State of Hawaii
Department of Agriculture
Agricultural Resource Management Division
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OFC. OF ENVIRONMENTAL QUALITY CONTROL

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Date: November 12, 2014

Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

Dear Director:

With this letter, the Department of Agriculture hereby transmits the final environmental assessment and finding of no significant impact (FEA-FONSI) for the Molokai Irrigation System Hydropower Plant situated at TMK (2)-53-003:015 (Lot 938-B-3) and TMK (2)-53-003:001, in the Molokai district on the island of Molokai for publication in the next available edition of the Environmental Notice.

The Department of Agriculture has included copies of comments that it received during the 30-day public comment period on the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI).

Enclosed is a completed OEQC Publication Form, two copies of the FEA-FONSI, an Adobe Acrobat
PDF file of the same and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If there are any questions, please contact Jeff Merz at 808-356-5318.

Sincerely,

Gordon Chong, P.E.
Agricultural Resource Management Division
State Department of Agriculture

Enclosures

Project Summary:

DOA is proposing to install a hydropower plant along the Moloka'i Irrigation System (MIS), whereby energy used for pumping water in the Waikolu Valley would be partially recovered by a turbine-generator installed alongside the existing pipeline. The hydroelectric power generation could reduce the ongoing costs of operating and maintaining the system by reducing the amount of electricity purchased to pump water into the system and by generating revenue from the sale of electricity to Maui Electric Company. The proposed project would also help to reduce Moloka'i's dependence on diesel fuel for electricity generation and help Moloka'i to meet the State of Hawai'i's 2030 Clean Energy Initiative of 60 percent clean energy by 2030.

AGENCY ACTIONS
SECTION 343-5(B), HRS
PUBLICATION FORM (FEBRUARY 2013 REVISION)

Project Name:	**Molokai Irrigation System – Hydropower Plant**
Island:	**Molokai**
District:	**Molokai**
TMK:	**2-53-003:015 (Lot 938-B-3) and 2-53-003:001**
Permits:	**State Public Utilities Commission Approval – Net Energy Metering Agreement** **Maui Department of Public Works – Building Permit, Grading & Grubbing Permit** **Maui County Planning Department – Special Use Permit (LUC)**

Proposing/Determination Agency:

State of Hawai‘i Department of Agriculture
Agricultural Resource Management Division
1428 South King Street
Honolulu, HI 96814
Gordon Chong, P.E.
(808) 973-1123

Consultant:

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, HI 96813
Martin Nakasone, P.E.
(808)529-7219

Status (check one only):

__DEA-AFNSI	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day comment period ensues upon publication in the periodic bulletin.
XX FEA-FONSI	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
__FEA-EISPN	Submit the proposing agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov); a 30-day consultation period ensues upon publication in the periodic bulletin.
__Act 172-12 EISPN	Submit the proposing agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov). NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.
__DEIS	The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the DEIS, a completed OEQC publication form, a distribution list,

along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.

__FEIS — The proposing agency simultaneously transmits to both the OEQC and the accepting authority, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqchawaii@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.

__ Section 11-200-23 Determination — The accepting authority simultaneously transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the proposing agency. No comment period ensues upon publication in the periodic bulletin.

__Section 11-200-27 Determination — The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.

__Withdrawal (explain)

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page)**:**

DOA is proposing to install a hydropower plant along the Molokaʻi Irrigation System (MIS), whereby energy used for pumping water in the Waikolu Valley would be partially recovered by a turbine-generator installed alongside the existing pipeline. The hydroelectric power generation could reduce the ongoing costs of operating and maintaining the system by reducing the amount of electricity purchased to pump water into the system and by generating revenue from the sale of electricity to Maui Electric Company. The proposed project would also help to reduce Molokaʻi's dependence on diesel fuel for electricity generation and help Molokaʻi to meet the State of Hawaiʻi's 2030 Clean Energy Initiative.

FINAL ENVIRONMENTAL ASSESSMENT/FINDING OF NO SIGNIFICANT IMPACT

MOLOKA‘I IRRIGATION SYSTEM HYDROPOWER PLANT MOLOKA‘I, HAWAI‘I

State of Hawai‘i Department of Agriculture
Agricultural Resource Management Division
1428 South King Street
Honolulu, Hawai‘i 96814

November 2014

FINAL ENVIRONMENTAL ASSESSMENT/FINDING OF NO SIGNIFICANT IMPACT

MOLOKAʻI IRRIGATION SYSTEM HYDROPOWER PLANT MOLOKAʻI, HAWAIʻI TMK: (2)-53-003:015 (LOT 938-B-3)

Prepared for:

State of Hawaiʻi Department of Agriculture
Agricultural Resource Management Division
1428 South King Street
Honolulu, Hawaiʻi 96814

Prepared by:

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, HI 96813-3698

November 2014

PROJECT SUMMARY

Project	Molokaʻi Irrigation System – Hydropower Plant
Approving Agency	State of Hawaiʻi Department of Agriculture Agricultural Resource Management Division 1428 South King Street Honolulu, Hawaiʻi 96814
Consultant/Preparer	AECOM Technical Services 1001 Bishop Street, Suite 1600 Honolulu, Hawaiʻi 96813
Triggers for Preparation of an EA – HRS Chapter 343	1. Use of State Funds 9. Proposal for a Power Generating Facility
Property Owner/Lessee	Molokaʻi Properties, Ltd.
Tax Map Key	(2)-53-003:015 (Lot 938-B-3) 1,717 acres (2)-53-003:001 1,768 acres
Location	Molokaʻi Ranch, Molokaʻi
Agencies Consulted	See Section 6.0 Distribution List and Attachment A for Agency Consultation Comments
State Land Use	Agriculture
Maui County Zoning	Agriculture
Existing Land Use	Agriculture-grazing and existing Molokaʻi Irrigation System
Proposed Action	Turbine-generator installation along existing easement of the Molokaʻi Irrigation System pipeline to recover energy used to pump water from the Waikolu Valley. This would generate renewable energy, which would help to reduce Molokaʻi's dependence on diesel fuel for electricity generation.
Determination	Finding of No Significant Impact (FONSI)
Permits that May be Required	State Public Utilities Commission Approval – Net Energy Metering Agreement Maui County Department of Public Works – Building Permit, Grading & Grubbing Permit Maui County Planning Department – Special Land Use Permit (LUC)

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ACRONYMS AND ABBREVIATIONS

%	percent
°F	degree Fahrenheit
§	Section
ALISH	Agricultural Lands of Importance to the State of Hawaiʻi
ALUM	Agricultural Land Use Map
BMP	best management practice
cfs	cubic feet per second
DAR	Hawaiʻi DLNR Division of Aquatic Resources
dBA	decibel (A-weighted scale)
DLNR	Hawaiʻi Department of Land and Natural Resources
DOA	Hawaiʻi Department of Agriculture
DOH	Hawaiʻi Department of Health
EA	Environmental Assessment
ft	feet or foot
ft^2	square feet
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
HAR	Hawaiʻi Administrative Rules
HIOSH	Hawaiʻi Department of Labor and Industrial Relations, Occupational Safety and Health Division
HRS	Hawaiʻi Revised Statutes
HvB	Holomua silt loam
HvB3	Holomua silt loam, severely eroded
IA	Implementing Actions
kW	kilowatt
LaE3	Lahaina silty clay, severely eroded
MCC	Maui County Code
MECO	Maui Electric Company
MIS	Molokaʻi Irrigation System
NAAQS	National Ambient Air Quality Standards
no.	number
OME	Oli silt loam
PLC	programmable logic controller
PUC	Public Utilities Commission
ROI	region of influence
rpm	revolutions per minute
RvT2	Very stony land, eroded
SCADA	Supervisory Control and Data Acquisition
SMA	Special Management Area
UIC	underground injection control
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1.0 INTRODUCTION

The Molokaʻi Irrigation System (MIS) is the largest state-owned system in Hawaiʻi. It is approximately 25 miles long from its source in Waikolu Valley on the northeast coast of Molokaʻi to the western end of its distribution system in southwestern Molokaʻi. MIS collects water from the northern Waikolu Valley to support farming of the semi-arid central plains of the Hoʻolehua and Palaʻa.

The proposed hydropower project is located along the MIS on the southern side of central Molokaʻi within Molokaʻi Ranch property boundaries (Figure 1). The proposed project is a minor modification to the MIS, whereby energy used for pumping water in the Waikolu Valley would be partially recovered by a turbine-generator installed alongside the existing pipeline. The proposed project would generate renewable energy, which would help to reduce Molokaʻi's dependence on diesel fuel for electricity generation. Electricity on Molokaʻi is supplied by Maui Electric Company (MECO).

The proposed project would complement the existing irrigation systems and would not adversely impact deliveries of water for irrigation.

1.1 PURPOSE AND NEED

The MIS is a major consumer of electricity used for pumping water from Waikolu Stream and from wells into the system and boosting water pressure on the irrigation distribution system. Hydroelectric power generation could reduce the ongoing costs of operating and maintaining the system by reducing the amount of electricity purchased to pump water into the system and by generating revenue from the sale of electricity to MECO.

Renewable energy generated by small hydropower projects would also reduce imports of oil for conventional diesel electric power generation and help Molokaʻi to meet the State of Hawaiʻi's 2030 Clean Energy Initiative of 70 percent clean energy by 2030.

1.2 PROJECT DESCRIPTION

1.2.1 Project Components

The proposed project would comprise the following components:

- Outdoor horizontal Francis turbine and generator enclosed in a weatherproof shelter.
- Piping and fittings to connect the turbine in a bypass arrangement.
- Outdoor synchronous bypass valve with fail-safe counterweight (gravity) closure mechanism.
- Controls and electrical equipment housed in an outdoor free-standing weatherproof enclosure or mounted on a concrete masonry unit wall.
- Installation of new section of 3,900 feet (ft) of power line and approximately 20 electrical transmission poles of approximately 38–40 ft in height to interconnect the project to the existing MECO power line which also supplies the Molokaʻi tunnel.
- Relocation of primary meter from the Molokaʻi tunnel to power line interconnection.
- Provide provisions for Hawaiian Telcom to install a new section of telephone line to interconnect the project to the existing Hawaiian Telcom line which also feeds the Molokaʻi tunnel.
- Renewable energy electrical interconnection with MECO.

1.2.2 Micro-Hydrological Technology

The micro-hydrological technology for the proposed project consists of a Francis turbine generator which is an inline water turbine and generator combined unit. Due to the small flows within the pipeline, a Francis turbine generator provides electricity within a smaller footprint. Two turbine manufacturers, Dependable and Norcan, are currently being evaluated to determine which would be more cost efficient for the proposed project.

1.2.3 Turbine Control and SCADA

1.2.3.1 Turbine Control

The operation of the turbine would have two modes – manual and automatic. Manual mode would allow an operator to start, stop, and adjust the turbine locally using a site-located human machine interface or remotely using a Supervisory Control and Data Acquisition (SCADA) system. Automatic operation would involve control of the turbine based on input from a pressure transducer.

The other important part of the system would be the synchronous bypass valve and its operation and control. This valve must be open whenever the turbine shuts down or when the pressure in the pipeline exceeds the maximum or minimum design flow of the turbine. The turbine system would include a built-in programmable logic controller (PLC). The PLC would allow stand-alone control of the turbine based on preprogrammed operating parameters, while the SCADA would monitor performance of the hydrological system and allow remote control.

To ensure that water deliveries are maintained, the synchronous bypass valve would include a fail-safe open. Specifically, the valve would have a counterweight or spring that would open it, and would be held closed by a hydraulic cylinder. In the event of a transmission line or plant outage, the valve would automatically open to ensure that water delivery is maintained.

1.2.3.2 SCADA and PLC Systems

The SCADA system at the hydroturbine site will communicate with the existing SCADA system at the Department of Agriculture (DOA) Molokaʻi office by utilizing either a new telephone service from Hawaiian Telcom or a wireless radio system to communicate with the existing Molokaʻi irrigation office via the West Portal. The existing SCADA system would need to be reprogrammed to accept the signal from the new hydro site and to allow remote monitoring via the internet.

The SCADA system would provide status updates and alarm features in case of malfunction of the hydropower system. The PLC system would include the hydroturbine-generator flow control, anti-surge control, load control, and unit sequencing.

1.2.4 Proposed Construction Activities

Proposed construction activities would include the following activities:

- Installation of appropriate erosion control measures.
- Grubbing and grading of land to prepare for pouring of concrete slab.
- Construction of concrete slab.
- Installation of above ground pipe, turbine and all appurtenances.
- Installation of power unit and enclosure.
- Installation of new section of 3,900 ft of power line and approximately 20 electrical transmission poles of approximately 38-40 ft in height to interconnect the project to the existing MECO power line which also feeds the Molokaʻi tunnel.
- Relocation of primary meter.
- Reprogram the existing SCADA system at the DOA Molokaʻi office to accept signal from proposed turbine.
- Possible installation of wireless radio antenna or telephone cables on power line poles.

LOCATION MAP

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83.
2. Aerial photo source: USGS 2006.

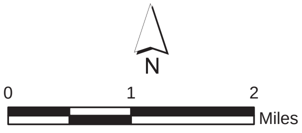


Figure 1
Site Location Map
Moloka'i Irrigation System - Hydropower Plant
Moloka'i, Hawai'i

Path: \\ushnl1fp003\data\Projects\USIG\Civil\DOA\Molokai-Hawaii Hydropower\400 Technical\406 Reports\406.1 Environmental Assessment\406.1.3 GIS\406.1.3.2 MXD\1. Site Location Map_rev01.mxd

1.2.5 Proposed Maintenance Activities

The Proposed Action would require no additional maintenance activities other than maintenance activities which currently occur (i.e. maintaining access way, routine system inspections, etc.). The turbine's life expectancy is 50 years. General maintenance is required yearly, with a major overhaul every 15 years.

1.2.6 Project Power Generation, Schedule, and Cost

The project proposes to use a 100 kilowatt (kW) induction generator operating at 900 revolutions per minute (rpm) including a capacitor. The generator is rated for 100 kW at 16.7 cubic feet per second (cfs) and operates at 30 percent (%)–100% of rated flow. Thirty percent flow is 5.01 cfs which occurs or is exceeded 95% of the time. The pumps only run at night approximately 10 hours a day to produce this flow.

The formula for this energy generation is summarized below:

100 kW hours x 10 hours a day x 365.25 days a year x 95% = 347,000 kW hours per year.

The power consumption in kilowatt-hours for Fiscal Year 2012 was 399,500 kW hours for that year. Given this usage, the power consumption of the pumps should be offset about 85%. The remaining 15% of the operating power will still need to be purchased from MECO.

Construction activities related to the Proposed Action are expected to take no more than 12 months to complete. Approval of engineering designs is expected as part of the building permit process in 2015 and would be completed 12 months after issuance of the building permit.

The Proposed Action has a preliminary construction cost estimate of $1.3 million. This project would be funded by DOA. Alternative 1 has an estimated cost of $650,000.

1.3 PERMITS AND APPROVALS THAT MAY BE REQUIRED

The following permits and approvals may be required for construction and operation of the proposed Molokaʻi Irrigation System - Hydropower Plant:

In addition to the environmental disclosure requirements of Hawaiʻi Revised Statutes (HRS) Chapter 343, implementation of the Proposed Action may require coordination and consultation with the following federal, state and county agencies for permits or approvals as presented in Table 1-1.

Table 1-1: Permits and Approvals that may be Required for Implementation of the Proposed Action

Permit or Approval	Description	Regulation(s)	Administrative Authority
State Public Utilities Commission Approval – NEM Agreement	Approval for a net metering project that may exceed a 50 kW capacity and/or exceed the aggregate net metering capacity authorized for Molokaʻi.	MECO, Rule 18 – Appendix II	PUC, MECO
County of Maui Grading & Grubbing Permit	A Grading Permit is required for excavation of fill, or for the temporary storage of soil, sand, gravel, rock, or any similar material. A Grubbing Permit is required for any act by which vegetation, including trees, timber, shrubbery and plants, is uprooted and removed from the surface of the ground.	MCC Chapter 20.08	DOPW, DSD
County of Maui -State Land Use Commission Special Use Permit	The described hydro-power plant use is not listed as an allowed use under HRS 205-2d(1-15) or 205-4.5(1-21); therefore, A State Special Permit (SUP) is required in accordance with HRS 205-6.	HRS 205-6	LUC

Permit or Approval	Description	Regulation(s)	Administrative Authority
County of Maui Building Permit	A Building Permit is required for the construction, alteration, moving, demolition, repair, and use of any building or structure within the county.	MCC Section 16.08.050; 16.16A	DOPW, DSD

DOPW Department of Public Works
DSD Development Services Division
LUC Land Use Commission
MCC Maui County Code
NEM net energy metering
PUC Public Utilities Commission

1.4 FINDINGS AND DETERMINATIONS

Based on the findings and the assessment of potential impacts from the proposed project, a determination has been made for a Finding of No Significant Impact (FONSI).

2.0 PROPOSED ACTION AND ALTERNATIVES TO THE PROPOSED ACTION

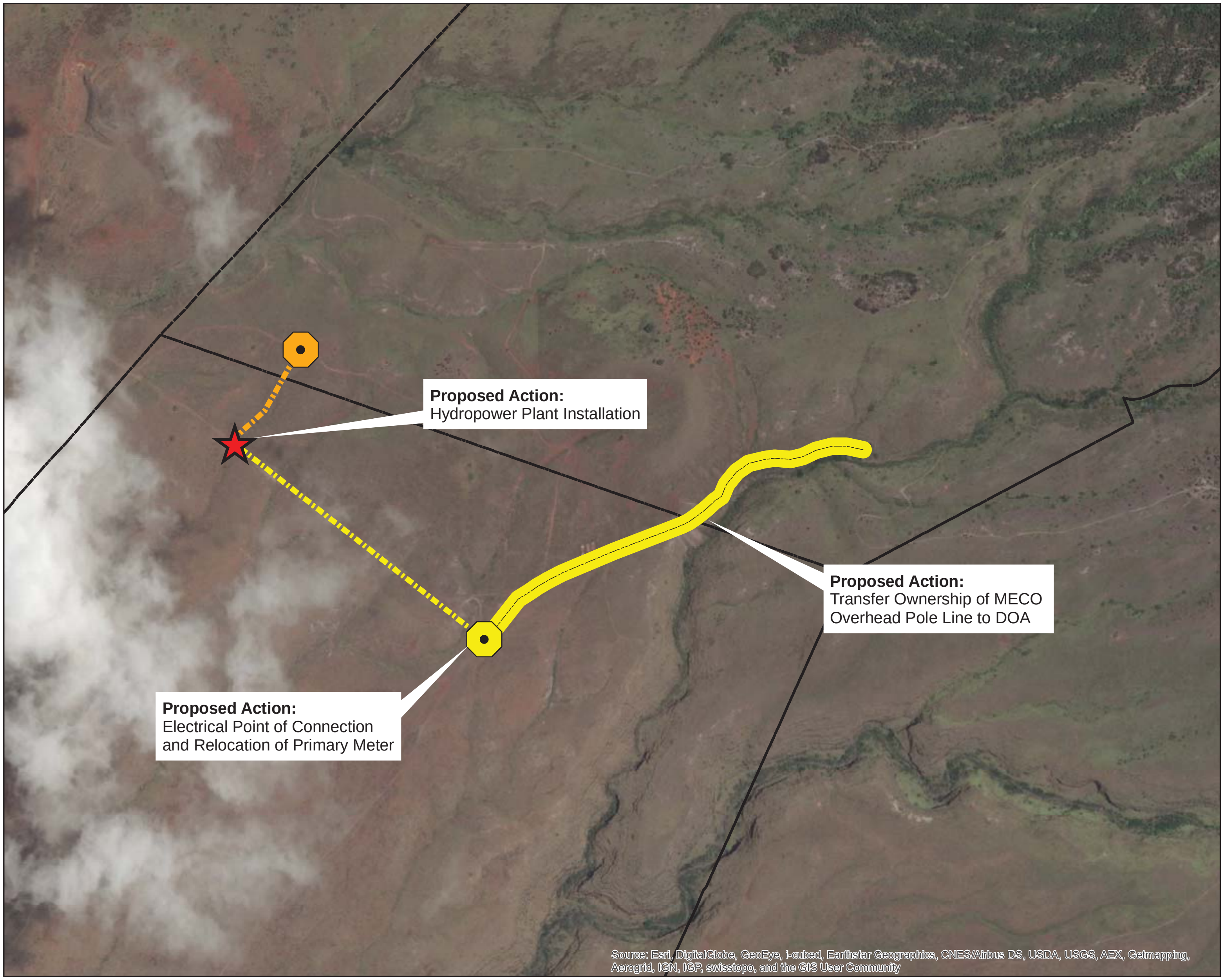
This section provides background information on the proposed project and a description of the Proposed Action, the No-Action Alternative, and the Alternative considered but not carried forward.

2.1 PROPOSED ACTION

The Proposed Action includes the development of the hydraulic potential that exists in the gravity flow water transmission pipeline that feeds the Kualapuʻu Reservoir. The project would involve installing a Francis generator turbine with-in the existing pipeline system and would require minimal modifications to the existing water delivery system (Figure 2).

Additionally, the Proposed Action also provides for the installation of a new overhead pole line from the hydropower installation facility back to the main dirt road at the junction that leads to West Portal and the relocation of the primary meter from the West Portal to the junction. This design would reuse a portion of the existing MECO service that currently feeds the Molokaʻi Irrigation Tunnel, thus allowing the power generated by the new hydroturbine site to offset the power being purchased from MECO under a Net Energy Metering (NEM) agreement. The length of this power line extension from the hydroturbine facility to the electrical point of connection is approximately 3,900 ft Installation of new section of 3,900 ft of power line and approximately 20 electrical transmission poles of approximately 38–40 ft in height to interconnect the project to the existing MECO power line which also feeds the Molokaʻi tunnel.

The Proposed Action was determined based on several factors, including public safety, construction cost, and sound engineering principles. Other factors considered included ease of access, community needs, environmental issues, aesthetics, local politics, permits and approvals, and land acquisitions required. This hydropower method would generate renewable energy and provide the assistance in achieving the State of Hawaiʻi's 2030 Clean Energy Initiative by reducing the need for conventional diesel electric power generation.



LOCATION MAP

LEGEND

- Propposed PowerLine
- Ownership Power Line
- Alternate 1 Power Line
- Parcel Boundary

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83.
2. Aerial photo source: USGS 2006.
3. Data source: http://hawaii.gov/dbedt/gis/

N

0 950 1,900 Feet

Figure 2
Proposed Action & Alternative Map
Molokaʻi Irrigation System -
Hydropower Plant
Molokaʻi, Hawaiʻi

2.2 ALTERNATIVE 1

Alternative 1 provides for the installation of additional MECO poles in order to extend the overhead pole line to the nearest existing MECO pole located upslope from the hydroturbine facility. The line will run parallel to the existing gulley and extend approximately 1,250 ft, with pole installation approximately every 200 ft from the hydroturbine facility to the electrical point of connection. This would also include two new electrical services. One service would be an overhead service from a pole mounted transformer that would provide power for the SCADA system, telemetry system, and miscellaneous loads at the hydropower site. The other service would be an underground service from a pad mounted transformer which would be used for the renewable energy connection to MECO and would require a Feed-In-Tariff interconnection agreement with MECO.

All the power generated at this site would offset energy purchases from MECO. All power generated with this alternative would offset the power purchased from MECO; however it would receive a lower annual revenue and have greater detrimental impacts on biological resources by having to install power line poles upslope along the existing gulley that is significantly more vegetated than along the road.

2.3 NO-ACTION ALTERNATIVE

In addition to the Proposed Action and Alternative 1, the No-Action Alternative is analyzed in this environmental assessment (EA). Under the No-Action Alternative, the MIS would continue to consume electricity for pumping waters from wells into the irrigation system and existing costs of operating and maintaining the system would remain. Additionally, MIS would not participate in renewable energy efforts to reduce imports of oil to help Moloka‘i meet the State of Hawai‘i’s 2030 Clean Energy Initiative.

2.4 ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD

The following hydroelectric development measure was considered but not carried forward for various reasons.

2.4.1 Waikolu Hydropower Development Alternative

The Waikolu Hydropower Development Alternative would involve construction of a new small intake about 3,500 ft upstream of the existing diversions on Waikolu Stream and installing a new surface penstock between the intake and the proposed powerhouse location near the entrance to the Moloka‘i tunnel. The disadvantages to this alternative are high initial construction cost due to accessibility of location.

3.0 ENVIRONMENTAL SETTING, POTENTIAL IMPACTS, AND MITIGATION MEASURES

This chapter describes the affected environment associated with the Proposed Action and Alternatives, as well as the No-Action Alternative; the potential impacts to resources; and proposed mitigation measures. Cumulative effects and irretrievable and irreversible commitment of resources are also addressed in this chapter.

The affected environment describes the natural and man-made environments, which include climate and air quality, noise, geology and soils, water quality, biological resources, cultural resources, land use and ownership, visual resources, natural hazards, hazardous materials and hazardous waste, public facilities and services, and socioeconomics. Unless otherwise specified, the region of influence (ROI) for individual resources is the proposed project site.

3.1 CLIMATE AND AIR QUALITY

3.1.1.1 CLIMATE

Due to the orographic effect of the large mountains, there are rapid changes in rainfall over fairly short distances between the windward (northeastern) and leeward (western) sides of the island. The eastern end of Moloka‘i is a tropical rainforest and can receive up to 300 inches of rainfall per year and the central and western parts of the island receive about 15 to 30 inches per year (USGS 2005). Wind direction can vary throughout the year, but trade winds from the northeast are common occurrences. Temperatures in the area are generally very consistent and moderate, with the Moloka‘i Airport recording an annual average high of 82 degrees Fahrenheit (°F) and an annual average low of 67 °F. Periodically, air quality is affected by volcanic emissions from the distant Kilauea volcano on the island of Hawai‘i.

3.1.1.2 AIR QUALITY

Ambient air quality, which refers to the purity of the general outdoor atmosphere, is regulated under the Clean Air Act and the U.S. Environmental Protection Agency National Ambient Air Quality Standards (NAAQS) (40 Code of Federal Regulations Part 50). The State of Hawai‘i Department of Health (DOH) also regulates air quality and established ambient air quality standards (DOH 2001) that are as strict or, in some cases, stricter than the NAAQS. The State of Hawai‘i has also established standards for fugitive dust emissions emanating from construction activities (DOH 2011). These standards prohibit any visible release of fugitive dust from construction sources without taking reasonable precautions.

The State of Hawai‘i monitors ambient air quality for six regulated pollutants including:

- Particulate matter less than 10 microns
- Particulate matter less than 2.5 microns
- Carbon monoxide
- Ozone
- Sulfur dioxide
- Nitrogen dioxide

Areas where ambient levels of a criteria pollutant are below the NAAQS are designated as being in “attainment.” Areas where levels of a criteria pollutant equal or exceed the NAAQS are designated as being in “nonattainment.” In 2006, the State of Hawai‘i was in attainment for all criteria pollutants (DOH 2006).

3.1.2 Existing Air Quality

The project is located on a secured portion of Moloka‘i Ranch along a dirt access road that runs along the existing irrigation pipes. Emissions from distant motor vehicles and farming equipment are the primary source of air pollutants in the project vicinity. Due to the infrequent occurrences of these activities in the immediate project area, concentrations of ambient pollutants are assumed to be well below the federal and state ambient air quality standards. No additional information on air quality was collected.

3.1.3 Potential Impacts and Mitigation

3.1.3.1 PROPOSED ACTION

Only short-term construction-related impacts to air quality are anticipated with implementation of the Proposed Action. During construction, potential emission sources that may affect air quality at the project site include the following:

- Diesel and/or gasoline-powered construction equipment and motor vehicles (additional sources of carbon monoxide and carbon dioxide).
- Fugitive dust emissions resulting from grading.
- Construction vehicles traveling to and from the proposed project area and onsite construction equipment consisting of primarily diesel engines would contribute to local air pollution. Construction activities may also generate short-term fugitive dust particulate emissions.

Because levels of criteria pollutants in Hawaiʻi are consistently well below federal and state air quality standards (DOH 2010), and because the prevailing trade winds rapidly carry pollutants offshore limiting the effect on receptors, increases in levels of criteria pollutants at the project area from construction activities are not expected to be significant. It is not anticipated that federal or state ambient air quality standards would be exceeded during construction activities.

3.1.3.2 Alternative 1

Same as Proposed Action.

3.1.3.3 No-Action Alternative

Under the No-Action Alternative, no construction activities would occur at the project area. No additional emission sources would be added; therefore, there would be no impact to the existing air quality.

3.1.3.4 Mitigation Measures

Construction activities would be conducted in accordance with State of Hawaiʻi air pollution control regulations (DOH 2011) and would employ the proper administrative and engineered controls to reduce air emissions. Dust control measures including a dust control (watering) program would be implemented.

3.2 Agricultural Resources

Agricultural resources are the natural production of food, feed, fiber and other desired products by cultivation of certain plants and the raising of domesticated animals. The island of Molokaʻi relies heavily on its agricultural resources, primarily vegetable farming and cattle ranching, for economic stability by creating more jobs and more revenue than any other sector (e.g., tourism, service, government, etc.).

Due to the climatic convergence of dense tropical rainforests to temperate grasslands, central Molokaʻi provides the optimal environment for farming. Fruits and vegetables crops are grown where extensive lowland plains and rich soils are abundant. In effort to preserve the agricultural reliance within the State of Hawaiʻi, the DOA created a mapping system to designate areas for specific farming purposes. The Agricultural Land Use Map (ALUM) displays farming lands designated for livestock, field crops, orchards, and other. Within those designations, the ALUM shows areas of specific product or activity such as grazing, dairy, flowers, papaya, coffee, aquaculture, and wetland crops.

The DOA also adopted an agricultural productivity rating system known as Agricultural Lands of Importance to the State of Hawaiʻi (ALISH). The value of agricultural land is evaluated through a description of soil attributes present within a specific area. The DOA evaluates and analyzes soil productivity, water retention, erosion, chemical makeup, and factors favorable for root growth. Hawaiian lands meeting a criteria determined by the DOA fall under one of three classifications: *Prime*, *Unique*, and *Other*.

Prime – land that has the best physical, chemical, and climatic properties for crop production.

Unique – land that is best suited for special or high-value crops such as watercress, coffee, or taro.

Other – land that may not be the most productive, but is convenient for agricultural purposes because of its location, access to water, or other factors.

The network of these important agricultural lands forms the most valuable resources within Maui County.

3.2.1 Existing Agricultural Use

The ALUM shows that the project vicinity is primarily designated as grazing lands (Figure 3). A small herd of cattle are present and have the ability to roam and graze throughout this secured portion of Molokaʻi Ranch where entrance must be accessed with permission through a series of locked gates. The project area is not located on any lands of importance as designated under the ALISH system. However; lands designated as *Other* are in close proximity to the project area.

3.2.2 Potential Impacts and Mitigation

3.2.2.1 Proposed Action

Implementation of the Proposed Action would result in only minimal short-term impacts to agricultural resources. Due to the small footprint of the hydroturbine facility and the power line installment along the existing roadway, the cattle would still be able to graze throughout Molokaʻi Ranch without restraint.

The Proposed Action would result in no change to the agricultural land use designation.

3.2.2.2 Alternative 1

Same as Proposed Action.

3.2.2.3 No-Action Alternative

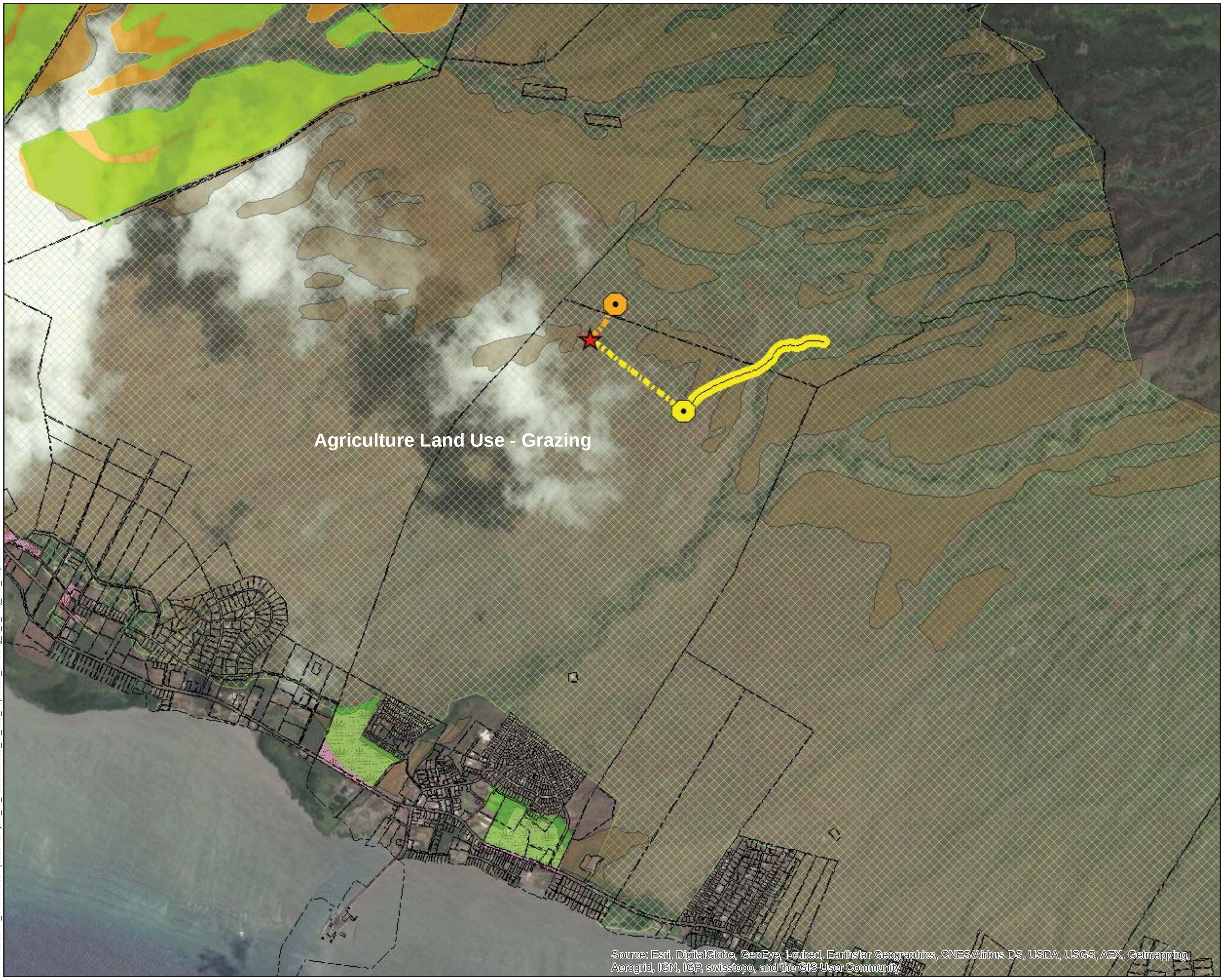
Under the No-Action Alternative, no construction activities would occur at the project area resulting in no change or disturbance to the existing agricultural resources. Therefore, no impacts from agricultural resources are anticipated under the No-Action Alternative.

3.2.2.4 Mitigation Measures

Construction activities would be conducted in a manner that would protect both grazing animals and construction personnel from harm. If cattle are encountered near the project area, construction activities would cease until animals are no longer within close proximity.

3.3 Noise

Noise is defined as unwanted sound and is one of the most common environmental issues of concern to the public. A number of factors affect sound as it is perceived by the human ear. These include the actual level of the sound (or noise), the frequencies involved, the period of exposure to the noise, and changes or fluctuations in the noise levels during exposure. The accepted unit of measure for noise levels is the decibel because it reflects the way humans perceive changes in sound amplitude. Sound levels are easily measured, but human response and perception of the wide variability in sound amplitudes is subjective.



Location Map

Legend

Agricultural Importance Class
- Prime Lands
- Other

Agriculture Land Use
- Grazing
- Vegetables/Melons
- Pineapple
- Parcel Boundary
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

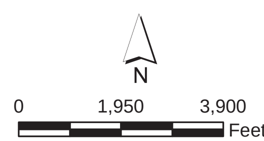


Figure 3
Agricultural Land Use and Agricultural Lands of Importance Map
Molokai Hydropower Project
Molokai, Hawaii

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The State of Hawaiʻi regulates noise exposure in the following statutes and rules: HRS §342F - *Noise Pollution*, HAR §11-46 – *Community Noise Control* (DOH 1996a), and HAR §12-200.1 *Occupational Noise Exposure* (DLIR 2006). Maximum permissible sound levels for Class C zoning districts including all areas equivalent to lands zoned agriculture, country, industrial, or similar type, is 70 (decibel [A-weighted scale]) dBA between the hours of 7:00 AM and 10:00 PM and 70 dBA between 10:00 PM and 7:00 AM (DOH 1996a).

3.3.1 Existing Noise Environment

The project is located on Molokaʻi Ranch in an area used for agricultural grazing approximately 3 miles from the nearest main road. No business, residential, farming or industrial establishments exist within a 2 mile radius from the project site. The absence of these establishments creates a very quiet noise environment.

3.3.2 Potential Impacts and Mitigation

3.3.2.1 Proposed Action

Noise generated during construction would be short-term. Construction equipment employed to implement the Proposed Action may include trucks, a crane, a back hoe, jack hammer, helicopter, diesel powered generators and air compressors. Noise generated by construction equipment could produce localized noise events of 100 dBA or higher at the construction site. Noise levels at 50 ft typically range between 55 and 88 dBA for equipment such as pick-up or dump trucks, jackhammers, lift booms, and excavators. Typical noise emission levels for construction equipment are provided in Table 3-1.

Table 3-1: Typical Noise Emission Levels for Construction Equipment

Type of Equipment	Noise Level at 50 Ft (dBA)
Air Compressor	81
Backhoe	80
Bulldozer	82
Chain Saw	85
Concrete/Grout Pumps	82
Crawler Service Crane (100-Ton)	83
Dump Truck	88
Drill Rigs	88
Excavator	85
Front End Loader	80
Generator	81
Jackhammer (Compressed Air)	85
Lift Booms	85
Pick-Up Trucks	55
Power-Actuated Hammers	88
Water Pump	76
Water Truck	55

Source: HMMH 2006.

Construction noise would decrease with distance from the project area through divergence, atmospheric absorption, shielding by intervening structures, and absorption and shielding by ground cover. All internal combustion powered equipment would be muffled and work would be limited to daytime hours. Upon completion of work, the area would return to preconstruction noise levels. Therefore, noise impacts would be less than significant.

3.3.2.2 Alternative 1

Same as Proposed Action.

3.3.2.3 No-Action Alternative

Under the No-Action Alternative, no construction activities would occur at the project area, and there would be no change to the existing noise environment. Therefore, no impacts from noise are anticipated under the No-Action Alternative.

3.3.2.4 Mitigation Measures

To minimize noise impacts, construction activities would be conducted in accordance with State of Hawaiʻi requirements set forth in HRS §342F, *Noise Pollution* and HAR §11-46, *Community Noise Control* (DOH 1996a), which establish maximum permissible sound levels from excessive noise sources, noise prevention, control, and abatement guidelines, and permit criteria.

The Hawaiʻi Occupational Safety and Health Division (HIOSH) has set the permissible occupational noise exposure at 90 dBA for a continuous 8-hour exposure. Permissible noise exposures for shorter periods are higher, with a maximum exposure of 115 dBA permissible for a duration of 15 minutes or less (DLIR 2006). Enforcement of HIOSH occupational noise exposure regulations would be the responsibility of the construction contractor. If workers experience noise exceeding HIOSH standards, administrative or engineering controls shall be implemented. Use of personal protective equipment such as earplugs or muffs may also be required.

To reduce nearby residential noise exposure, construction activities would be conducted on weekdays and in daytime hours in accordance with HRS §342-F-1. In the event that work occurs after normal working hours (i.e., at night or on weekends), or if permissible noise levels are exceeded, appropriate permitting and monitoring, as well as development and implementation of administrative and engineering controls shall be employed.

3.4 Geology and Soils

3.4.1 Geology

Molokaʻi's roughly rectangular shape results from two main shield volcanoes: Mauna Loa referred to as West Molokaʻi Volcano dates from about 1.9 million years ago, and Wailua referred to as East Molokaʻi volcano dates from about 1.75 million years ago making it the fifth largest of the major Hawaiian Islands with an area of approximately 261 square miles. Lava from east Molokaʻi flowed westerly above the lowland areas of the Hoʻolehua Saddle and collided with the eastern flanks of the preexisting West Molokaʻi volcano producing the elongated island.

Bisecting the island, the broad low-lying coastal plain along the south shore between the two volcanoes is composed of eroded sediment of the East and West Moloka'i Volcanoes. The southeastern edge of the island is bordered by an alluvial plain constructed from a series of semi-contiguous alluvial fans associated with upland gulches. Years after its last eruption, the northern portion of the east Molokaʻi volcano slid into the ocean leaving behind the towering cliffs on the northeast side of the island.

3.4.2 Soils

The *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokaʻi, and Lanai,* prepared by the U.S. Department of Agriculture Soil Conservation Service (USDA 1972) classifies the soils of the project area in central/south-central Molokaʻi as Holomua silt loam (HvB), Holomua silt loam, severely eroded (HvB3), Lahaina silty clay, severely eroded (LaE3), Oli silt loam (OME), and Very stony land, eroded (rVT2).

3.4.2.1 PROPOSED ACTION AREA SOILS

The soils of the Proposed Action area include the following:

- **Holomua silt loam, severely eroded (HvB3)** – Depth to a root restrictive layer is greater than 60 inches and slopes are generally 3 to 7 percent. The natural drainage class is well drained and water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low and no zone of water saturation within a depth of 72 inches. This soil does not meet hydric criteria.
- **Holomua silt loam (HvB)** – Depth to a root restrictive layer is greater than 60 inches and slopes are generally 3 to 7 percent. The natural drainage class is well drained and water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low and no zone of water saturation within a depth of 72 inches. This soil does not meet hydric criteria.
- **Very Stony Land, eroded (rVT2)** – Depth to a root restrictive layer (bedrock, paralithic) is 5 to 35 inches and slopes are generally 7 to 30 percent. The natural drainage class is well drained and water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is very low. Shrink-swell potential is moderate and no zone of water saturation within a depth of 72 inches. This soil does not meet hydric criteria.

3.4.2.2 ALTERNATIVE 1 SOILS

In addition to the soils of the Proposed Action area, the soils of Alternative 1 include a small presence of the following:

- **Holomua silt loam, severely eroded (HvB3)** – Depth to a root restrictive layer is greater than 60 inches and slopes are generally 3 to 7 percent. The natural drainage class is well drained and water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low and no zone of water saturation within a depth of 72 inches. This soil does not meet hydric criteria.

A soil classification map reflecting the Proposed Action area and the Alternative 1 area described above is provided as Figure 4.

3.4.3 Potential Impacts and Mitigation

3.4.3.1 PROPOSED ACTION

The Proposed Action includes temporary disturbance to the soils due to the grading of an area of approximately 2,500 square ft (ft^2) for the installation of the hydroturbine facility. A fence will also be installed surrounding this area and is estimated to be approximately 14 ft by 17 ft.

Additionally, the Proposed Action involves the installation of approximately 20 power poles, spaced every 200 ft, along the existing roadway to connect to the existing MECO power line poles. The construction footprint for each pole will be approximately 10 ft in diameter. The total disturbed area for the Proposed Action would be 4,100 ft^2.

3.4.3.2 ALTERNATIVE 1

The Alternative would include the same temporary disturbance for the hydroturbine facility installation, but would involve an alignment that would require only approximately 6 power poles. The construction footprint for each pole would remain the same as the Proposed Action. The total disturbed area for the Alternative would be 2,620 ft^2.

3.4.3.3 No-Action Alternative

Under the No-Action Alternative, no construction activities would occur at the project area, and there would be no change to the existing soils. Therefore, no impacts from soils are anticipated under the No-Action Alternative.

3.4.3.4 Mitigation Measures

Disturbed areas would be properly managed using best management practices (BMPs) for erosion and sediment control. BMPs will include installation of dust control fences or silt fences, gravel berms silt barriers, site barriers or other approved sediment trapping devices at the downstream side of the grading area and sediment pit. These measures would be installed prior to ground disturbing activities and would be inspected and maintained throughout the construction period.

3.5 Water Resources

This section describes the availability and quality of water resources, including surface water and groundwater. Surface water includes lakes, perennial/intermittent streams, and drainage ways. Groundwater includes water present in aquifers (perched, unconfined, confined, or artesian).

3.5.1 Surface Waters

Generation of surface water typically begins in the mountains as rainfall where surface water moves downgradient and collects in streams and gulches. A portion of this rainfall infiltrates through the ground surface and streambeds, recharging the underlying aquifer. Due to the geology and climate of Moloka‘i, there is a high contrast in the distribution of water resources across the island. Eastern Moloka‘i can receive up to 300 in of rainfall per year as a result from its high elevation and mountainous terrain. Western Moloka‘i has a lower elevation with a relatively flat terrain which results in a scarcity of water resources.

The State of Hawai‘i Division of Aquatic Resources (DAR) has created a coding system that identifies the island, region, and specific watershed of water resources located within the Hawaiian Islands. The Hawai‘i Stream Assessment code was created as a cooperative effort by the Commission on Water Resource Management, Department of Land Resources, University of Hawai‘i, and the National Park Service to easily identify the island, hydrographic unit, stream, and tributary segments of streams in the Hawaiian watersheds. The project area is located within the Kaunakakai Gulch (DAR Watershed Code 43010) and two streams, Kakalahale Stream and Kiowea Stream, codes 43011001 and 43012001 respectively, intersect the proposed project area and are represented in Figure 5 (DLNR).

3.5.2 Wetlands

The United States Fish and Wildlife Service (USFWS) National Wetlands Inventory shows no wetlands within the project area.

3.5.3 Groundwater

Aquifers occur in the flank lavas of the volcanic domes, in rift zones characterized by dikes, on poorly permeable perching members, or within the sedimentary sequence. The aquifers of Hawai‘i have been incorporated into a classification scheme determined by the Island, Sector, System, Type, and Status of aquifer. Groundwater beneath the proposed project area occurs within two aquifer systems; the Central Manawainui Aquifer with a sustainable yield of 2 MGD and the Southeast Kamiloloa Aquifer with a sustainable yield of 3 MGD as shown in Figure 6 (Mink and Lau 1992).

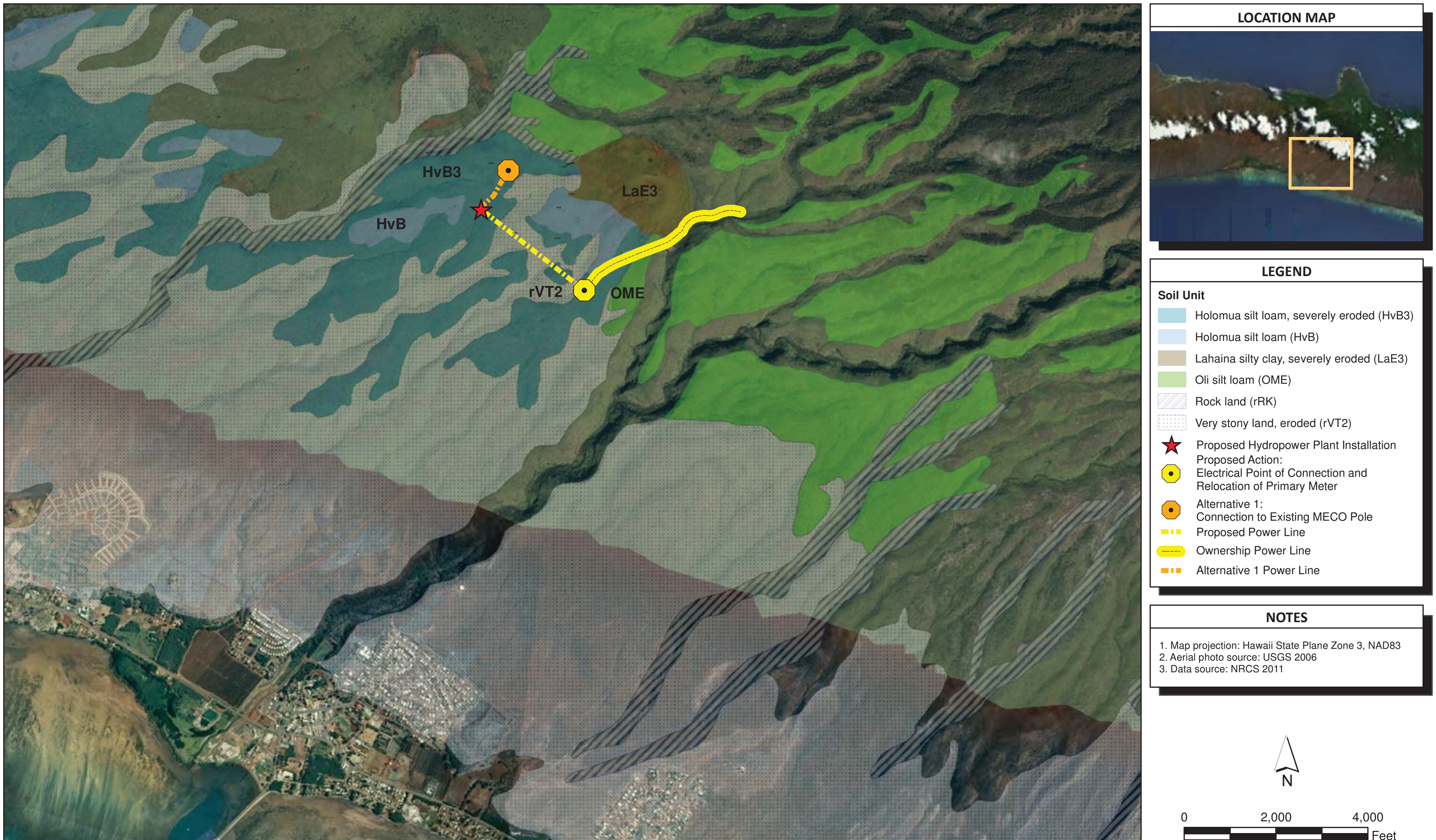
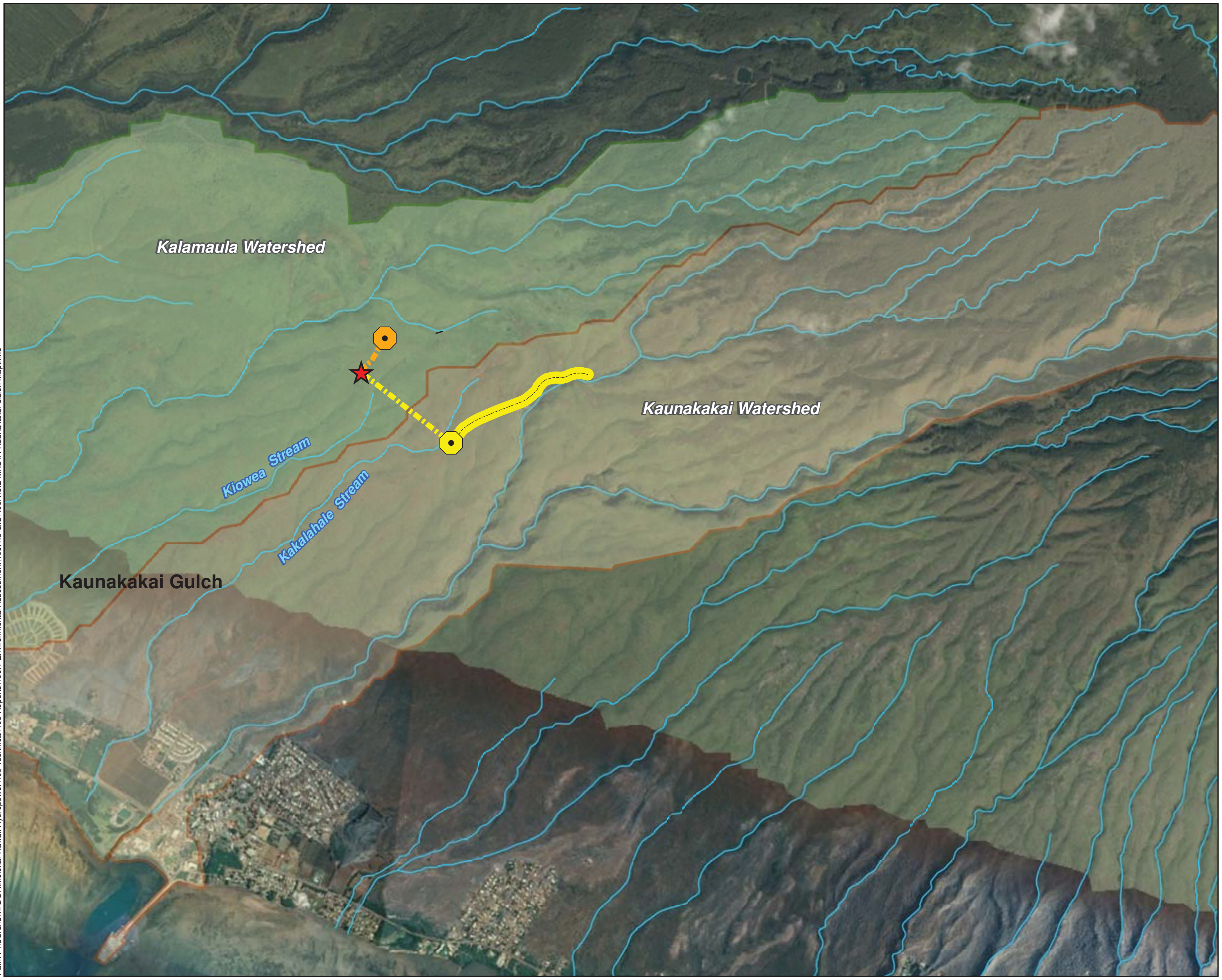


Figure 4
NRCS Soils
Molokai Hydropower Project
Molokai, Hawaii

Path: P:\USIG\Civil\DOA\Molokai-Hawaii Hydropower\400 Technical\406 Reports\406.1 Environmental Assessment\406.1.3 GIS\406.1.3.2 MXD\4. NRCS Soils.mxd



LOCATION MAP

LEGEND

Watershed

- Kalamaula Watershed
- Kaunakakai Watershed
- Streams
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS 2006
3. Data source: http://hawaii.gov/dbedt/gis/

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Figure 5
Kaunakakai Gulch Map
Molokai Hydropower Project
Molokai, Hawaii

Path: P:\USIG\Civil\DOA\Molokai-Hawaii Hydropower\400 Technical\406 Reports\406.1 Environmental Assessment\406.1.3 GIS\406.1.3.2 MXD\7. Kaunakakai Gulch Map.mxd

LOCATION MAP

LEGEND

Aquifer System

- KAMILOLOA
- KUALAPUU
- MANAWAINUI
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

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Figure 6
Molokai Aquifer System
Molokai Hydropower Project
Molokai, Hawaii

Path: P:\USIG\Civil\DOA\Molokai-Hawaii Hydropower\400 Technical\406 Reports\406.1 Environmental Assessment\406.1.3 GIS\406.1.3.2 MXD\5. Molokai Aquifer System_rev01.mxd

Central Manawainui Aquifer is classified as a basal aquifer containing freshwater in contact with seawater that is unconfined where the water table occurs in the horizontal flank lavas (Aquifer Code 40202111). The groundwater status is reported as potentially usable for drinking. The groundwater within this aquifer is described as containing water with a low salinity of 250-1000 milligrams per liter Cl^-, and is irreplaceable with a high vulnerability to contamination (Status Code 21211).

Southeast Kamiloloa Aquifer is classified as high-level, where fresh water does not come in contact with seawater and the water table is in the upper surface of the saturated aquifer on an impermeable layer (Aquifer Code 40301214). The groundwater status is reported as potentially usable for drinking. The groundwater within this aquifer is described as containing fresh water with a salinity <250 milligrams per liter Cl^-, and is irreplaceable with a high vulnerability to contamination (Status Code 22111).

The State of Hawai‘i underground injection control (UIC) program was established by the DOH Safe Drinking Water Branch to protect the quality of underground sources of drinking water. As part of this program, a UIC line was delineated on USGS maps for each island. Groundwater inland of this line is considered by the State to be a potential source of drinking water. Groundwater in areas seaward of this line are not considered potential drinking water sources.

A review of the UIC map for the Island of Moloka‘i indicates the proposed project area is located above the UIC line (Figure 7).

3.5.4 Potential Impacts and Mitigation

3.5.4.1 Proposed Action

Kakalahale Stream and Kiowea Stream are located within the Proposed Project area. The installation of the new overhead pole line along the access road crosses Kakalahale Stream and is within close proximity to Kiowea Stream. The length of this power line extension from the hydroturbine facility to the electrical point of connection is approximately 3,900 ft, with power line poles installed every 200 ft. Design of power line installation would avoid placing poles in or near both Kakalahale and Kiowea Streams. There would be no permanent changes to the drainage patterns with implementation of the Proposed Action.

Construction plans and specifications for the Proposed Action would include BMPs to minimize erosion on the project site during and after construction, as well as measures to contain runoff on site during construction. Temporary erosion control measures would be used during construction to prevent soil loss and to minimize surface runoff into adjacent areas. No impacts to surface water or groundwater resources are anticipated with the implementation of the Proposed Action.

3.5.4.2 Alternative 1

There are no lakes or streams in the project area for Alternative 1. Short-term construction-related impacts for Alternative 1 would include the installation of MECO power poles to extend approximately 1,250 ft upslope along the existing gulley to the nearest point of connection. BMPs to minimize erosion and sediment runoff will be implemented during and after construction to prevent flow from entering downslope Kiowea Stream.

3.5.4.3 No-Action Alternative

Under the No-Action Alternative, no hydropower development measures would be implemented and there would be no change to the water resources within the project area. Therefore, no impacts to water resources are anticipated with implementation of the No-Action Alternative.

3.5.4.4 Mitigation Measures

Disturbed areas would be properly managed using BMPs for erosion and sediment control. BMPs will include installation of dust control fences or silt fences, gravel berms silt barriers, filter runoff or other approved sediment trapping devices at the downstream side of the grading area and sediment pit. These measures would be installed prior to ground disturbing activities and would be inspected and maintained throughout the construction period.

3.6 BIOLOGICAL RESOURCES

The project area is located on the lowland dry region of south central Molokaʻi where the rolling terrain has been overgrazed by non-native livestock and dominated by non-native flora. A search of the USFWS online database of listed species and review of Hawaiʻi GIS layers for occurrences of Hawaiʻi listed species layers were conducted. The search concluded that no state or federal listed species, candidate species, or species otherwise determined to be rare or of special concern were observed within the proposed project area (Figure 8). A site visit conducted in January 2012 confirmed that no state or federal listed species, candidate species, rare species, species of special concern or critical habitat for these species exists within or near the proposed project area.

3.6.1 Flora

Observations identified that many grass species are present within the project area, such as Guinea grass (*Panicum maximum)*, cocklebur (*Xanthium saccharatum),* and finger grass (*Chloris barbata).* Non-native Lantana (*Lantana sp.)* and kiawe trees (*Prosopis pallida)* are also present. Brushfires are a common occurrence on Molokaʻi, and as a result the proposed project area has new growth and numerous trees and shrubs with fire scars. No flora listed as Threatened, Endangered or Species of Concern by the State of Hawaiʻi or by any federal jurisdictional agency was observed during the site visit (Figure 9).

3.6.2 Fauna

The site visit identified one terrestrial fauna species within the proposed project area: California Quail (*Callipepla californica),* as well as a swarm of an unknown species of wasp. Avifauna and mammals common to the Project site and surrounding areas include non-native cattle, deer, mongoose, rat, and wild pig. No fauna including seabirds, waterbirds, or terrestrial fauna listed as Threatened, Endangered, or Species of Special Concern by the State of Hawaiʻi or by any federal jurisdictional agency were observed during the site visit (Figure 10).

At the request of the U.S. Fish and Wildlife Service during the project referral process a radar survey was conducted to determine the presence of Hawaiian Petrels and Newell's Shearwaters. A report was completed entitled *Radar and Visual Studies of Hawaiian Petrels and Newell's Shearwaters at the Proposed Molokai Irrigation System Hydropower Plant.* (Appendix B). This report involved two observers monitoring movements of seabirds at one sampling station for a total of ten nights in the summer of 2014. Standard ornithological radar and audiovisual methods used during previous studies of seabirds in the Hawaiian Islands were used.

The team observed a total of three landward-flying and eight seaward-flying radar targets that fit the criteria for Petrel/Shearwater targets. No Hawaiian Petrels or Newell's Shearwaters were detected during visual observations. During the study the team concurrently recorded a total of three Petrel/Shearwater targets on vertical radar. Flight altitudes of these vertical targets ranged from 216–564 ft (66–172 meters) above ground level with a mean ± southeasterly flight altitude of 419 ±104 ft (128 ±32 meters) above ground level. Therefore 0% of these observations occurred at or below the height of the proposed transmission line 39 ft (12 meters) average height above ground level.

LOCATION MAP

LEGEND

Underground Injection Control Line

- Not Coded
- Below (makai) UIC Line
- Above (mauka) UIC Line
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/
4. Below (makai) UIC Line:
   - Underlying aquifer not considered drinking water source
   - Wider variety of wells allowed
   - Injection wells need UIC Permit or Permit exemption
   - Permit limitations are imposed
5. Above (mauka) UIC Line:
   - Underlying aquifer considered drinking water source
   - Limited types of injection wells allowed
   - Injection wells need UIC Permit or Permit exemption
   - Permit limitations are imposed and requirements are more stringent

N

0 2,000 4,000 Feet

Figure 7
Molokai Underground Injection Control Map
Molokai Hydropower Project
Molokai, Hawaii

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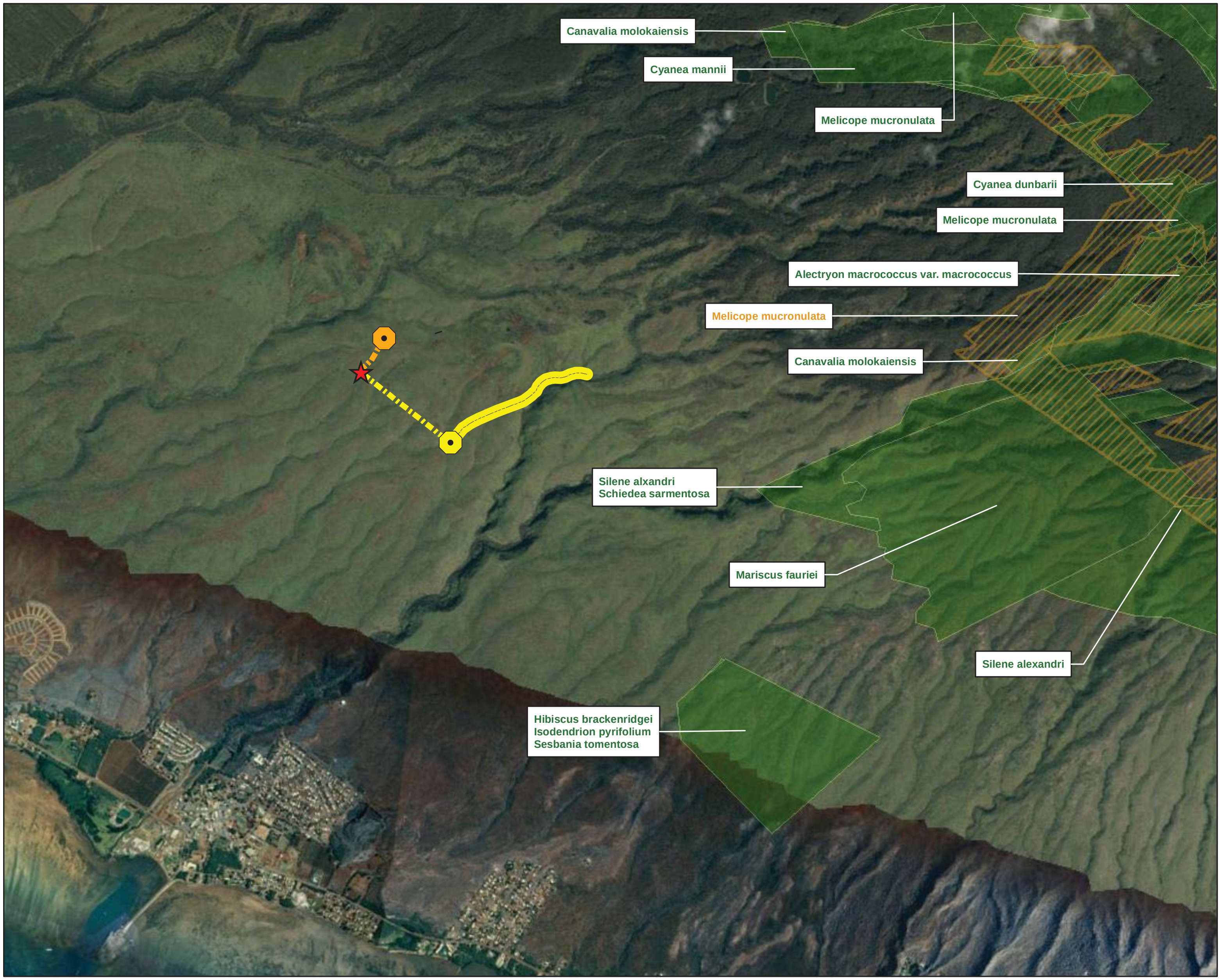

LOCATION MAP

LEGEND

- Critical Habitats for Molokai Moths
- Critical Habitats for Molokai Plants
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS 2006
3. Data source: http://hawaii.gov/dbedt/gis/
4. Scientific Name: Moth species
5. Scientific Name: Plant species

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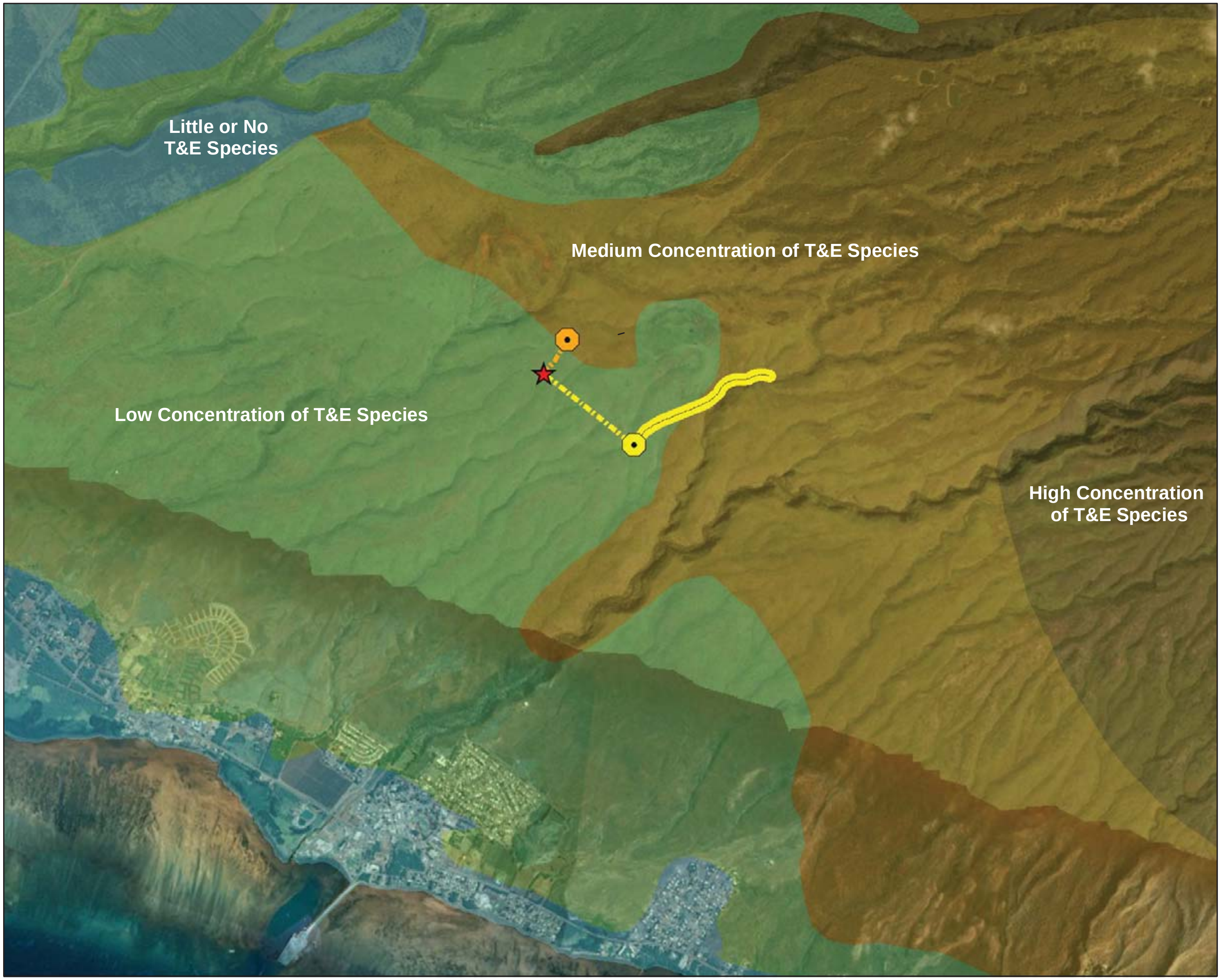
Figure 8
Molokai Critical Habitats Map
Molokai Hydropower Project
Molokai, Hawaii



LOCATION MAP

LEGEND

Threatened & Endangered Flora Density

- Little or no T&E species
- Low concentration of T&E species
- Medium concentration of T&E species
- High concentration of T&E species
- Very high concentration of T&E species
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

NOTES

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/
4. T&E - Threatened & Endangered

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Figure 9
Threatened & Endangered Flora Density
Molokai Hydropower Project
Molokai, Hawaii

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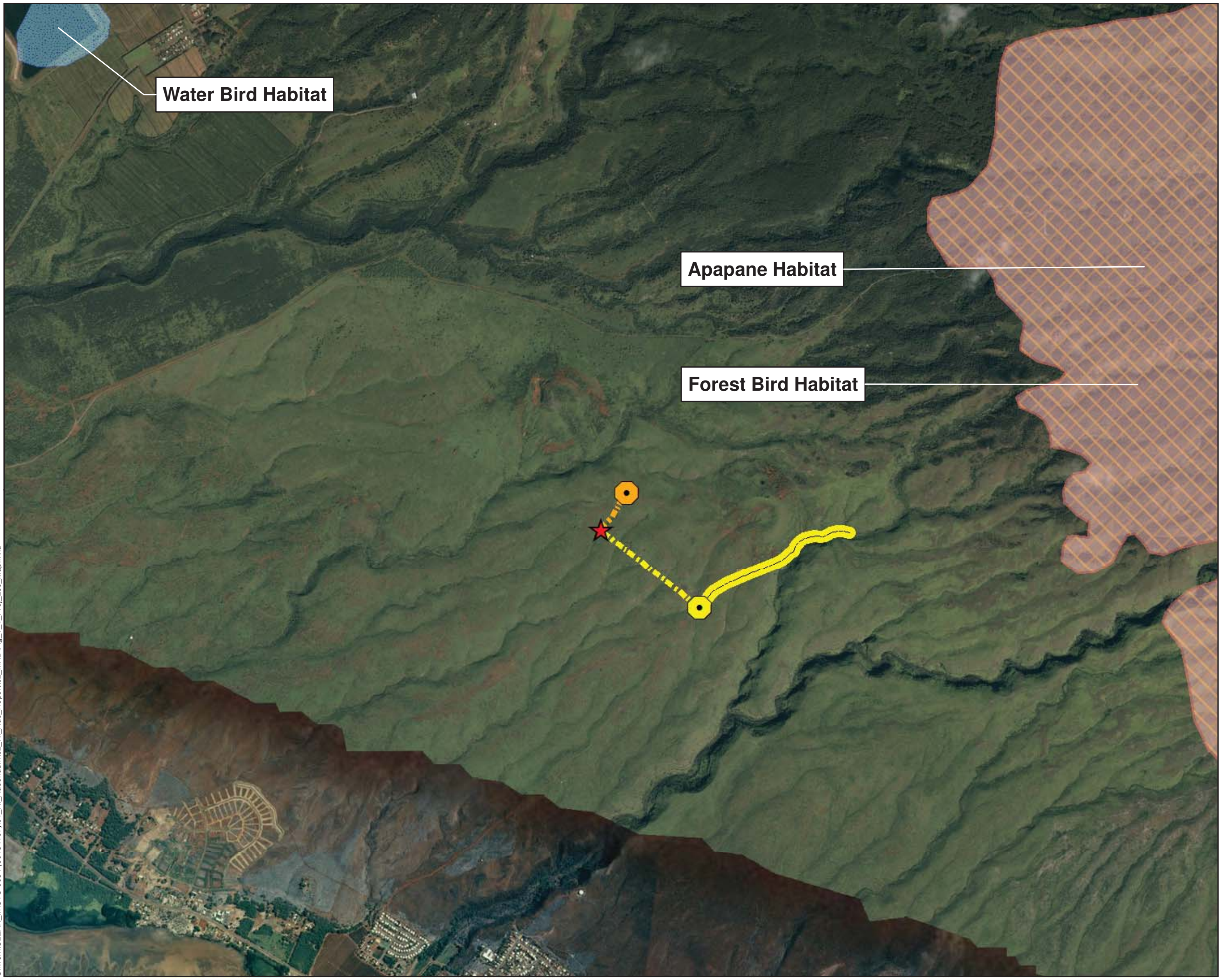

Location Map

Legend

- Forest Bird Habitat
- Apapane Habitat
- Water Bird Habitat
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

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Figure 10
Threatened & Endangered Fauna Map
Molokai Hydropower Project
Molokai, Hawaii

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The mean nightly passage rate of petrel/shearwater targets that was recorded on radar was lower than passage rates from most other studies in the Hawaiian Islands. Both the flight altitudes collected at the project and a larger dataset of visual observations from other sites in the Hawaiian Islands suggest that most, if not all, Hawaiian Petrels and Newell's Shearwater flying over the project area would occur above the height of the proposed transmission line. Therefore, although there is some level of risk to Hawaiian Petrels and Newell's Shearwaters at the project site the estimated number of annual collision fatalities (is estimated to be) very low. The team estimated that an average of approximately 0.13 Hawaiian Petrels/year and 0.01 Newell's Shearwaters/year would fly within the space occupied by the proposed transmission line.

3.6.3 Potential Impacts and Mitigation

3.6.3.1 Proposed Action

Only short-term construction-related impacts to biological resources are anticipated with implementation of the Proposed Action. The Proposed Action would include minor grading of the land to prepare for installation of the concrete slab, turbine, above ground pipe and power line poles. No rare botanical species or species listed as endangered or threatened by the State of Hawai‘i or the USFWS have been identified within the project area. The project area is not located within an area identified by the State of Hawaii as critical habitat for any fauna as shown in Figure 10. Likewise, no areas of Critical Habitat have been determined to be within close proximity to the project area. Based on the Hawaiian Petrels and Newell's Shearwaters survey study discussed in Section 3.6.2 above, the estimated number of annual bird collision fatalities is estimated to be very low. Therefore, no significant adverse impacts to biological resources are anticipated.

3.6.3.2 Alternative 1

The Alternative 1 power line alignment was not identified at the time of the January 2012 site walk. Should Alternative 1 become the recommended alignment to proceed in completing the purpose of this project, it is recommended that an additional site walk take place along the alternative power line alignment. However, due to the similar vegetation and topography as the Proposed Action project area, no significant adverse impacts to biological resources are anticipated in the Alternative 1 project area.

3.6.3.3 No-Action Alternative

Under the No-Action Alternative, no hydropower development measures would be installed. There would be no impacts to biological resources under the No-Action Alternative.

3.6.3.4 Mitigation Measures

Site-specific BMPs to control erosion and other pollutants, including filter socks, catch basin filter, and drain inlet protection, would be installed before construction. The BMPs would be maintained throughout the entire construction period. The contractor would be responsible for inspecting the BMPs weekly and repairing as necessary.

3.7 Cultural Resources

During the pre-contact era, the Moloka‘i population base was primarily concentrated at the island's windward coasts. The area was rich in ocean resources and the deep valleys with perennial streams supported a lifestyle based on subsistence agriculture, primarily associated with intensive taro production. The onset of western contact resulted in a reduced reliance on subsistence agriculture and increased dependence on a plantation and ranching-based economy. Herd animals (e.g., cattle, sheep, deer, goat, and horse) were introduced and had a notably adverse impact on the landscape due to their grazing (Wiesler and Kirch 1982). The Moloka‘i Ranch was founded at the end of the 19th century, purchasing lands formerly owned by King Kamehameha V.

According to traditional Hawaiian burial beliefs, following death, the *uhane*, or spirit, must remain near *na iwi*, or bones. Burial sites are chosen by Hawaiians for symbolic purposes in places for safekeeping. Today, federal and state laws protect both marked and unmarked burial sites.

3.7.1 Potential Impacts and Mitigation

3.7.1.1 Proposed Action

No surface historic properties were observed within the Project area. Consultation with the State Historic Preservation Division was initiated on 9 March 2012, and is currently under review with the consulting archaeologists at Maui Archaeology to determine the appropriate scope of work to complete the Project's historic preservation review process.

3.7.1.2 Alternative 1

Same as Proposed Action.

3.7.1.3 No-Action Alternative

Under the No-Action Alternative, no work would be performed at the project site. No impacts to cultural resources would occur with implementation of the No-Action Alternative.

3.7.1.4 Mitigation Measures

Should site work uncover subsurface features, work in the immediate area would cease and the State Historic Preservation Division and Maui Archaeology would be contacted for establishment of appropriate mitigation measures in accordance with Chapter 6E, Hawai'i Revised Statutes.

3.8 Land Use and Ownership

3.8.1 Existing Land Use and Ownership

The proposed project area is located on Moloka'i Ranch (owner: Molokai Properties, Ltd). with entry and exit to the site crossing over lands owned by the Department of Hawaiian Homelands (Figure 12). Current land uses on the property include agriculture cultivation and the existing Moloka'i irrigation system.

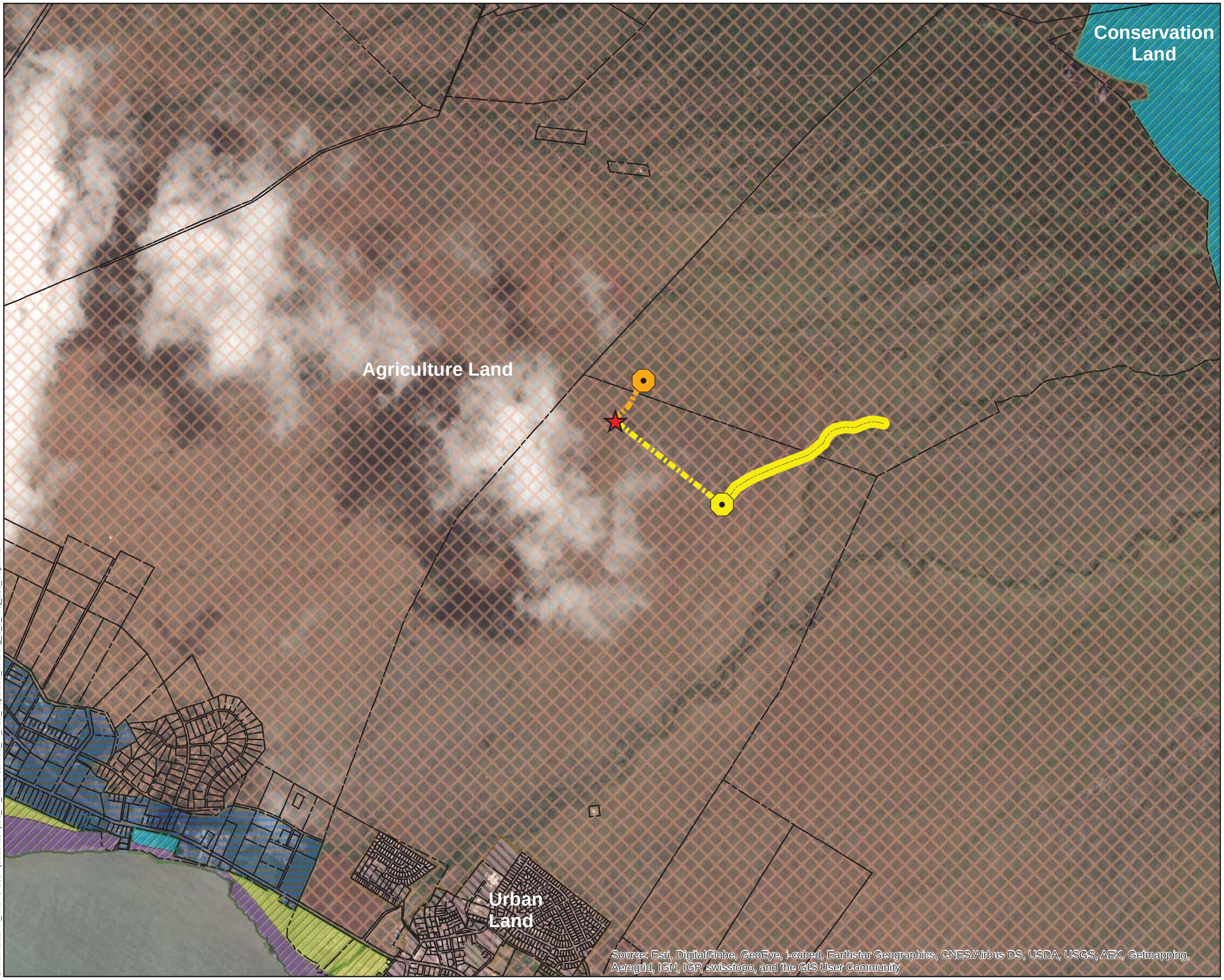
3.8.2 State Land Use Districts

The Hawai'i Land Use Law of HRS Chapter 205, HRS, classifies all land in the state into four land use districts: Urban, Agricultural, Conservation, and Rural. The State of Hawai'i Land Use Commission designated the proposed project area as Agriculture Land Use - *This use indicates areas for agricultural activity which would be in keeping with the economic base of the County and the requirements and procedures of Chapter 205 HRS, as amended.* The ALUM has designated this agricultural land as grazing land. No other State Land Use Districts and no ALISH lands exist in close proximity to the project area (Figure 11). The proposed project is located in the Agricultural District as defined under districting and classification of lands, Section 205-2 (d)(2), HRS.

Section 205-2 Districting and classification of lands:

(a) Agricultural districts shall include:

2. Farming activities or uses related to animal husbandry, and game and fish propagation;
6. Bona fide agricultural services and uses that support the agricultural activities of the fee or leasehold owner of the property.



Location Map

Legend

State Land Use District
- Agricultural
- Conservation
- Rural
- Urban

Conservation District
- General Subzone
- Limited Subzone
- Resource Subzone
- Parcel Boundary

- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

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Figure 11
State Land Use District and Conservation District Subzone Map
Molokai Hydropower Project
Molokai, Hawaii

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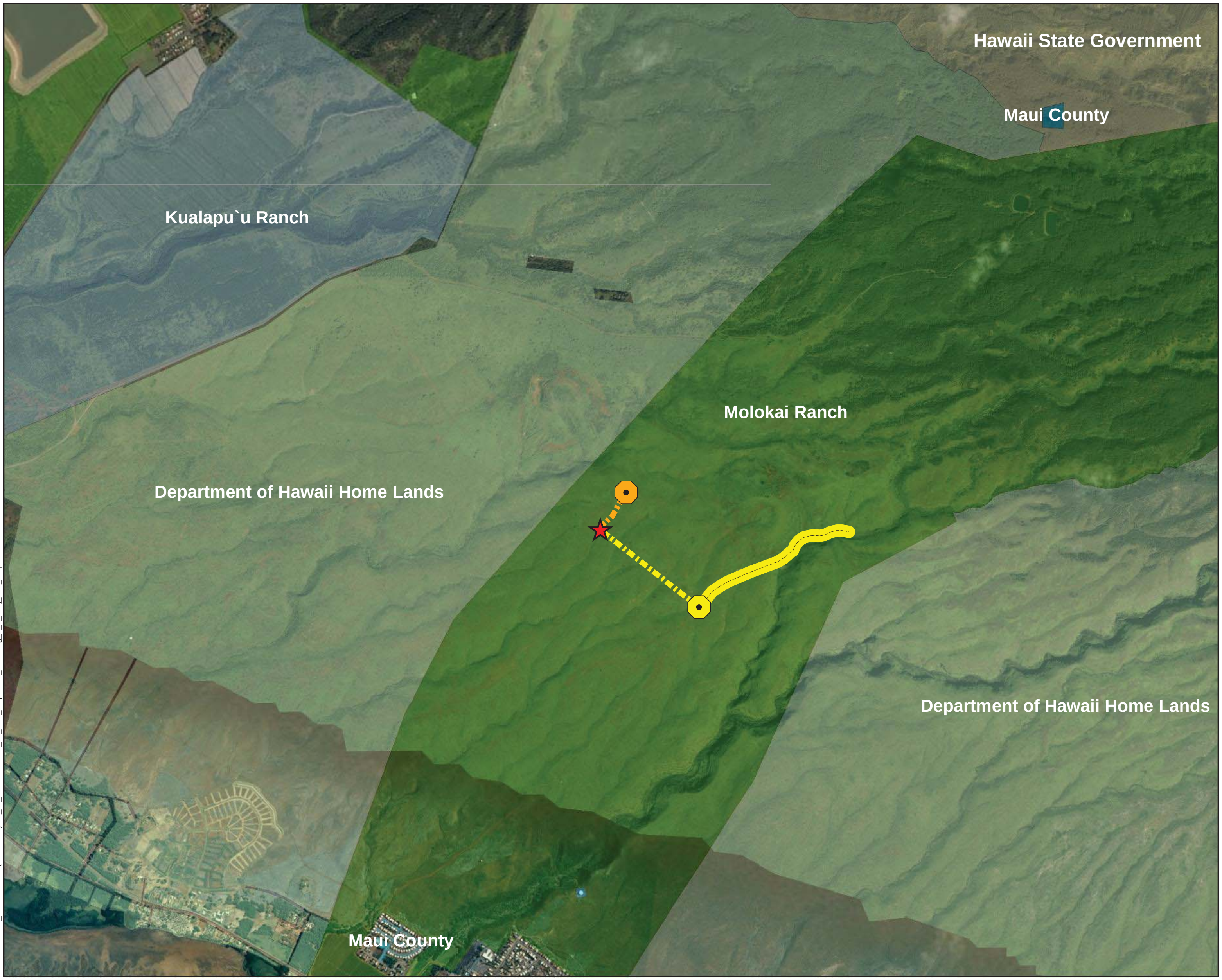

Location Map

Legend

Major Land Owner

- Molokai Ranch
- Hawaii State Government
- Department of Hawaii Home Lands
- Maui County
- Kualapuu Ranch
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

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Figure 12
Land Ownership Zone Map
Molokai Hydropower Project
Molokai, Hawaii

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3.8.3 County Land Use Zoning Districts

There are three County zoning classifications found on the two parcels on which the project is proposed including: Agricultural, Interim and P/Q-P-1 (Public/Quasi-Public). However, the area of the actual project is small encompassing a total disturbed area of 4,100 ft^2. and is completely located within the County of Maui Agricultural zoning district. Under Chapter 19.30A *Agricultural District* of the Maui County Code, two purposes of this district are to:

3. Promote agricultural development
4. Preserve and protect agricultural resources

The proposed project is a permitted use as noted in Section 19.30A.050 *Permitted Uses* of the Maui County Code – including:

6. Principal Use – Minor Utility Facilities
7. Accessory Use – Energy Systems, Small Scale

In addition, the proposed irrigation hydropower system would comply with Section 19.30A.030 *District Standards* of the Maui County Code including height limits and setbacks from property lines.

All development within the Special Management Area (SMA) is administered through the County of Maui Department of Planning pursuant to the objectives, policies and SMA guidelines as provided by HRS Chapter 205A. The proposed project is located outside the SMA and not located in close proximity to the shoreline. Therefore, no SMA permit is required.

Under provisions of Section 19.510.070 *Special Use Permits* of the Maui County Code, certain proposed uses on agricultural land trigger the need for a State Land Use Commission Special Use Permit. The described hydro-power plant use is not listed as an allowed use under HRS 205-2d(1-15) or 205-4.5(1-21); therefore, A State Special Permit (SUP) is required in accordance with HRS 205-6.

Project compliance with relevant land use plans and policies is further discussed in Sections 4.1 and 4.2 below.

3.8.4 Potential Impacts and Mitigation

3.8.4.1 Proposed Action

Implementation of the Proposed Action would result in no change to land use or ownership within the project area. However, the segment of the power line extension to the nearest existing MECO pole northeast of the hydropower site location will would require additional easement acquisition.

3.8.4.2 Alternative 1

Alternative 1 would result in a transfer of ownership of the existing power line located along the access road that leads to West Portal from MECO to DOA. The majority of Alternative 1 would be completed within the existing MIS easement.

3.8.4.3 No-Action Alternative

Under the No-Action Alternative, no work would be performed at the project site. Existing land use and ownership would remain; therefore, no impacts to land use and ownership would occur with the No-Action Alternative.

3.8.4.4 Mitigation Measures

No impacts are expected from this resource; thus, no mitigation measures would be required.

3.9 VISUAL RESOURCES

Visual resources are the aggregate of characteristic features imparting visually aesthetic qualities to a natural, rural, or urban environment. The visual resources for the proposed project area include the viewsheds from the main scenic highways, Mauna Loa Highway and Kamehameha V Highway, approximately 3 miles downslope, and the housing developments of Kaunakakai.

3.9.1 Existing Scenic and Visual Environment

The proposed project area is on grazing lands of Molokaʻi Ranch. The terrain consists of rolling hills covered with native and invasive vegetation that averages a height of 5 ft and below with occasional shrubs and trees exceeding that height within the drainage features. The proposed project is located along the existing MIS water line and access road that was completed in 1968.

3.9.2 Potential Impacts and Mitigation

3.9.2.1 PROPOSED ACTION

The proposed action is not anticipated to have a substantial, adverse impact to existing views.

3.9.2.2 ALTERNATIVE 1

Same as Proposed Action.

3.9.2.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, no work would be performed at the project site. No impacts to visual resources would occur with implementation of the No-Action Alternative.

3.9.2.4 MITIGATION MEASURES

No impacts are expected from this resource, thus no mitigation measures would be required.

3.10 NATURAL HAZARDS

Natural hazards that may occur in and affect the proposed project area include floods, tsunamis, hurricanes, earthquakes, flooding, and other natural events.

3.10.1 Floods

The State of Hawaii Flood Hazard Assessment Report map dated May 2012 shows the project site is in Zone X (Figure 13), which means that it is outside of the 500-year floodplain (NFIP 2012).

3.10.2 Tsunamis

Tsunamis are a series of destructive ocean waves generated by seismic activity that could affect shorelines of Hawaiʻi. Tsunamis affecting Hawaiʻi are typically generated in the waters off South America, the west coast of the United States, Alaska, and Japan. Local tsunamis have also been generated by seismic activity on the Island of Hawaiʻi.

The County of Maui Civil Defense Agency establishes tsunami evacuation zones and maps for all coastal areas on Molokaʻi. The project area is not within a tsunami evacuation zone (Maui 2012).

3.10.3 Hurricanes

The Hawaiian Islands are seasonally affected by Pacific hurricanes from June to November. These storms generally travel toward the islands from a southerly or southeasterly direction and can deposit large amounts of rain with high winds on the Hawaiian Islands. The storms generally contribute to localized flooding and coastal storm surges. Coastal storm surges would not impact the proposed project area.

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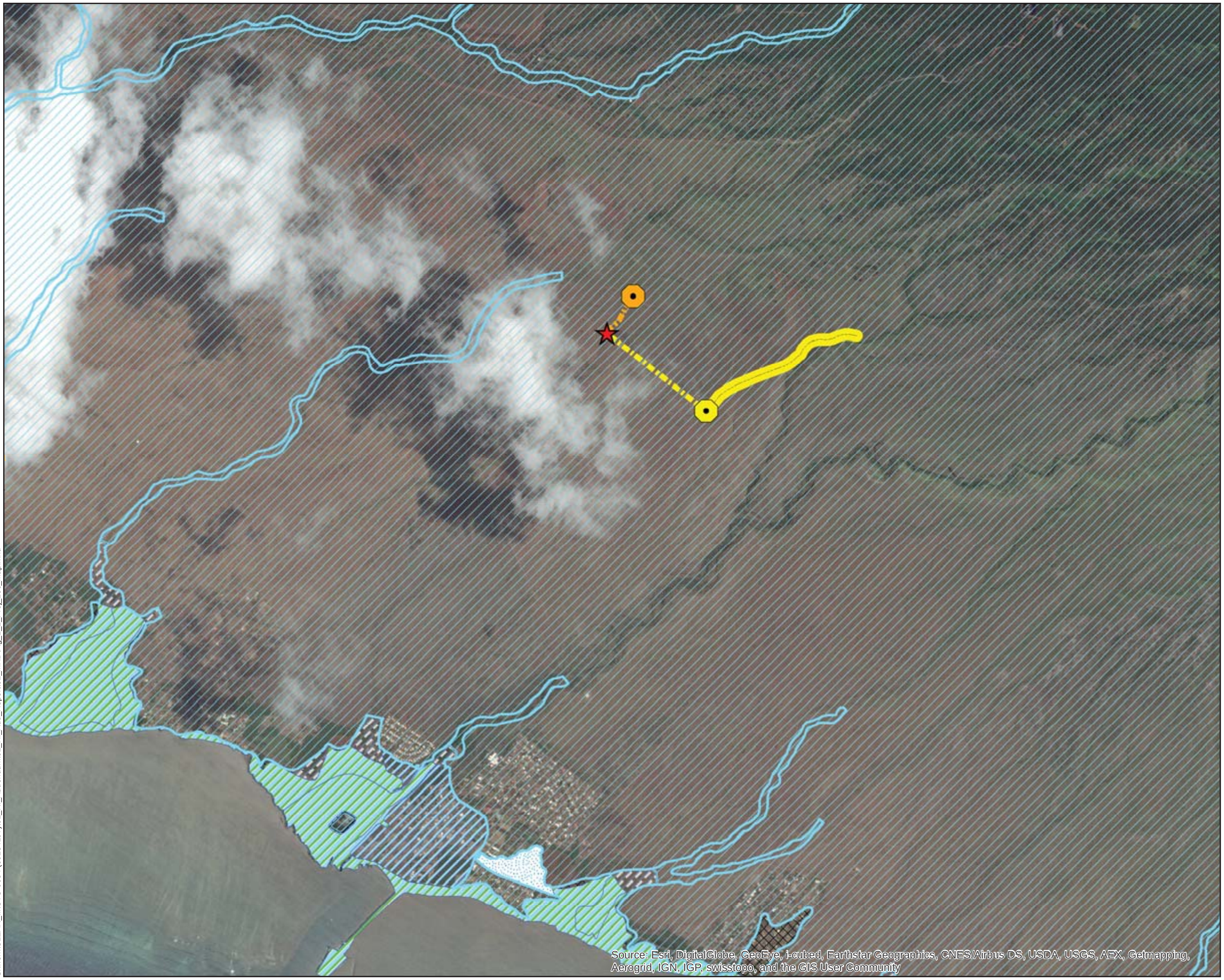

Location Map

Legend

Flood Hazard Zone

- 0.2 PCT Annual Chance Flood Zone
- Zone A
- Zone AE
- Zone AH
- Zone X
- X Protected by Levee Zone
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/
4. Refer to gis.hawaiinfip.org/FHAT for descriptions of flood hazard zones.

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Figure 13
State of Hawaii Flood Hazard Areas
Molokai Hydropower Project
Molokai, Hawaii

3.10.4 Earthquakes

Seismic activity usually occurs on the Island of Hawaiʻi, and has been felt as far away as Molokaʻi. Molokaʻi is listed in Seismic Zone 2B under the Uniform Building Code (USGS 1998). Zone 2B indicates a location that has moderate to severe potential for ground motion created by seismic activity.

3.10.5 Potential Impacts and Mitigation

3.10.5.1 Proposed Action

Heavy rainfall associated with tropical storms has the potential to initiate soil erosion in the project area.

Tsunami and flooding in the project area are unlikely due to its elevation, upslope site location, and the well-drained soils in the project area. The project is not expected to be adversely effected by flooding.

Earthquakes can pose a threat to unstable slopes, but disruptive seismic events are relatively uncommon in this region. The contractor would exercise caution at the worksite should an advance warning from the State and County civil defense agencies be issued.

3.10.5.2 Alternative 1

Portions of Alternative 1 may be constructed near, through, or along a steep ravine. Rapid surface water runoff due to heavy rainfall would accelerate soil erosion that may increase the potential of rockfall or landslides along the Alternative 1 area. The same precautionary efforts would be implemented as stated in the Proposed Action.

3.10.5.3 No-Action Alternative

Under the No-Action Alternative, no hydropower installation would be implemented and the existing irrigation system and diesel generated sources of power would remain. The No-Action Alternative would have no impact at the project site relative to natural hazards.

3.10.5.4 Mitigation Measures

Construction activities would be short-term and would include the appropriate measures to reduce the possibility of contributing to any potential natural hazards. Attention would be paid to approaching weather systems to provide proper stormwater runoff measures due to heavy rainfall. Where necessary, silt fencing will be installed to prevent further soil erosion as a result of construction activities. No further mitigation measures are proposed.

3.11 Hazardous Materials and Hazardous Waste

For the purpose of the following analysis, the term hazardous materials or hazardous wastes refers to those substances defined by the Comprehensive Environmental Response, Compensation, and Liability Act.

The proposed project site is undeveloped. A visual survey of the project site shows no evidence of previous structures, buildings, facilities, or underground storage tanks that might contain hazardous materials.

3.11.1 Potential Impacts and Mitigation

3.11.1.1 Proposed Action

Construction equipment and vehicles contain hazardous materials such as gasoline, diesel, oil, and hydraulic and brake fluids. Accidental release of these materials into the environment is possible, but not anticipated. Material management practices would be used to reduce the risk of spills or other accidental release of materials and substances into the environment.

No significant impacts related to hazardous materials or hazardous wastes are anticipated with implementation of the Proposed Action.

3.11.1.2 ALTERNATIVE 1

Same as Proposed Action.

3.11.1.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, no construction activities would occur at the project site, and no hazardous materials would be brought to the project area. Therefore, no impacts from hazardous materials are anticipated with the No-Action Alternative.

3.11.1.4 MITIGATION MEASURES

Site-specific BMPs, including procedures for hazardous material storage, handling, and staging; spill prevention, control, and response; waste disposal; and good housekeeping would be developed and implemented by the construction contractor. These BMPs would greatly reduce the likelihood of hazardous materials being released into the environment. The construction contractor would be responsible for compliance with all applicable federal, state, and local regulations governing the transportation, use, storage, and/or disposal of hazardous material and hazardous wastes during construction.

3.12 PUBLIC FACILITIES AND SERVICES

3.12.1 Recreational Areas

The proposed project area is located on Molokaʻi Ranch in an enclosed portion that is utilized for livestock grazing and is not open to the public for recreation trails. Na Ala Hele trails and the Molokaʻi Forest Reserve (Figure 14) are not within close proximity to the proposed project site.

3.12.2 Transportation and Traffic

The proposed project site is located along a dirt road approximately 3 miles uphill from the nearest community of Kaunakakai. Access to the proposed project site is monitored by two separate locked gates that do not allow public admittance.

3.12.3 Utilities and Infrastructure

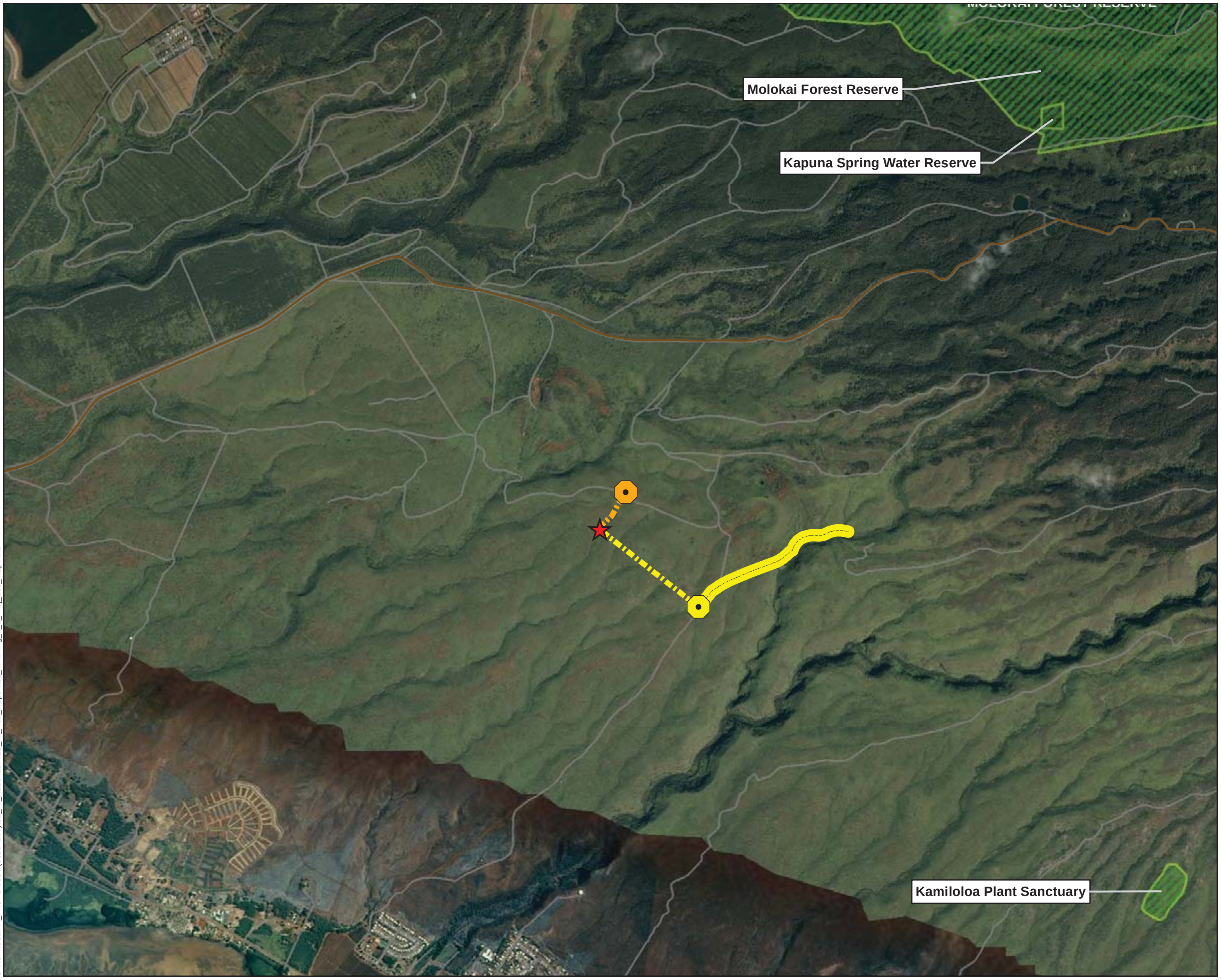
The utilities and infrastructure located within the proposed project area include the MIS pipes and MECO transmission lines and poles.

No impacts to sanitary sewer systems, storm water discharges, and solid waste disposal would occur.

3.12.4 Emergency Services

The proposed project area is located approximately 3 miles uphill from the nearest community of Kaunakakai and would not impede on regular emergency services routes due to its remote location. Should an emergency occur at the proposed project site, access through the two locked gates would be allowed.

Police services for the area are provided by the Molokaʻi Police Department's Kaunakakai headquarters. Fire protection is provided by the Molokaʻi Fire Department's Kaunakakai station. Ambulance service is provided by American Medical Response Molokaʻi Division in Kaunakakai.



Location Map

Legend

- Hiking Trails
- Roads
- Reserves
- Proposed Hydropower Plant Installation
- Proposed Action: Electrical Point of Connection and Relocation of Primary Meter
- Alternative 1: Connection to Existing MECO Pole
- Proposed Power Line
- Ownership Power Line
- Alternative 1 Power Line

Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

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Figure 14
Forest and Recreation Areas Map
Molokai Hydropower Project
Molokai, Hawaii

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3.12.5 Potential Impacts and Mitigation

3.12.5.1 PROPOSED ACTION

The Proposed Action would not impact or close any recreational areas or roadways. It would not generate any new demand for police, fire, or ambulance services. During construction, however, these services may be required in the event of an injury or construction accident. This potential use for such services is not expected to result in the requirement for new personnel or for construction of new police, fire, or ambulance facilities.

3.12.5.2 ALTERNATIVE 1

Same as Proposed Action.

3.12.5.3 NO-ACTION ALTERNATIVE

No impacts to recreational areas, transportation, traffic, utilities, infrastructure, or emergency services are anticipated with implementation of the No-Action Alternative.

3.12.5.4 MITIGATION MEASURES

No impacts are expected from this resource, thus no mitigation measures would be required.

3.13 SOCIOECONOMICS

This section summarizes the demographic and income characteristics of residents near the proposed project area. Census data are used to describe the existing social and economic characteristics of project area and to determine whether any minority or low-income population may experience disproportionately high adverse impact from the Proposed Action or alternatives.

The project area is located within Census Tract 317 and is represented in Figure 15. Data summarized in Table 3-2 and Figure 15 are taken from the 2010 U.S. Census. (U.S. Census Bureau 2010). The socioeconomics for the County of Maui is presented for reference.

Table 3-2: Population and Demographics

	County of Maui		Moloka‘i Census Tract 317	
Characteristic	**no.**	**Percent**	**no.**	**Percent**
Population	154,834	100.0	4,503	100.0
Ethnicity				
White	53,336	34.4	784	17.4
Black or African American	870	0.5	19	0.4
American Indian or Alaska Native	603	0.3	15	0.3
Asian	44,595	28.8	804	17.8
Native Hawaiian and Other Pacific Islander	16,051	10.3	1,103	24.4
Some Other Race	3.051	1.9	12	0.2
Two or More Races	36,328	23.4	1,766	39.2
Median Household Income (1999)	$60,502	—	$42,053	—

Notes:
no. number
Source: U.S. Census Bureau 2010.

3.13.1 Potential Impacts and Mitigation

3.13.1.1 Proposed Action

No socioeconomic impacts are expected with implementation of the Proposed Action because the Proposed Action would not impact employment, income, or demographics within the project area.

3.13.1.2 Alternative 1

No socioeconomic impacts are expected with implementation of Alternative 1 because Alternative 1 would not impact employment, income, or demographics within the project area.

3.13.1.3 No-Action Alternative

No socioeconomic impacts are expected with implementation of the No-Action Alternative because the No-Action Alternative would not impact employment, income, or demographics within the project area.

3.13.1.4 Mitigation Measures

No impacts are expected from this resource, thus no mitigation measures would be required.

3.14 Cumulative Impacts

Cumulative impacts refer to impacts on the environment that result from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such actions. Cumulative impacts can result from individually minor yet collectively significant actions taking place over a period of time. Land use in the proposed project vicinity is comprised of agriculture land. No other past, present, or planned actions associated with these land uses have been identified that would contribute to cumulative impacts for any resources. Therefore, no significant cumulative impacts would be anticipated from implementation of the Proposed Action or the No-Action Alternative.

3.15 Irretrievable and Irreversible Commitment of Resources

Implementation of the Proposed Action would not result in an irreversible or irretrievable commitment of resource, except for financial resources, fuel, or other consumable materials required for construction.

4.0 RELATIONSHIP TO STATE AND COUNTY LAND USE PLANS AND POLICIES

4.1 State Planning Documents

4.1.1 Hawai‘i State Plan

The Hawai‘i State Plan, Chapter 226 of HRS, adopted in 1978 and revised in 1988, establishes the overall theme, goals, objectives, and priority guidelines to guide the future long-range development of the State (Department of Planning and Economic Development 1978).

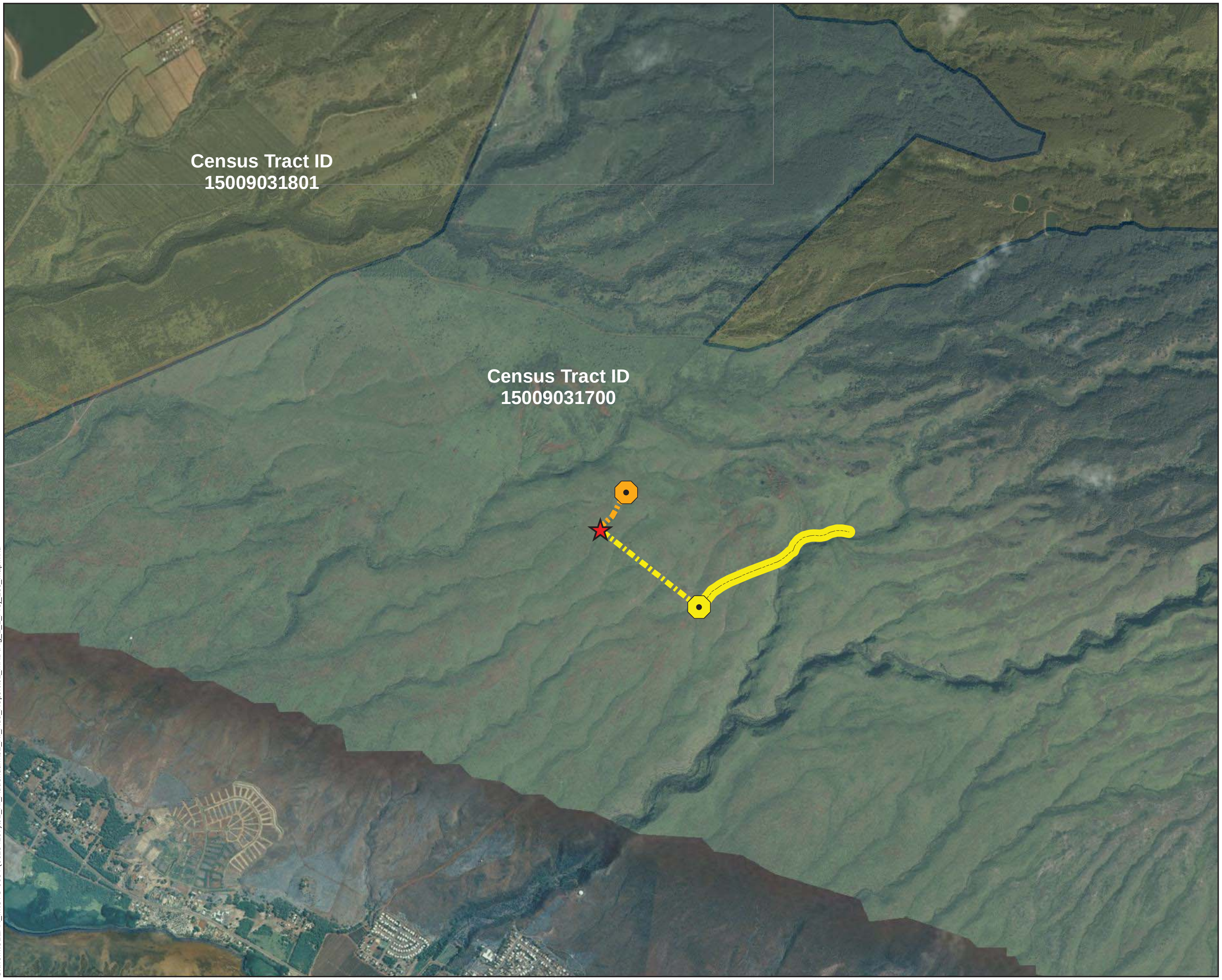
The proposed project supports and is consistent with the following State Plan objectives and policies:

Section 226-10: Objective and policies for the economy – potential growth activities.

(a) Planning for the State’s economy with regard to the potential growth activities shall be directed towards achievement of the objective of development and expansion of potential growth activities that serve to increase and diversify Hawai‘i’s economic base.

(b) To achieve the potential growth activity objective:

    4. Accelerate research and development of new energy-related industries based on wind, solar, ocean and underground resources, and solid waste.



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Location Map

Legend

Census Tract ID

- 15009031700
- 15009031801
- Proposed Hydropower Plant Installation
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Notes

1. Map projection: Hawaii State Plane Zone 3, NAD83
2. Aerial photo source: USGS, 2006
3. Data source: http://hawaii.gov/dbedt/gis/

N

0 2,000 4,000 Feet

Figure 15
2010 Census Tracts Map
Molokai Hydropower Project
Molokai, Hawaii

Section 226-13: Objectives and policies for the physical environment-land, air, and water quality.

(a) Planning for the State's physical environment with regards to land, air, and water quality shall be directed towards achievement of the following objectives:

1. Maintenance and pursuit of improved quality in Hawai'i's land, air, and water resources.

2. Promote the proper management of Hawai'i's land and water resources.

(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:

2. Promote the proper management of Hawai'i's land and water resources.

3. Promote effective measures to achieve desired quality in Hawai'i's surface, ground, and coastal waters.

Section 226-14: Objectives and policies for facility systems – in general.

(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

(b) To achieve the general facility systems objective, it shall be the policy of this State to:

2. Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.

3. Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.

4. Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems.

Section 226-18: Objectives and policies for facility systems – energy.

(b) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:

1. Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people.

2. Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased.

(c) To achieve the energy objectives, it shall be the policy of this State to ensure the short- and long-term provision of adequate, reasonably priced, and dependable energy services to accommodate demand.

(d) To further achieve the energy objectives, it shall be the policy of this State to:

1. Support research and development as well as promote the use of renewable energy sources.

2. Ensure that the combination of energy supplies and energy-saving systems is sufficient to support the demands of growth.

3. Base decisions of least-cost supply-side and demand-side energy resource options on a comparison of their total costs and benefits when a least-cost is determined by a reasonably comprehensive, quantitative, and qualitative accounting of their long-term, direct and indirect economic, environmental, social, cultural, and public health costs and benefits.

4. Promote all cost-effective conservation of power and fuel supplies through measures, including:

    A. Development of cost-effective demand-side management programs.

    C. Adoption of energy-efficient practices and technologies.

5. Ensure, to the extent that new supply-side resources are needed, that the development or expansion of energy systems uses the least-cost energy supply option and maximizes efficient technologies.

6. Support research, development, demonstration, and use of energy efficiency, load management, and other demand-side management programs, practices, and technologies.

4.1.2 State Functional Plans

The State Functional Plans are designed to implement the broader goals, objectives, and policies of the State Plan through specific actions identified as Implementing Actions (IA). While the proposed project is not specifically identified as an IA, the project maintains consistency with the following plans:

- Energy Functional Plan (DBEDT 1991)
- Agriculture Functional Plan (DBEDT 1991)

4.2 MAUI COUNTY PLANNING DOCUMENTS

4.2.1 2030 General Plan, Countywide Policy Plan

The Maui County Plan, Chapter 2.80B of Maui County Code (MCC), adopted in 1990 and revised in 2010, establishes the overall theme, goals, objectives, and priority guidelines to guide the future long-range development of the county (Maui 2010).

The proposed project supports and is consistent with the following Maui County Plan objectives and policies:

Goal F. Strengthen the Local Economy

Objective 2: Diversify and expand sustainable forms of agriculture and aquaculture.

Policy e: Support ordinances, programs, and policies that keep agricultural land and water available and affordable to farmers.

Objective 4: Expand economic sectors that increase living-wage job choices and are compatible with community values.

Policy a: Renewable-energy industry

Goal I. Improve Physical Infrastructure

Objective 1: Improve water systems to assure access to sustainable, clean, reliable, and affordable sources of water.

Objective 3: Significantly increase the use of renewable and green technologies to promote energy efficiency and energy self-sufficiency.

Policy a: Promote the use of locally renewable energy sources, and reward energy efficiency.

Policy d: Encourage small-scale energy generation that utilizes wind, sun, water, biowaste, and other renewable sources of energy.

Policy e: Expand renewable-energy production.

Policy j: Encourage green footprint practices.

Policy k: Reduce Maui County's dependence on fossil fuels and energy imports.

Policy m: Promote and support environmentally friendly practices in all energy sectors.

4.2.2 Moloka‘i Community Plan (2001)

The Moloka‘i Community Plan, Chapter 2.80B of MCC, adopted in 1980 and updated in 1991, establishes the overall theme, goals, objectives, and priority guidelines to guide the future long-range development of the county (Maui 2012). The Moloka‘i Community Plan designates the project area as: *Agriculture (AC) – This use indicates areas for agricultural activity which would be in keeping with the economic base of the County and the requirements and procedures of Chapter 205 HRS, as amended.* The proposed project supports and is consistent with the following Moloka‘i Community Plan objectives and policies:

Economic Activity

Objective 3: Maintain agriculture as an important economic activity on the island.

Objective 12: Promote self-sufficiency by using local raw materials, food products and natural energy sources without negatively impacting the local resources' carrying capacity.

Energy and Public Utilities

Objective 1: Accelerate the development of alternative energy sources, such as solar and wind to help reduce the dependence on oil and fossil fuels.

Objective 2: Provide incentives to promote the use of alternative energy sources.

Water

Objective 3: Improve current water quality and distribution system and develop new water sources for the Moloka‘i Community Plan area without taking water from Pelekunu and Wailau Valleys.

Objective 4: Develop improved transmission and/or storage systems to provide better fire protection.

Objective 5: Promote programs for water conservation as well as ground water and wellhead protection.

5.0 FINDINGS AND CONCLUSION

The approving agency (Department of Agriculture) proposes a FONSI for this project. This finding is based on consideration of all agency and public comments on the Draft EA. In accordance with HAR §11-200-12 (DOH 1996b), the approving agency has considered every phase of the Proposed Action, the expected consequences, both primary (direct) and secondary (indirect), and the cumulative as well as the short-term and long-term effects of the action, in order to determine whether the Proposed Action may have a significant effect on the environment. In making this determination, the Proposed Action has been evaluated with respect to the significance criteria established in HAR §11-200-12.

- **Involves an irrevocable commitment to, loss or destruction of any natural or cultural resources.**

  Only short-term construction related impacts are anticipated for ambient air quality, agricultural resources, soils, and biological resources. The Proposed Action would clear approximately 4,100 ft^2 of existing vegetation and surface soils. No special status species have been identified within the project area.

  No surface historic properties were observed within the Project area. Consultation with the State Historic Preservation Division was initiated on March 9, 2012, and is currently under review with the consulting archaeologists at Maui Archaeology to determine the appropriate scope of work to complete the Project's historic preservation review process.

- **Curtails the range of beneficial uses of the environment.**

  There would be no change to the current or potential land use within the project area because of the Proposed Action. Management and use of the land would remain consistent with a designation of agricultural use and no new uses are proposed with implementation of the Proposed Action.

- **Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.**

  The Proposed Action is consistent with the state environmental policies, goals, and guidelines established in Chapter 344, HRS. The DOA has integrated the review of environmental effects with existing planning processes, and has developed the design for avoiding, minimizing, and mitigating any adverse environmental effects. Other agencies identified as having expertise or jurisdiction by law, were also consulted during the planning and permitting processes. In accordance with HRS §344-5, this EA was made available for public review and comment for a period of 30 days. All comments received during the public comment period are responded to in this Final EA.

- **Substantially affects the economic welfare, social welfare, and cultural practices of the community or State.**

  No socioeconomic impacts to the community are anticipated with implementation of the Proposed Action.

- **Substantially affects public health.**

  The Proposed Action would not have long-term impacts on public safety and health.

- **Involves substantial secondary impacts, such as population changes or effects on public facilities.**

  No adverse secondary impacts are anticipated with implementation of the Proposed Action.

- **Involves a substantial degradation of environmental quality.**

  No long-term adverse impacts to any resource evaluated in this EA are anticipated with implementation of the Proposed Action.

- **Is individually limited, but cumulatively has considerable effect on the environment, or involves a commitment for larger actions.**

  The Proposed Action does not involve a commitment for larger actions. Land use in the proposed project vicinity is designated as agricultural land. No other past, present, or planned actions associated with these land uses have been identified that would contribute to adverse cumulative impacts for any of the resources considered in this EA.

- **Substantially affects a rare, threatened, or endangered species or its habitat.**

  No special status species have been identified within the project area. No adverse impacts to rare, threatened, or endangered species or its habitat are anticipated with implementation of the Proposed Action.

- **Detrimentally affects air or water quality or ambient noise levels.**

  Short-term adverse construction impacts to air quality and ambient noise levels are possible during implementation of the Proposed Action. However, BMPs to be implemented during construction would reduce these impacts. The Proposed Action would have no long-term impacts on air quality noise, or surface water quality.

- **Affects or is likely to suffer damage by being located in an environmentally sensitive area, such as flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, freshwater, or coastal waters.**

  The project area is not located in a flood plain, tsunami zone, or coastal area. The Proposed Action will not likely suffer damage from any natural disasters.

- **Substantially affects scenic vistas and view planes identified in County or state plans or studies.**

  The Proposed Action would have no long-term adverse impacts on the scenic quality of the roadway corridor.

- **Requires substantial energy consumption.**

  Implementation of the Proposed Action would generate renewable energy and provide the assistance in achieving the State of Hawai‘i’s 2030 Clean Energy Initiative by reducing the need of conventional diesel electric power generation.

5.1 DETERMINATION

To determine whether the Proposed Action would have a significant impact on the human, natural, or historic environments, this EA evaluated the direct and indirect effects and short-term, long-term, and cumulative impacts. The Proposed Action has been evaluated with respect to the significance criteria, as discussed in Section 5.0. Based on this evaluation, the Proposed Action would not have a significant adverse impact on the environment. Therefore, a FONSI determination has been made.

6.0 DISTRIBUTION LIST

Copies of the Draft EA were provided to the recipients listed below and are also available upon request.

Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawai`i 96813

Department of Land and Natural Resources
Historic Preservation Division
601 Kamokila Boulevard
Kapolei, Hawai‘i 96707

Hawai‘i Department of Agriculture
Office of the Chairperson
1428 S. King Street
Honolulu, HI 96814

Hawai‘i State Library
478 South King Street
Honolulu, HI 96813

Hawaiian Telcom
1177 Bishop Street
Honolulu, HI 96813

Maui Community College
375 Kamehameha V Highway
Kaunakakai, HI 96748

County of Maui
Department of Water Supply
200 S. High St
Kalana O Maui Building
Wailuku, HI 96793

County of Maui
Department of Planning Current Division
250 S. High Street
Kalana Pakui Building Suite 200
Wailuku, HI 96793

The Moloka‘i Dispatch
PO Box 482219
Kaunakakai, HI 96748

Maui Electric Company
210 W. Kamehameha Ave
Kahului, HI 96732

Moloka‘i Public Library
15 Ala Malama
Kaunakakai, HI 96748

Moloka‘i Ranch
Moloka‘i Properties Limited
119 Merchant Street #408
Honolulu, HI 96813

Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, HI 96813

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
PO Box 50088
Honolulu, HI 96850

7.0 LIST OF CONTRIBUTORS

Contributors to the preparation of the EA are listed below.

Ms. Jennifer Scheffel, Environmental Planner and Project Manager
Years of Experience: 13

Mr. Jeff Merz, Environmental Planner
Years of Experience: 20

Ms. Katie Langford, Staff Environmental Scientist
Years of Experience: 4

Ms. Yue Qiu, Staff Environmental Scientist
Years of Experience: 1

Ms. Julia Staley, Environmental Planner
Years of Experience: 6

8.0 REFERENCES

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Appendix A
Agency Correspondence

NEIL ABERCROMBIE
GOVERNOR
RICHARD C. LIM
DIRECTOR
MARY ALICE EVANS
DEPUTY DIRECTOR

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

STRATEGIC INDUSTRIES DIVISION
235 South Beretania Street, Leiopapa A Kamehameha Bldg., 5th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804
Web site: www.hawaii.gov/dbedt/info/energy

Telephone: (808) 587-3807
Fax: (808) 586-2536

August 16, 2012

Ms. Jennifer Scheffel, Project Manager
AECOM Technical Services
1001 Bishop Street, Suite 1600
Honolulu, Hawaii 96813

Subject: Comments to Draft Environmental Assessment for Molokai Irrigation System Hydropower Plant

Dear Ms. Scheffel:

The Hawaii State Energy Office within the Department of Business, Economic Development & Tourism (DBEDT) is pleased to provide these comments on the Draft Environmental Assessment (DEA) for the Molokai Irrigation System (MIS) Hydropower Plant on Molokai, Hawaii (Project). We would also appreciate being included on the distribution list for this Project and any future environmental documents relating to energy projects in Hawaii.

001CMT1 The Hawaii State Energy Office strongly supports the Hawaii Department of Agriculture's (DOA) efforts to reduce its fossil fuel consumption and possibly earn revenue through hydroelectricity generation and sales. The Project is an excellent example of how DOA could reduce the ongoing costs of operating and maintaining its agricultural operations while supporting Hawaii's clean energy goals.

001CMT2 The proposed MIS hydroelectric plant appears to have negligible negative impacts, as it will be a small in-line hydro system in a remote location, several miles mauka of Kaunakakai on private land owned by Molokai Ranch. The footprint will be minimal, and the area is already highly degraded by fires and grazing. Any negative impacts due to construction disturbance will be temporary outweighed by the benefits of electricity generation.

001CMT3 The DEA does not provide information on the power generation capacity anticipated for the proposed turbine. Since a Francis turbine is specified and the flow rate and pressure of the irrigation system is certainly known, both a capacity in kilowatts and a range of expected output in kilowatt-hours per year should be cited. 001CMT4 Also of interest would be the power consumption, in kilowatt-hours per year, of the irrigation system pumps which will be partially offset by this installation. This could be factored into Section 1.2.6 (Project Schedule and Cost).

RECEIVED AUG 21 2012

001CMT5 The proposed action anticipates transferring ownership of a segment of transmission lines presently owned by Maui Electric Company (MECO) to DOA. We encourage DOA to continue talks with MECO to determine the responsibilities of all parties regarding infrastructure operations and maintenance, and caution that transfer of line/pole ownership would likely require a long-term commitment by DOA to maintain this equipment.

001CMT6 Finally, please continue consultation with Maui County and the other relevant regulatory agencies to determine all potential permits and approvals. We note other permits and approvals required for other hydro projects have included:

- Historic Preservation Review (H.R.S. §6E), State Historic Preservation Division, Hawaii Department of Land and Natural Resources (DLNR)
- Endangered Species Act Compliance, Division of Forestry and Wildlife, DLNR
- Coastal Zone Management Act Consistency Review, Hawaii Office of Planning
- Stream Channel Alteration, Change to Instream Flow, Stream Diversion Works Permit, Commission on Water Resource Management, DLNR
- Clean Water Act Compliance, Clean Water Branch, Hawaii Department of Health (DOH)
- Clean Air Act Compliance, Clean Air Branch, DOH
- County Zoning Permit, Maui County Planning Department

001CMT7 Thank you for the opportunity to comment on the proposed project. Once again, we commend DOA for taking initiative to reduce Hawaii's dependence on costly imported petroleum. If you have any questions, please call Andrea Gill at (808) 933-0312 or email her at AGill@dbedt.hawaii.gov.

Sincerely,

Mark B. Glick
Energy Program Administrator

C: Glenn Okamoto, Hawaii Department of Agriculture
Office of Environmental Quality Control

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 31, 2012

AECOM
Attention: Ms. Jennifer Scheffel
1001 Bishop Street; Suite 1600
Honolulu, Hawaii 96813-3698

Dear Ms. Scheffel:

SUBJECT: Draft Environmental Assessment for the Molokai Irrigation System Hydropower Plant

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

002CMT1

At this time, the DLNR has no comments to offer on the subject matter. If you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 4, 2012

AECOM
Attention: Ms. Jennifer Scheffel
1001 Bishop Street; Suite 1600
Honolulu, Hawaii 96813-3698

Dear Ms. Scheffel:

SUBJECT: Draft Environmental Assessment for the Molokai Irrigation System Hydropower Plant

Thank you for the opportunity to review and comment on the subject matter. In addition to the comments previously sent you on August 31, 2012, enclosed are comments from the Division of Aquatic Resources on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc: Central Files

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 21, 2012

MEMORANDUM

DAR4438

RECEIVED
LAND DIVISION
2012 SEP -4 A 10:53
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Maui District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Assessment for the Molokai Irrigation System Hydropower Plant
LOCATION: Island of Molokai
APPLICANT: AECOM on behalf of the State Department of Agriculture

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by August 31, 2012.

Only one (1) copy of the CD is available for your review in Land Division office, Room 220.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Lydia Morikawa at 587-0410. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: [signature]
Print Name: Robert T. Nishimoto
Date: 8/27/2012

cc: Central Files

DIVISION OF AQUATIC RESOURCES - MAUI
DEPARTMENT OF LAND & NATURAL RESOURCES
130 Mahalani Street
Wailuku, Hawai'i 96793
August 27, 2012

To: Lydia Morikawa, Land

From: Skippy Hau, Aquatic Biologist

Subject: Draft EA Molokai Irrigation System Hydropower Plant (DAR 4438) (Due Date: August 31, 2012)

003CMT1 (P.7) This project proposes to use a Francis generator turbine. There is no description of the hydropower plant. Figure 2 only shows the proposed location on a map.
003CMT2 What does the generator turbine look like? What are the actual specifications for it?

003CMT3 Where are the estimated calculations for evaluating water use and electricity generated? How efficient is it?
003CMT4 What is the service life for the generator and what kind of maintenance and servicing is required of this system.
003CMT5 If one generator is placed on the system would it be more effective with two or possibly three generators to take advantage of the elevation change?

This draft appears incomplete.

(2.4.1 Development Alternative)
003CMT6 The intake is planned 3,500 feet upstream. Please describe the existing intake structure and new proposed intake structure.
003CMT7 Will there be any modifications to restore a minimum flow in the stream?

003CMT8 (3.4.3.1) Is this project feasible with the proposed addition of 20 power poles?

003CMT9 (Figure 9.) The use of little or no threatened or endangered species and low, medium and high classifications appear subjective without references for field data or surveys?

ALAN M. ARAKAWA
Mayor

WILLIAM R. SPENCE
Director

MICHELE CHOUTEAU McLEAN
Deputy Director

COUNTY OF MAUI

DEPARTMENT OF PLANNING

September 14, 2012

Ms. Jennifer Scheffel
AECOM
1001 Bishop Street, Suite 1600
Honolulu, Hawaii 96813-3698

Dear Ms. Scheffel:

SUBJECT: COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED MOLOKAI IRRIGATION SYSTEM (MIS) HYDROPOWER PLANT, LOCATED AT KAUNAKAKAI, ISLAND OF MOLOKAI, HAWAII; TMK: (2) 5-3-003:015 (EAC 2012/0015)

The Department of Planning (Department) is in receipt of the above-referenced document for the proposed MIS Hydropower Plant. The Department understands the proposed action includes the following:

A. The Proposing Agency is: State of Hawaii, Department of Agriculture;

B. The Applicant proposes to install a turbine-generator along an existing easement of the MIS pipeline to recover energy used to pump water from the Waikolu Valley in order to generate renewable energy, which would help to reduce dependence on diesel fuel for electricity generation. The proposed project would comprise the following components:

   1. Outdoor horizontal Francis turbine and generator enclosed in a weatherproof shelter;

   2. Piping and fittings to connect the turbine in a bypass arrangement;

   3. Outdoor synchronous bypass valve with fail-safe counterweight (gravity) closure mechanism;

   4. Controls and electrical equipment housed in an outdoor free-standing weatherproof enclosure or mounted on a concrete masonry unit wall;

   5. Installation of new section of power line to interconnect the project to the existing Molokai Electric Company (MECO) power line which also feeds the Molokai tunnel;

6. Relocation of primary meter from the Molokai tunnel to power line interconnection;

7. Provide provisions for Hawaiian Telcom to install a new section of telephone line to interconnect the project to the existing Hawaiian Telcom line which also feeds the Molokai tunnel; and

8. Renewable energy electrical interconnection with MECO.

C. No land use changes are required for this project;

D. The Accepting Authority for the EA is listed as the Office of Environmental Quality Control (OEQC); and

E. The trigger for the completion of the Chapter 343, Hawaii Revised Statutes (HRS), EA process is not identified.

Based on the foregoing, the Department provides the following comments in preparation of the Final EA:

1. The land use designations for the project area are as follows:

   a. State Land Use: Agricultural
Urban

   b. Molokai Community Plan: Agricultural
Open Space
Park
Single Family
P/Q-P (Public/Quasi-Public)

   c. County Zoning: Agricultural
Interim
P/Q-P-1 (Public/Quasi-Public)

   d. Other: Not within the Special Management Area (SMA);

2. Include a discussion of all land use designations. Since there are multiple designations on the parcel, identify the project area and its designation (State Land Use, Community Plan, County Zoning, and any other designations, such as Special Management Area [SMA]);

3. Include a parcel map with project area clearly marked. Identify size of entire parcel and size and location within parcel of the project area;

4. Identify the end users of the water system and what effect the project will have on them. Discuss costs and benefits to end users;

5. We suggest that rather than referencing "FEMA FIRM *Community* Panel 150030190E" you utilize the Hawaii Flood Hazard Assessment tool (FHAT) at http://gis.hawaiinfip.org/FHAT/. A copy of the FHAT report is attached for your reference;

6. The EA does not identify its trigger. It would appear that the trigger is State funding. Please identify this in the Final EA;

7. Clarify the identity of the property owner. The EA lists "Molokai Ranch" as the property owner/lessee. The Department of Finance, Real Property Tax lists the property owner as "Molokai Properties, Ltd." Include owners' authorization in EA documents;

8. Clarify the approving agency or proposing agency. OEQC is an environmental clearinghouse and does not function as such an agency;

9. Request comments from the Molokai Planning Commission; and

10. Consult the Department's Zoning Administration and Enforcement Division (ZAED) for a determination as to whether a State Land Use Commission Special Use Permit (SUP) is required for the proposed use.

Thank you for the opportunity to comment. Please include the Department on the distribution list of the Final EA and further documents. Should you require further clarification, please contact Interim Molokai Planner Livit Callentine at livit.callentine@mauicounty.gov or at (808) 270-5537.

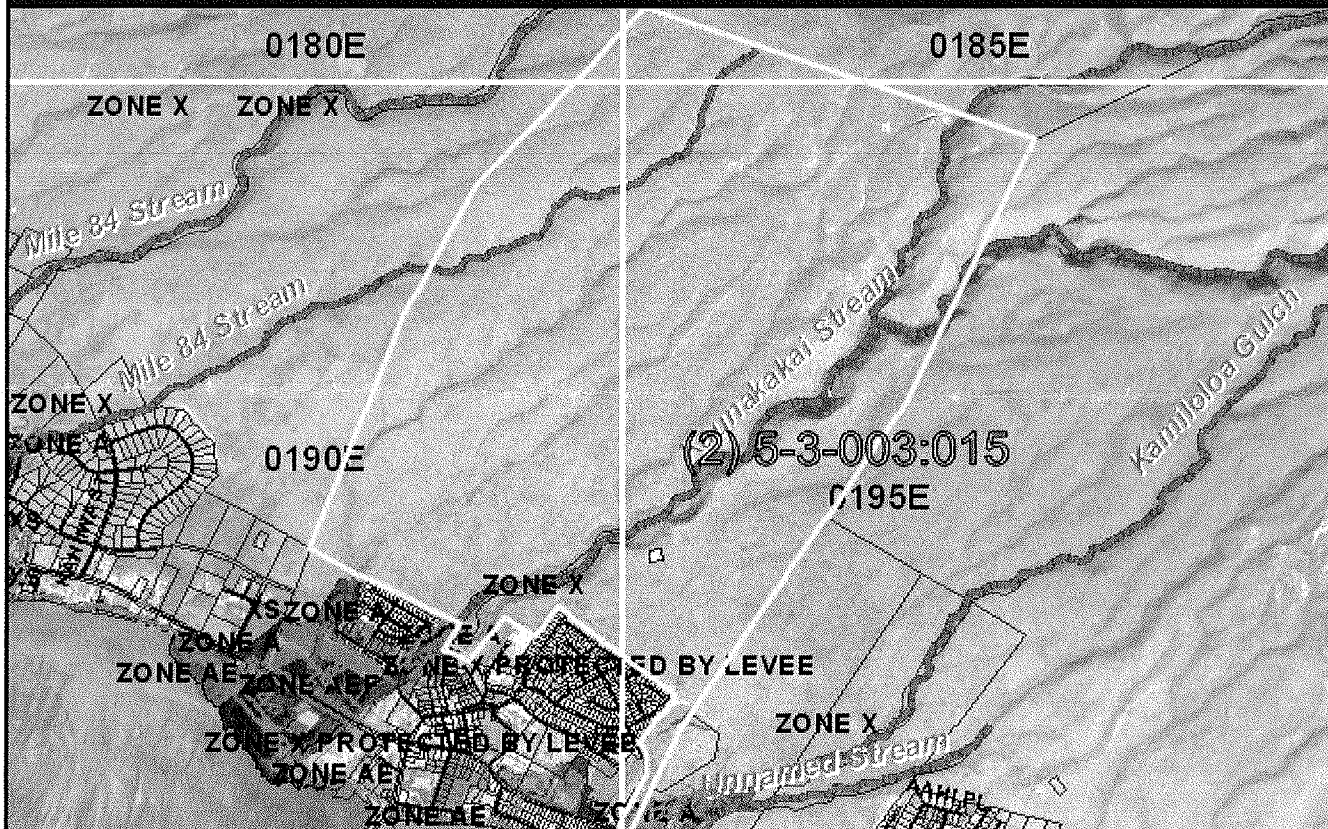
Sincerely,

WILLIAM SPENCE
Planning Director

Attachment
xc: Clayton I. Yoshida, AICP, Planning Program Administrator (PDF)
Aaron H. Shinmoto, PE, Planning Program Administrator (PDF)
John F. Summers, Planning Program Administrator (PDF)
Livit U. Callentine, AICP, Interim Molokai Planner (PDF)
Suzette Esmeralda, Secretary to Boards and Commissions (PDF)
Nina-Lehua Kawano, Molokai Clerk (PDF)
Julia Staley, AECOM
Project File
General File
WRS:LUC:nlk
K:\WP_DOCS\PLANNING\EAC\2012\0015_Moloka'iIrrigation\Draft EA Comments.DOC

State of Hawaii

FLOOD HAZARD ASSESSMENT REPORT



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD ZONE DEFINITIONS

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD – The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- **Zone A:** No BFE determined.
- **Zone AE:** BFE determined.
- **Zone AH:** Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- **Zone AO:** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- **Zone V:** Coastal flood zone with velocity hazard (wave action); no BFE determined.
- **Zone VE:** Coastal flood zone with velocity hazard (wave action); BFE determined.
- **Zone AEF:** Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA – An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- **Zone XS (X shaded):** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- **Zone X:** Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D:** Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

PROPERTY INFORMATION

COUNTY:	MAUI
TMK NO:	(2) 5-3-003-015
PARCEL ADDRESS:	KAUNAKAKAI KAUNAKAKAI, HI 96748
FIRM INDEX DATE:	SEPTEMBER 25, 2009
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL(S):	1500030190E-SEPTEMBER 25, 2009 1500030180E-SEPTEMBER 25, 2009 1500030185E-SEPTEMBER 25, 2009 1500030195E-SEPTEMBER 25, 2009
PARCEL DATA FROM:	MAY 2012
IMAGERY DATA FROM:	MAY 2005

IMPORTANT PHONE NUMBERS

County NFIP Coordinator
County of Maui
Francis Cerizo, CFM (808) 270-7771

State NFIP Coordinator
Carol Tyau-Beam, P.E., CFM (808) 587-0267

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

SEP 0 7 2012

In Reply Refer To:
2012-TA-0428

Ms. Jennifer Scheffel
Project Planner
AECOM
1001 Bishop Street, Suite 1600
Honolulu, Hawaii 96813-3698

Subject: Draft Environmental Assessment for the Proposed Irrigation System Hydropower Plant, Molokai

Dear Ms. Scheffel:

The U.S. Fish and Wildlife Service (Service) received your letter on August 2, 2012, requesting our comments on the Draft Environmental Assessment (DEA) pertaining to the proposed construction of a hydropower facility on the island of Molokai.

Project Description

The proposed action involves the development of a hydropower facility to generate electricity from an existing gravity-flow water transmission pipeline feeding the Kualapuu Reservoir [TMK (2)-53-003:015]. The proposed project is a modification of the Molokai Irrigation System which is administrated by the State of Hawaii Department of Agriculture. Renewable energy generated by the proposed project would be sold to the Maui Electric Company (MECO), with the added benefit that energy used for pumping water out of Waikolu Stream (northeast of the proposed project) would be partially recovered. The proposed action also includes the installation of additional power poles and an overhead powerline extending from the proposed hydropower facility to a connection point with an existing MECO transmission line 3,900 feet to the southeast.

Species Affected

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program, three species protected by the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*) are known to occur within the proposed action area and could be impacted by the proposed action: the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), the endangered Hawaiian petrel (*Pterodroma sandwichensis*) and threatened Newell's shearwater (*Puffinus auricularis newelli*).

The Hawaiian hoary bat is known to occur in forested areas throughout the island of Molokai. This bat roosts in both exotic and native woody vegetation and, while foraging, leaves young unattended in "nursery" trees and shrubs. If trees or shrubs suitable for bat roosting are cleared during the hoary bat breeding season (June 1 to September 15), there is a risk that young bats could inadvertently be harmed or killed. As a result, the Service recommends that woody plants greater than 15 feet tall should not be removed or trimmed during the Hawaiian hoary bat breeding season.

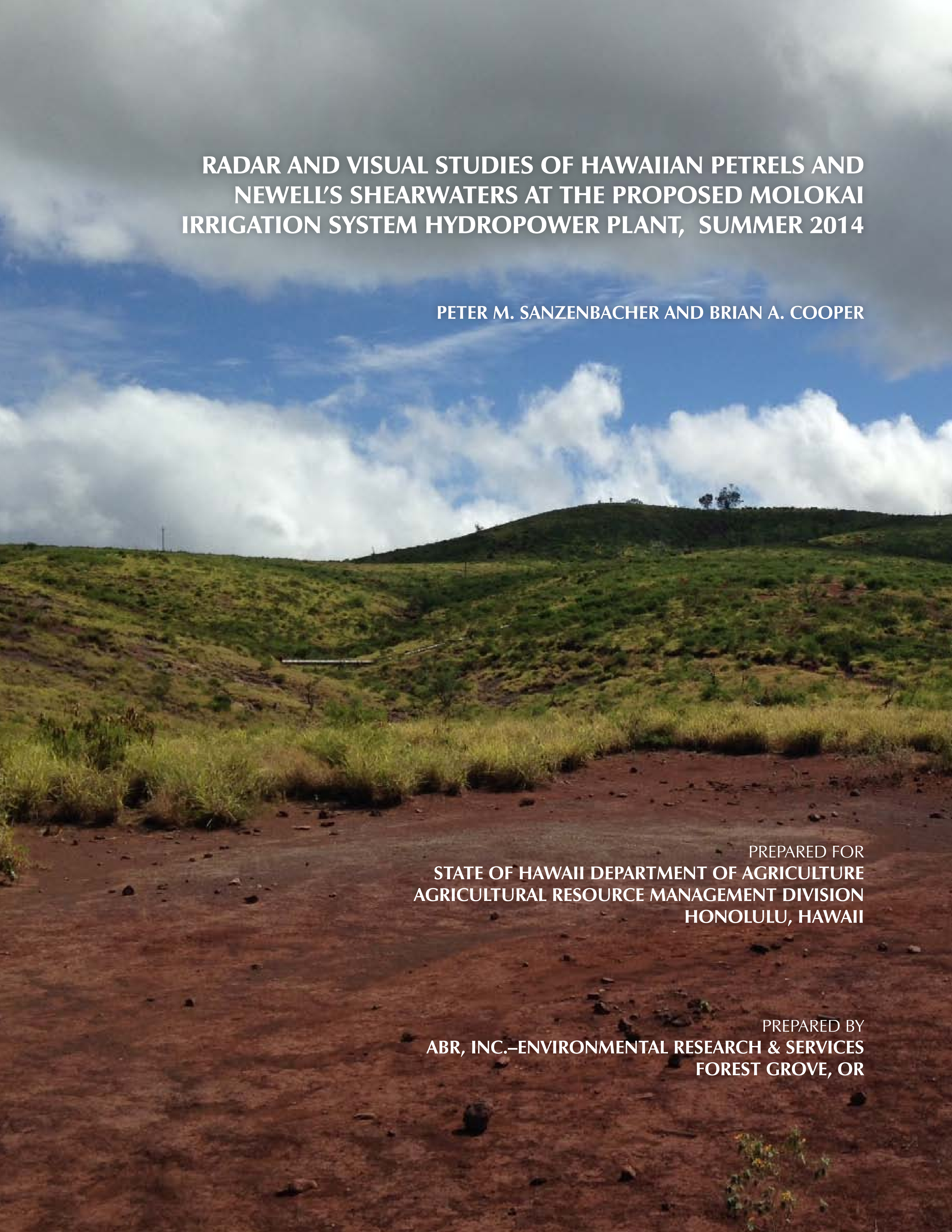
The Hawaiian petrel and Newell's shearwater, collectively referred to as seabirds, are known to transit through the proposed action area while flying between the ocean and nesting sites in the mountains during their breeding season (March through December). Seabird fatalities resulting from collisions with artificial structures that extend above the surrounding vegetation have been documented in Hawaii where high densities of transiting seabirds occur. Additionally, artificial lighting, such as flood lighting for construction work and site security, can adversely impact seabirds by causing disorientation which may result in collision with utility lines, buildings, fences, and vehicles. Fledging seabirds are especially affected by artificial lighting and have a tendency to exhaust themselves while circling the light sources and become grounded. Too weak to fly, these birds become vulnerable to depredation by feral predators such as dogs, cats, and mongoose. Therefore, the Service recommends that no outdoor flood lighting be installed as part of the proposed action. Project-related lighting should be minimized. All project-related lights should be shielded so the bulb is not visible at or above bulb-height. Motion sensors and timers should be installed on any necessary project-related lighting to minimize periods of illumination. Due to the presence of remnant populations of Hawaiian petrels and Newell's shearwaters in nearby Wailau, Waikolu, and Pelekunu Valleys, the Service recommends that nocturnal avian radar surveys be conducted during the seabird breeding season to assess potential impacts resulting from the construction of the proposed transmission line and other project-related appurtenances. Please contact us for further guidance regarding survey protocols.

It is unclear if there is a Federal nexus associated with this project. If funding or permitting of the construction or operation of the proposed hydropower facility originates from a Federal agency, then said agency must consult with the Service per section 7(a)(2) of the ESA if the implementation of the proposed project may adversely affect a listed species. The Service will be happy to provide further guidance regarding action agency effects determinations for the species in the project area. If you have any questions concerning these recommendations please contact Ian Bordenave at (808) 792-9400 for further assistance.

Sincerely,

for Loyal Mehrhoff
Field Supervisor

Appendix B
Radar and Visual Studies of Hawaiian Petrels and Newell's Shearwaters at the Proposed Molokai Irrigation System Hydropower Plant



RADAR AND VISUAL STUDIES OF HAWAIIAN PETRELS AND NEWELL'S SHEARWATERS AT THE PROPOSED MOLOKAI IRRIGATION SYSTEM HYDROPOWER PLANT, SUMMER 2014

PETER M. SANZENBACHER AND BRIAN A. COOPER

PREPARED FOR
STATE OF HAWAII DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESOURCE MANAGEMENT DIVISION
HONOLULU, HAWAII

PREPARED BY
ABR, INC.–ENVIRONMENTAL RESEARCH & SERVICES
FOREST GROVE, OR

RADAR AND VISUAL STUDIES OF HAWAIIAN PETRELS AND NEWELL'S SHEARWATERS AT THE PROPOSED MOLOKAI IRRIGATION SYSTEM HYDROPOWER PLANT, SUMMER 2014

FINAL REPORT

Prepared for

State of Hawaii Department of Agriculture
Agricultural Resource Management Division
1428 South King Street
Honolulu, HI 96814

Prepared by

Peter M. Sanzenbacher and Brian A. Cooper

ABR, Inc.—Environmental Research & Services
P.O. Box 249
Forest Grove, OR 97116–0249

October 2014

Printed on recycled paper.

EXECUTIVE SUMMARY

- The Hawaii Department of Agriculture has proposed construction of the Molokai Irrigation District Hydropower Facility (hereafter Project). As part of the environmental permitting process, ABR, Inc. was contracted to collect information on risk to federally-listed seabirds at the Project and in particular assess risk at a proposed section of overhead transmission line. The specific objectives of the study were to: (1) collect baseline information on flight directions, passage rates, and flight altitudes of Hawaiian Petrels (*Pterodroma sandwichensis*) and Newell's Shearwaters (*Puffinus auricularis newelli*) at the Project; (2) provide an estimate of the daily and seasonal numbers of petrels and shearwaters that fly over the Project area; and (3) provide an estimate of annual fatality rates of petrels and shearwater at the Project.
- Two observers monitored movements of seabirds at one sampling station for a total of ten nights in summer 2014 (22–31 July) following standard ornithological radar and audiovisual (AV) methods used during previous studies of seabirds in the Hawaiian Islands. We observed a total of 3 landward-flying and 8 seaward-flying radar targets that fit our criteria for petrel/shearwater targets. We did not detect any Hawaiian Petrels or Newell's Shearwaters during AV observations.
- The mean nightly passage rate of petrel/shearwater targets (i.e., landward and seaward rates combined) within the 1.5 km sampling radius at the Project was 0.19 ± 0.07 targets/h. Relative to a 1-km front the mean nightly passage rate was 0.07 ± 0.02 targets/km/h. A general assessment of petrel/ shearwater target flight paths did not indicate any distinct flight corridors or concentration points over the Project or larger radar sampling area.
- During our study we concurrently recorded a total of 3 petrel/shearwater targets on vertical radar. Flight altitudes of these vertical targets ranged from 66–172 m above ground level (agl) with a mean (± SE) flight altitude of 128 ± 32 m agl. Thefore 0% of these observations occurred at or below the height of the proposed transmission line (12 m agl).
- To model the estimated collision-caused mortality at the transmission line, we used the following information to generate an estimate of exposure risk: mean passage rates of petrel/shearwater targets observed on radar in summer 2014, visual estimates of flight altitudes of petrels/shearwaters collected throughout the Hawaiian Islands, and dimensions and characteristics of the proposed transmission line components.
- We estimated that an average of approximately 0.13 Hawaiian Petrels/yr and 0.01 Newell's Shearwaters/yr would fly within the space occupied by the proposed transmission line. Current evidence suggests that a high proportion of seabirds detect and avoid transmission lines (i.e., ≥99%), however, we used a conservative range of assumptions for avoidance rates in our fatality models (i.e., 90%, 95%, and 99% avoidance) and estimated a collision-caused fatality rate of 0.0013–0.0130 Hawaiian Petrels/yr and 0.0001–0.0010 Newell's Shearwaters /yr.
- We used a Poisson distribution to estimate the probability that one, two, three, etc. Hawaiian Petrels or Newell's Shearwaters might be killed each year based on a range of avoidance factors. The probability of zero annual collision fatalties ranged from 0.9867–0.9987 for Hawaiian Petrels and 0.9990–0.9999 for Newell's Shearwaters whereas the probability of two annual collision fatalities was <0.0001 for each species.
- The mean nightly passage rate of petrel/shearwater targets that we recorded on radar was lower than passage rates from most other studies in the Hawaiian Islands. Both the flight altitudes collected at the project and a larger dataset of visual observations from other sites in the Hawiian Islands suggest that most, if not all, Hawaiian Petrels and Newell's Shearwater flying over the Project would occur

above the height of the proposed transmission line. Therefore, although there is some level of risk to Hawaiian Petrels and Newell's Shearwaters at the Project the estimated number of annual collision fatalities was very low.

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ACKNOWLEDGMENTS

Funding for this research came from the State of Hawaii Department of Agriculture. We thank the following: Gordon Chong at Hawaii Department of Agriculture and Diane Kodama at AECOM for assistance with project coordination; Dennis Toba at Ronald N.S. Ho & Associates, Inc. for technical information on the project structures; and Oscar Ignacio and his crew at the Hawaii Department of Agriculture on Molokai for help with access to the project site. At ABR, Tom DeLong provided contract support; Rich Blaha provided GIS support; Matt Apling, Susan Cooper, and Delee Spiesschaert provided field/logistical support; Todd Mabee reviewed the report; and Pam Odom produced the report.

INTRODUCTION

The Hawaii Department of Agriculture (HDAG) has proposed the construction of a hydropower facility (hereafter Project) on the island of Molokai (Figure 1). The Project would be integrated with the Molokai Irrigation System and provide a renewable source of energy to supplement electricity demands for pumping water through the irrigation distribution system serving large areas of agricultural production on Molokai. In addition to installing a hydropower turbine along the existing irrigation pipeline, the Project also includes erecting a new section of overhead transmission line to interconnect with an existing overhead transmission line operated by Maui Electric Company. As part of the environmental assessment and permitting process, HDAG contracted ABR, Inc. (ABR) to collect information on federally-listed seabirds in the vicinity of the Project.

Two seabird species that are protected under the federal Endangered Species Act (ESA) could occur in the Project area: the endangered Hawaiian Petrel (*Pterodroma sandwichensis*, 'Ua'u) and the threatened Newell's Shearwater (*Puffinus auricularis newelli*, 'A'o). There is interest in studying Hawaiian Petrels and Newell's Shearwaters at the Project because of concerns regarding collisions with transmission lines and

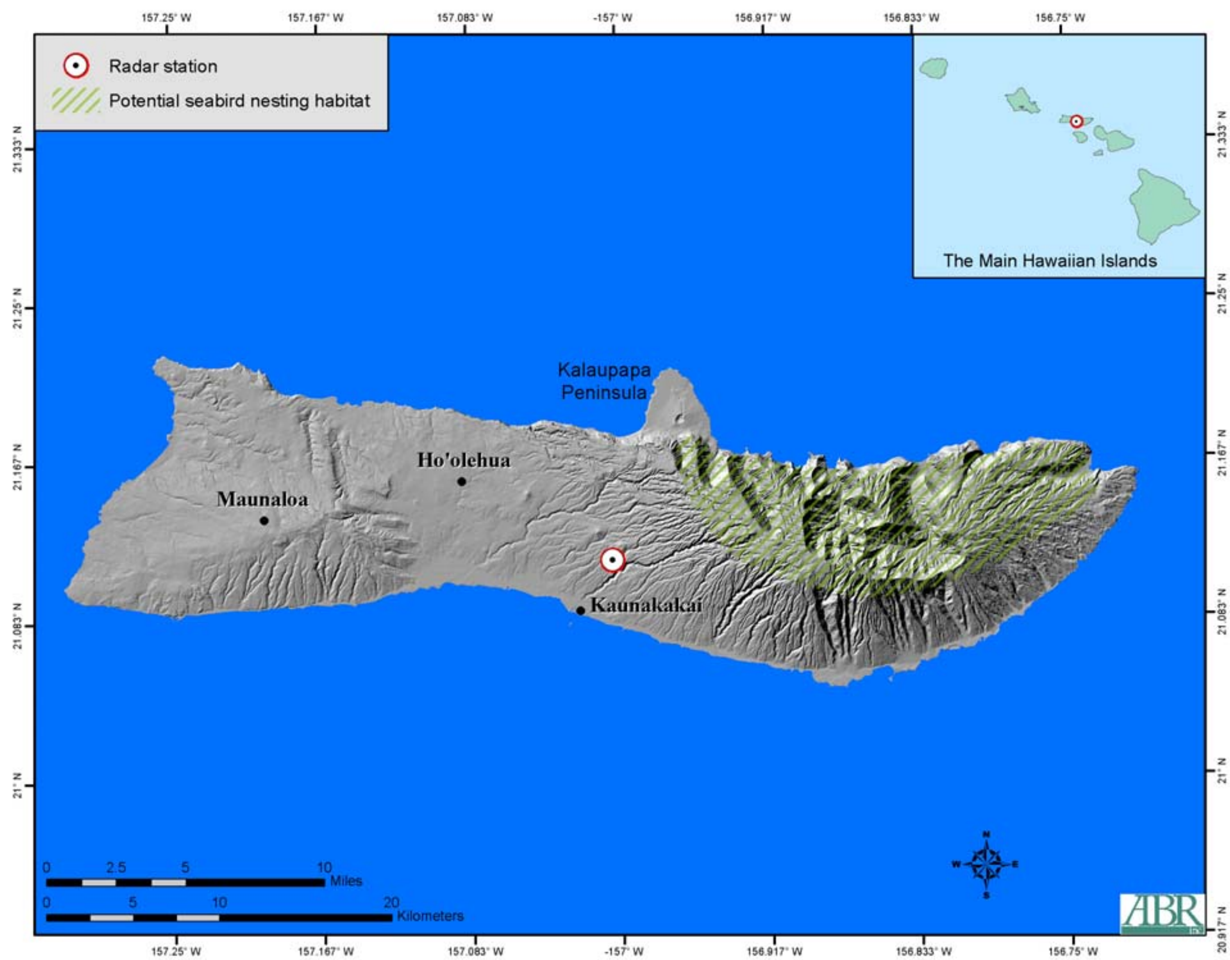

Figure 1. Map of the island of Molokai with location of the proposed Molokai Irrigation System Hydropower Plant and the summer 2014 seabird radar and audiovisual sampling station. Note that the outer boundaries of the potential Hawaiian Petrel/Newell's Shearwater nesting habitat are approximations based on topography, vegetation, and information found in Ainley et al. (1997b) and Simons and Hodges (1998).

associated structures. For example, many Newell's Shearwaters are killed each year on Kauai as a result of collisions with transmission lines (Podolsky et al. 1998). Ornithological radar and night-vision techniques have been shown to be successful in studying these seabirds across the Main Hawaiian Islands, including: Kauai (Cooper and Day 1995, 1998; Day and Cooper 1995, Day et al. 2003a); Maui (Cooper and Day 2003, 2004a); Molokai (Day and Cooper 2002); Hawaii (Reynolds et al. 1997, Day et al. 2003b); Lanai (Cooper et al. 2008); and Oahu (Day and Cooper 2010, Cooper et al. 2011). This report summarizes the results of radar and audiovisual (AV) studies of Hawaiian Petrels and Newell's Shearwaters conducted by ABR at the Project in summer 2014. The objectives of these studies were to: (1) collect baseline information on flight directions, passage rates, and flight altitudes of Hawaiian Petrels and Newell's Shearwaters in the area of the Project; (2) provide an estimate of the daily and seasonal numbers of petrels and shearwaters that fly over the Project area; and (3) provide an estimate of annual fatality rates of petrels and shearwater at the Project.

BACKGROUND

The Hawaiian Petrel and the Newell's Shearwater are tropical Pacific species that nest only on the Hawaiian Islands (AOU 1998) and attend inland nest sites during crepuscular and nocturnal hours of the breeding season. The populations of both species have declined significantly in historical times: they formerly nested widely over all of the Main Hawaiian Islands but now generally are restricted to scattered colonies in more inaccessible locations, with the exception of Kauai where these birds are more widespread (Ainley et al. 1997a, Simons and Hodges 1998, Pyle and Pyle 2009).

HAWAIIAN PETREL

The Hawaiian Petrel nests on most of the Main Hawaiian Islands (Harrison et al. 1984, Harrison 1990, Pyle and Pyle 2009) including Maui (Simons and Hodges 1998, Cooper and Day 2003), Lanai (Conant 1980, Penniman et al. 2008), Kauai (Day and Cooper 1995; Ainley et al. 1995, 1997b), Hawaii (Hu et al. 2001, Day et al. 2003b), and Molokai (Simons and Hodges 1998, Day and Cooper 2002). Munro (1941, 1960) could find no records of the Hawaiian Petrel on Oahu and stated that ancient Hawaiians probably had exterminated this species there.

There is little information on the occurrence and nesting distribution of the Hawaiian Petrel on the island of Molokai. Historical observations from the late 1800s and early 1900s indicate Hawaiian Petrels were once a common species in eastern areas of Molokai (see Pyle and Pyle 2009). Munro (1941, 1960) later wrote that the persistence of nesting populations of petrels on Molokai was questionable due to predation by the introduced mongoose; however, observations in the 1980s of Hawaiian Petrels off the north coast of Molokai (Pratt 1988) along with vocalizations heard in the upper Wailau Valley (Simons and Hodges 1998) suggested that petrels continued to nest on the island. More recently, Day and Cooper (2002) documented probable Hawaiian Petrel radar targets, based on the timing of detections, flying into the Waialeia, Waikolu, Waihanau valleys east of the Kalaupapa Peninsula. Also petrels were heard during 2008 avian surveys in the eastern mountains (H. Mounce, pers. comm.). Therefore, although the number and exact locations of Hawaiian Petrels breeding on Molokai are not known it is likely that this species still nests in the northeastern valleys of the island.

NEWELL'S SHEARWATER

The Newell's Shearwater nests on several of the Main Hawaiian Islands (Harrison et al. 1984, Harrison 1990, Pyle and Pyle 2009), with the largest numbers clearly occurring on Kauai (Day and Cooper 1995, Ainley et al. 1995, 1997a, Day et al. 2003a). These birds also nest on Hawaii (Reynolds and Richotte 1997, Reynolds et al. 1997, Day et al. 2003b), Maui (Wood and Bily 2008, KWP II 2011), Molokai (Pratt 1988, Day and Cooper 2002), and while not proven to do so, may still nest in very small numbers on Oahu (Banko 1980b, Conant 1980, Pyle 1983, Pyle and Pyle 2009).

The occurrence and nesting distribution of the Newell's Shearwater on the island of Molokai are not fully understood. Reports of Newell's Shearwaters on Molokai from the early 1900s include a few birds heard calling over the Waikolu and Pelekunu valleys (Bryan 1908) and several dead birds found at the head of windward valleys after a storm (Perkins 1903, cited in Banko 1980a; King and Gould 1967). Munro (1960) wrote that the introduced mongoose severely impacted and potentially resulted in the extirpation of nesting Newell's Shearwaters on Molokai; however, Day and Cooper (2002) speculated that at least two breeding colonies likely still persisted based on records of birds calling in the Pelekunu and Wailau valley in 1979–1980 and two birds calling while flying up Kamalo Gulch in 1988 (Pratt 1988). Additionally, Day and Cooper (2002) observed probable Newell's Shearwater radar targets, based on the timing of detections, entering the Waikolu and Waialeia valleys to the east of the Kalaupapa Peninsula. Therefore, similar to Hawaiian Petrels, although the number and exact locations of Newell's Shearwater breeding colonies on Molokai are not known it is likely that this species still nests in the valleys of northeastern Molokai.

STUDY AREA

The Project is located on undeveloped lands in central Molokai ~3 km north-northeast of Kaunakakai (Figures 1 and 2). The Project elevation ranges from ~260–280 m above sea level (asl) in terrain that slopes upward toward the northeast. Two prominent landscape features, Pu'u Luahine and Kakalahale, are situated directly upslope to the north and rise another ~100 m above the Project area. Also, Kaunakakai Gulch runs upslope to the east of the Project. There are existing dirt roads that access the Project from the west and south and run the length of the proposed transmission line. Vegetation at the Project includes non-native grasses and low shrubs (i.e., ~1–2 m tall) and scattered small trees.

The Project component that poses a potential collision risk for seabirds is the proposed section of overhead transmission line running ~1,106 linear meters (lm) east from the turbine generator to interconnect with the existing MECO overhead transmission line (Figure 2). The proposed transmission line will include 19–20 power poles, each with a height of ~12-m above ground level (agl) and a diameter tapering from 33.78–20.32 cm (mid-point = 27.05 cm). For structural support there will be guy wires at 5 of the power poles with a diameter of 1.11 cm and a total combined length of 38.10 m. The transmission configuration will consist of 3 individual overhead conductors (wires), each with a diameter of ~0.81 cm, spread out horizontally near the top of the power poles. Additionally, below the conductor wires there will be a single telephone wire lashed to a support cable with a combined diameter of 1.91 cm. None of the Projects structures will have lighting.

The location of our radar and audiovisual sampling station (N 21.11461°, W -157.0040°; 265 m asl) was at the east end of the proposed transmission line and just south of the proposed interconnection with the existing MECO transmission line (Figure 2). The sampling station provided unobstructed radar coverage of the entire Project footprint.

METHODS

STUDY DESIGN

We used marine radars and binoculars and night-vision optics to collect data on the passage rates, flight paths, flight behaviors, and flight altitudes of Hawaiian Petrels and Newell's Shearwaters at the project site for ten nights in summer 2014 (22–31 July). The sampling duration (i.e., ten nights) was based on previous radar studies of seabirds in the Hawaiian Islands and the summer sampling dates coincide with the incubation period of both species (Ainley et al. 1995, Simons and Hodges 1998, Deringer 2009). The nightly sampling effort consisted of a three-hour period beginning at sunset and a two-hour period beginning two hours prior to sunrise with each period divided into 30-minute (min) sampling sessions. The nightly sampling periods were selected to correspond with the evening and morning peaks of movement of Hawaiian Petrels and Newell's Shearwaters, as described near breeding colonies on Kauai (Day and Cooper 1995, Deringer 2009). For the purpose of recording data, a calendar day began at 0701 h and ended at 0700 h the following morning; that way, an evening and the following morning were classified as occurring on the same sampling day.

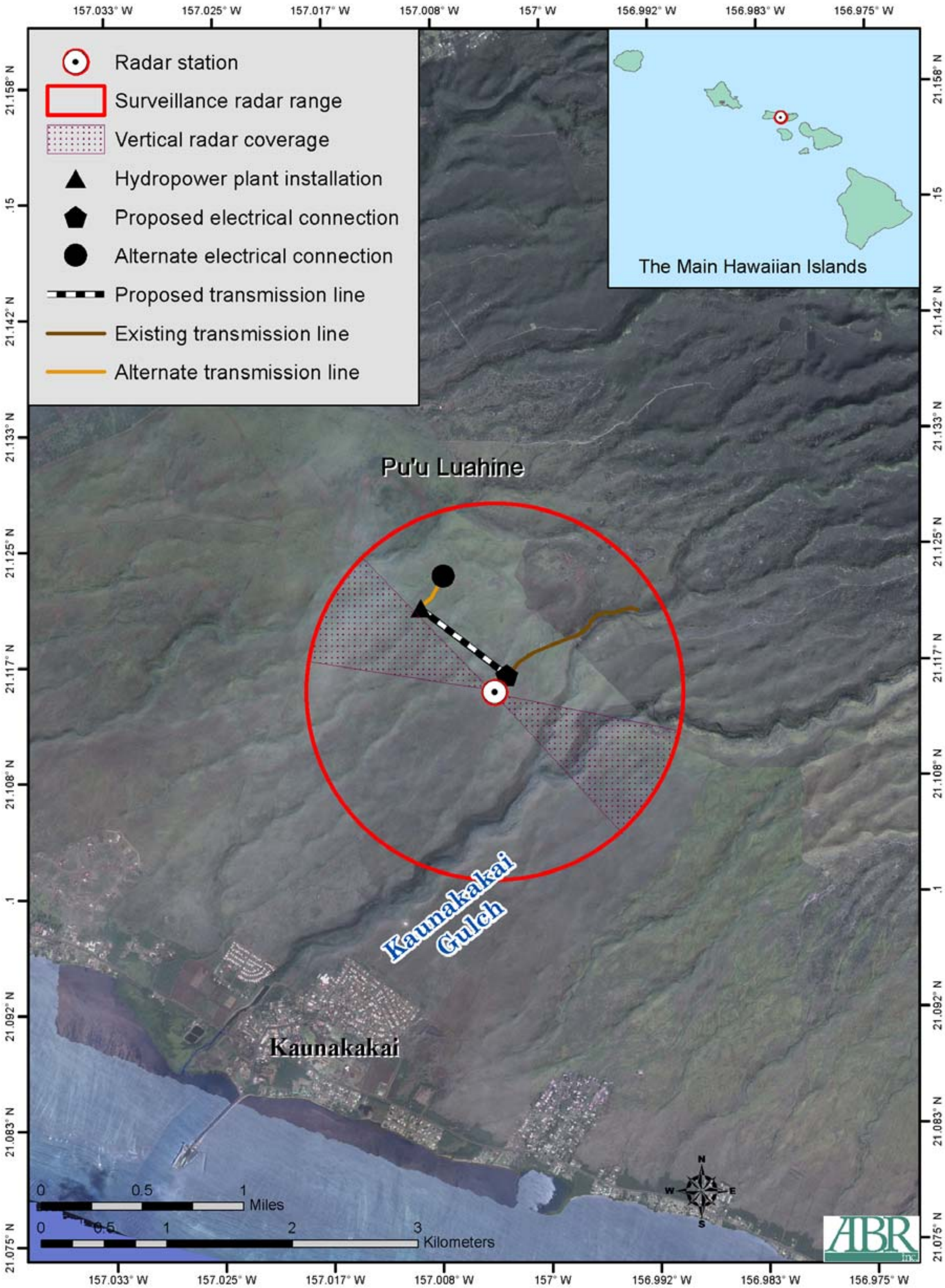

Figure 2. Location of the proposed Molokai Irrigation System Hydropower Plant components and the summer 2014 seabird radar and audiovisual sampling station on the island of Molokai.

RADAR EQUIPMENT

Our radar setup consisted of two marine radars mounted on vehicles (Figure 3). One radar was operated in surveillance mode and scanned a 1.5 km radius area to record flight paths, passage rates, and flight speeds of seabird targets. The other radar was operated in vertical mode to scan an area roughly parallel with the proposed transmission line and measure flight altitudes of seabird targets. The radar units were Furuno FR-1510 MKIIIs (X-band, 9.410 GHz, 2-m waveguide, 12 kW output) operated at a sampling range of 1.5 km with the pulse length set at 0.07 microseconds. In order to minimize ground clutter (areas obscured on radar by vegetation or surrounding topography) and increase the amount of vertical airspace sampled, the surveillance radar antenna was tilted upward at ~10° and we used a clutter lip on the lower edge of the antenna. Figure 4 shows the approximate sampling airspace for the Furuno FR-1510 marine radar in a) surveillance and b) vertical mode at the 1.5-km range setting, as determined by field trials with Rock Pigeons (*Columba livia*; Cooper et al. 2006); which are smaller (and probably have lower radar detectability) than petrels and shearwaters. Based on these trials and our prior studies, differences in detectability based on distance were not sufficient at the 1.5-km range to necessitate a correction factor. To ensure that our radar units perform to specifications, all ABR radars are periodically maintained and tested by licensed Furuno radar dealers. In addition, ABR tunes all radars seasonally and performs side-by-side comparisons annually to insure that all units collect comparable information.

DATA COLLECTION

During each survey period one observer operated the surveillance and vertical radars concurrently while another observer conducted audiovisual (AV) observations. At the start of each sampling session we collected environmental and weather data, including information on wind speed and direction, cloud cover, ceiling height, visibility, precipitation and moon phase. We recorded all radar images with frame grabbers (Epiphan Systems Inc., Ottawa, ON) for review and archiving of seabird targets and post-processing of flight altitudes.

We define a petrel/shearwater radar target as a radar echo that represents one or more birds meeting the criteria developed by Day and Cooper (1995) to identify Hawaiian Petrels and Newell's

Figure 3. The surveillance and vertical radars used for studies of Hawaiian Petrels and Newell's Shearwaters at the proposed Molokai Irrigation System Hydropower Plant, island of Molokai, summer 2014.

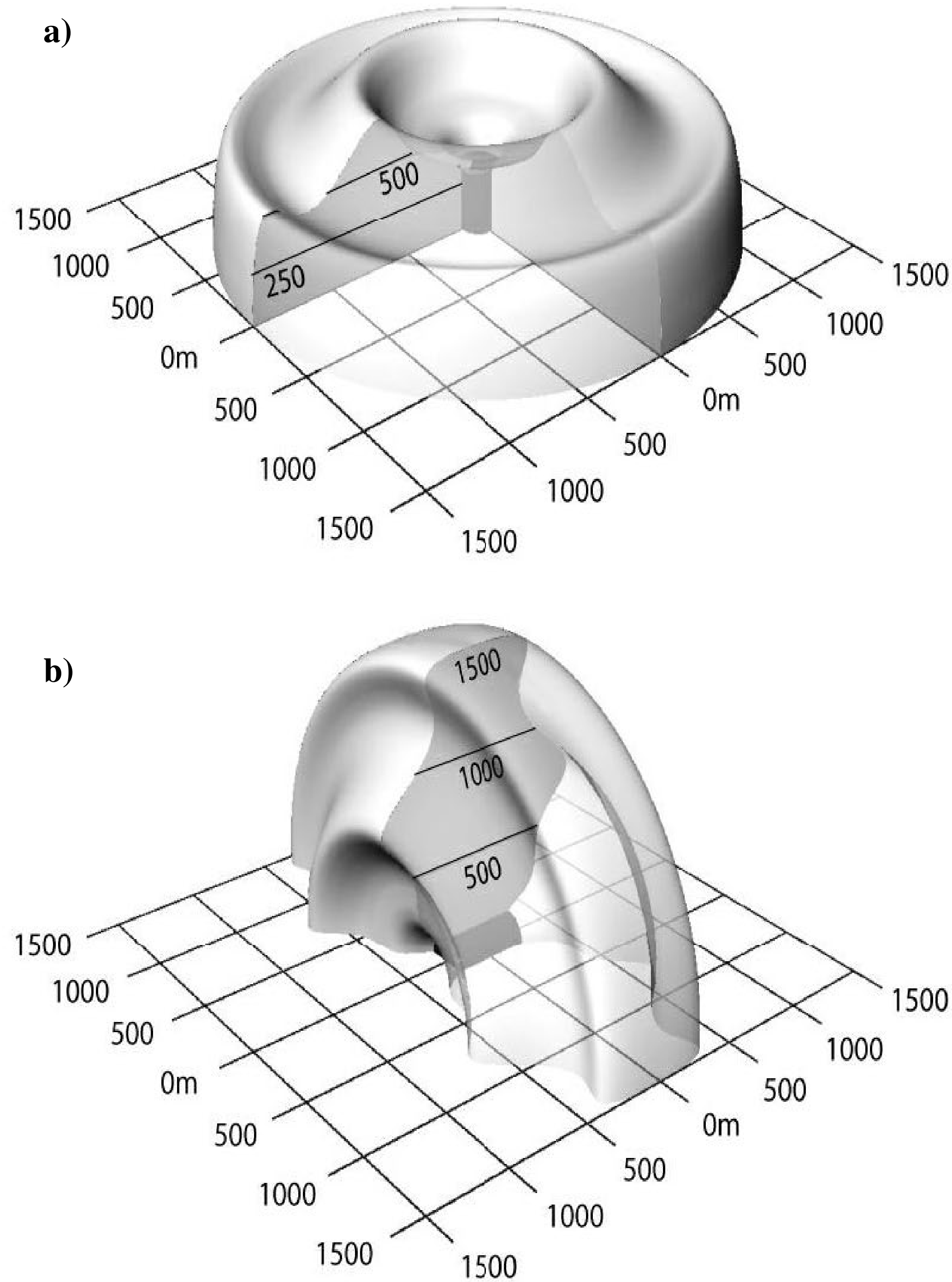

Figure 4. Approximate sampling airspace for petrels and shearwaters with the Furuno FR–1510 marine radar at the 1.5-km range setting, in a) surveillance and b) vertical antenna orientations, as determined by field trials with Rock Pigeons. Note that the shape of the radar beam within 250 m of the origin (i.e., the darkened area) was not determined.

Shearwaters on radar. Specifically, we used the airspeed, signature (i.e., size and appearance), flight characteristics, timing, and flight directions of radar targets to distinguish Hawaiian Petrel and Newell's Shearwater targets from other species. Because Hawaiian Petrels and Newell's Shearwaters look similar on radar we were unable to differentiate these two species; thus, hereafter we refer to these radar targets as "petrel/shearwater targets". The airspeed cutoff for inclusion as a petrel/shearwater target was ≥50km/h (≥30 mi/h). We computed airspeeds (i.e., groundspeeds corrected for wind speed and relative direction) of surveillance radar targets with the formula used by Mabee et al. (2006). We also removed radar targets identified by AV observers as being of other bird species. For each radar target that met the selection criteria for petrel/shearwater targets, we recorded the following key data: species (if identified by AV observer); number of birds (if identified by AV observer); time; flight direction; flight behavior; velocity; distance from the radar. Following surveys we used the timing, direction, and distance of petrel/shearwater targets on surveillance radar to locate these targets on the recorded vertical radar images. We measured flight altitudes relative to the radar location and then used digital elevation models to report flight altitudes of targets relative to ground level where the bird was detected.

We conducted AV sampling concurrently with the radar sampling to help identify targets observed on radar and to obtain additional flight-altitude information for species of interest (i.e., Hawaiian Petrels and Newell's Shearwaters). The AV sampling is particularly important for identifying the presence of other species that can at times appear similar to petrel/shearwater targets on radar and thus contaminate radar data during these studies. Examples of these non-target species include Barn Owl (*Tyto alba*) and Pacific Golden-Plover (*Pluvialis fulva*). During AV sampling, we used 10X binoculars during crepuscular periods and Generation 3 night-vision goggles (Model ATN-PVS7; American Technologies Network Corporation, San Francisco, CA) during nocturnal periods. The magnification of the night-vision goggles was 1×, and their performance was enhanced with the use of a 3-million-candlepower spotlight fitted with an infrared filter to prevent blinding or attracting birds. Observers also used vocalizations of birds passing overhead to assist in identifying radar targets. For each bird observed during AV sampling, we recorded: time; species; number of individuals composing each target; flight direction; and flight altitude. For any species of interest heard but not seen, we recorded species, direction of calls, and approximate distance from the observer.

DATA ANALYSIS

RADAR AND AUDIOVISUAL DATA SUMMARY

We entered all radar and AV data directly into Microsoft Excel spreadsheets (Microsoft, Redlands, CA). We checked data files visually for errors after each night of sampling and then checked files for errors and outliers at the end of the field season, prior to data analyses. We used Microsoft Excel and SPSS statistical software (SPSS 2009) to conduct all data summaries.

Data analyses included only radar targets that met the selection criteria for petrel/shearwater targets or were identified as a Hawaiian Petrel or Newell's Shearwater during concurrent AV observations. We categorized the general flight directions of each petrel/shearwater target as landward, seaward, or "other". Based on the location of the Project relative to the orientation of the shoreline and areas of northeastern Molokai thought to support petrel or shearwater colonies, we defined landward flight directions as flights heading between 350°–115° and seaward flight directions as flights heading between 170°–290° (Figure 5). "Other" flight directions included anything outside the landward or seaward categories (i.e., 116°–169° or 291°–349°). Because the flight directions of "other" targets were not representative of flights between the ocean and inland petrel or shearwater nesting habitat we assumed these targets were not petrels or shearwaters and excluded them from data summaries and fatality modeling.

PASSAGE RATES AND FLIGHT PATHS

In order to evaluate the amount and variation of seabird activity in the study area we tabulated counts of landward and seaward petrel/shearwater targets recorded during each sampling session, then converted counts to estimates of passage rates of

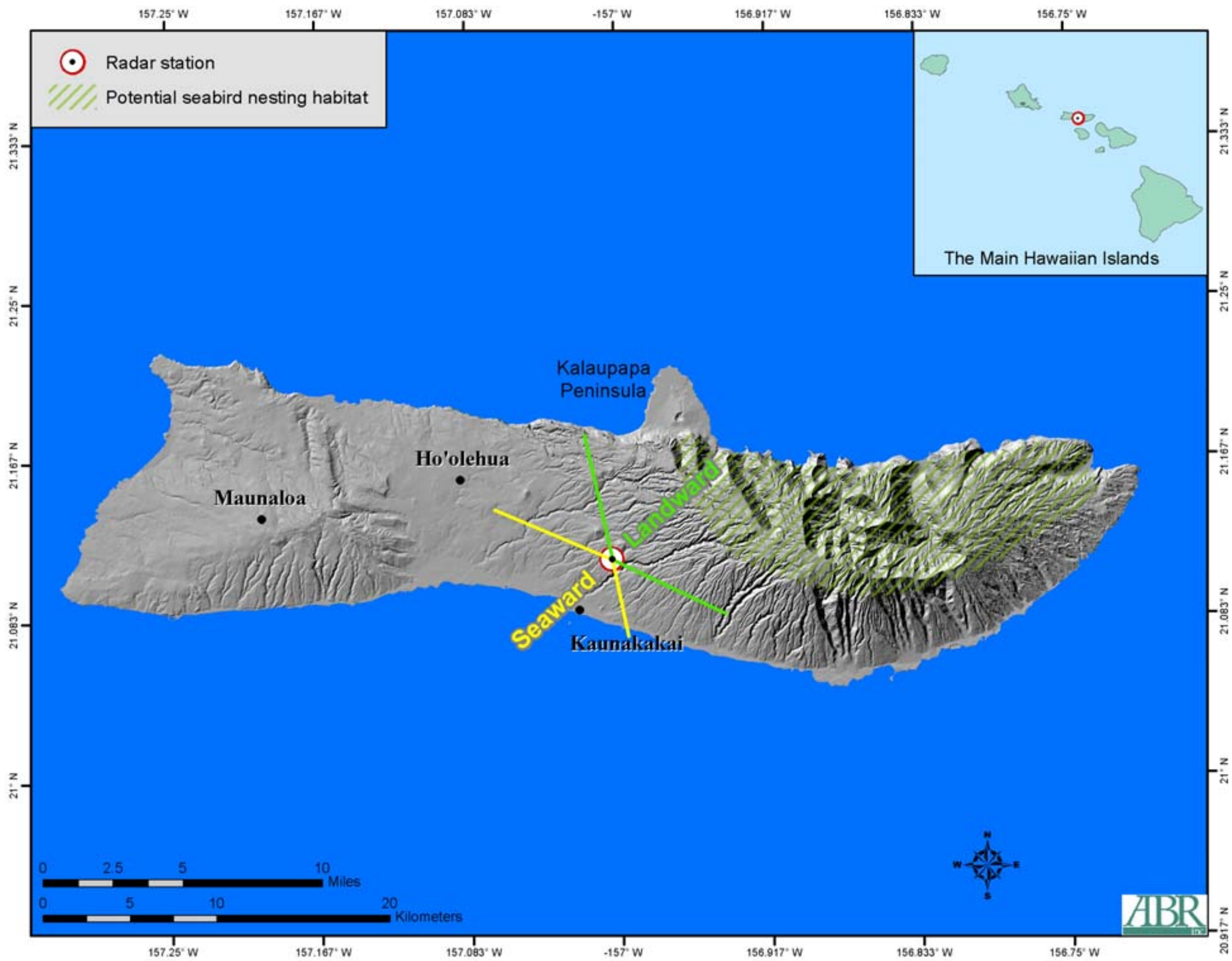

Figure 5. Map of the island of Molokai indicating petrel/shearwater target flight directions designated as landward (heading between 350°–115°) and seaward (heading between 170°–290°) during summer 2014, based on the location of the proposed Molokai Irrigation System Hydropower Plant relative to the orientation of the shoreline and areas of northeastern Molokai thought to support Hawaiian Petrel or Newell's Shearwater colonies. Potential nesting habitat was based on topography, vegetation, and information found in Ainley et al. [1997b] and Simons and Hodges [1998]).

birds (petrel/shearwater targets/h), based on the number of minutes sampled per session. We used all of the estimated passage rates across sampling sessions to calculate the mean ± 1 standard error (SE) nightly passage rate of petrel/shearwater targets at the site. Passage rates calculated as targets/h are the most commonly used radar metric to describe activity and movements of Hawaiian Petrels and Newell's Shearwaters in the Hawaiian Islands and use of this metric allows for comparisons with similar studies at other sites. We also provide passage rates calculated for a 1-km linear front (i.e., targets/km/h) as this allows for inference on the movement rates of birds relative to the ~1.1 km linear extent of the Project. Finally, we plotted all flight paths of petrel/shearwater targets on a map of the Project to determine if there were any patterns in flight paths (e.g., distinct flight corridors) within the sampling area.

FLIGHT ALTITUDES

Determining the flight altitudes of Hawaiian Petrels and Newell's Shearwaters in the vicinity of the Project assists with assessing potential risk to these birds at the Project. We summarized the mean flight altitudes of petrel/shearwater targets measured on vertical radar and any known seabird targets (i.e., Hawaiian Petrels, Newell's Shearwaters, and unidentified petrels/shearwaters) recorded during AV observations.

EXPOSURE AND FATALITY RATES

The risk-assessment model that we have developed uses the radar data on seasonal passage rates to estimate numbers of birds flying over the Project area during the breeding season. The model then uses information on the physical characteristics of those structures (e.g., the transmission line) that present a collision risk to estimate horizontal exposure probabilities, uses flight-altitude data and information on the height of the structures to estimate vertical exposure probabilities, and combines these exposure probabilities with the passage rates to generate annual exposure rates (Figure 6). These exposure rates represent the estimated numbers of petrels and shearwaters that pass within the airspace occupied by the transmission line each year. We then combine these exposure rates with (1) the probability that a collision results in a fatality; and (2) the probability that birds detect and avoid structures, to estimate annual fatality rates at the proposed Project.

Note that data from the entire breeding period (i.e., spring, summer, and fall) are used to model annual exposure and fatality rates. During the current study we apply summer data across the entire breeding period to calculate these rates. The number of petrels and shearwaters visiting breeding colonies generally tends to be lower in spring and fall than summer; colony attendance is sporadic in spring and in the fall attendance by nonbreeders and failed breeders declines with the progression from chick-rearing to fledging (Serventy et al. 1971, Warham 1990, Ainley et al. 1997a, Simons and Hodges 1998). Therefore, the annual exposure rates and fatality rates based on summer data alone that we present in this report are likely to overestimate actual rates.

Exposure Rates

The exposure rate is calculated as the product of three variables: annual passage rate, horizontal exposure probability, and vertical exposure

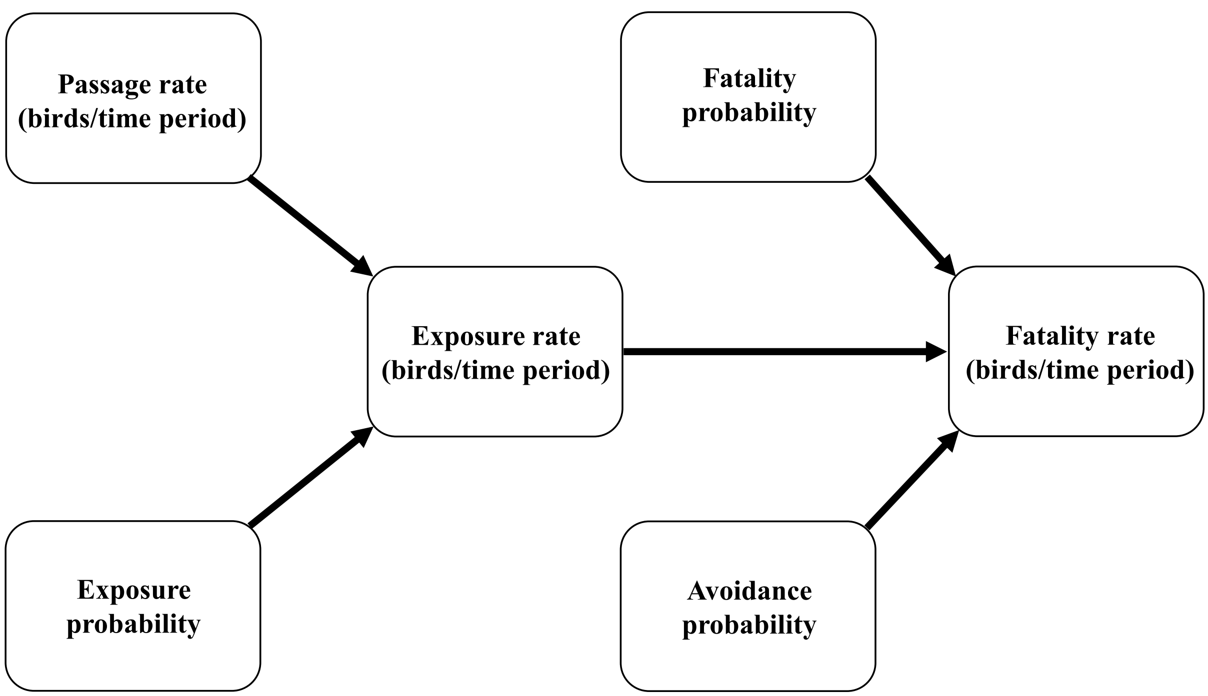

Figure 6. Major variables used in estimating possible fatalities of Hawaiian Petrels and Newell's Shearwaters at a transmission line at the proposed Molokai Irrigation System Hydropower Plant on the island of Molokai.

probability (Figure 6). As such, it is an estimate of the number of birds flying in the vicinity of a structure (i.e., crossing the radar screen) that could fly in a horizontal location and at a low-enough altitude that they could interact with that structure.

Passage rates

We generated annual passage rates from the radar data by: (1) multiplying the average passage rates (targets/h) by 5 h to estimate the number of targets moving over the radar station during the peak nightly movement periods; (2) adjusting the sum of those counts to account for the estimated percentage of movement that occurs during the middle of the night (12.6%; Cooper and Day, unpub. data); (3) multiplying that total number of targets/night by the mean number of Hawaiian Petrels and Newell's Shearwaters per radar target (1.05 ± SE 0.01 birds/flock; n = 2,062 visual observations of shearwater/petrel radar targets; R. Day and B. Cooper, unpub. data) to generate an estimate of the average number of petrels and shearwaters passing in the vicinity of the Project during a night; and (4) multiplying those numbers by the number of nights that these birds were exposed to risk in each season (i.e., 60 nights in the spring, 120 nights in the summer, and 75 nights in the fall for Hawaiian Petrel [Simons and Hodges 1998]; and 30 nights in the spring, 120 nights in the summer, and 60 nights in the fall for Newell's Shearwater [Ainley et al. 1997a; Deringer 2009]). Because there are records of both Hawaiian Petrels and Newell's Shearwater from Molokai (Pyle and Pyle 2009) but little information on the size of nesting populations for each species and we did not have any visual observations of petrels or shearwaters during our study, it was not possible to determine the actual proportions of petrel/shearwater targets represented by each species. Thus, we assumed that 50% of the petrel/shearwater targets were Hawaiian Petrels and 50% were Newell's Shearwaters.

Exposure probabilities

Exposure probabilities consist of both horizontal and vertical components. Note that our horizontal and vertical exposure "probabilities" actually are just fractions of sampled airspace occupied by structures, rather than usual statistical probabilities. Hence, we assume that the probability of exposure is equal to the fraction of sampled air space that was occupied by the transmission line and that there is a uniform distribution of birds in the sampled airspace.

The horizontal exposure probability is the probability that a bird seen on radar will pass over the two-dimensional space (as viewed from the side or front) occupied by the transmission line located somewhere on the radar screen. This probability is calculated from information on the two-dimensional area of the transmission line and the two-dimensional area sampled by the radar screen. The ensuing ratio of the cross-sectional area of the transmission line to the cross-sectional area sampled by the radar indicates the probability of interacting with (i.e., flying over the airspace occupied by) the transmission line.

The vertical exposure probability is the probability that a bird seen on radar will be flying at an altitude low enough to pass through the airspace occupied by the transmission line. This probability is calculated from information on the height of the structure and observed or assumed flight altitudes of birds at the Project. Because the number of petrel and shearwater flight altitudes observed at the Project was small (n = 3 petrel/shearwater radar targets) we chose to use a larger dataset of visual observations (691 Hawaiian Petrels, 714 Newell's Shearwaters) from other inland sites not at colonies throughout the Hawaiian Islands (Cooper, unpub. data). Based on this larger dataset we assumed that 1.45% of all Hawaiian Petrels and 0.14% of all Newell's Shearwater passing over the Project fly at or below the height of the proposed transmission line (i.e., ≤12 m agl).

Fatality Rates

As previously stated, the annual estimated fatality rate is calculated as the product of: (1) the exposure rate; (2) the fatality probability; and (3) the avoidance probability.

Fatality probability

The estimate of fatality-probability is derived as the probability of dying if it collides with the transmission line. Because any collision with a human-made structure falls under the ESA definition of "take," we used an estimate of 100% for this fatality-probability parameter; however, note that the actual probability of fatality resulting from a collision may be less than 100% because a bird can hit a transmission line and not die (e.g., a bird could brush a wingtip but avoid injury/death).

Avoidance probability

The avoidance rate is the probability that a bird will see the transmission line (e.g., power poles, guy wires, and transmission/telephone wires) and change flight direction, flight altitude, or both, so that it completely avoids flying through the space occupied by the structure. Because avoidance rates are largely unknown, we present fatality estimates for a conservative range of probabilities of collision avoidance by these birds by assuming that 90%, 95%, or 99% of all petrels and shearwaters flying near a transmission line will detect and avoid it.

ESTIMATING THE LIKELIHOOD OF FATALITY LEVELS

In addition to the above metric that derives rates of fatalities we also used a Poisson distribution (Rice 1995) to estimate the probability that one, two, three, etc. birds would be killed each year. If the expected number of fatalities per year is λ, then the probability that there are exactly k fatalities (k = 0, 1, 2, ...10) is equal to:

$$f(k;\lambda)=\frac{\lambda^k e^{-\lambda}}{k!},$$

where

- e is the base of the natural logarithm (e = 2.71828...)
- k is the number of fatalities each year — the probability of which is given by the function
- $k!$ is the factorial of k
- λ is a positive real number, equal to the expected number of fatalities per year

We derived λ as the product of the annual number of birds passing through the proposed development (daily passage rate * annual adjustment factors) and the probability of collision (horizontal interaction probability * vertical interaction probability * probability of fatality if interaction * avoidance rate).

RESULTS

RADAR OBSERVATIONS

No sampling nights were canceled due to weather (i.e., rain) during this study, but we did lose a total of 28 minutes of radar sampling due to insects that obscured large portions of the radar sampling area on two different nights.

PASSAGE RATES AND FLIGHT PATHS

During our ten survey nights in summer 2014, we observed a total of 3 landward and 8 seaward radar targets that fit our criteria for petrel/shearwater targets (Figure 7, Table 1). This included 1 landward target that we detected during a period of intense insect activity that obscured large portions of the radar screen and prevented systematic sampling. Therefore we report this target but did not include it in calculations of passage rates or collision fatality estimates. We also observed 21 targets that fit our criteria for petrel/shearwater targets but were flying in “other” directions and therefore were assumed not to be petrels or shearwaters.

The mean landward passage rate was 0.07 ± 0.04 targets/h during the evening and 0 targets/h in the morning (Table 2). In contrast the seaward passage rate was 0.17 ± 0.09 targets/h during evening and 0.15 ± 0.08 targets/h in the morning. The mean overall nightly passage rate of petrel/shearwater targets (i.e., landward and seaward rates combined) was 0.19 ± 0.07 targets/h. Along a 1-km front the mean nightly passage rate of petrel/shearwater targets was 0.07 ± 0.02 targets/km/h. An assessment of petrel/shearwater target flight paths and trajectories did not indicate any distinct flight corridors or concentration points over any particular portion of the Project (Figure 7).

FLIGHT ALTITUDES

We recorded a total of 3 flight altitudes of petrel/shearwater targets on vertical radar. These targets were at 66 m agl, 147 m agl, and 172 m agl and each was flying in a seaward direction. The mean flight altitude of these targets was 128 ± 32 m agl. Thus, all (100%) of the targets observed on vertical radar flew above the height (i.e., >12 m agl) of the proposed Project structures.

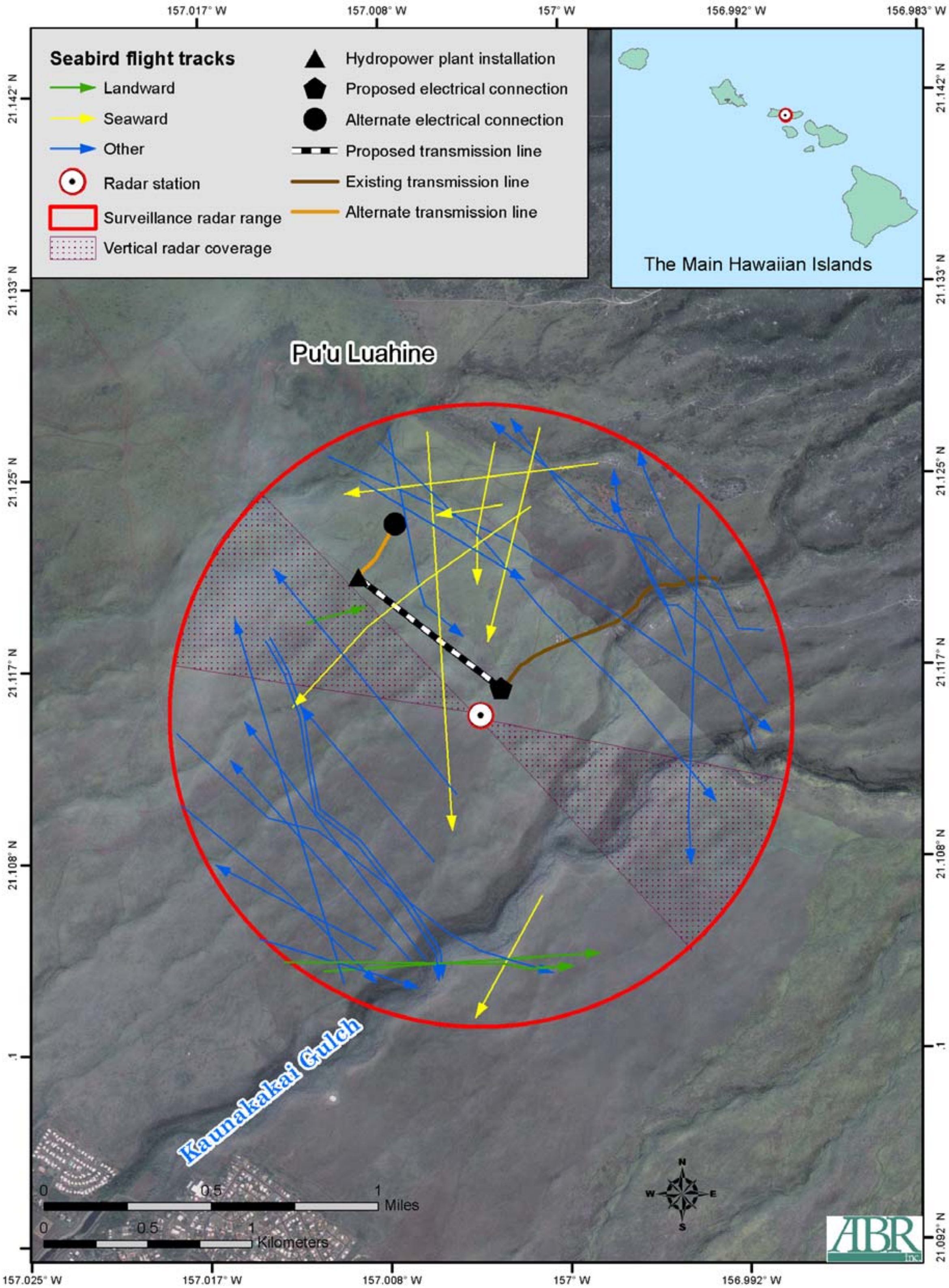

Figure 7. Flight paths of petrel/shearwater radar targets (landward and seaward) and "other" targets observed in summer 2014 at the proposed Molokai Irrigation System Hydropower Plant.

Table 1. Sampling dates and summary of the total number of petrel/shearwater radar targets (landward/seaward), "other" targets, and audio-visual observations of species of interest in the vicinity of the proposed Molokai Irrigation District Hydropower Plant, during summer 2014. Numbers in parentheses are the number of targets observed crossing the proposed transmission line.

		Total Number of Radar Targets			
Date	Period	Landward[1]	Seaward[2]	Other[3]	Audio-visual observations[4]
22 July	Eve	0	0	1 (0)	1 UNOW
	Morn	0	1 (1)	1 (0)	1 UNOW
23 July	Eve	1 (0)	2 (1)	0	
	Morn	0	0	1 (0)	1 SEOW
24 July	Eve	0	0	6 (0)	1 BAOW, 1 SEOW
	Morn	0	1 (0)	1 (0)	1 BAOW
25 July	Eve	0	0	1 (0)	1 SEOW, 1 UNOW
	Morn	0	1 (0)	2 (0)	1 BAOW
26 July	Eve	1[5] (1)	0	2 (0)	1 UNOW
	Morn	0	0	0	2 UNOW
27 July	Eve	0	2 (2)	0	
	Morn	0	0	1 (0)	2 SEOW
28 July	Eve	1 (0)	0	0	
	Morn	0	0	0	
29 July	Eve	0	0	1 (0)	
	Morn	0	0	2 (0)	1 BAOW
30 July	Eve	0	1 (0)	0	
	Morn	0	0	1 (0)	2 BAOW
31 July	Eve	0	0	1 (0)	
	Morn	0	0	0	1 BAOW
Radar Totals:		3 (1)	8 (4)	21 (0)	

[1] Landward flight directions = 350–110°.
[2] Seaward flight directions = 160–280°.
[3] Other flight directions = 111–159° and 281–349°.
[4] Audio-visuals: BAOW = Barn Owl; SEOW = Short-eared Owl; UNOW = Unknown owl species.
[5] Detected during period of rain that prevented sampling entire area so not included in full data analysis.

AUDIOVISUAL OBSERVATIONS

During our 10 nights of AV sampling we did not detect any Hawaiian Petrels or Newell's Shearwaters. Other species of interest observed during AV sampling included 7 Barn Owls, 5 Short-eared Owls (Pueo; *Asio flammeus*), and 6 unidentified Owls (Table 1).

EXPOSURE RATES

Based on the average nightly (evening + morning) passage rate from summer 2014 (Table 2), we estimate that approximately 0.13 Hawaiian Petrel/yr and 0.01 Newell's Shearwater/yr would fly within the space occupied by the transmission line structures (Table 3). Note that these calculations are exposure rates and therefore include an unknown proportion of birds that would detect and avoid the transmission line.

FATALITY MODELING

The individual steps involved in calculating fatality rates are shown in Table 3. We speculate that the proportions of birds that detect and avoid transmission lines is substantial (see Discussion), but limited petrel/shearwater-specific data are available to use for estimates of avoidance rates for these structures. Because it is necessary to estimate the fatality of petrels and shearwaters at the proposed Project, we assumed that 90%, 95%, or 99% of all birds will be able to detect and avoid the transmission line. Assuming that 100% of the birds colliding with the transmission line die, we estimated a fatality rate of 0.0013–0.0130 Hawaiian Petrels/yr and 0.0001–0.0010 Newell's Shearwaters/yr (Table 3).

LIKELIHOOD OF FATALITY LEVELS

To facilitate a clearer understanding of the likelihood of a Hawaiian Petrel or Newell's Shearwater collision with the proposed transmission line we used a Poisson distribution to estimate the probability that one, two, three, etc. birds might be killed each year based on a range of avoidance factors (Table 4). For example, the probability of zero annual collision fatalities ranged from 0.9867–0.9987 for Hawaiian Petrels and 0.9990–0.9999 for Newell's Shearwaters; whereas the probability of one annual collision fatality ranged from 0.0013–0.0132 and 0.0001–0.0010 respectively (Table 4).

DISCUSSION

SPECIES COMPOSITION

Historical observations indicate both Hawaiian Petrels and Newell's Shearwaters once nested on Molokai (see Introduction) and more recent information (e.g., Day and Cooper 2002) suggests that small breeding populations of these seabirds persist in areas of northeast Molokai, particularly in the valleys directly east of the Kalaupapa Peninsula (Figure 1). We did not detect any petrels or shearwaters during AV observations but we did record low passage rates of petrel/shearwater radar targets over the Project. In some cases non-target species, such as owls, can look similar on radar to petrel/shearwater targets. The AV observations helped to reduce contamination of the radar data but ultimately the radar data errs on the conservative side because it is likely to include some non-target species as petrel/shearwater targets. Because we did not get

Table 2. Mean passage rates (targets/h ± SE) of landward and seaward flying petrel/shearwater radar targets observed at the proposed Molokai Irrigation District Hydropower Plant, during summer 2014. *n* = number of sampling days.

Time period (*n*)	Landward[1]	Seaward[2]	Combined
Evening (10)	0.07 ± 0.04	0.17 ± 0.09	0.23 ± 0.11
Morning (10)	0.00 ± 0.00	0.15 ± 0.08	0.15 ± 0.08
Evening + Morning			0.19 ± 0.07

[1] Landward flight directions = 350–115°.
[2] Seaward flight directions = 170–290°.

Table 3. Estimated average exposure rates and fatality rates of Hawaiian Petrel and Newell's Shearwater at a transmission line at the proposed Molokai Irrigation District Hydropower Project, island of Molokai, Hawaii. Results are based on radar data collected in summer 2014 and values of particular importance are in boxes.

Variable/parameter for Molokai Hydropower transmission line	Hawaiian Petrel	Newell's Shearwater
PASSAGE RATE (PR)		
A) Mean passage rate (targets/h)		
A1) Mean rate during nightly peak movement periods in spring (based on summer 2014 data)	0.19	0.19
A2) Mean rate during nightly peak movement periods in summer (based on summer 2014 data)	0.19	0.19
A3) Mean rate during nightly peak movement periods in fall (based on summer 2014 data)	0.19	0.19
B) Number of hours of evening and morning peak period of movement	5	5
C) Mean number of targets during evening and morning peak movement periods		
C1) Spring (A1 * B)	0.96	0.96
C2) Summer (A2 * B)	0.96	0.96
C3) Fall (A3 * B)	0.96	0.96
D) Mean proportion of birds moving during off-peak h of night[1]	0.13	0.13
E) Seasonal passage rate (targets/night = (C * D)+ C)		
E1) Spring	1.08	1.08
E2) Summer	1.08	1.08
E3) Fall	1.08	1.08
F) Mean number of birds/target[2]	1.03	1.03
G) Estimated proportion of targets that are Hawaiian Petrels vs. Newell's Shearwaters	0.50	0.50
H) Daily passage rate (bird passes/day = E * F * G)		
H1) Spring	0.56	0.56
H2) Summer	0.56	0.56
H3) Fall	0.56	0.56
I) Fatality domain (days/year)		
I1) Spring	60	30
I2) Summer	120	120
I3) Fall	75	60
J) Annual passage rate (bird passes/year = (H1 * I1) + (H2 * I2) + (H3 * I3)), rounded to next whole number	142	117
HORIZONTAL INTERACTION PROBABILITY (HIP)[3]		
K) Area of each 12-m high power pole (= pole height * (pole width[4] + seabird wingspan[5]))	15.01	13.93
L) Number of 12-m high power poles	20	20
M) Area of all power poles (= K * L)	300.12	278.52
N) Area of 6 guy wire segments (= 38.1 m combined length * (wire diameter[6] + seabird wingspan[5]))	37.76	34.33
O) Area of single horizontal row of transmission wire (= 1,006 m total length * (wire diameter[7] + seabird wingspan[5]))	994.06	977.11
P) Area of single horizontal row of telephone wire (= 1,006 m total length * (wire diameter[8] + seabird wingspan[5]))	1,005.04	914.50
Q) Total area of power poles, guy wires, transmission wire and telephone wire (= M + N + O + P)	2,336.98	2,204.46
R) Cross-sectional sampling area of radar at or below 12-m height of transmission line structures (= 3,000 m sampling diameter * 12.0 m height)	36,000	36,000
S) Interaction probability (= Q/R)	0.0649	0.0612
VERTICAL INTERACTION PROBABILITY (VIP)		
T) Proportion of petrels/shearwaters flying ≤ height of transmission line structures (≤ 12.0 m) based on visual observations of seabird flight altitudes at inland sites in the Hawaiian Islands[9]	0.0145	0.0014
EXPOSURE RATE (ER = PR * HIP * VIP)		

Table 3. Continued.

Variable/parameter for Molokai Hydropower transmission line	Hawaiian Petrel	Newell's Shearwater
U) Annual exposure rate (bird passes/year = J * S * T)	0.1300	0.0100
FATALITY PROBABILITY (FP)[10]		
V) Probability of fatality if an interaction with transmission line structures	1.00	1.00
FATALITY RATE (= ER * FP)		
Annual fatality rate with 90% exhibiting collision avoidance (birds/year = U * V * 0.10)	0.0130	0.0010
Annual fatality rate with 95% exhibiting collision avoidance (birds/year = U * V * 0.05)	0.0065	0.0005
Annual fatality rate with 99% exhibiting collision avoidance (birds/year = U * V * 0.01)	0.0013	0.0001

[1] Accounts for hours of night when sampling not conducted and based on other studies of petrels/shearwaters in the Hawaiian Islands.
[2] Based on concurrent radar and visual observations from other studies of petrels/shearwaters in the Hawaiian Islands.
[3] All area measurements calculated as square meters.
[4] Power pole width tapers from 33.78 cm at bottom to 20.32 cm at top. For calculations used mid-point value of 27.05 cm.
[5] Hawaiian Petrel wingspan = 98 cm; Newell's Shearwater wingspan = 89 cm.
[6] Guy wire diameter = 1.11 cm.
[7] Transmission wire diameter = 0.81 cm. Only used one wire in area calculations because all three wires will be in a single horizontal row.
[8] Telephone wire diameter = 1.91 cm. There will be a single telephone wire below the primary conductors (transmission wires).
[9] Vertical Interaction Probability was calculated using flight altitudes from visual observations of Hawaiian Petrels (*n* = 691) and Newell's Shearwaters (*n* = 714) observed during inland studies of seabirds in the Hawaiian Islands. Observations at colonies not included.
[10] Used 100% fatality probability due to ESA definition of "take"; however, actual probability of fatality with collision <100%.

Table 4. Summary of the estimated probability of different annual collision fatality levels of Hawaiian Petrels and Newell's Shearwaters at the proposed Molokai Irrigation District Hydropower Project, island of Molokai, Hawaii. Note that results are based on the assumption that each species represents 50% of total annual collision fatalities.

	Hawaiian Petrel			Newell's Shearwater		
Number of annual collisions	90% Avoidance	95% Avoidance	99% Avoidance	90% Avoidance	95% Avoidance	99% Avoidance
0	0.9867	0.9934	0.9987	0.9990	0.9995	0.9999
1	0.0132	0.0066	0.0013	0.0010	0.0005	0.0001
2	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
3	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
4	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
5	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

concurrent visual observations of any petrel/shearwater targets and because the exact locations of petrel and shearwater breeding colonies on Molokai are not known, we were unable to determine the proportion of petrel/shearwater targets that were Hawaiian Petrels versus Newell's Shearwaters but assume that both species could occur over the Project.

PASSAGE RATES

Comparisons of radar passage rates from the current study with similar radar studies from other sites in the Hawaiian Islands provides some context on Hawaiian Petrel and Newell's Shearwater activity at the Project. In fact, the overall mean passage rate of petrel/shearwater targets from the current study was lower than the mean passage rate from all other Hawaiian Islands (Table 5). In terms of Molokai comparisons, our evening passage rate (mean = 0.2 ± 0.1 targets/h, Table 2) was much lower than evening passage rates recorded by Day and Cooper (2002) on the north shore of Molokai (range = 0.8–9.6 targets/h, Table 5). This was not surprising because neither Hawaiian Petrel nor Newell's Shearwater are thought to nest in large numbers on Molokai and the Project area was not in close proximity to any known breeding colonies or potential habitat. Additionally, both Hawaiian Petrels and Newell's Shearwaters are known to use river valleys and other landscape features as flight corridors when traveling between the ocean and inland breeding areas (Day and Cooper 1995, Day et al. 2003b). We believe that it is most likely that Hawaiian Petrels and Newell's Shearwaters use the numerous large river valleys along the northern shores of the island to access the potential breeding habitat on eastern Molokai, because those would be the shortest and most direct routes into that area (Figure 1). In contrast, there are no similarly large valleys in the vicinity of the Project that provide direct access up to the potential breeding areas from the ocean. That fact, plus the low petrel/shearwater passage rates we observed in our study, suggests that few Hawaiian Petrels or Newell's Shearwaters access the Molokai colonies over the Project area.

FLIGHT ALTITUDES

The flight altitudes of petrel/shearwater targets recorded during our study (mean = 128 ± 32 m agl) were all higher than the maximal height of the proposed transmission line (12 m agl); however, it is difficult to draw conclusions from this small sample of flight altitudes from vertical radar (n = 3 targets). A larger sample of visual observations of Hawaiian Petrels and Newell's Shearwaters from inland sites (not at colonies) across the Hawaiian Islands found that >98% of petrel observations (n = 691 total observations) and >99% of shearwater observations (n = 714 total observations) occurred >12 m agl (ABR, unpub. data). Flight altitudes from radar data are often biased against birds flying very low to the ground, where they can be more difficult to detect on vertical radar, whereas flight altitudes from visual observations are generally biased against higher flying birds that can be more difficult to see than lower flying birds. Regardless, both sources of data suggest that the number of petrels and shearwaters occurring within the zone of risk at the Project (i.e., at or below the height of the transmission line) was very low.

Certain factors are known to affect the flight altitudes of petrels and shearwaters traveling between the ocean and inland nesting areas. For instance, Cooper and Day (1998) found that flight altitudes of Newell's Shearwaters on Kauai were significantly higher at inland sites (>800 m from coastline) than coastal sites (<100 m from coastline). In fact, even a few hundred meters inland these birds flew at significantly higher altitudes than directly along the coastline (Cooper and Day 1998). The Project is located ~3.5 km from the nearest section of coastline to the south. Additionally, the proposed transmission line runs directly below a series of low hills, as well as the larger Pu'u Luahine. If birds approaching the Project increase flight altitude or maintain higher flight altitudes in order to pass over those adjacent hillsides, it would increase the likelihood that birds fly over the Project above the height of the proposed transmission line (i.e., >12 m agl). For example, previous studies have shown that both Hawaiian Petrels and Newell's Shearwaters generally increase flight altitudes to fly above the

Table 5. Summary of passage rates (targets/h) of probable Hawaiian Petrel and/or Newell's Shearwater targets observed during radar studies on the main Hawaiian Islands. Results for the current study on the island of Molokai are marked in bold.

		Passage rate (targets/h)[1]			Species[2]	
Island (Season)	Year	Mean	Range	No. sites sampled	(HAPE, NESH, or BOTH)	Source
Molokai (summer)	**2014**	**0.19**	**-**	**1**	**BOTH**	**Current study**
Molokai (summer)	2002	4.2	0.8–9.6	4	BOTH	Day and Cooper 2002
Kauai (summer)	2001	131.0	7–569	17	BOTH	Day et al. 2003a; Day and Cooper 2001
Kauai (fall)	1993	160.0	35–320	14	BOTH	Cooper and Day 1995
Oahu (summer)	2008, 2009	0.5	0.2–0.6	3	NESH	Day and Cooper 2008, Cooper et al. 2011
Oahu (fall)[3]	2007, 2009	0.3	0.3	1	NESH	Day and Cooper 2008
Lanai (summer)	2007	2.9	0.5–7.1	9	HAPE	Cooper et al. 2007
East Maui (summer)	2001, 2004	38.6	1.9–134	12	HAPE	Cooper and Day 2003, Day et al. 2005
East Maui (fall)	2004	13.6	6.2–26.8	4	HAPE	Day et al. 2005
West Maui (summer)	1999, 2001, 2008, 2009	5.2	0.3–21	11	BOTH	Cooper and Day 2003, 2009; Day and Cooper 1999; Sanzenbacher and Cooper 2008, 2009
West Maui (fall)	2004, 2008	1.5	0.0–1.1	4	BOTH	Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009
Hawaii (summer)	2001, 2003	1.8	0–25.8	25	BOTH	Day et al. 2003b;Day and Cooper 2003, 2004, 2005
Hawaii (fall)	2002	0.5	0.1–0.7	6	BOTH	Day et al. 2003c

[1] All rates are total movement rates (i.e., landward + seaward) for evening and morning combined, if available, or evening only if morning data not available.
[2] HAPE = Hawaiian Petrel; NESH = Newell's Shearwater; BOTH = both Hawaiian Petrel and Newell's Shearwater potentially present.
[3] Fall passage rates from studies at the Kawailoa Wind Energy Project excluded due to reported high levels of contamination of radar data by non-target species.

level of the tree line and other vegetation when flying to/from nesting areas (Podolsky et al. 1998, ABR, unpub. data). Thus, both the inland location and topography at the Project increases the likelihood that those petrels and shearwaters passing over the site will occur above the height of the proposed transmission line and result in lower risk to these seabirds.

COLLISION RISK ASSESSMENT

The primary risk to seabirds at the Project is the possibility of collisions with the proposed transmission line. Hawaiian Petrels and Newell's Shearwaters have been killed at overhead wires (i.e., transmission and telephone lines) and utility poles in Hawaii (Telfer et al. 1987, Hodges 1992, Cooper and Day 1998, Podolsky et al. 1998). For example, Ainley et al. (1995) estimated that up to 350 Newell's Shearwater fatalities occurred on Kauai each year due to collisions with utility structures (e.g., overhead wires) and an additional 70 chicks died each year resulting from the loss of nesting adults. More recently the number of collision fatalities at utility structures on Kauai has decreased, in part due to mitigation efforts to minimize fatalities, with an estimated 88 Newell's Shearwater collision fatalities in 2008 (KIUC 2010). The proposed transmission line at the current Project includes overhead wires, utility poles, and guy wires; thus there is the potential for collisions at these structures by Hawaiian Petrels and Newell's Shearwaters flying between the ocean and inland nesting areas.

EXPOSURE RATES AND FATALITY ESTIMATES

We estimated that an average of approximately 0.13 Hawaiian Petrels/yr and 0.01 Newell's Shearwaters/yr would fly within the space occupied by the proposed transmission line (Table 3). We used this exposure rate as a starting point for developing a complete avian risk assessment; however, we emphasize that it currently is unknown whether bird use (i.e., exposure) and fatality at structures are strongly correlated. For example, Cooper and Day (1998) found no relationship between passage rates and fatality rates of Hawaiian Petrels and Newell's Shearwaters at transmission lines on Kauai, indicating that other factors had a greater effect on collision fatalities than passage rates. For instance, artificial lights are known to attract various species of seabird, including Hawaiian Petrels and Newell's Shearwaters, and result in the grounding of birds that become disoriented and exhausted after circling lights or colliding with nearby structures (Ainley et al. 1997a, Podolsky et al. 1998, LeCorre et al. 2002, Rodriguez and Rodriguez 2009, Miles et al. 2010). Telfer et al. (1987) found that fallout of petrels and shearwaters on Kauai was most concentrated around urban areas and in particular along the coast and at river mouths. Thankfully the minimization and modification (e.g., shielding) of lighting on structures has been shown to reduce the incidence of downed seabirds (Reed et al 1985, Telfer et al. 1987). No lighting is planned for the Project so this is not a risk factor.

Another factor that might influence collision rates is weather conditions. We do not know of any studies to date that have shown correlations between specific weather conditions and fatalities of Hawaiian Petrels or Newell's Shearwaters; However, collisions of Laysan Albatross (*Phoebastria immutabilis*) with a large array of communication-tower antenna wires and guy wires adjacent to large, high-density albatross breeding colonies on Midway Atoll occurred at a far higher rate during periods of high winds, rain, and poor visibility than during periods of less severe weather: 838 (>25%) of the 2,901 birds killed during the study were killed during two storms (Fisher 1966).

Collision Avoidance Rates

Some data are available on the proportion of petrels and shearwaters that do not collide with transmission lines because of collision-avoidance behavior (i.e., birds that alter their flight paths to avoid collision). For example, work conducted on Kauai from 1992–2002 (Cooper and Day 1998; ABR, unpub. data) suggests that the behavioral-avoidance rate of petrels and shearwaters at transmission lines is very high: of the 207 Hawaiian Petrels observed flying within 150 m of transmission lines, 40 (19%) exhibited behavioral responses and there were no collisions. Similarly, of the 392 Newell's Shearwaters observed flying within 150 m of transmission lines, 29 (7%) exhibited behavioral responses. Thus, the observed collision-avoidance rate for each species was 100% (i.e., all interactions resulted in collision avoidance).

Results from studies at other structures in Hawaii provide additional insights on collision-avoidance behavior of petrels and shearwaters. For instance, observations of Hawaiian Petrels at an aerial display location on Hawaii Island indicated that displaying petrels actively avoided fences in their path (Swift 2004). Only one collision out of 1,539 flight passes (i.e., <0.1% of passes resulted in a collision) was observed during treatment nights, and of the 17 birds that exhibited close-in avoidance maneuvers at the fences, only one (~6%) collided with them. The behavior of Hawaiian Petrels was also studied as they approached large communication towers near a petrel breeding colony on Lanai (Tetra Tech 2008). In that study, all 20 (100%) of the Hawaiian Petrels that were on a collision-course toward communication towers exhibited avoidance behavior and avoided collision.

Additional indirect data on collision avoidance are available from studies associated with the operational KWP I wind energy facility on Maui and the six meteorological towers on Lanai. Based on fatality searches and observations during the first five years of operation at the 20-turbines and three met towers at the KWP I facility, the estimated total annual take was 0.93 Hawaiian Petrels and 0 Newell's Shearwater fatalities per year. (KWP II 2011). Cooper and Day (2004b) used similar methods as the current study to model seabird fatality for the KWP I wind turbines, based on passage rates from radar studies at the site (Day and Cooper 1999; Cooper and Day 2004a, 2004b). They estimated that the combined annual fatality of Hawaiian Petrels and Newell's Shearwaters at the KWP I turbines would be ~3–18 birds/yr with a 50% avoidance rate, ~1–2 birds/yr with a 95% avoidance rate, and <1 bird/yr with a 99% avoidance rate. Thus the fatality model that used a 99% avoidance value was a closer fit with the measured fatality rates than were the fatality estimates based on lower avoidance rates. Similarly, 0 Hawaiian Petrels were found in five years of fatality searches at 1–6 met towers on Lanai (USFWS 2011; A. Oller, Tetra Tech, pers. comm.), which fit the preconstruction fatality estimates based upon radar data and a >99% avoidance factor (i.e., <0.07–0.77 petrels/met tower/yr with an assumption of 99% avoidance; Cooper et al. 2008). Thus, the two wind energy projects in Hawaii with preconstruction fatality estimates and post-construction fatality data both suggest that fatality models based on an assumption that 99% of petrels avoided structures (i.e., wind turbines and met towers) produced more realistic estimates of fatality than did models using lower avoidance values.

In summary, currently available data suggest that the avoidance rate of petrels and shearwaters at transmission lines is high and approaches 100%. The ability of Hawaiian Petrels and Newell's Shearwater to detect and avoid objects under low-light conditions makes sense from a life-history standpoint, since they are known to forage extensively at night and to fly through forests near their nests during low-light conditions. We agree with others (Chamberlain et al. 2006, Fox et al. 2006) that species-specific, weather-specific, and site-specific avoidance data are needed in models to estimate fatality rates accurately. Until further petrel- and shearwater-specific data on the relationship between exposure and fatality rates are available for transmission lines, however, we continue to provide a conservative range of assumptions for avoidance rates in our fatality models (i.e., 90%, 95%, and 99% avoidance). With an assumption of a 99% avoidance rate, the estimated annual take at the proposed transmission line would be 0.0013 Hawaiian Petrels/yr and 0.0001 Newell's Shearwaters/yr (Table 3).

POTENTIAL BIASES

There are factors that could lead to overestimating or underestimating actual radar passage rates and estimated fatalities at the Project. One factor that was likely to have created a positive bias was the inclusion of targets that were not petrels or shearwaters. Our use of target filters and concurrent AV observations minimizes the inclusion of non-target species; however, low levels of contamination were likely present in our radar data and influenced passage rates and fatality estimates. A factor that could create a negative bias in our passage rates and fatality estimates would be if targets were missed because they flew undetected through the radar sampling area.

However, the radar station provided very good coverage of the area so it is unlikely that we missed petrel/shearwater targets due to gaps in coverage.

Interannual variation in the number of birds visiting nesting colonies could increase or decrease our passage rate and fatality estimates. There are examples of sites with high interannual variation in petrel and shearwater radar counts, such as three sites on Kauai where counts were ~100–300 birds/hr lower (approximately four times lower) in fall 1992 than in fall 1993; the lower counts in 1992 were attributed to the effects of Hurricane Iniki (Day and Cooper 1995). We don't know of any specific events during the 2014 breeding season that would have influenced numbers of Hawaiian Petrels and Newell's Shearwaters attending colonies in a positive or negative direction. Oceanographic factors (e.g., El Niño–Southern Oscillation [ENSO] events) also can vary among seasons and years and are known to affect the distribution, abundance, and reproduction of seabirds (e.g., Ainley et al. 1994, Oedekoven et al. 2001). During 2014 there has been some warming of the Pacific; however, conditions during the summer were still ENSO-neutral (NOAA 2014). Thus, it is unlikely that El Niño-related oceanographic effects would have significantly affected the petrel and shearwater passage rates observed in this study.

The proportion of the petrel/shearwater passage rate observed at the Project that was represented by Hawaiian Petrels versus Newell's Shearwaters has a major influence on the fatality estimates for each species. For instance, if 100% of the petrel/shearwater targets were Hawaiian Petrels then that would result in an annual fatality rate of 0.0027–0.0270 birds/yr for the species and zero Newell's Shearwater fatalities. In contrast, if Newell's Shearwaters comprised 100% of the petrel/shearwater targets then that would result in an annual fatality rate of 0.0002–0.0020 birds/yr for this species and zero Hawaiian Petrel fatalities. However, more information on nesting populations of each species on Molokai and the flight paths that these birds use to access nesting colonies on the island would be required to estimate with a high degree of confidence the proportions of petrel/shearwater targets at the Project represented by each species. Thus, we provide fatality estimates with the basic assumption that 50% of the petrel/shearwater targets were Hawaiian Petrels and 50% were Newell's Shearwaters.

CONCLUSIONS

We documented passage rates and flight altitudes of Hawaiian Petrels and Newell's Shearwaters flying over the Project during radar and audiovisual sampling in summer 2014. The passage rate of petrel/shearwater targets was low and, in fact, lower than passage rates from almost all other similar studies in the Hawaiian Islands. The flight altitudes of all three petrel/shearwater targets observed on vertical radar were above the height of the proposed transmission line. A larger dataset of visual observations of Hawaiian Petrels and Newell's Shearwaters from throughout the Hawaiian Islands similarly suggests that a very small proportion of petrels and shearwaters flying over the Project would occur below the height of the proposed transmission line. Based on the observed passage rate of petrel/shearwater targets at the Project, assumed proportion of petrels and shearwaters that would fly above the height of the proposed transmission line, and the weight of evidence for a high avoidance rate of transmission lines by petrels and shearwaters, we estimated the risk of collision fatalities of Hawaiian Petrels (0.0013–0.0130 birds/yr) and Newell's Shearwaters (0.0001–0.0010 birds/yr) at the Project was very low.

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