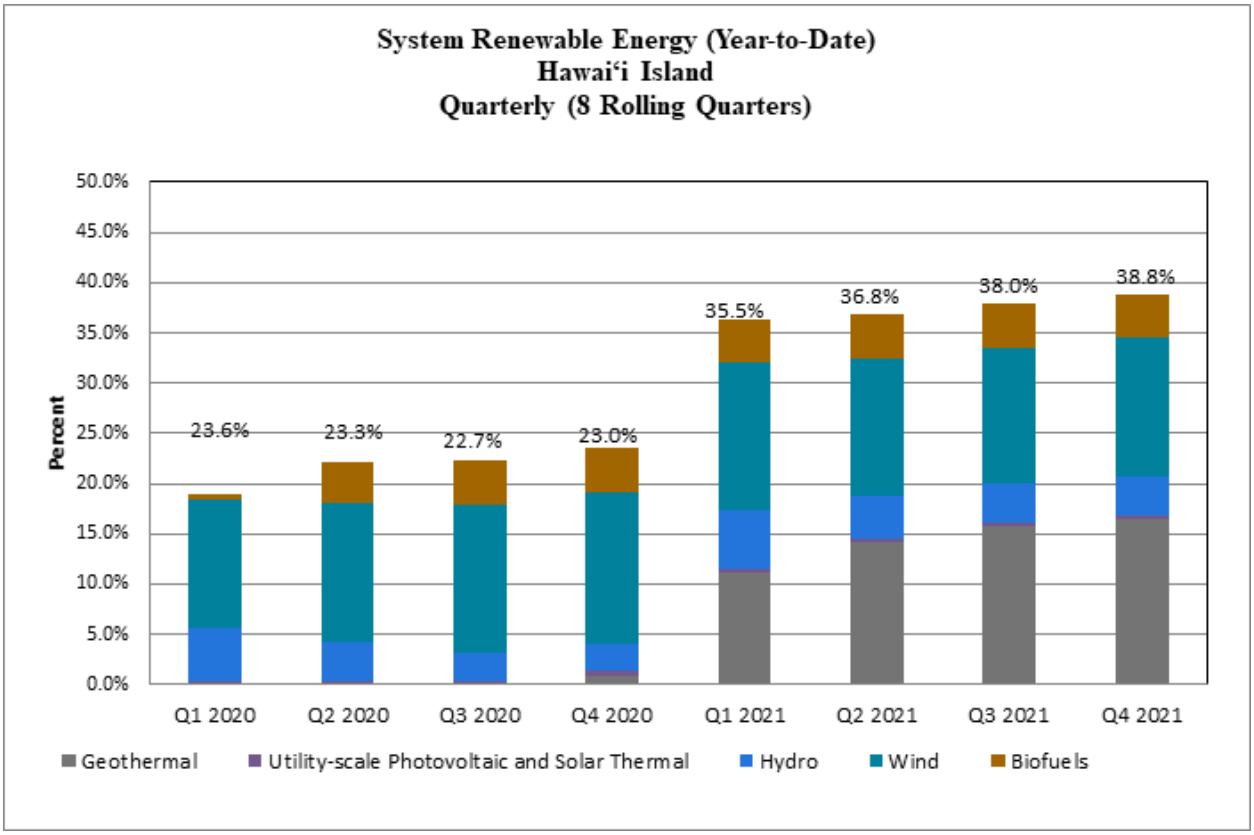
[2] Hawaiian Electric does not provide power on Kauai, so this comparison includes Oahu, Maui County, and Hawai‘i Island.

Type of Source	Source Name	Amount Generated (Megawatts)
	Waimea	7.5
	Hill	5.5
	Dispersed generation	5.0
Independent Power Producers	Hamakua Energy (Oil)	60.0
	Puna Geothermal Venture (Geothermal)	38.0
	Total firm capacity	**251.3**
Variable (As-Available) Generation		
Hawaiian Electric Plants	Puueo Hydro	3.4
	Waiau Hydro	1.1
Independent Power Producers	Pakini Nui Wind, Wailuku River Hydro, Hawi Renewable Development, Customer-site renewable, Shared Solar	150.9
	Approximate non-firm capacity	**155.4**

Source: Hawaiian Electric 2022a
[1] Retired Units: Shipman (oil) (capacity: 15.2 MW): 0 MW generated in 2021

The amount of power generated on Hawai‘i Island from renewable energy in 2020, before PGV came back online, was between 22.7 percent and 23.6 percent (Graph 1). With the production of energy from geothermal resources at PGV, Hawai‘i Island was able to increase this amount to approximately 38 percent in 2021 (Hawaiian Electric 2022a).

Graph 1 Hawaii Island Percent System Renewable Energy



Source: Hawaiian Electric 2022a

Hawaiian Electric also identifies additional solar, biomass, and energy projects in development on Hawai‘i Island, which would add approximately 184.5 MW if they come online (Hawaiian Electric 2021b).

Project Purpose

The purpose of the Project is to continue supplying electrical power produced using renewable geothermal resources in response to Hawaiian Electric's forecasted need for energy on Hawai‘i Island. According to the PUC, "in addition to providing new energy and firm dispatchable capacity, the 8 MW upgrade increases PGV's ability to provide inertia and useful grid services such as primary frequency response, and reactive power to Hawaiian Electric's system." The upgrades would be useful and complementary to other generators and to those expected to be added in the coming years.

The proposed upgrades, described in further detail below in Section 2.2, would occur in two phases to adapt to HELCO's projected increase in energy demand. The Project is consistent with both state and county goals to increase efficiency at an operating power facility to generate more energy for the residents of Hawai‘i Island in an area already set aside for this purpose, reducing energy costs for residents, and decreasing Hawai‘i's reliance on imported fossil fuels.

1.4 Alternatives

The Project (the Proposed Action) consists of upgrading certain generating equipment and increasing geothermal energy production at an existing operating facility. The applicant, PGV, is a geothermal power producer with no plans to investigate different alternative energy sources in Hawai‘i County such as solar, wind, tidal power, or biomass. Neither PGV nor Ormat have additional land positions for geothermal energy that would give them the ability to utilize other locations on Hawai‘i Island or elsewhere in the state to commercially produce energy using geothermal resources. Further, PGV is not proposing to work with HELCO or Hawaii Electric to export the energy generated at the PGV facility from Hawai‘i Island.

Therefore, the only practical alternative to the Proposed Action is the No Action Alternative. Under this alternative, Ormat would not upgrade equipment at the PGV facility. Since the proposed location of the upgraded energy generating units is within the current PGV site and within the Kapoho Section of the Kīlauea Lower East Rift Geothermal Resource Subzone, future actions at the site would likely be associated directly or indirectly with energy production although other land uses including farming, tourism, or housing would not be precluded. These future actions would depend on many factors including the market and government permitting and are not proposed at this time. For the purposes of analysis in the anticipated EIS for the Project, however, the No Action Alternative considers mainly the consequences of the present situation, which is the current operation of the geothermal energy production facility through 2027 or an extended term of the PPA under the status quo conditions. This provides a useful baseline for comparison of impacts with the Proposed Action, and it will be actively considered throughout the EIS, as required by HEPA rules.

1.5 Geothermal Land Use Background and Project Location

Geothermal Resource Subzones: A Brief History

The development of geothermal energy began in Hawai‘i in 1961 with the drilling of the first exploratory wells. Under direction of the University of Hawai‘i, the Hawaii Geothermal Project (HGP) began in 1972, which led to the drilling of the first successful well in 1976 and to the construction of the 3 MW HGP-A operating plant in 1981, which was funded by the National Science Foundation and the U.S. Department of Energy with contributions by the state. The HGP-A plant operated for approximately eight years and demonstrated the technical and economic feasibility of geothermal energy in Hawai‘i. In an effort to promote use of indigenous resources for energy production, Hawai‘i's State Legislature enacted the Geothermal Resource Subzone Assessment and Designation Law (296-83) determining that the development and exploration of Hawai‘i's geothermal resources is of statewide concern, and that this interest must be balanced with preserving Hawai‘i's unique social and natural environment (Yoshihara 1985).

Act 296-83 mandated the creation of "geothermal resource subzones" where geothermal development could take place, regardless of the existing land use classification (urban, rural, agricultural, and

conservation). The intent was not to overhaul or displace the existing land use system but to add the requirement of a subzone procedure application to geothermal activities. The counties would continue to maintain jurisdiction and authority to approve site-specific activities on agricultural, rural, and urban lands, while the Board of Land Natural Resources (BLNR) would continue to maintain jurisdiction on conservation lands (Yoshihara 1985).

The subzones were defined in HRS Section 205-5.1 and designated subzones included: Lihue (Kauaʻi); Koolau and Waianae (Oahu); West Molokai (Molokai); Palawai (Lanai); Honolua, Lahaina, Olowalu, Haleakala Northwest Rift Zone, Haleakala Southwest Rift Zone, Haleakala East Rift Zone (Maui), and Kohala, Kawaihae, Hualalai, Mauna Kea Northwest Rift Zone, Mauna Kea East Rift Zone, Mauna Loa Northeast Rift Zone, Mauna Loa Southwest Rift Zone, Kīlauea Southwest Rift Zone, and Kīlauea East Rift Zone (Hawaiʻi) (https://files.hawaii.gov/dbedt/op/gis/maps/geothermal_maps.pdf). However, HRS Section 205-5.1 was repealed by Act 97 (2012). Geothermal resource development is a permitted use in all State Land Use districts in accordance with HRS 205.2.

Project Location

The Project is located on an approximately 815-acre site in the Kapoho Section of the Kīlauea Lower East Rift Geothermal Resource Subzone, an area that has produced geothermal heat for hundreds of years and is expected to continue producing geothermal heat for hundreds of years to come.

It should be noted that the State of Hawaiʻi owns all mineral rights (including geothermal resources) in the state, including those for the Project, and has issued a Geothermal Resources Mining Lease for the existing PGV facility under which the Project would continue to operate.

2.0 Project Description

2.1 Existing Operations

Construction and operation of the facility has been previously authorized under a variety of permits issued by the County of Hawai‘i. The 1987 Puna Geothermal Venture Project EIS, as noted earlier, was submitted to the County of Hawai‘i (PGV 1987). Ormat is the parent company of PGV and has over 56 years of experience in developing and operating geothermal power facilities and producing geothermal energy, and currently owns and operates over 1,000 MW of geothermal energy production, storage, photovoltaic solar, and recovered energy generation around the globe. The description provided below is a summary of the authorized and existing facilities and operations as of May 2022. Where applicable, the 1987 EIS is referenced in the description of authorized operations below.

2.1.1 Existing Operations: Geothermal Wells and Wellfield Facilities

The existing facility currently consists of five well pads (A, B, D, E, and F), of which three have operational wells (pads A, B, and E). Wells are spaced approximately 50 to 100 feet apart within the well pad and are drilled to a depth of approximately 4,000 to 8,000 feet below the surface. The piping subsystem begins downstream of the master shutoff valves at each wellhead and includes production, throttling, and isolation valves, and flow rate metering devices and instrumentation required for local or remote monitoring and control of each well. A rock catcher (rock particle separator) is installed immediately downstream of each wellhead. The subsystem includes a moisture separator that flashes the geothermal fluids into steam and brine fractions. A list of past and current wells is included in **Table 2-1**.

Table 2-1 Past and Current Wells at PGV

Well Number	Well Type	Status	Well Pad
KS-1	Plugged or covered	Out of Service	A
KS-1A	Injection	Out of Service	A
KS-2	Plugged or covered	Out of Service	B
KS-3	Injection	In Service	E
KS-4	Plugged or covered	Out of Service	E
KS-5	Production	Out of Service	E
KS-6	Production	Out of Service	E
KS-7	Plugged or covered	Out of Service	F
KS-8	Plugged or covered	Out of Service	D
KS-9	Production	Out of Service	A
KS-10	Production	Out of Service	A
KS-11	Injection	In Service	A
KS-13	Injection	In Service	A
KS-14	Production	In Service	E
KS-15	Injection	In Service	B
KS-16	Production	Out of Service	A
KS-17	Production	In Service	A
KS-18	Production	In Service	E
KS-19	Injection	Planned	E
KS-20	Injection	In Service	A
MW-4	Monitoring	In Service	B
MW-5	Monitoring	In Service	B

Source: EPA 2021

Monitoring Wells

Because groundwater monitoring wells MW-1, MW-2, and MW-3 were inundated by lava during a June 2018 eruption of the Kīlauea volcano, new groundwater monitoring wells were needed to maintain the number of monitoring wells at the site. Therefore, PGV replaced the inundated wells with two onsite monitoring wells, MW-4 and MW-5, and one offsite and downgradient monitoring well (Lippe Well at Pohoiki or MW-6).

Production and Injection Wells

Geothermal wells for the current operations are identified as either production or injection depending upon the performance of the well. Each production well has an approximate average flow rate of 90,000 pounds per hour of steam deliverable to the power plant. Injection wells are used to reinject brine and process fluids generated in the operation of the power plant back into the geothermal reservoir. Marginal geothermal production wells (wells that contained less than desired steam flow or steam fraction) can be converted into injection wells as needed.

Currently, PGV is permitted to operate six injection wells. An additional ten production wells could be converted to injection wells pursuant to the Environmental Protection Agency's (EPA's) Underground Injection Control (UIC) Permit (October 19, 2021) (EPA 2021). As of 2022, three production and five injection wells are in service. An additional eight injection wells were approved as part of the UIC Permit renewal.

The Project also operates under a State UIC permit, issued by the Hawai'i Department of Health (DOH) Safe Drinking Water Branch. The application for renewal of this permit was submitted in March 2020, and that renewal process is on-going with DOH.

2.1.2 Existing Operations: Gathering Systems

Three gathering systems—steam, condensate, and brine—are used to collect and transport fluids to the appropriate downstream processing units. All three gathering systems consist of independent piping networks that interconnect only where two streams are present. All pipes are engineered for stresses induced by thermal, pressure, dead, and seismic loads. The gathering systems generally follow the shortest route from the source to the destination; however, terrain, visual impacts, and existing road alignments partially dictate the layout. All pipelines are painted dark green or grey and vegetation is encouraged to grow around the pipes to minimize visual impacts.

The steam gathering system transports steam from the well pads to the turbine in the power plant. Steam pipelines begin as a single line from each well pad and join before reaching the power plant and include a moisture separator to remove any entrained water.

The condensate gathering system collects steam that condenses in the steam gathering pipelines at the two moisture separators and at low points in the steam gathering system. The condensate gathering system transfers the collected condensate, under pressure, to the steam turbine condenser.

The brine gathering system collects the brine generated at the well pad separator. The brine is transported to a heat exchanger in the power plant and then to the injection wells for reinjection into the geothermal reservoir.

2.1.3 Existing Operations: Power Plant

Electricity is generated in the steam power plant through the use of Ormat energy converters (OECs). PGV currently operates 10 OECs for power production. Geothermal steam powers the steam turbine which converts the energy into mechanical work, which is then used to rotate the generator, creating electricity. Depressurized steam leaves the turbine and enters into a heat exchanger where it boils pentane, a low boiling point hydrocarbon. In the process, the steam condenses and is collected into a holding tank at the bottom of the condenser. The vaporized pentane turns a binary turbine before being exhausted into an air

cooler to be condensed. The liquid pentane then flows back into the heat exchanger to begin the 'closed loop' system again.

The steam entering the heat exchanger contains non-condensable gases (NCGs) including hydrogen sulfide (H_2S), carbon dioxide (CO_2), nitrogen gas (N_2), and hydrogen gas (H_2). These gases are removed using a steam ejector vacuum system, compressed, and piped into the reinjection system.

The hot geothermal brine is pumped to a heat exchanger located in an OEC. In the heat exchanger, the brine boils pentane, a low boiling point hydrocarbon. The lower temperature brine is collected and combined with the condensed steam before being piped into the reinjection system. The vaporized pentane turns a binary turbine and is then treated in a similar manner as described above.

Each turbine is equipped with a bypass system so that it can operate even during turbine upset conditions or plant start-up. Steam turbine bypass valves open and the pentane 'closed-loop' would continue to operate.

Integrated Two Level Units

PGV currently operates two integrated two level units (ITLUs) for power production. Each ITLU consists of two turbines coupled to a synchronous generator. Geothermal brine is diverted to the unit, where the brine flows through four heat exchangers, two vaporizers and two preheaters, which heat and vaporize pentane. Before entering the turbine, the vaporized pentane passes through a liquid separator which removes liquid from the vapor.

2.1.4 Existing Operations: Supporting Infrastructure

Additional infrastructure and ancillary facilities at the PGV facility include the maintenance building, an administration building, a control building, a machine shop, a warehouse facility, transformers, and chemical tanks.

Following damage during the 2018 Lower Puna eruption and in order to resume operations, PGV coordinated with HELCO to rebuild the substation and transmission lines. During this effort, HELCO and PGV each rebuilt their respective components of the substation (e.g., switches, breakers, meters) and coordinated to connect the components. The rebuilding effort was funded by PGV.

2.1.5 Existing Operations: Staffing

Current staff for the existing facility includes approximately 31 employees for operation and maintenance.

2.1.6 Existing Operations: Pentane Recovery, Pollution Abatement, and Hazard Control

The facility's principal pollution recovery and abatement systems and hazard controls for potential geologic hazards are described below. Pentane is a hydrocarbon used as a working fluid in a closed-loop system in the operations and is recovered as part of operations. Abatement for H_2S consists of reinjection into the geothermal reservoir. Reinjection is essentially a closed loop disposal system since the fluids are returned to the same geologic zone from where they originated. This section also describes mitigation for noise and potential geologic hazards.

Pentane Recovery

The Vapor Recovery Maintenance Unit (VRMU) is used to evacuate and recover pentane before venting NCGs from the pentane system (turbines, cooler, heat exchanger, etc.). The VRMU uses a four-step recovery and an activated carbon filtering system. Recovered pentane is returned to the pentane storage vessels.

The Vapor Recovery Unit (VRU) is normally used to remove pentane before venting NCGs from the pentane system (turbines, cooler, heat exchanger, etc.). The VRU uses a two-stage refrigeration cycle to recover the pentane, and then the recovered pentane is returned to the pentane storage vessels.

Pollution Abatement

The following H_2S abatement systems are summarized from PGV's Noncovered Source Permit No. 0008-02-N (PGV 2014).

Sulfa-Treat System: The Sulfa-Treat system collects and abates fugitive H_2S emissions which result from upset conditions of the steam turbine seals. The system operates on a vacuum to collect the fugitive emissions from the seals and then uses a system of abatement reactors in series to chemically abate the H_2S emissions.

Power Plant – NCG System: This system has the potential for fugitive H_2S emissions through leaking seals, flanges, valves, and other points. Sensors with alarms set for 10 parts per million are located on each turbine/generator unit. The alarms are activated in the control room and immediately alert personnel of fugitive H_2S emissions so that corrective action can be taken.

Wellfield Pads, Injection Wells, Production Wells, and Associated System: Wells and associated equipment have the potential for fugitive H_2S emissions. Sensors are located strategically throughout the wellfield. H_2S emissions during maintenance operations are abated using a portable H_2S abatement vessel.

Emergency Steam Release Facility (ESRF): This system, including associated tanks and equipment, is designed to handle emergency situations such as a problem with the electrical transmission line(s) out of the power plant, upset of the geothermal fluid injection system, or if the pressure in the steam line exceeds the set points. The ESRF is used for upset conditions to prevent a release of unabated H_2S to the atmosphere.

Solid Waste

Solid waste is generated from time to time from scale cleanouts of geothermal piping. PGV is considered an episodical generator. All scale is treated as hazardous waste and is disposed of in accordance with Federal requirements. Solid waste generated by employees and operations is collected weekly by a local solid waste contractor, and wastewater is disposed in a cesspool onsite.

Noise

Noise levels are monitored continuously, and results are posted on PGV's publicly accessible website. The facility adheres to Hawai‘i guidelines on noise.

Several steps are taken to reduce normal operation noise levels. These steps include:

- Insulating pipes, valves, and equipment;
- Enclosing equipment in structures, where feasible;
- Installing silencers on pressurized steam outlets; and
- Purchasing quiet fans and motors (PGV 1987).

Geologic Hazards

Volcanic and seismic hazards for the existing facility exist, with risks posed to engineered structures and installations. These risks have been significantly mitigated through procedures in facility siting, design, and operation as described in the 1987 Puna Geothermal Venture Project EIS (PGV 1987).

Risks from volcanic hazards include lava eruptions, lava flows, ash falls, splatter falls, and associated surface disruptions. The existing facility was sited on higher ground to avoid lava flows in the low area, which was demonstrated effective during the 2018 Lower Puna eruption. A layer of volcanic cinders was placed to protect the lower well pads and key elements of pipelines from lava flow. Each wellhead in low ground is protected from lava flow by a plan for the timely full closure of the master valves and by burying the cellar and wellhead with cinders (PGV 1987).

Potential seismic hazards are generated by earthquakes and include ground motion, ground ruptures, and subsidence. The strength and duration of motion from the strongest projected earthquake that might impact the Puna area can be largely mitigated by appropriate design. Critical components of the site (e.g., abatement equipment, above-grade pipe supports) were constructed to comply with the most stringent (Seismic Zone 4) seismic building requirements, even though the current vicinity area is officially in a Seismic Zone 3. This planning proved effective during the volcanic eruption in 2018 which inundated extensive areas surrounding PGV's facility.

Fluid pipelines are the structures most vulnerable to disruption from geologic hazards. This risk was mitigated by appropriate design of the piping system to allow flexibility and movement. Automatic shutoff of the power plant takes place under extreme conditions, and pipeline damage is repaired in the shortest practical period of time. PGV coordinates closely with Hawaii Volcano Observatory, the Hawaii Institute of Geophysics, and state and county officials to further reduce risk and ensure timely warnings of impending geologic hazards (PGV 1987).

2.1.7 Existing Operations: Monitoring and Maintenance

An important part of the operation of the facility is regular monitoring and maintenance of both the power plant and the wellfield. Qualified staff are on-site at all times when the plant is operating. Routine maintenance is conducted by workers during the normal daytime work shift. When operating units are out of service, maintenance work continues 24 hours per day, seven days per week, until full power output can be resumed. If all units are operating at approximately full power, the maintenance work is done by one shift per day, five days per week. The information in this section is summarized from the 1987 Puna Geothermal Venture Project EIS (PGV 1987).

Wellfield Monitoring

All wellheads are equipped with temperature and pressure gauges on the well casing below the master valves. Flow from each well is measured in the line downstream of each control valve. Flow indication is local, and operation of the flow control valves are capable in automatic or manual modes. The control valves at the steam release facility have air-piston operators that respond automatically to signals from the plant control room or upon sensing overpressure in the steam pipeline. The H_2S abatement system at the steam release bypass will operate automatically when steam is vented.

Wellfield Maintenance

Wellfield maintenance is generally performed without shutting off the flow of steam from any well. When this action cannot be taken or is unsafe, maintenance work for the wellfield would be phased to minimize the number and time that wells are shut down. Remedial drilling of wells is usually needed for proper wellfield maintenance and is anticipated every two to five years for each well.

Power Plant Monitoring

The power plant is designed with an automatic control system. The plant operator performs restart checks and manual valving, monitors the plant during operation, and regularly inspects the equipment. The power generating units are operated from a single control room, and control systems operate automatically to prevent injuries to plant personnel or equipment. Standby equipment starts automatically to avoid tripping a turbine-generator unit during normal operations. An independent, self-contained control system is associated with each generating unit.

Power Plant Maintenance

Scheduled maintenance is conducted at each generating unit at intervals of one to two years, as needed. Thorough maintenance procedures, such as turbine disassembly/inspection and condenser inspection/repair, are conducted during these planned outages. Scheduled maintenance periods require approximately one to two weeks for each unit and are coordinated with HELCO to ensure the maintenance of a reliable power system. Maintenance crews are engaged 24 hours a day, seven days per week during this maintenance and work crews work eight- to 12-hour shifts.

2.1.8 Existing Operations: Emergency Response Plan

PGV has developed an Emergency Response Plan (ERP) for the PGV facility in compliance with Condition #26 of GRP 87-2, and in conformance with discussions with the County of Hawai'i Civil Defense Agency (CDA), Hawai'i DOH, and the staff of the Hawai'i State Emergency Response Commission (ERC). The most recent version of the ERP was updated in 2022.

The ERP provides a plan of action to deal with facility emergency situations which may threaten the health, safety, and welfare of the employees and other persons in the vicinity of the facility site. This plan is the basis of all actions by PGV's personnel and management staff in responding to these situations and is updated appropriately when necessary. Site personnel also follow related site Safety, Environmental and Operating Procedures.

2.1.9 Existing Operations: Decommissioning

At the end of the useful life of the facility, the facility and the wellfield would be shut down and the structures and equipment would be removed. Economic and resource conditions would dictate when the facility should be decommissioned. As part of decommissioning, the facility site would be returned to its natural state and the following steps would be taken:

- Structures and piping would be removed;
- Dry or abandoned wells would be abandoned in accordance with existing permits and plugged with concrete, wellhead equipment and casing would be removed to below grade, well casing capped, and the surface restored;
- Roadways would be abandoned consistent with the lease agreement with the landowner; and
- The site would be regraded to approximate natural contours, and the site would be seeded or planted with vegetation.

2.1.10 Existing Operations: Existing Permits

Table 2-2 includes a list of existing permits for the facility.

Table 2-2 Existing Permits for the Current Facility

Permit Title	Agency
Federal	
Underground Injection Control (UIC) HI596002	Environmental Protection Agency
State	
Underground Injection Control (UIC) UH-1529	Department of Health, State of Hawaii
Authority to Construct 7 Geothermal Wells (UIC)	Department of Health, State of Hawaii
Noncovered Source Permit No. 0008-02-N	Department of Health, State of Hawaii
Noncovered Source Permit No. 0008-03-N	Department of Health, State of Hawaii
Plan of Operation	Department of Land and Natural Resources, State of Hawaii
County	
Geothermal Resource Permit (GRP 87-2), last updated on 02/06/2001 for up to 60 MW	Hawaii County Planning Commission

Permit Title	Agency
Building Permit	Hawaii County Planning Department
Grading Permit	Hawaii County Planning Department

2.2 Proposed Operations

The Project includes two phases, Phase 1 would increase the generating capacity to 46 MW (which is 8 MW more than the current approval) and Phase 2 would increase the generating capacity to 60 MW. The property boundary of 815 acres would remain the same under the Proposed Action.

The following description is based on the schematic plan for the Project. As required by the ARPPA, PGV would provide a complete set of detailed engineering, vendor and manufacturing and as-built drawings and calculations relating to the design and construction of the facility to HELCO for review after they are submitted to the appropriate government authority. Per the conditions in the ARPPA, construction work is subject to HELCO inspections and monitoring.

2.2.1 Proposed Operations: Power Generation

Phase 1

As described in the ARPPA to achieve this increase in Phase 1, the 12 existing OECs (combined power generating units) currently in use would be replaced with three new OECs which are designed to utilize the energy of geothermal steam and brine. The three new OECs would be identical in construction, and would be named OEC 41, 42, and 43. Each new OEC would utilize both steam at 678 kilo-pounds per hour (kph) and brine at 226 kph, producing together 52.5 MW gross power and 46 MW net power. Proposed units are shown on **Figure 3**.

Each new OEC unit includes a synchronous generator that is driven by an organic turbine, air-cooled condenser, cycle pump and control system. The gathering system conveys steam and brine from the existing separator to the facility. The steam and brine pass through the new OEC units and flow through the gathering system to the reinjection system which collects a mixture of the cooled brine and condensate that passed through the facility and reinjects it into injection wells by the facility's re-injection pumps. The operation of the gathering system as it currently exists will be the same for the new OECs.

Phase 2

During Phase 2, a fourth new OEC unit would be installed and connected to the infrastructure described in Phase 1 (OEC 44) (**Figure 3**). This would allow for the production of up to 60 MW of power.

2.2.2 Proposed Operations: Geothermal Wells and Wellfield Facilities

The Project would either use the existing well pads in their current location or construct new well pads in accordance with approved permits.

2.2.3 Proposed Operations: Gathering System

As part of Phase 1, PGV would utilize the existing gathering system to the extent possible and install new piping. In Phase 2, it is expected that there would be a 20 percent increase in piping infrastructure (above existing) to connect a fourth new OEC.

2.2.4 Proposed Operations: Supporting Infrastructure

Phase 1

Existing infrastructure associated with the facility that would remain for the Project, and includes the administration buildings, the control room, electrical substation and distribution lines, and maintenance areas.

Phase 1 would involve facility upgrades including reducing steel structures, piping, mechanical components, and associated flange connections.

The following supporting electrical equipment for the new OEC units would be installed as described in the ARPPA for Phase 1:

- 13.8 kilovolt (kV) circuit breakers;
- Three step-up transformers;
- Three lightning arresters mounted on the high voltage side of the step-up transformer;
- Three 69 kV circuit breakers (one per transformer);
- Three sets of 69 kV primary and secondary metering devices connected to one metering set of instrument transformers per transformer, to monitor each of three step-up transformers;
- Dial-up telephone line installed close to 69 kV metering cabinet to allow remote metering reading;
- Fiberglass or stainless-steel demarcation cabinet located along the switching station fence; and
- Underground cable and duct line from the switching station to the Facility.

As part of the Project, PGV would also comply with specific interconnection relays and relay settings, generation relays and generation relay settings, and specific features for the switching station which would be connected to the high-voltage circuit breaker.

Phase 2

It is expected that there would be a 20 percent increase in balance of plant (BOP) as part of Phase 2, with all supporting components of the facility contributing to overall power generation from the new OECs and power delivery increasing by approximately 20 percent.

2.2.5 Proposed Operations: Staffing

During construction of the Project, approximately 75 temporary employees would be utilized, of which approximately one-third would be local, and two-thirds would be from off-island, depending on availability and expertise. Operation of the Project would not be anticipated to increase the permanent staff at the PGV facility of 31 employees.

2.2.6 Proposed Operations: Pentane Recovery, Pollution Abatement, and Hazard Control

These systems would be the same as those described in Section 2.1.6. Even though as a result of new technology the new OECs are much quieter than existing OECs, PGV would still purchase and install quiet fans and motors.

2.2.7 Proposed Operations: Construction Schedule

In compliance with the Guaranteed Project Milestones identified in the ARPPA, PGV would complete construction of the proposed facility and associated infrastructure within 18 months after completion of the environmental review requirements set by the PUC.

2.2.8 Proposed Operations: Monitoring and Maintenance

Monitoring and maintenance under the Proposed Action would be consistent with the activities described for the existing facility (see Section 2.1.7). The reduced number of pipes associated with fewer generating units and the smaller footprint associated with the Project would reduce the amount of monitoring and maintenance equipment compared to the current facility.

2.2.9 Proposed Operations: Emergency Response Plan

The ERP described for the existing facility in Section 2.1.8 would continue to be implemented under the Proposed Action.

2.2.10 Proposed Operations: Project Closure

The 1987 Puna Geothermal Venture Project EIS (PGV 1987) stated that the decommissioning process refers to the shutdown of the wellfield and removal of structures and equipment at the end of the useful life of the facility. At that time, the facility was estimated to have an approximately 35-year useful life, with the actual useful life dictated by economic and resource conditions. The facility has now been commercially operating for almost 30 years and the economic and resource conditions make it feasible and desirable to repower the facility to extend its useful life beyond the 35 years estimated in 1987. As the term of the AARPA approaches its end in 2056, PGV will again evaluate whether, based on economic and resource conditions, the power plant and well field should be refurbished to further extend the useful life of the facility, or whether the facility should be decommissioned. When decommissioned, the site will then be returned to its natural state. The following steps will be taken during decommissioning:

- Structures (including wellfields, supporting structures, and OECs) and piping will be removed.
- Dry or abandoned wells will be plugged with concrete, wellhead equipment and casing removed to below grade, well casing capped, and the surface restored.
- Roadways will be abandoned to the extent agreed upon with the landowner.
- The site will be regraded to approximate contours that match the 2018 lava flow, and the area will be seeded or planted with natural vegetation.

3.0 Project Setting

The EIS will examine the pertinent features of the physical and natural environment. Existing data will be compiled from past environmental studies, and new studies will be completed to address the potential impacts within several discipline areas. This section describes the setting, or affected environment, in Project vicinity.

3.1 Geology

The Proposed Action is located near the eastern tip of Hawai‘i Island. This region is on the eastern flank of Kīlauea Volcano, the southernmost of five volcanos that make up Hawai‘i Island. Kīlauea is one of the world’s most active volcanoes; since 1952, it has erupted dozens of times. From 1983 to 2018, eruptive activity was nearly continuous along the East Rift Zone. In 2018, the decades-long continuous activity on the East Rift Zone ended, and the summit lava lake drained following an intrusion into, and eruption from, Kīlauea's LERZ.

The East Rift Zone extends as a belt of land approximately one to two miles wide and 75 miles long, of which approximately 31 miles are on land. The rift is a constructive ridge consisting of surface features including open fissures, faults, small grabens, pit craters, cones, and vents. Most recently, flow thickness from the 2018 Lower Puna eruption ranged from 16 to 920 feet of lava (Houghton et al. 2021), with approximately 65 feet atop the pre-eruption ground surface at the site.

Below the ground surface is a system of closely spaced, vertical to steeply dipping dikes with an approximate width of 1.5 to 2.5 miles which intrude a sequence of layered Mauna Loa and Kīlauea lava flows. The dike complex is the primary heat source for the Puna geothermal system. Magma chambers below the surface, where storing and partial cooling of magma take place, may provide a supplemental heat source for the geothermal reservoir.

The existing facility is a geothermal energy conversion plant located above a natural geothermal reservoir in which geothermal fluids are brought to the surface by production wells, heat is extracted, and then cooled fluids are reinjected through the injection wells. Production flow rate and injection flow rates at the wells are equivalent. The injection pressure at the existing facility is just enough for the injected fluid to flow from the injection reservoir to the production reservoir and is not designed to significantly increase subsurface pressure. Conditions of the EPA’s UIC permit includes injection pressure limits, which are based on formation testing, to reduce the potential for the creation of new fractures from current activities and to protect any potential underground source of drinking water (EPA 2021).

Volcanically and/or tectonically active areas have associated levels of risk to property and life. Kīlauea Volcano and its associated LERZ is one of the most seismically active areas in the world. Potential hazards within the rift zone include earthquakes, surface deformation, lava flows, eruptions, and subsidence associated with faulting. Earthquake activity in the vicinity of PGV has been attributed to two mechanisms: tectonically related faulting and volcanically related movements. Thousands of earthquakes occur in Hawai‘i every year, though most are not strong enough to cause damage or impact residents. PGV is located within Lava Hazard Zone 1, indicating the highest potential risk where vents have been repeatedly active in historic time. The location of the Proposed Action is somewhat topographically protected from potential flows; however, several wells were damaged in the 2018 Lower Puna eruption.

In the event of a volcanic hazard with the potential to threaten the facility or block a well, all production and injection wells would be shut-in (i.e., pumps stopped and injection ceased) and PGV would implement the ERP.

The U.S. Geological Survey (USGS) notes that although there is minimal subsidence along the LERZ at a rate of approximately one centimeter per year (0.4 inch per year) since measurements began in 1958, there is no evidence that the activities at the existing facility are resulting in additional subsidence above the background level (USGS 2012, EPA 2021).

Additionally, the USGS did not find evidence that the 2018 Lower Puna eruption was triggered or influenced by human activities. The 2018 Lower Puna eruption was caused by injection of magma downrift from Puʻu ʻŌʻō and the summit of Kīlauea, and the event fits a pattern of activity that has occurred many times previously on the East Rift Zone and is within the range of normal behavior for Kīlauea Volcano. The 2018 Lower Puna eruption happened within Lava Hazard Zone 1 and the erupted lava flowed through that zone into Lava Hazard Zone 2. The high volume and eruption rate are commensurate with previous LERZ eruptions and the 2018 fissures were located in the same area that has hosted many past eruptions (USGS 2020).

Risks to PGV due to volcanic and tectonic activity have been mitigated by siting and design and engineering standards as described in the 1987 Puna Geothermal Venture Project EIS (PGV 1987). The EIS for the Project will provide additional information and analyze potential impacts from geology.

3.2 Hydrology

Groundwater in the vicinity of the Project area includes the geothermal reservoir and the groundwater aquifer. The geothermal reservoir is located at a depth of approximately 4,000 to 8,000 feet below the ground surface and is the deep volcanic rock formation from which PGV draws and into which it reinjects, geothermal fluids. As a result of its composition, depth, and temperature, the geothermal reservoir is not a source of drinking water. The geothermal reservoir is separated from the groundwater aquifer in the LERZ by a semi-permeable confining layer (or “cap rock”) that is located at depth of between approximately 2,750 and 4,000 feet below the ground surface (EPA 2021).

The groundwater aquifer consists of the shallow basal groundwater body in the LERZ. The portion of the groundwater aquifer that serves as water supply in the area is at least 2,000 feet above the cap rock. The fluids injected into the geothermal reservoir do not migrate to the basal groundwater layer because injection pressures are too low to allow upward migration; rather, injected fluids flow towards the production wells used to produce the geothermal fluids and generate electricity (EPA 2021).

The groundwater aquifer in the vicinity of the Project area does not include potable water since the cap rock separating the reservoir and aquifer is not impermeable. Naturally occurring geothermal fluids leak into the shallow aquifer, naturally degrading water quality due to the high salinity of the geothermal fluids (PGV 1987).

The PGV Hydrologic Monitoring Program was initiated in 1990 and provided a plan to monitor water levels and water quality within the Project area and the vicinity (SAIC 1990). Proposed monitoring locations included the shallow aquifer at locations within the Project boundaries and downgradient of the Project. The monitoring plan scope included the establishment of baseline conditions and the implementation of quarterly monitoring thereafter. Samples collected as part of monitoring are analyzed for potential impacts from the facility from organic compounds (e.g., pentane, isopropanol). Sampling did confirm detection of pentane in one monitoring well near the power plant at a low concentration that was not indicative of source (and could be naturally occurring), and isopropanol was below detection in all samples except for three collected from the plant. In summary, the USGS determined that that there has not been shallow groundwater contamination by organic compounds from geothermal operations. However, the analysis did conclude that increased residential and agricultural activity has contaminated shallow groundwater and, by coastal seeps, the nearshore seawater (USGS 2020).

Conditions of the EPA’s UIC permit includes injection pressure limits which are based on formation testing to reduce the potential for the creation of fractures, and well construction requirements to ensure that injected fluids do not migrate to and endanger underground sources of drinking water. As part of the UIC, there are continuous monitoring and systematic testing requirements to ensure that each injection well has mechanical integrity and groundwater is monitored for any potential indicators that suggest impacts to water quality from injection activities.

Per the GRP, the EPA’s UIC permit and the Hawaii State Safe Drinking Water Branch UIC permit, PGV also conducts hydrological monitoring (according to a monitoring program reviewed by the State and EPA) semi-annually to ensure the existing facility does not contaminate groundwater and sends reports of this

monitoring to the State Safe Drinking Water Branch, the EPA and the Planning Department. As stated in the GRP, if pollution of the aquifer is demonstrated to occur from Project operation or maintenance activities, as determined by the Planning Director in consultation with the Department of Water Supply and DLNR, PGV would need to act to abate these impacts and eliminate the source of pollution.

The EIS will evaluate impacts from the Proposed Action to hydrological resources.

3.3 Air Quality and Climate Change

Air emissions from the facility are subject to the requirements set forth in the HAR, Title 11 Chapter 60.1-Air Pollution Control. To obtain an air quality permit in Hawai‘i, an industrial source must identify all potential air emissions of regulated pollutants associated with its operations, describe pollutant controls, identify applicable regulatory requirements, and demonstrate compliance with National Ambient Air Quality Standards (NAAQS) and Hawai‘i State Ambient Air Quality Standards (AAQS) . Air pollutant emission sources that are listed in 40 Code of Federal Regulations (CFR) 60, New Source Performance Standards, may be required to meet the applicable performance standards identified for that source category. Air pollutant emission sources also may need to comply with National Emission Standards for Hazardous Air Pollutants, which limit hazardous air pollutants (HAPs) from specified processes if that process is listed in 40 CFR Part 63. The facility currently operates under an approved DOH non-covered source permit (a state air pollution control permit).

As part of the 1987 Puna Geothermal Venture Project EIS (PGV 1987), an air quality impact assessment was performed for the Proposed Action as part of the EIS submittal and to demonstrate compliance with the regulations. The assessment described emissions of H_2S, nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), total suspended particulates (TSP), radon (Rn), mercury (Hg) and some trace elements from various stages of the facility including the following: well drilling, venting, flow testing and workover; clearing and construction; power plant operation; and facility decommissioning. A dispersion modeling analysis was performed using then-EPA approved models (ISCST, MPTER and COMPLEX I) to assess the impacts of H_2S and TSP and were found to be in compliance with federal and state air quality standards. The dispersion modeling analysis was aided with the availability of on-site meteorological data, as well as background H_2S and TSP concentration data (PGV 1987).

A public health assessment was performed to examine the health impacts from Hawai‘i Island geothermal operations, in particular from the lower Puna district operations. This study did not conduct a separate air quality assessment but reviewed existing independent studies/health risk assessments for the area. Existing studies concluded that PGV plant operations are unlikely to pose a threat to the air quality in nearby residential areas. Recommendations were made to substantially improve the existing monitoring systems and protocols which were found to be inadequate. The recommendations called for the availability of real time and reliable gas, particulate and meteorological data for citizens to view and make informed decisions to protect themselves from fugitive emissions (Adler 2013).

An Air Dispersion Modeling Report for PGV was prepared in April 2021 as an update to the analysis performed in 1991 for the 1992 ERP using AERMOD, which is currently approved by the EPA, and incorporating the USGS terrain files of the post-eruption terrain. The report analyzed the dispersion of H_2S, the emission of greatest potential health concern, and used the same 12 “worst case“ upset condition scenarios used in the original air dispersion modeling. The updated report concluded that the evacuation warning level for H_2S would not be exceeded under any scenario.

The systems utilized for pentane recovery and H_2S abatement are described in Section 2.1.6. In addition to control systems, PGV also conducts monitoring and reporting as required by its DOH noncovered source permit (a state air pollution control permit) for its current operations. These reports are provided to the DOH, DLNR, and the County of Hawai‘i Planning Department. PGV publishes real-time data for H_2S and wind direction on their website: https://punageothermalproject.com/.

An air quality assessment will be prepared for this Project and will be included in the EIS. The assessment will analyze criteria pollutant emissions, conduct dispersion modeling, and evaluate greenhouse gas emissions and potential impacts to climate change from the Project.

3.4 Noise

The most prominent noise sources within the Project vicinity include the existing PGV facility operations, traffic noise, and environmental noise sources, such as wind, birds, and insects. PGV currently conducts continuous noise monitoring at three locations within the property boundary (**Figure 2**):

- Southeast Fenceline Monitoring Site A1 – This site was chosen due to a cluster of homes that are topographically downgradient from the existing operations.
- Southwest Fenceline Monitoring Site B1 – This site was chosen due to the proximity of the Nanawale Estates subdivision. This location was destroyed by the 2018 Lower Puna eruption but was rebuilt.
- West Fenceline Monitoring Site C1 – This site was chosen due to the proximity of homes at the Leilani Estates subdivision.

The DOH revised its noise regulation effective September 23, 1996. The new regulations identify Class C zoning districts, which include the PGV power plant, as all areas equivalent to lands zoned for agriculture, country, industrial, or similar uses. The maximum permissible sound level for Class C property is 70 dBA, regardless of the time of day. A data acquisition and storage computer located in the PGV plant operations center polls each data logger once every five minutes. The five-minute averaged data are checked for noise levels in excess of 68 dBA, and the computer generates an alarm if an exceedance is detected.

Data from PGV's continuous noise monitoring indicates that noise levels are generally lowest at Site B1 and highest at Site A1. Noise levels fluctuate throughout the day, with the majority of nighttime exceedances occurring from coqui frogs (*Eleutherodactylus coqui*) and daytime exceedances often occurring from the presence of wild pigs (*Sus* spp.) at the facility. As stated in the ERP, PGV notifies the CDA, County of Hawai'i Planning Department, and DOH Noise and Radiation Branch in the event that any upset of PGV's operations leads to an exceedance of the appropriate ambient noise levels and actions are taken at the site to stop the source of the noise. PGV will continue to coordinate with the CDA and other agencies to advise them of the anticipated duration of the upset and high noise level situation.

Additionally, PGV's operations department investigates every noise alarm, documents its possible source, and logs it in the control room logbook. If DOH is contacted by the public regarding a noise complaint for the facility, PGV is contacted to reveal the possible source and reports to DOH.

During regular operations at the existing facility, PGV applies Best Available Control Technology (BACT) for noise emissions to minimize noise from the facility and its activities. Noise emission surveys have been performed throughout the operational lifespan of the facility. These surveys have been performed by Acoustical Engineers, with results including BACT recommendations.

A noise assessment report is being prepared for this Project and will be included in the EIS. The report will analyze the construction and operational impacts of the Project to the existing noise conditions in the surrounding area.

3.5 Biological Resources

The additional disturbance for the Proposed Action would occur on areas recently covered by 2018 Lower Puna eruption or on previously disturbed areas. There are no known biological resources in the area of proposed disturbance, including vegetation, wildlife, and soil resources; however, primary succession on the lava flow (e.g., plant and animal colonization, soil development) is expected to continue in the surrounding areas.

Surrounding habitat includes some areas with native grasses and shrubs. In higher elevations, where the 2018 lava flow did not reach, there is a mixed forest. Biological surveys completed for the 1987 Puna Geothermal Venture Project EIS (PGV 1987) inventoried biological resources within a one-mile buffer of the existing plant site and found at that time that approximately one-third of the area was covered by the

1955 lava flow. A large portion of the area surveyed in 1987 had been modified by previous human activities and consisted of cultivated and fallow fields, and *Metrosideros* forest occupied most of the native vegetation types that were present in the area. Prior to its construction, the site of the existing power plant and well pad consisted of non-native scrub vegetation and abandoned papaya plants.

The EIS will evaluate impacts from the Proposed Action to biological resources.

3.6 Socioeconomics and Environmental Justice

The details below represent the best available information for the existing social and economic condition of the area of analysis using publicly available data. However, due to the uncertainties related to the ongoing COVID-19-related economic impacts and changes in regional economic and social conditions, the data below may be inexact.

The Project is located in Census Tract 15001021101 (211.01), which includes the area bounded to the west by Pāhoa Kalapana Road, to the north by Highway 132, and to the southeast by the Pacific Ocean. The Project area does not occur within a Census Designated Place (CDP); however, impacts to the adjacent Leilani Estates, Nanawale Estates, and Pāhoa CDPs may occur. Impacts to the entire County of Hawai‘i are also discussed where appropriate.

3.6.1 Population and Demographics

The State of Hawai‘i experienced growth from 2010 to 2016; however, population growth slowed from 2017 to 2019 and decreased in 2020 (**Table 3-1**). Estimates suggest that the population of Hawai‘i will continue to decrease, largely driven by migration to the mainland U.S. because of the economic impact of the COVID-19 pandemic (USCB 2022). Since 2010, Hawai‘i County has experienced a period of sustained growth, increasing by approximately 12 percent, making it Hawai‘i’s second fastest growing county after Kaua‘i County.

During the period from 2010 to 2020, the populations of Census Tract 211.01, and the Leilani Estates, Nanawale Estates, and Pāhoa CDPs fluctuated but ultimately increased in population. Most notably, populations decreased for these locations following the 2018 Lower Puna eruption but have since made modest recoveries.

Table 3-1 Population Characteristics

Year	Leilani Estates CDP	Nanawale Estates CDP	Pāhoa CDP	Census Tract 211.01	Hawai‘i County	Hawai‘i
2010	1,563	1,377	890	2,829	180,362	1,333,591
2011	1,634	1,500	983	3,012	182,997	1,346,554
2012	1,653	1,384	865	3,133	185,399	1,362,730
2013	1,749	1,316	879	3,111	187,044	1,376,298
2014	1,729	1,661	862	3,062	189,382	1,392,704
2015	1,557	1,714	826	3,117	191,482	1,406,299
2016	1,629	1,590	731	3,101	193,680	1,413,673
2017	1,655	1,766	772	3,196	196,325	1,421,658
2018	1,708	1,995	896	3,359	197,658	1,422,029
2019	1,576	1,707	805	3,054	199,459	1,422,094
2020	1,784	1,385	1,234	3,328	201,350	1,420,074
Percent Change 2010 to 2020	14%	1%	39%	18%	12%	6%

Sources: USCB 2019a, USCB 2020a

Census Tract 211.01 and the Leilani Estates CDP are considerably less racially diverse than both the State of Hawai‘i and Hawai‘i County with approximately 61 percent and 62 percent of the population identifying

as white, respectively, as compared to Hawai'i's 23 percent and Hawai'i County's 34 percent. Similarly, both Asians and Native Hawaiian and other Pacific Islanders make up a smaller portion of the population in Census Tract 211.01 and the Leilani Estates CDP than in Hawai'i and Hawai'i County (**Table 3-2**).

Table 3-2 Race and Ethnicity

Race or Ethnicity	Leilani Estates CDP	Nanawale Estates CDP	Pāhoa CDP	Census Tract 211.01	Hawai'i County	Hawai'i
White	62%	34%	17%	61%	34%	23%
Black or African American	2%	3%	<1%	1%	1%	2%
American Indian and Alaska Native	1%	3%	1%	1%	1%	<1%
Asian	4%	20%	34%	8%	20%	37%
Native Hawaiian and Other Pacific Islander	8%	26%	20%	8%	14%	11%
Some Other Race	2%	3%	1%	2%	2%	2%
Two or More Races	22%	40%	27%	18%	30%	25%
Hispanic or Latino	10%	12%	9%	8%	11%	10%

Source: USCB 2020b

There would be no minority environmental justice population within the Project vicinity that exceeds 50 percent or more than ten percent of the reference population (i.e., Hawai'i). Additionally, no American Indian environmental justice populations would be present. The percentage of the population identified as belonging to a minority group in the Project vicinity would not be equal to or greater than 50 percent, nor would it be more than 10 percentage points higher than that of the State of Hawai'i reference population (**Table 3-2**).

3.6.2 Economy and Employment

Hawai'i County's primary economic driver is tourism, with approximately 16 percent of jobs in the arts, entertainment, recreation and accommodation and food services industry and 12 percent of jobs in retail trade. Other industries with substantial employment in Hawai'i County include educational services and healthcare and social assistance services and public administration, with 20 percent and 11 percent of jobs, respectively (**Table 3-3**). Within the Puna region, agricultural jobs are the primary form of employment, with significant banana, papaya, macadamia nut, and flower production (County of Hawai'i 2005).

Table 3-3 2019 Industry Employment

Industry	Leilani Estates CDP	Nanawale Estates CDP	Pāhoa CDP	Census Tract 211.01	Hawai'i County	Hawai'i
Agriculture, forestry, fishing and hunting, and mining:	4%	10%	1%	13%	5%	1%
Construction	18%	16%	10%	15%	8%	8%
Manufacturing	4%	3%	0%	8%	2%	3%
Wholesale trade	0%	0%	0%	0%	2%	3%
Retail trade	11%	8%	6%	11%	12%	10%
Transportation and warehousing, and utilities:	0%	7%	1%	0%	5%	6%
Information	1%	0%	0%	1%	1%	2%
Finance and insurance, and real estate and rental and leasing:	3%	10%	4%	3%	6%	7%
Professional, scientific, and management, and	16%	9%	11%	9%	11%	10%

Industry	Leilani Estates CDP	Nanawale Estates CDP	Pāhoa CDP	Census Tract 211.01	Hawai‘i County	Hawai‘i
administrative and waste management services:						
Educational services, and health care and social assistance:	33%	25%	41%	29%	19%	20%
Arts, entertainment, and recreation, and accommodation and food services:	5%	10%	9%	3%	16%	15%
Other services, except public administration	2%	2%	6%	1%	5%	4%
Public administration	4%	1%	11%	7%	8%	11%

Source: USCB 2019b

As of March 2022, Hawai‘i County had an unemployment level of approximately 3.3 percent. Unemployment in Hawai‘i has recovered since a peak in April 2020 at 21.9 percent due to the COVID-19 pandemic and was 3.5 percent as of March 2022. Unemployment in Hawai‘i County also peaked in April 2020 at 21.9 percent (DBEDT 2022).

3.6.3 Income

Within Hawai‘i County, the industries with the highest average wages include utilities ($104,696), management of companies and enterprises ($79,317), and finance and insurance ($74,750).

Jobs at PGV would fall under the power generation and supply industry. Average wages for the power generation and supply industry are the second highest for any industry in Hawai‘i County, with an average salary of $110,657 for 2020. Power generation and supply salaries were the ninth highest for the State of Hawai‘i at $110,684 annually (DBEDT 2020).

Estimates for 2019 indicate that both median household income and per capita personal income in Census Tract 211.01 lag behind the state average by approximately 61 percent and 13 percent, respectively (**Table 3-4**). Additionally, the poverty rate for the Leilani Estates, Nanawale Estates, and Pāhoa CDPs and Census Tract 211.01 is considerably higher than the reference population of Hawai‘i. This would constitute a low-income environmental justice population within the Project vicinity.

Table 3-4 Median Household Income, Per Capita Income, and Poverty Rate of Individuals

	Leilani Estates CDP	Nanawale Estates CDP	Pāhoa CDP	Census Tract 211.01	Hawai‘i County	Hawai‘i
Household Median Income (dollars)	$31,734	$42,563	$27,708	$32,386	$65,401	$83,173
Per Capita Income (2019 dollars)	$27,431	$23,131	$23,518	$30,932	$30,542	$35,567
Percent Below Poverty Line	26.3%	16.7%	23.6%	29.5%	15.6%	9.4%

Source: USCB 2019c, USCB 2019d, USCB 2019e

3.6.4 Housing

Workers typically choose a residence location based on a combination of job proximity, housing availability, and access to public and private services. The Kīlauea Voluntary Housing Buyout Program was initiated in April 2021 and used federal funds to purchase properties impacted by the 2018 Lower Puna eruption. Eligible properties must have been impacted by the disaster, whether by inundation, or isolation, damage by fires caused by lava, or secondary effects of volcanic activity, such as heating or gasses. Acquired residences will be removed and properties will be managed as open space with the possibility of limited agricultural use. Large portions of the Project vicinity, including the eastern portion of the Leilani Estates

CDP were impacted by the 2018 Lower Puna eruption and are eligible for the buyout. A total of 612 homes, including 294 primary residences, were destroyed during the eruption (County of Hawai‘i 2022a). As a result, housing opportunities in the vicinity of the Project are limited.

Data from the 2020 Census indicates that Census Tract 211.01 has an estimated 415 vacant units out of 1,958 units for a total vacancy of 21 percent. Vacancy within the Leilani Estates CDP is estimated at 13 percent, with approximately 113 vacant units. These vacancy estimates likely include vacant properties that are eligible for the buyout program due to property damage or isolation; therefore, vacancy within the Project vicinity is likely lower than estimated. Housing near the Project is also available within the Nanawale Estates CDP and the Pāhoa CDP, with vacancy rates of 17 percent and 25 percent, respectively. These areas were unaffected by the 2018 Lower Puna eruption (USCB 2020c).

Short-term lodging opportunities within the Project vicinity are limited. There are no hotels in the Project vicinity. The establishment of new short-term vacation rentals is prohibited within much of the area surrounding the Project; however, exceptions for existing establishments apply, and there are several private residences available for rent, primarily in the south near the Kehena Black Sand Beach (Planning Department 2022).

Table 3-5 Housing Vacancy Rates within the Area of Analysis (2020 Estimates)

Location	Total housing units	Occupied housing units	Vacant housing units	Vacancy Rate (percent)	Vacancy Rate by Type (Percent)	
					Homeowner Units	Rental Units
Leilani Estates CDP	887	774	113	13%	0.0%	6.6%
Nanawale Estates CDP	691	573	118	17%	0.0%	4.7%
Pāhoa CDP	359	268	91	25%	6.6%	18.2%
Census Tract 211.01	1,958	1,543	415	21%	0.0%	5.6%
Hawai‘i County	87,824	69,453	18,371	21%	2.6%	9.6%
Hawai‘i	542,674	459,424	83,250	15%	1.4%	9.4%

Source: USCB 2020c

3.6.5 Community Development

A Geothermal Relocation Fund was created in 1996 and was subsequently expanded in 2008 to the Geothermal Relocation and Community Benefits Fund. The fund can be used for two primary purposes: to purchase property from owner/occupants near the PGV plant and for infrastructure and service improvements in Lower Puna. The Hawai’i County Planning Department administers the fund. This fund collects geothermal royalties for the “utilization of geothermal resources” (Kohala Center 2012). Examples of community benefits supported by the fund include the purchase of two 33-passenger buses for the region, Pahoa Pool and community center upgrades, and road upgrades (Planning Department 2010).

The EIS will evaluate impacts from the Proposed Action to socioeconomic conditions and Environmental Justice populations.

3.7 Historic Resources

Similar to the description in Section 3.5 (for biological resources), the additional disturbance for the Proposed Action would occur on areas recently covered by 2018 Lower Puna eruption or on previously disturbed areas. In 1984, a systematic inventory of the existing 17-acre facility and a review of resources in a one-mile radius of the facility was conducted and no historic resources were located. As part of the application for subsequent grading permits associated with the existing facility, PGV has complied with the Chapter 6E-42 (Historic Preservation Review) process to demonstrate that no subsequent work has affected historic properties.

The EIS will evaluate impacts from the Proposed Action to historic resources.

3.8 Cultural Practices

In Native Hawaiian culture, Pele's home is the Halemaʻumaʻu crater of the Kīlauea Volcano. Some Native Hawaiians recognize Pele as a goddess and her body includes forms of lava, magma, heat, and steam and believe Pele is responsible for volcanic eruptions and the landscape of the Hawaiian Islands. The Puna District has played an important role in local history, belief, and religion. Hawaiian chants and hula frequently focus on Pele and the Puna District, as well as Hawaiʻi Island. Numerous places in the Puna District are important to Pele, Native Hawaiian beliefs, and customs. These places are contained in Pele stories, chants, and legends (PGV 1987).

To ensure that consultation is conducted and potential cultural impacts from the Project are identified, a cultural impact assessment (CIA) will be prepared.

The EIS will incorporate the results from the CIA including the outcome of consultations with Native Hawaiian practitioners and Native Hawaiian organizations and discuss any impacts to cultural practices.

3.9 Aesthetics

The most prominent visual features within the proposed Project area and vicinity include the existing PGV operations and lava formations from the 2018 Lower Puna eruption.

The 1987 Puna Geothermal Venture Project EIS (PGV 1987) prepared for PGV evaluated views from eight viewpoints located along nearby roads or within subdivisions or public parks. They were:

- One view from the west of the power plant along Pāhoa-Pohoiki Road (Point 1);
- Two views from the north along Kapoho Road (Points 2 and 3);
- Three views from the southwest in Leilani Estates subdivision (Points 4, 5, and 6);
- One view from the south in Lanipuna Gardens subdivision (Point 7); and
- One view from the east along Highway 137 (Point 8).

The previous EIS (PGV 1987) concluded that “most, if not all,” visual impacts would be temporary, with views of the plant insignificant once planned landscaping matures and provides screening. Design considerations, including additional landscaping, painting of structures and pipelines, and site lighting treatment, were prescribed as mitigation through various county and state permit requirements. These measures were presented as further reducing visual effects or visibility of the existing operations.

The 2018 Lower Puna eruption significantly altered the visual landscape surrounding the Proposed Action by the creation of new topographic features and the destruction of potentially shielding vegetation. Additionally, many sources with aesthetic impact concerns (i.e., houses, roads, and public parks) in the area were destroyed. As a result, modified viewpoints (**Figure 6**) are proposed to assess the visual character in the Project area and vicinity. These include:

- One view from the southwest along the path of the Pāhoa-Pohoiki Road, which was destroyed during the 2018 Lower Puna eruption but will be rebuilt. This point will be modified from the original Point 1 to be located at the highest possible elevation on the lava flow.

- One view from the north along Kapoho Road (original Point 2)

- Two views southwest in Leilani Estates. The original Point 4 will assess impacts to the homes remaining in Leilani Estates and will serve as a proxy for any others that are rebuilt nearby. The original Point 6 will be modified to be located at the intersection of the potentially rebuilt roads, Leilani Avenue and Pāhoa-Pohoiki Road.

- One view from the south in Lanipuna Gardens. The original Point 7 will be modified based on topography and the visibility of PGV.

The EIS will evaluate impacts from the Proposed Action to aesthetics and visual landscape.

3.10 Hazardous Materials and Solid Waste

Hazardous materials currently utilized or present at the facility include lubrication and fuel oil, pentane, and H_2S. Lubrication and fuel oil are utilized for operating equipment, pentane is a hydrocarbon used as a working fluid in geothermal energy operations, and H_2S which is emitted as a gas result from volcanic activity and is managed and abated as part of operations at the facility. **Table 3-6** includes a summary of hazardous material storage at the facility.

Table 3-6 Onsite Hazardous Fuel Storage Locations

Material	Quantity	Capacity (nominal capacity) in gallons	Notes
Pentane	2	10,000	To support geothermal energy conversion activities
Pentane	1	10,000	Located at Pad D
Diesel	1	<100	For emergency water pump in the wellfield
Diesel	1	500	For diesel-driven emergency firewater pump at power plant
Diesel	1	1,500	For standby generator at power plant
Diesel	1	1,000	For vehicle use
Diesel	1	13,000	To fill day tanks for engines used for drilling rig
Diesel	4	40	Day storage tanks, one for each of three Waukesha engines (drilling rig) and one share for the two Caterpillar engines (drilling rig)
Diesel	1	3,000	Day storage tank, for top drive engine for drilling rig
Diesel	4	500	Day storage tanks, one for each of the engines listed as Stack #S-DR4 through #S-DR7
Unleaded gasoline	1	1,000	For vehicle use

The current recovery of pentane, H_2S abatement, and solid waste management are described in Section 2.1.6, Pollution Abatement and Hazard Control. The VRMU and VRU for pentane, as well as H_2S abatement, are described in Section 2.1.6. With these systems in place, injection fluids are designed to be contained. As stated in the ERP, if injection fluids were to escape containment, PGV would implement the ERP. The ERP includes steps to notify emergency response organizations (including the CDA and DOH, local fire and police departments, the DLNR, and the public), and evaluate any potentially hazardous situations. As part of PGV's UIC Permit with the EPA (Part III.D.1 and 2), if this situation were to occur, the EPA may also require an assessment of any endangerment, and if necessary, a remedial response.

As described in the DOH noncovered source air permit and the ERP, monitoring for H_2S occurs continuously at the site. Detectors for pentane, fire, and gas are located throughout the facility and monitored continuously as described in the ERP.

The ERP includes details regarding spill control and containment for spills or leaks of chemicals, including hydrocarbons, which could occur related to transfer or storage of pentane, caustic soda, treatment chemicals, diesel fuel, or unleaded gasoline. The EIS will include an analysis of potential off-site impacts from the proposed Project. Caustic soda is considered hazardous because of its corrosivity, but is otherwise not toxic, and the quantity stored on site will not be able to move off site under any upset condition.

As described in the ERP, although geothermal brine spills may occur, the brine from the wells at the facility does not contain levels of constituents which necessitate its classification as hazardous waste. Brine chemistry will be evaluated analytically each year to monitor any changes in brine characteristics.

Rubbish generated from operations and employees is collected regularly, and wastewater disposal is managed in a large-quantity septic system per state and federal regulations.

The EIS will evaluate impacts from the Proposed Action to hazardous and solid waste.

3.11 Transportation and Access

Access to the facility from Pāhoa is east along Highway 132. The 2018 Lower Puna eruption destroyed the portion of Highway 132 to the area known as Four Corners (intersection of Highway 132 and Highway 137) east of the facility, heading towards Kapoho. PGV restored the portion of Highway 132 near the existing operations in 2020 to regain access to the facility and also provide access to residents who had lost access to their properties with the lava flow.

As part of the Kīlauea Eruption Recovery effort, Hawai‘i County proposes to utilize Federal Emergency Management Agency funds to restore infrastructure including roads and water lines along Pohiki Road and Highway 137. Hawai‘i County expects construction for the projects to begin in the fourth quarter of 2023 following completion of an Environmental Assessment (EA) (County of Hawai‘i 2022b).

The EIS will evaluate impacts from the Proposed Action to transportation and access.

4.0 Consistency with Government Plans and Policies and Relevant EAs and EISs Considered

4.1 Land Use Laws

The Project is consistent with Hawai‘i Land Use Law (Chapter 206, HRS) since it is situated within the Kapoho Section of the Kīlauea Lower East Rift Geothermal Resource Subzone. Subzones were areas of significant geothermal potential where geothermal exploration and production is encouraged (see Section 1.5). Note that HRS Section 205-5.1 creating such geothermal subzones was repealed by Act 97 (2012).

4.2 Hawai‘i State Plan and Hawai‘i State Functional Plans

The Hawai‘i State Planning Act (Chapter 226 HRS, as amended) establishes a set of themes, goals, objectives, and policies that are meant to guide the state’s long-run growth and development activities. The Project supports and furthers the state’s primary economic objective, to develop and diversify Hawai‘i's economic base. A major goal of the state is to increase energy self-sufficiency. A second energy goal is to achieve dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people. The Project supports the state's major energy objective and policy of increasing energy self-sufficiency. By upgrading equipment and capacity of the facility, the Project would supply a large percentage of Hawai‘i Island’s renewable firm capacity and energy and would be another important step for self-sufficiency for the state. HELCO’s forecast for an increase in the Hawai‘i Island’s energy needs would help to be met through the Project.

The Statewide Planning System identified in Chapter 226 HRS requires State Functional Plans, which implement state and county actions. The Department of Business, Economic Development & Tourism (DBEDT) originally developed the Energy Functional Plan in 1984 and updated it in 1991. The Project is consistent with DBEDT’s 1991 Energy Functional Plan. One of five areas of concern addressed in the plan is alternate energy resource development. The objective is to promote alternate and renewable energy technologies through commercialization in order to shift demand from petroleum to indigenous renewable resources. In response to the state’s dependence on imported petroleum, contribution of greenhouse gases from fossil fuel combustion, and possible disruption in oil supplies, the Functional Plan states:

> A reduction of our dependence on oil and fossil fuels can be achieved by a balanced combination of demand reduction through the development of conservation and energy efficiency resources and the displacement of fossil fuels with new energy sources through alternate and renewable energy resource development.

Objective B in the Energy Functional Plan: “Displace oil and fossil fuels consumption through the application of appropriate alternate and renewable energy resources and technologies.”

The existing facility and Project are consistent with Action B(1): “Assist with the Development of Geothermal First to Serve the Island of Hawai‘i, and then for Export if Economically, Environmentally and Socially Acceptable and Feasible.”

4.3 Hawai‘i Energy Policy

As described in Section 1.3, the HCEI was established to reduce the state’s dependence on imported petroleum for energy production and locally produce more clean energy. In 2015, Hawai‘i set a renewable energy goal of 100 percent by 2045 with interim targets of 30 percent by 2020, 40 percent by 2030, and 70 percent by 2040 (HCEI 2022). Additionally, Hawaiian Electric has committed to increasing Hawai‘i’s use of clean energy and reducing dependency on imported oil, with a goal to cut carbon emissions from power generation by 70% by 2030 and by 2045 to achieve net zero or net negative carbon emissions (Hawaiian Electric 2021a).

4.4 County of Hawai‘i General Plan

The General Plan for the County of Hawai‘i is a policy document expressing the broad goals and policies for the long-range development of the Island of Hawai‘i (County of Hawai‘i 2005). The plan was adopted by ordinance in 1989 and revised in 2005. The General Plan itself is organized into thirteen functional elements. In general, the Project would be consistent with the goals, policies and objectives, standards, and principles for several function areas. The Project is consistent with the following relevant energy goals and policies of the county.

Energy Goals:

- Strive towards self-sufficiency.
- Establish the Big Island as a demonstration community for the development and use of natural energy resources.

Policies:

- Encourage the development of alternate energy resources.
- Strive to assure a sufficient supply of energy to support present and future demands.
- Strive to diversify the energy supply and minimize the environmental impacts associated with energy usage.
- Continue to encourage the development of geothermal resources to meet the energy needs of the County of Hawai‘i.

The Project is consistent with the energy goals and policies in the General Plan by continuing to provide renewable geothermal energy and helping the county achieve self-sufficiency.

4.5 Required Permits and Approvals

Table 4-1 summarizes the status of permits for the existing facility, existing permits which need to be amended for the Project, and new permits that are required for the Project. The amount of energy proposed for Phase 1 (46 MW) is covered under the ARPPA approved by the PUC, but PGV and HELCO would be required to amend the agreement to generate 60 MW of power prior to implementing Phase 2.

Table 4-1 Existing and Required Permits for the Current Facility

Permit Title	Agency	Existing, To be Amended for Proposed Project, or New Permit Needed for Proposed Project
Federal		
Under Ground Injection Control (UIC) HI596002	Environmental Protection Agency	Existing, courtesy notification for the Project
State		
Under Ground Injection Control (UIC) UH-1529	Department of Health, State of Hawaii	Existing, renewal in progress, courtesy notification for the Project
Authority to Construct 7 Geothermal Wells (UIC)	Department of Health, State of Hawaii	Existing
Noncovered Source Permit No. 0008-02-N	Department of Health, State of Hawaii	Existing, renewal in progress, Amendment needed for the Project
Noncovered Source Permit No. 0008-03-N	Department of Health, State of Hawaii	Existing
Plan of Operation	Department of Land and Natural Resources, State of Hawaii	Existing, courtesy notification for the Project
County		
Geothermal Resource Permit (GRP 87-2)	Hawai‘i County Planning Commission, Last updated on 02/06/2001 for up to 60 MW	Notification for the Project

Permit Title	Agency	Existing, To be Amended for Proposed Project, or New Permit Needed for Proposed Project
Building Permit	Hawai‘i County Planning Department	Need new
Grading Permit	Hawai‘i County Planning Department	Need new

4.6 Relevant EAs and EISs Considered

The primary relevant Chapter 343, HRS document considered is the EIS prepared by PGV in 1987.

5.0 Consultation

Consultation with stakeholders to discuss potential impacts of the Project is a requirement prior to filing a Draft EIS under HAR Section 11-200.1-23. Accordingly, PGV will consult with elected officials, agency representatives, community leaders and neighbors throughout the duration of the process. Information gleaned from these meetings helped to identify important issues and provide guidance on the scope of the studies for the EIS. Agency and community issues will be considered in greater detail in the EIS.

Publication of this EIS Preparation Notice (EISPN) in the State of Hawai'i's Environmental Review Program's monthly publication *The Environmental Notice* starts a 30-day public review and comment period, within which agencies, groups and individuals have an opportunity to provide written comments regarding potential environmental effects from the Project. PGV will respond to substantive comments (defined as those pertaining to the scope of the EIS), with comments and applicable responses included in the EIS. Information collected during the scoping process will also be incorporated into the EIS to identify important issues and provide guidance.

HAR Section 11-200.1-23 also requires a public scoping meeting to be held during the 30-day EISPN comment period. Scoping serves as an opportunity to obtain input from the community, agencies, and other stakeholders regarding the issues and resources they would like to see addressed and analyzed throughout the EIS process. An in-person public scoping meeting will be held at Pāhoa Community Center on Wednesday August 17, 2022, from 5:00 – 8:00 PM.

5.1 Early Consultation

PGV holds quarterly meetings where public concerns and comments about the existing operations are regularly addressed. PGV provides regular reports to agencies as part of requirements for existing permits. Video recordings of previous quarterly meetings can be viewed at www.punageothermalproject.com.

5.2 Agencies and Parties to be Consulted

A list of agencies, organizations, and individuals that will be contacted during the publication of the EISPN and/or prior to filing the Draft EIS is provided in **Table 5-1**. Cultural practitioners will also be consulted as part of the cultural consultation process for the forthcoming CIA. Additional parties of interest may be identified during the review period of the EISPN.

Table 5-1 Agencies and Parties to be Consulted

Name	Affiliation
Elected Officials	
David Ige	Governor of Hawai'i
Mazie Hirono	Senator
Brian Schatz	Senator
Kai Kahele	US Representative, Hawai'i 2nd Congressional District
Joy San Buenaventura	Hawai'i State Senator, District 2
Greggor Ilagan	Hawai'i State Representative, District 4
Ashley Lehualani Kierkiewicz	Hawai'i County Council, District 4
Mitch Roth	Mayor, County of Hawai'i
Government Agencies	

Name	Affiliation
Environmental Protection Agency, Region 9	Federal
United States Geologic Survey, Hawaiian Volcano Observatory	Federal
United States Fish and Wildlife Service	Federal
U.S. Department of Energy	Federal
Public Utilities Commission	State of Hawai‘i
Hawaii State Energy Office	State of Hawai‘i
Department of Agriculture	State of Hawai‘i
Department of Business, Economic Development, and Tourism	State of Hawai‘i
Department of Business, Economic Development, and Tourism, Hawai‘i State Energy Office	State of Hawai‘i
Department of Defense	State of Hawai‘i
Department of Education	State of Hawai‘i
Department of Hawaiian Home Lands	State of Hawai‘i
Office of Hawaiian Affairs	State of Hawai‘i
Department of Health, Clear Air Branch	State of Hawai‘i
Department of Health, Environmental Management Division	State of Hawai‘i
Department of Land and Natural Resources	State of Hawai‘i
Department of Land and Natural Resources, State Historic Preservation Division	State of Hawai‘i
Department of Transportation	State of Hawai‘i
Office of Capital Improvement	University of Hawai‘i
Water Resources Research Center	University of Hawai‘i
Environmental Center	University of Hawai‘i
Department of Environmental Management	County of Hawai‘i
Fire Department	County of Hawai‘i
Department of Parks and Recreation	County of Hawai‘i
Planning Department	County of Hawai‘i
Police Department	County of Hawai‘i
Department of Public Works	County of Hawai‘i
Department of Research and Development	County of Hawai‘i
Department of Water Supply	County of Hawai‘i

Name	Affiliation
Non-Profit Groups	
Kamehameha Schools	NA
Nanawale Community Association	NA
Leilani Community Association	NA
Main Street Pahoa	NA
Pōhaku Pelemaka	NA
Men of Pa'a	NA
Nā Maka Hāloa O Waipiʻo	NA
ʻO Makuʻu Ke Kahua	NA
Hoʻoulu Lāhui	NA
Japanese Chamber of Commerce & Industry of Hawaiʻi	NA
Hawaii Island Chamber of Commerce	NA
Hawaii Island Economic Development Board	NA
Hawaii Leeward Planning Conference	NA
Native Hawaiian Chamber of Commerce	NA
Sustainable Energy Hawaii	NA
Earth Justice Warriors	NA
Puna Pono Alliance	NA
Malama O Puna	NA
Hawaiʻi Groundwater and Geothermal Resource Center	NA
Parker Ranch	NA
Ulupono Initiative LLC	NA
Blue Planet Foundation	NA
Sierra Club of Hawaiʻi	NA
Neighbors and Concerned Citizens	
Interested individuals will be identified in early consultation and throughout the environmental review process	
Other	
Hawaiian Electric Light Company	NA

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15001_1400000US15001021101_1600000US1544562,1553975,1559900&tid=ACSST5Y2019.S1903.

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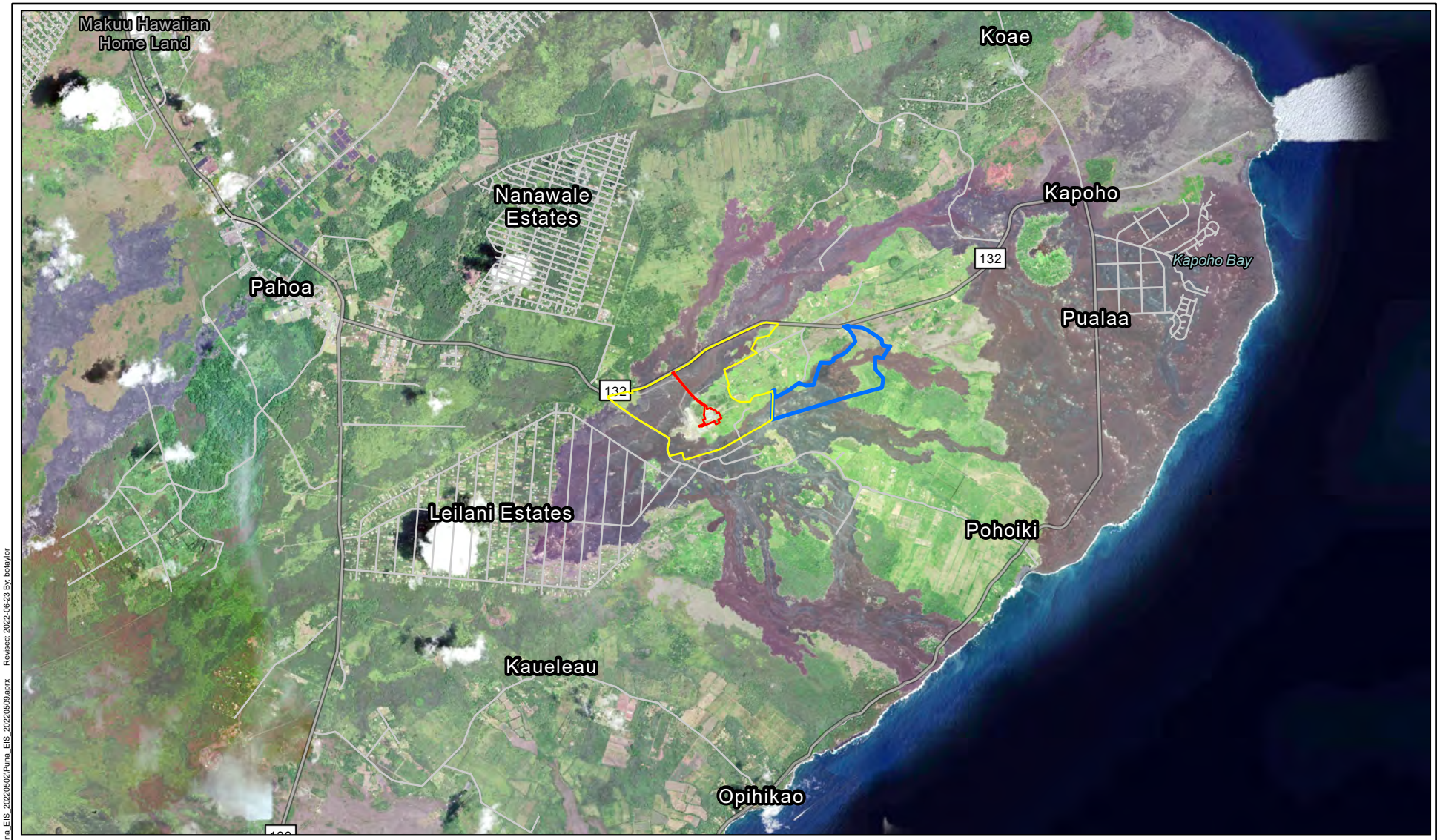
APPENDIX A
Figures



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Stantec

Feet

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Hawaii County, HI
NAD 1983 StatePlane Hawaii 1 FIPS 5101 Feet

DRAWN BY: BT	1ST REVIEW: JT	2ND REVIEW: ML
DATE: 2022-06-23	PROJECT NO: 185805496	

PUNA GEOTHERMAL VENTURE
GEOTHERMAL REPOWER PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Figure 1
Project Location

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Service Layer Credits: Sol_ImageryVivid_2020; Web Map Service data provided by USDA-FPAC. Images provided © 2021 Maxar Technologies Inc.
Hybrid Reference Layer: Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, USDA
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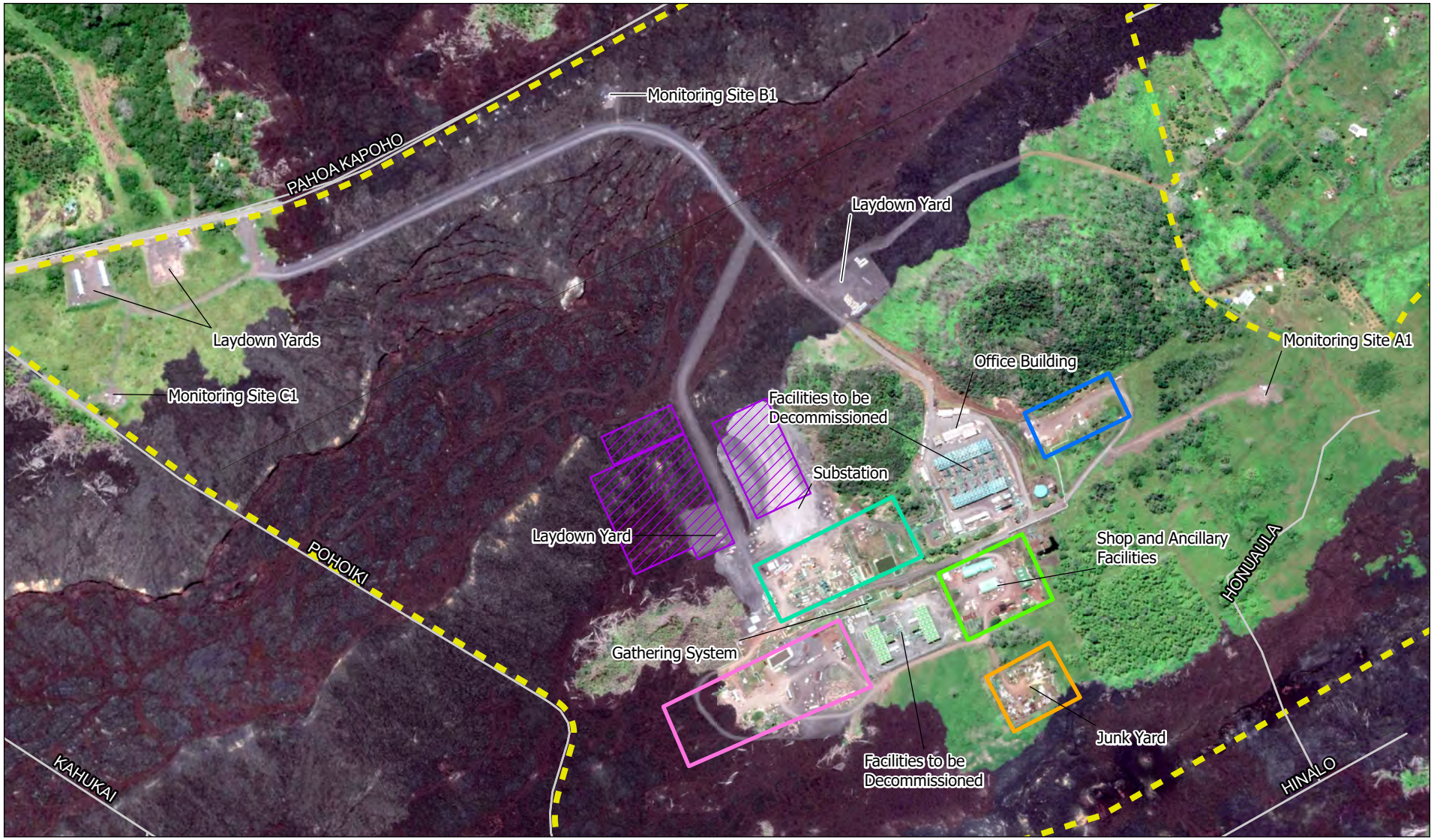
Light Gray Reference: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

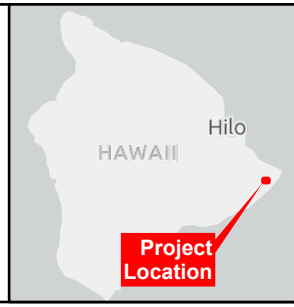


Legend

- Proposed Disturbance
- PGV Property Boundary

Existing Well Pads

- Pad A
- Pad B
- Pad D (no active wells as of 2022)
- Pad E
- Pad F (no active wells as of 2022)



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1 in = 700 feet

Hawaii County, HI
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DATE: 2022-05-11	PROJECT NO: 185805496	

PUNA GEOTHERMAL VENTURE
GEOTHERMAL REPOWER PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Figure 2
Existing Facilities

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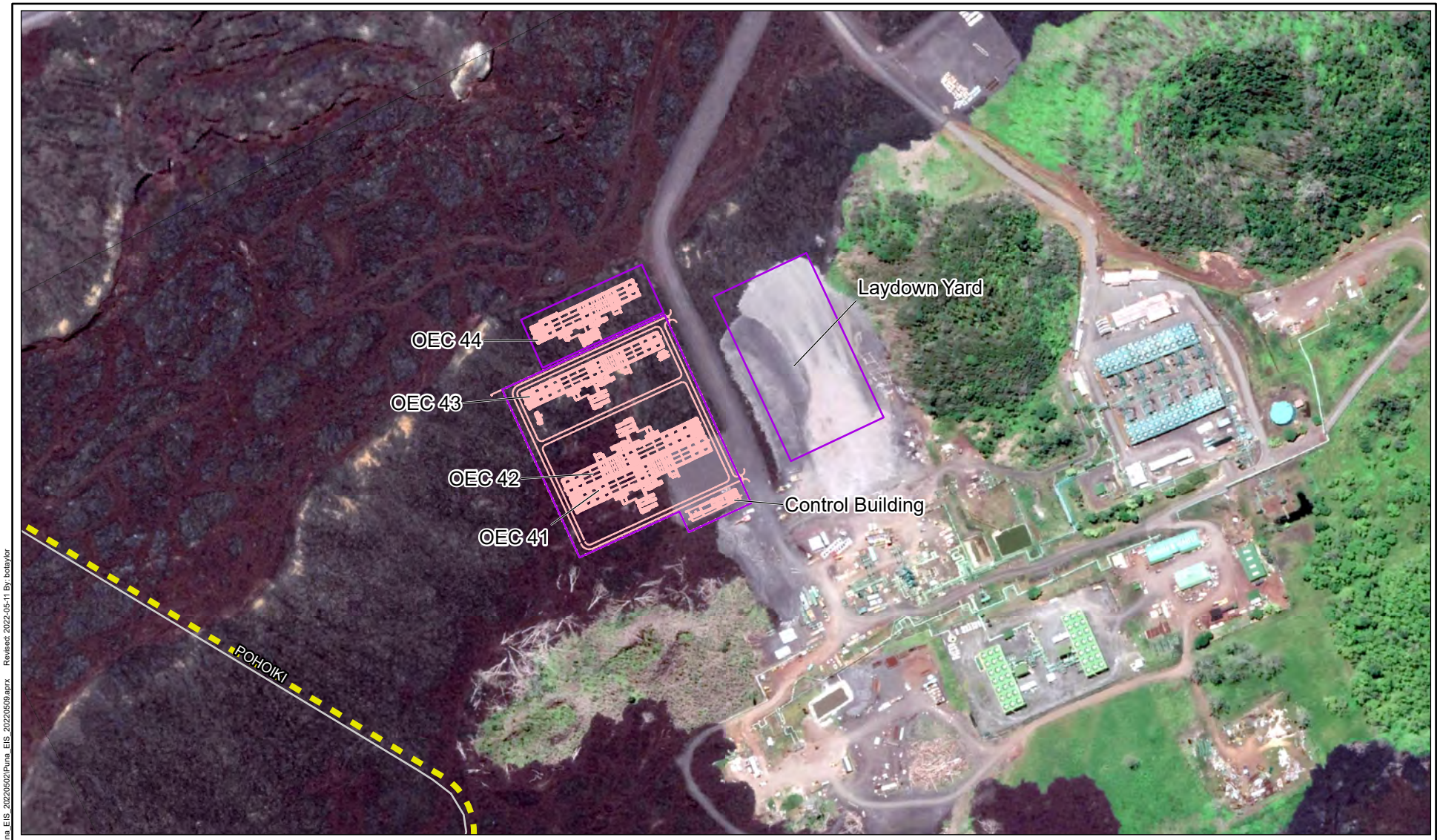

Legend

- Proposed Disturbance
- PGV Property Boundary
- Proposed Facilities

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Feet
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1 in = 400 feet

Hawaii County, HI
NAD 1983 StatePlane Hawaii 1 FIPS 5101 Feet

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DATE: 2022-05-11	PROJECT NO: 185805496	

PUNA GEOTHERMAL VENTURE
GEOTHERMAL REPOWER PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Figure 3
Proposed Project

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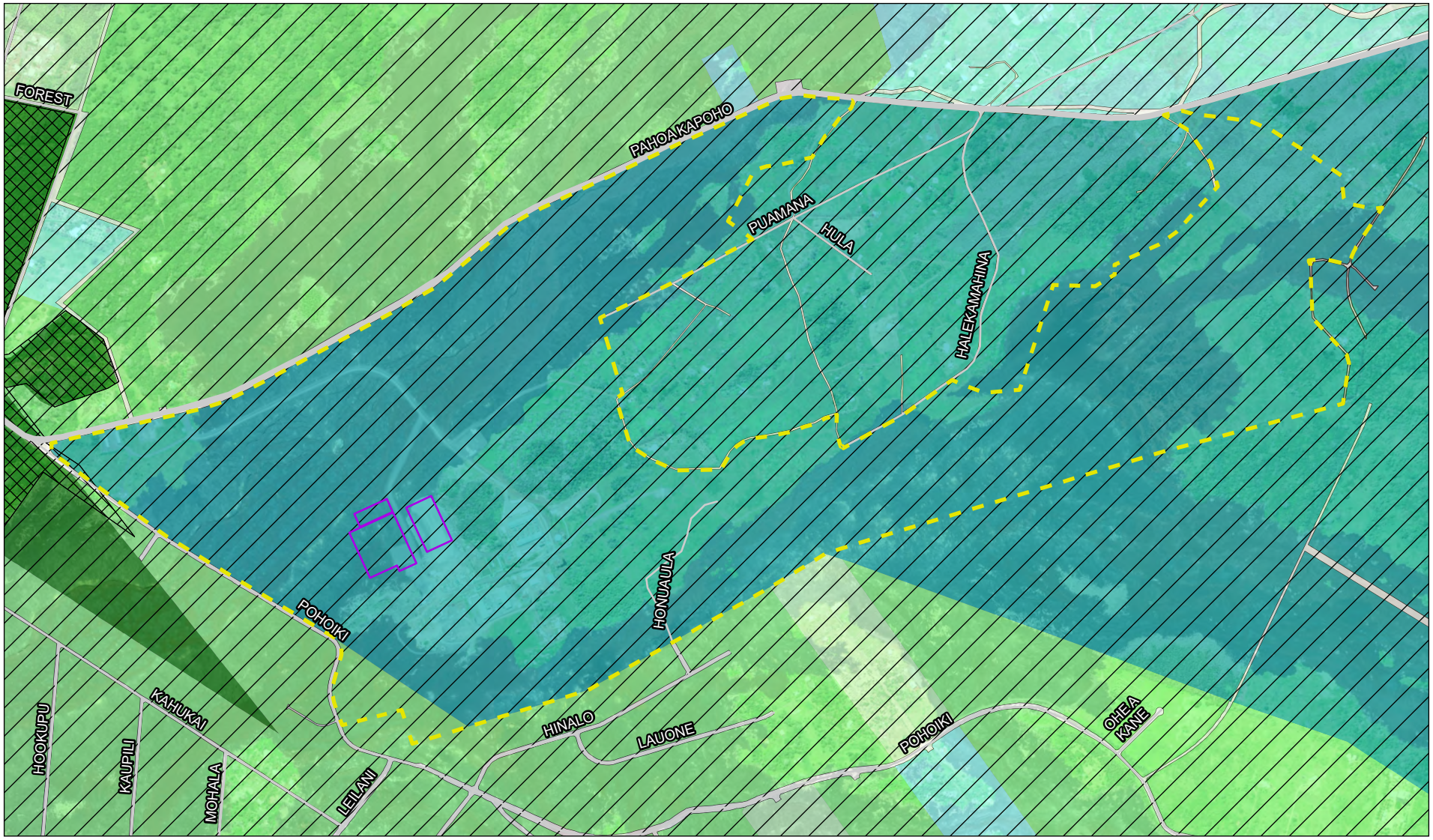
Service Layer Credits: Light Gray Base: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
Light Gray Reference: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
World Imagery: Resource Mapping Hawaii, Maxar



Legend

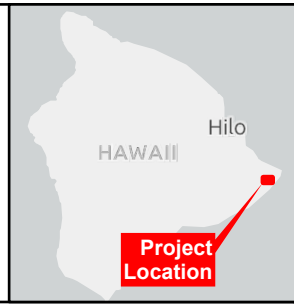
- Proposed Disturbance
- PGV Property Boundary

Land Use Code

- Agricultural
- Conservation

Zoning

- Road
- A-10a
- A-1a
- A-3a
- A-5a
- Open



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1 in = 1,500 feet

Hawaii County, HI
NAD 1983 StatePlane Hawaii 1 FIPS 5101 Feet

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DATE: 2022-06-23	PROJECT NO: 185805496	

PUNA GEOTHERMAL VENTURE
GEOTHERMAL REPOWER PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Figure 4
State Land Use District

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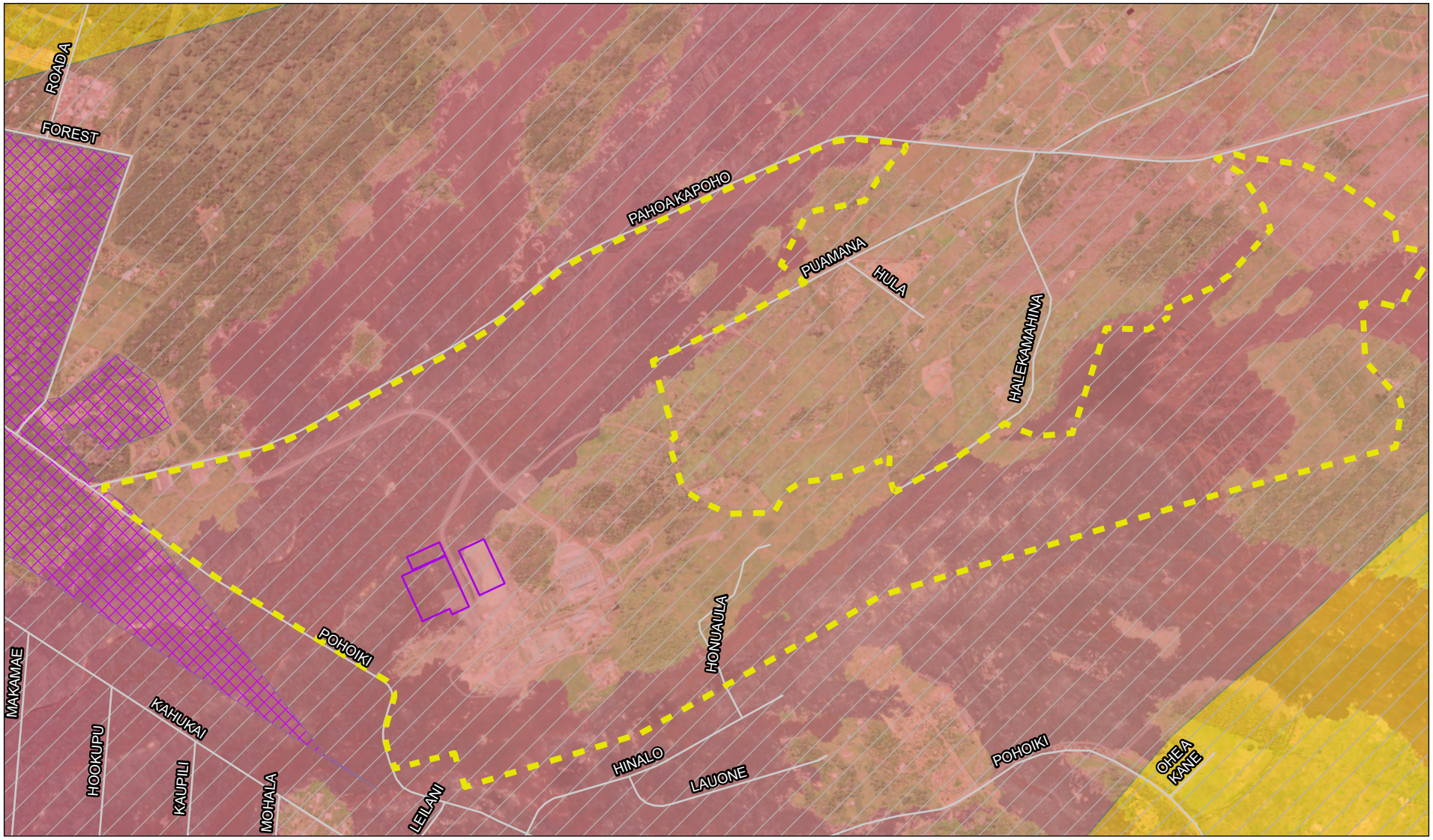

Legend

- Proposed Disturbance

Flood Hazard Zone

- D
- X

Lava Hazard Zone

- 1
- 2

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Stantec

0 750 1,500 Feet

1 in = 1,500 feet

Hawaii County, HI
NAD 1983 StatePlane Hawaii 1 FIPS 5101 Feet

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PUNA GEOTHERMAL VENTURE
GEOTHERMAL REPOWER PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Figure 5
Flood Map

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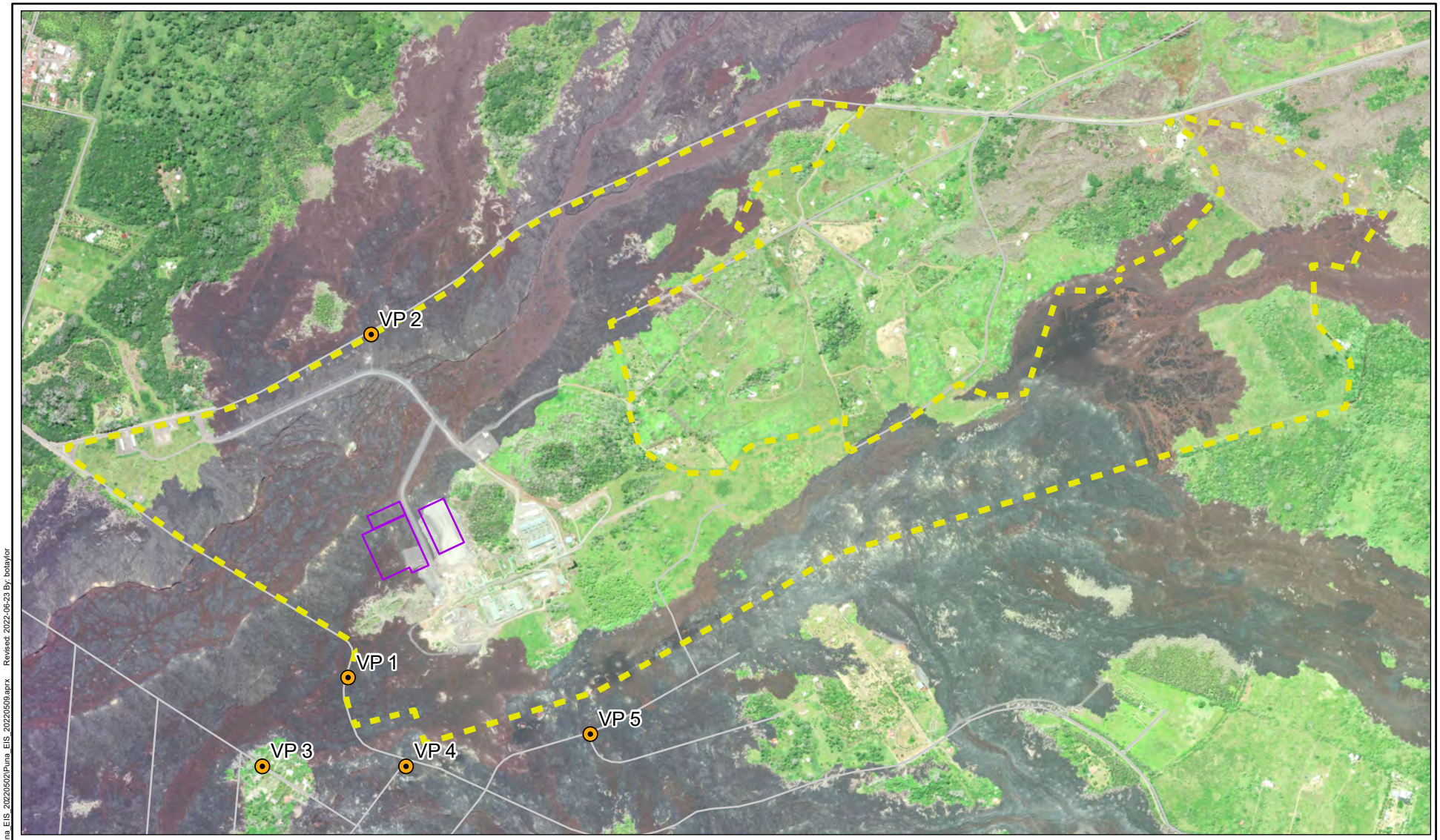

Legend

- Proposed Disturbance
- Suggested Viewpoints

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Feet
0 750 1,500
1 in = 1,500 feet

Hawaii County, HI
NAD 1983 StatePlane Hawaii 1 FIPS 5101 Feet

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DATE: 2022-06-23	PROJECT NO: 185805496	

PUNA GEOTHERMAL VENTURE
GEOTHERMAL REPOWER PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Figure 6
Suggested Viewpoints for Visual Analysis

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