HAWAIʻI INTERISLAND RENEWABLE ENERGY PROGRAM (HIREP)

REFERENCE INFORMATION

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ACRONYMS AND ABBREVIATIONS

ac	acre
AC	alternating current
ADCP	Acoustic Doppler Current Profiler
AFPA	American Folklife Preservation Act
AHPA	Archaeological & Historic Preservation Act
AIRFA	American Indian Religious Freedom Act
AIS	Archaeological Inventory Survey
ALISH	Agricultural Lands of Importance to the State of Hawai‘i
AMP	Archaeological Monitoring Plan
AMSL	above mean sea level
ARPA	Archaeological Resources Protection Act
ARRA	American Recovery and Reinvestment Act of 2009
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
Ave	Avenue
Blvd	Boulevard
BMP	best management practice
BMUS	Bottomfish Management Unit Species
BNM	Broadcast Notice to Mariners
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation and Enforcement (now BOEM)
BFRA	Bottomfish Restricted Fishing Area
BSEE	Bureau of Safety and Environmental Enforcement
C.F.R.	Code of Federal Regulations
CAA	Clean Air Act
CAG	Cultural Advisory Group
CCD	Census County Divisions
CCL	curved carapace length
CCM	Conservation and Construction Measure
CDA	Civil Defense Agency
CDP	Census Designated Place
CDUA	Conservation District Use
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CIA	Cultural Impact Assessment
cm	centimeter

COMIAU	County of Maui Infrastructure Assessment Update
CRAMP	Coral Reef Assessment and Monitoring Program
CRMP	Cultural Resources Management Plan
CSH	Cultural Surveys Hawai‘i
CWA	Clean Water Act
CWB	Clean Water Branch
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Plan
CZM-SMA	Coastal Zone Management – Special Management Area
DAR	Division of Aquatic Resources
dB	decibel
dBA	decibel-A weighted
DBEDT	Department of Business, Economic Development & Tourism
DC	direct current
DC/NDC	direction connection/no direction connection
DHS	Department of Homeland Security
DLIR	Department of Labor and Industrial Relations
DLNR	Department of Land and Natural Resources
DMM	discarded military munitions
DOA	Hawai‘i Department of Agriculture
DOBOR	Division of Boating and Ocean Recreation
DOC	Department of Commerce
DOCARE	Division of Conservation and Resources Enforcement
DoD	Department of Defense
DOE	Department of Energy
DOFAW	Division of Forestry and Wildlife
DOI	United States Department of the Interior
DOT	United States Department of Transportation
DWS	Department of Workforce Services
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EI	Environmental Interest
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
ELF	extremely low frequency
EMF	electromagnetic field
EMI	electromagnetic interference
EMR	electromagnetic radiation
EO	Executive Order
EP&R	Emergency Preparedness and Response section

EPO	Environmental Planning Office
ESA	Endangered Species Act
ESQD	Explosive Safety Quantity Distance
FAD	Fish Aggregating Devices
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FEP	Fishery Ecosystem Plan
FERC	Federal Energy Regulatory Commission
FFCA	Federal Facility Compliance Act
FFS	French Frigate Shoals
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Maps
fm	fathom
FMA	Fisheries Management Area
FMC	Federal Maritime Commission
FMP	Fishery Management Plan
ft	foot/feet
FUDS	Formerly Used Defense Sites
FWS	Fish and Wildlife Service
GIS	Geographic Information System
GMA	Game Management Area
GPS	Global Positioning System
HAPC	Habitat Areas of Particular Concern
HAR	Hawai‘i Administrative Rule
HCEI	Hawai‘i Clean Energy Initiative
HDAR	Hawai‘i Division of Aquatic Resources
HDD	horizontal direction drilling
HDOH	Hawai‘i Department of Health
HDOT	State of Hawai‘i, Department of Transportation
HDPE	high density poly ethylene
HECO	Hawaiian Electric Company
HEER	Hazard Evaluation and Emergency Response
HELCO	Hawaiian Electric Light Company
HEPA	Hawai‘i Environmental Protection Act
HIDAR	Hawai‘i Division of Aquatic Resources
HI-GAP	Hawai‘i Gap Analysis
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
HIOSH	Hawai‘i Occupational Safety and Health Division
HIREP	Hawai‘i Interisland Renewable Energy Program
H-POWER	Honolulu Program of Waste to Energy Recovery
HRS	Hawai‘i Revised Statutes
HUMMA	Hawai‘i Undersea Military Munitions Assessment

HURL	Hawaiʻi Underwater Research Laboratory
HVAC	high voltage alternate current
Hz	hertz
IBC	International Building Code
IEC	International Electrical Code
IMPLAN	Impacts for Planning Economic Model
INRMP	Integrated Natural Resource Management Plan
IP	Internet Protocol
IUCN	International Union for Conservation of Nature
JB	Joint Base
JBPHH	Joint Base Pearl Harbor Hickam
kg	kilogram
KIUC	Kauai Island Utility Cooperative
km	kilometer
km^2	square kilometer
KMR	Kapalama Military Reservation
KOP	key observation point
kV	kilovolt
lb	pound
LBP	lead-based paint
LCM	loss circulation materials
LID	low impact development
LNM	Local Notice to Mariners
LPG	liquefied petroleum gas
m	meter
MARFORRES	Marine Corps Forces Reserve
MBTA	Migratory Bird Treaty Act
MCBCP	Marine Corps Base Camp Pendleton
MCBH	Marine Corps Base Hawaiʻi at Kāneʻohe Bay
mcy	millions of cubic yards
MEC	Munitions and Explosives of Concern
MECO	Maui Electric Company
mgd	gallons per day
MPD	Maui Police Department
mm	millimeter
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MPRSA	Marine Protection, Research and Sanctuaries Act
MSA	Magnuson-Stevens Fisheries Conservation and Management Act

MUS	Management Unit Species
MW	megawatt
MWR	Morale, Welfare and Recreation
NAGPRA	Native American Graves Protection & Repatriation Act
NARS	Natural Area Reserve System
NEC	National Electrical Code
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHO	Native Hawaiian Organization
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NIST	National Institute of Science and Technology
nm or nmi	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
nT	nanotesla
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NWS	National Weather Service
OCCL	Office of Conservation and Coastal Lands
OCS	Outer Continental Shelf
OHA	Office of Hawaiian Affairs
OIRC	Offshore Islet Restoration Committee
OLE	Office of Law Enforcement
OP	Office of Planning
OSHA	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
OTEC	Ocean Thermal Energy Conversion
P.L	Public Law
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
PHNWR	Pearl Harbor National Wildlife Refuge
PIR	Pacific Islands Region

POD	Pacific Ocean Division
POV	privately owned vehicle
PRD	PIRO's Protected Resources Division
PUC DP	Primary Urban Center Development Plan
PUC	Primary Urban Center
PUC	Public Utilities Commission
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
Rd	Road
ROH	Revised Ordinances of Honolulu
ROI	Region of Influence
ROV	remotely operated vehicle
ROW	right-of-way
SARA	Superfund Amendments and Reauthorization Act
SAWCS	Statewide Aquatic Wildlife Conservation Strategy
SCAP	Stream Channel Alteration Permit
SCL	straight carapace length
SCORP	State Comprehensive Outdoor Recreation Plan
SDAR	Site Discovery, Assessment and Remediation
SDWA	Safe Drinking Water Act
SGCN	Species of Greatest Conservation Need
SHPD	State Historic Preservation Division
SHPDA	State Health Planning and Development Agency
SHPO	State Historic Preservation Officer
SLH	Session Laws of Hawai‘i
SMA	Special Management Area
SOC	Species of Concern
SOEST	School of Ocean and Earth Sciences and Technology
SSA	sole source aquifer
SWCD	Soil and Water Conservation District
SWPPP	Storm Water Pollution Prevention Plan
TAC	Total Allowable Catch
TC	towed camera sled
TEU	20-foot equivalent unit
TMDL	total maximum daily load
TMP	Transportation Management Plan
TowCam	towed camera sled
TV	television
U.S.	United States
U.S.C.	U.S. Code
UBC	Uniform Building Code
UIC	Underground Injection Control

UN	United Nations
USACE	U.S. Army Corps of Engineers
USATCHES	U.S. Army Technical Center for Explosives Safety
USCG	U.S. Coast Guard
USDA	United States Department of Agriculture
USEPA	U.S. Environmental Protection Agency)
USFWS (FWS)	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
USPS	United States Postal Service
UST	underground storage tank
UV	ultraviolet
UXO	unexploded ordnance
UXOInfo	UXOInfo.com
VCP	vitrified clay pipe
WGSL	Waimanalo Gulch Sanitary Landfill
WMM	waste military munitions
WPRFMC	Western Pacific Regional Fishery Management Council
WQC	Water Quality Certification
WWRD	Wastewater Reclamation Division
WWTP	Waste Water Treatment Plant
µT	microtesla
°C	degrees Celsius

LIST OF HAWAIIAN WORDS – Hawaiian Reference for Cultural Resource Section

ala hele – trails
ala kahakai – coastal trails
ʻāina – land, earth
ʻaumakua – family or personal gods, deified ancestors who might assume the shape of plants, animals, or other natural phenomena
ʻOhana – family, relative, kin group
ʻopihi – limpet, saltwater snail
aho – line, cord, lashing
ahupuaʻa – land division usually extending from the uplands to the sea
Haumea – Earth
heʻe - octopus
Heiau – pre-Christian place of worship, shrine
hīnaʻi – basket or container made of braided vine, pandanus, or other material; a basket fish trap
hoe waʻa – oarsman, paddler; to paddle a canoe
hōʻailona – symbol or sign
hula - dance
kahuna lāʻau lapaʻau – herbal medicine healer
Kālai waʻa – canoe carver; to build a canoe
kapa – tapa, cloth made from bark; formerly clothes of any kind or cloth
kī – ti; a woody plant consisting of a branched or unbranched, slender, ringed stem, ending in a cluster of narrow-oblong leaves
Koʻa lawaiʻa – fishing grounds, usually identified by lining up with marks onshore; shrine, often consisting of piles of coral or stone
kukui – candlenut tree; large tree in the spurge family bearing nuts containing white, oily kernels which were formally used for light
kumu – teacher, tutor, model
kumu hula – hula teacher
kanu ʻana – burial sites
kuleana – responsibility
kūpuna – grandparent, ancestor, relative or close friend of grandparent's generation
lei – garland, wreath; necklace of flowers
limu – general name for plants living under water; seaweed
lōkahi – unity, agreement, accord, unison, harmony
loko iʻa – fish pond
makaʻāinana – commoner, populace, people in general, citizen, subject
makana – gift, present, donation, to give a gift
mālama ʻāina – to care for the land
Mana – supernatural or divine power, miraculous power, spiritual power
mana kupua – one possessing power, magic, supernatural powers
manaʻo – thought, idea, belief, opinion

moʻolelo – story, tale, myth, history, tradition, legend
nā iwi – ancestral bones
oli – chant that was not danced to, especially with prolonged phrases chanted in one breath
olonā – native shrub with large, obate, fine-toothed leaves; bark is a highly valued source of strong, durable fiber
Puʻu – hill, mound, heap
pule – prayer, incantation, blessing, grace
ʻuhane – spirit
Wahi pana – legendary place, important location
Wai – water, liquid or liquor of any kind other than seawater
Waiwai – assets, valuables, value, worth, wealth, importance

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EXECUTIVE SUMMARY

INTRODUCTION

This Hawai‘i Interisland Renewable Energy Program (HIREP) reference work provides information for use in future environmental reviews of the interisland transfer of generated power through one or more undersea cables.

The body of the work is contained in two documents: the *HIREP Reference Information* document and the *HIREP Background Information* document. Other volumes related to this effort provide information from preliminary scoping meetings held in early 2011.

The information provided is intended to be consistent with requirements of the National Environmental Policy Act of 1969 (NEPA), Title 42 United States Code (U.S.C.) Sections 4321–4370h, as implemented by the Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [C.F.R.] Parts 1500–1508). Statutes and regulations potentially applicable to the development of energy projects may include, but are not limited to, those listed in Table ES-1.

BACKGROUND

Hawai‘i depends on imported fossil fuel (mostly oil) for over 85 percent of its energy for land, air, and sea transportation, and for the generation of electricity. Hawai‘i has the highest energy dependence on imported oil of any state in the United States (U.S.) and is thereby the most vulnerable to price increases and changes in oil availability.

The Hawai‘i Clean Energy Initiative (HCEI), a partnership between the State of Hawai‘i and the U.S. Department of Energy (USDOE), has as its goal that a combination of efficiency (30 percent) and renewable resources (40 percent) will together be used to meet 70 percent of Hawai‘i’s energy needs by the year 2030. The State of Hawai‘i and USDOE are committed to investigating solutions to meet the HCEI goals. Within the State, implementation of the HCEI is being led by the Department of Business, Economic Development and Tourism (DBEDT).

Consistent with the HCEI, Hawai‘i’s Renewable Portfolio Standard calls for 15 percent renewably generated electricity by 2015, 25 percent by 2020, and 40 percent by 2030 (see Hawai‘i Revised Statutes [HRS] Chapter 269-91 [2012] et seq.); Hawai‘i’s Energy Efficiency Portfolio Standard calls for a statewide reduction in electricity use of 4,300 gigawatt hours via efficiency measures by 2030 (HRS Chapter 269-96 [2012]).

A complete range of energy scenarios are under consideration, including efficiency improvements, ocean/wave energy, generation using municipal solid waste and other forms of biomass, utility-

scale solar projects, rooftop solar, wind projects, and generation using geothermal and hydropower resources. To reach the HCEI goals of 70 percent clean energy by 2030, it will be necessary to further evaluate and attract knowledgeable input on, and potentially investment toward, the most feasible, commercially scalable, and economic technologies available.

DESCRIPTION OF PROGRAMMATIC EVALUATION

A programmatic-level review evaluates temporary, permanent, direct, indirect, and cumulative impacts to the natural, built, and socioeconomic environments that may occur as a result of implementation of a program.

PUBLIC INVOLVEMENT AND SCOPING

An extensive formal and informal community involvement process was implemented in 2010 to inform the public and garner feedback on the HIREP program. A separate HIREP Scoping Report details the formal scoping activities and comments received.

A common theme that emerged from informal as well as formal public comments during the public outreach period was the desire to expand the interisland renewable energy program beyond wind alone and to consider siting beyond the Maui County islands originally identified.

ALTERNATIVES

The initial HIREP undersea power cable system analysis considered an undersea power cable to transfer power between islands, bounded by power converter stations at each end. One converter station would receive power (typically alternating current [AC] power) from the generation source; convert that power to a form appropriate for transmission (typically direct current [DC] for longer distances); a cable would transmit the power undersea (and possibly overland) to a second converter station on the recipient island; and the second converter station would convert the power back to alternating current for distribution through the electrical grid.

This description of assumed facilities and implementation activities is essential to define the potential cable routing, landing site areas, and configuration of the converter stations; define the environmental setting in areas potentially affected by the cable system implementation; and identify the potential environmental impacts and recommended conservation and construction measures to avoid or minimize environmental effects. The evaluation includes the following assumptions:

- The system may encompass up to four islands—Lānaʻi, Maui, Molokaʻi, and Oʻahu.
- Potential undersea power cable corridors are defined by the mapping generated by the University of Hawaiʻi, School of Ocean and Earth Sciences and Technology during their marine surveys for DBEDT.

- This evaluation assumed a cable alignment from Maui to Lānaʻi to Molokaʻi to Oʻahu to minimize cable lengths, minimize the amount of trenching needed during cable installation, and minimize the converter station space requirements.
- Landing site areas were defined by using a "zone" definition of potential landing site areas to fit with the programmatic approach.
- The evaluation assumed the use of horizontal directional drilling (HDD) under beach areas and beyond the shallow inshore and coral reef habitats, to minimize environmental effects.
- "Suitable" landing site areas assumed a 10,000-foot HDD reach.
- Converter stations were assumed to be located within 1 kilometer of the shoreline, within the identified landing site areas, for purposes of defining the affected area and determining potential environmental impacts.
- Converter stations could have "combiner capability" to integrate renewable energy power generated locally with renewable energy in transmission from other islands, and this capability would have no effect on station size or configuration.

Specific routes for future proposed cable projects, specific landing site locations, and converter station locations and configurations would be identified in the subsequent "project implementation" phase and project-specific environmental review.

A detailed description of the facilities and activities associated with a conceptual undersea power cable system between several of the Hawaiian Islands is presented in Chapter 2.

REGULATORY REQUIREMENTS

This reference information has been prepared to support environmental review, in part, pursuant to the following:

- Hawaiʻi Environmental Protection Act (Hawaiʻi Administrative Rule, Title 11, Department of Health, Chapter 200; and HRS Chapter 343;
- NEPA (42 U.S.C. §§ 4321–4370h), which requires an environmental analysis for major federal actions having the potential to significantly impact the quality of the human environment; and
- CEQ Regulations (40 C.F.R. Parts 1500–1508), which implement the requirements of NEPA.

Future project-specific actions would be subject to a range of permitting requirements, a number of which are listed in Appendix C.

SUMMARY OF POTENTIAL IMPACTS AND CONSERVATION AND CONSTRUCTION MEASURES

Environmental impacts on the following resources are evaluated in this document: air quality and climate change; cultural resources; geology and soils; land transportation; land use; marine transportation; marine/benthic species and habitat; natural hazards, hazardous waste, and munitions and explosives of concern; noise and vibration; public health and safety; public services/infrastructure; recreation; socioeconomics and environmental justice; terrestrial/coastal biological resources, species, and habitat; visual resources; and water resources.

Table ES-2 provides a brief summary of potential environmental impacts, by resource area, for the undersea cable system that might be implemented as a feature of the HIREP. Also presented for each resource area are summarized conservation and construction measures that could avoid or minimize potential environmental effects. A detailed discussion of potential environmental impacts, and conservation and construction measures for each of these resources is provided in Chapter 3.

Table ES-1. Federal Laws and Regulations Considered

Title	Citation
Archaeological Resources Protection Act of 1979	16 U.S.C. §§ 470aa–470mm
Clean Air Act	42 U.S.C. §§ 7401–7671q
Clean Water Act (1972, as amended)	33 U.S.C. §§ 1251–1387
Coastal Zone Management Act (1972, as amended)	16 U.S.C. §§ 1451–1466
Comprehensive Environmental Response, Compensation, and Liability Act (1980)	42 U.S.C. §§ 9601–9675
Endangered Species Act (1973, as amended)	16 U.S.C. §§ 1531–1544
Energy Policy Act (2005)	42 U.S.C. §§ 15801 - 388
EO 12372 (Intergovernmental Review of Federal Programs) (1977, 1983, and 1984)	47 Federal Register 30959
EO 12898 (Environmental Justice) (1994)	59 Federal Register 7629
EO 11988 (Floodplain Management) (1977)	42 Federal Register 26951
EO 13045 (Environmental Justice for Children) (1997)	62 Federal Register 19885
EO 13423 (Strengthening Federal Environmental, Energy, and Transportation Management) (2007)	72 Federal Register 3919
EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) and Migratory Bird Treaty Act	66 Federal Register 3853, 16 U.S.C. §§ 703–712
EO 11990 (Protection of Wetlands) 1977	42 Federal Register 26961
Marine Mammal Protection Act (1972, as amended)	16 U.S.C. §§ 1361–1407
National Historic Preservation Act of 1966, as amended (1994)	16 U.S.C. §§ 470–470x-6
National Register of Historic Places (1977)	36 C.F.R. § 60
Pollution Prevention Act of 1990	42 U.S.C. §§ 13101–13109
Resource Conservation and Recovery Act (1976)	42 U.S.C. §§ 6901–6992k
Rivers and Harbors Appropriation Act of 1899, Section 10	33 U.S.C. § 403
Safe Drinking Water Act	42 U.S.C. §§ 300f–300j-26

EO = Executive Order
C.F.R. = Code of Federal Regulations
U.S.C. = United States Code

Table ES-2. Summary of Potential Environmental Impacts and Conservation and Construction Measures

Potential Environmental Impacts	Recommended Conservation and Construction Measures
AIR QUALITY AND CLIMATE CHANGE	
General Construction Terrestrial Impacts Potential short-term construction-related impacts would be primarily from fugitive dust and construction vehicle emissions. **General Operation Terrestrial Impacts** Operation of a converter station could result in stationary-source emissions (converter equipment) and mobile-source emissions (operation and maintenance vehicle trips). Factors considered in determining whether an undersea power cable system would have an impact on air quality include the following: • The amount of net increase or decrease in annual emissions of criteria pollutants; • Results of dispersion modeling; • Time periods of emissions; • Emissions of precursors to ozone or other secondary pollutants; • Whether sensitive receptors would be exposed to substantial pollutant concentrations; or • Whether objectionable odors would be created and affect a substantial number of people. The specific impacts, and the location and degree of severity of those impacts, would be assessed at the time of environmental review of a specific project. Converter stations by their nature emit little to zero air emissions; therefore, the stations would not be considered a major source as defined by the Hawai‘i Department of Health. **General Marine Impacts** Temporary air quality impacts may result from operation of vessels or machinery during the cable-laying process. Emissions from construction of the converter stations could be estimated with air quality modeling once equipment and duration of construction are scheduled. Post-construction air quality impacts from the cable itself may occur if periodic maintenance and inspection are required. **Greenhouse Gas Emissions and Climate Change** **Construction Impacts** GHG emissions from construction of the converter stations can be estimated with air quality modeling once equipment and duration of construction are scheduled. **Operation Impacts** Use of the cable system to transmit renewable energy to be used in place of fossil fuels would reduce emissions of GHGs.	Measures are recommended (see Section 3.1) to manage dust; reduce vehicular emissions; and avoid impact of transport of materials.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
CULTURAL RESOURCES	
Potential Impacts of the Project While all of the landing site areas have been dramatically altered since Western contact, many of the areas in remote rural communities are largely undeveloped. As such, it can be reasonably expected that significant surface and subsurface archaeological and historic features may be present. Significant cultural resources, including historic properties listed or eligible for listing in the NRHP, could be affected by potential renewable energy	Measures are recommended (see Section 3.2) to identify, document, monitor, and protect cultural resources through consultations with SHPD, OHA, NHOs, and potential lineal and cultural descendants; archival and on-site reviews; planning

Potential Environmental Impacts	Recommended Conservation and Construction Measures
developments regardless of the type and technology employed. Cultural resources are nonrenewable and, once damaged or destroyed, are not recoverable. **Specific Impacts on Cultural and Relevant Natural Resources** Complete destruction of historic properties could result from the clearing, grading, and excavation of the landing site area and from construction of the facilities and associated infrastructure if archaeological sites, historic structures, or traditional cultural properties are located within the footprint of the project. Degradation and/or destruction of historic properties could result from the alteration of topography, alteration of hydrologic patterns, removal of soils, erosion of soils, runoff into and sedimentation of adjacent areas, and oil or other contaminant spills if sites are located on or near the landing site area. Increases of human access and subsequent disturbance of cultural resources could result from the establishment of corridors or facilities in otherwise intact and inaccessible areas. Visual degradation of settings associated with significant cultural resources and cultural landscapes could result from the presence of a utility-scale renewable energy development and associated land disturbances and ancillary facilities. Noise degradation of settings associated with significant cultural resources and landscapes could also result from the presence of the utility-scale renewable energy projects and associated land disturbances of ancillary facilities. Impacts to cultural resources can occur during all phases of offshore development where the potential exists for seafloor disturbance in previously undisturbed areas. **Specific Impacts from Various Related Activities** **Technology-Specific Impacts** The technology-specific renewable energy project (wind, solar, geothermal, OTEC, etc.) could have different impacts on cultural resources dependent on the land requirements (e.g., large acreage vs. concentrated location) or impact on view planes. Water requirements could have impacts on cultural resources (e.g., runoff into nearshore waters). **Site Construction Impacts** The amount of area disturbed could be considerable and could destroy or permanently alter the cultural landscape and resources present. An indirect effect of ground disturbance would be soil erosion, which could also impact cultural resources outside the construction footprint. The development of associated access roads would provide access to areas that might have been previously inaccessible. Any increase in the presence of humans in an uncontrolled and unmonitored environment containing significant cultural resources increases the potential for adverse impacts caused by looting (unauthorized collection of artifacts), vandalism, and inadvertent destruction of resources. Visual impacts on cultural resources and landscapes could occur during the construction phase. Access to traditional and customary cultural resources during construction can be limited when areas are temporarily closed for safety purposes. Site construction impacts may also occur in the ocean. Disturbance to the seafloor (e.g., trenching, dredging, or horizontal directional drilling) could disrupt shipwrecks, buried prehistoric offshore archaeological sites, cultural resources including fishing *ko'a lawai'a*, and access to fishing and ocean resources. **Site Operation Impacts** Fewer impacts on cultural resources are likely to occur from the operation of a renewable energy project than from its construction.	and monitoring; education; funding of historic preservation efforts; and awareness and enforcement of requirements to reduce, restrict, or prohibit disturbances in especially sensitive areas. Also, to the maximum extent possible, the following measures are recommended: Use previously disturbed lands, rather than pristine undeveloped lands. Consolidate infrastructure requirements and temporary construction areas. Minimize the area disturbed by meteorological towers or other testing facilities. Use existing roads; minimize the number and length/size of the new roads and proposed construction sites. Locate meteorological towers and other testing facilities in nonsensitive areas. Schedule installation and conduct monitoring to avoid disruption of wildlife reproductive, nesting, or other important behavior. Periodically inspect meteorological towers or other testing facilities for structural integrity. Comply with applicable laws, including NAGPRA or the State Burial Laws, in the case of inadvertent discovery of historic sites or human burial remains. Use cultural as well as archaeological monitors where there is a probability of encountering cultural resources, especially Hawaiian burials. Protect culturally sensitive water resources, including freshwater springs, fishponds, and nearshore waters, from silt. Avoid culturally important plant species. If guaranteeing access elsewhere is an appropriate mitigation measure, do so in consultation with NHOs, OHA, and potential lineal and cultural

Potential Environmental Impacts	Recommended Conservation and Construction Measures
Human presence potentially increases the likelihood of unauthorized collection of artifacts and vandalism, as well as inadvertent destruction of cultural resources. The operation of a renewable energy project may have a visual impact on the cultural resources and landscapes (e.g., wind turbines). **Site Decommissioning Impacts** Generally, fewer impacts on cultural resources are anticipated than would occur from the decommissioning of any given specific project; however, these resources still suffer negative effects. The visual impact on cultural resources would be mostly removed following decommissioning, as long as the site was restored to its preconstruction state.	descendants. Avoid culturally important wildlife species (e.g., pigs) and their habitats, especially in rural subsistence communities. Implement cultural orientations or cultural training/education programs for construction workers, contractors, and consultants. Develop a decommissioning plan prior to termination of the renewable energy facility. Apply management plans, conservation measures, and stipulations developed for construction to similar activities during decommissioning. Salvage topsoil from all decommissioning activities. Use native plants to reclaim areas of disturbed soil. Restore vegetation cover, composition, and diversity commensurate with the ecological setting.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
GEOLOGY AND SOILS	
All of the sites, regardless of island or location, would likely require clearing, grading, excavating, engineering and recontouring of soils for access roads, cable installation, and converter station construction. These activities have the greatest potential impacts to soils and, to a lesser degree, geology. In general, steep, sloped areas (defined here as those exceeding 20 percent) are not traditionally conducive to the placement of structures and/or access roads. With alteration and compaction of soils, impacts to natural drainage channels, groundwater recharge areas, and aquifers may occur. Construction of culverts, drainage conveyance channels, and erosion control structures permanently or temporarily, may occur where access roads are needed to cross ravines. Pockets of Important Agricultural Lands/ALISH do occur in potential landing site areas.	The following measures are recommended (see Section 3.3): Avoid the selection of landing sites in areas with steep topography, potential seismic hazards, or other geological hazards. Where necessary, prepare a geotechnical study. Avoid the selection of landing area sites on soils designated as “Prime,” or on or near wetlands or surface water/drainageways. If disturbing more than 1 acre of land, secure a Water Quality Certification and implement erosion control measures.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
LAND TRANSPORTATION	
<u>Description of Impact Types</u> The majority of transportation operations would involve the delivery of materials	The following measures are recommended (see Section

Potential Environmental Impacts	Recommended Conservation and Construction Measures
and equipment during the construction phase. The amount of materials and the type of the equipment may vary based on site features and the design selected. Oversized equipment and overweight materials for site access, site preparation, and foundation construction would be needed. Potential impacts of cable system implementation in general may include: • Deterioration of the current pavement condition, depending on the load carried per truck and the frequency of the delivery. • Alteration of the existing roadway conditions. Road widening may be needed to accommodate large trucks. Unpaved roads may need to be surfaced for use during construction and operation periods. • Construction of new roads may be needed if portions of the landing site areas do not have existing roads. • Temporary increase in traffic congestion due to oversized vehicles traveling at slow speeds. • Potential transportation safety issues resulting from traffic congestion and deteriorated road conditions. • Potential impacts to the harbors, due to heavy equipment being shipped and loaded at harbors, affecting harbor operations or requiring alteration of an existing harbor to accommodate oversized equipment movers/cargos.	3.4): Identify efficient routes for transporting construction materials. Analyze and adhere to roadway capacity requirements. Develop transportation management plans. Conduct traffic analysis to determine potential traffic impacts. Coordinate state, county, federal, and private transportation activities. Provide for improved accessibility to shipping, docking, and storage facilities. Increase the capacities of airport and harbor systems and support facilities to effectively accommodate transshipment and storage needs. Obtain applicable permits for highway use. Preserve roadway corridors that have historic, scenic, or unique physical attributes. Evaluate alternatives before widening roads.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
LAND USE	
<u>Description of Impact Types</u> **Consistency with Existing Regulations** If conformity with the existing regulation cannot be made due to the absence of land or land with the desired land use designation (i.e., agricultural), it may be necessary to seek reclassification of land through the State Land Use Commission, rezoning, and/or seeking a land use variance with respective county governments. Activities associated with the cable laying and HDD are permitted uses in state waters in the conservation use districts. **Degree of Impact** A project found to be consistent with existing regulations could still be found to have an impact on the surrounding land use. For example, a converter station sited adjacent to residential parcels could be considered to have a greater degree of impact than if sited adjacent to an industrial activity.	The following measures are recommended (see Section 3.5): Site any development to minimize displacement of existing uses. Avoid impeding publicly accessible coastal recreational opportunities. Protect, preserve, and restore natural and man-made historic and prehistoric resources in the coastal zone management area. Protect, preserve, and restore or improve the quality of coastal scenic and open space resources. Protect valuable coastal ecosystems, including reefs,

Potential Environmental Impacts	Recommended Conservation and Construction Measures
	from disruption and minimize adverse impacts on all coastal ecosystems.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
MARINE TRANSPORTATION	
General Description of Impact Types The placement of the cable during the construction phase would likely have the greatest potential impact of disrupting commerce, safety operations, military movements, and marine transportation. Construction impacts would be temporary in nature. The primary impacts during construction may include: • Volume of dredge material to achieve appropriate cable depth • Impact of cable-laying vessel on navigation The placement/construction of the cable and eventual operations would need to be designed so that the cable would not disrupt ocean commerce, transportation, and recreation nor compromise military security and missions in the area. During the operations and maintenance phases, the following areas could be affected by program implementation: • Military or other security impacts if maintenance personnel need to access a secured port operations area; • Comparison of various parcels of land around harbors in terms of relative value for cargo operations, and opportunity cost to give up space for electrical infrastructure in lieu of traditional commercial harbor operations; and • Ability to expand high-value marine assets (wharves in particular) that may be affected with addition of new long-term constraints in terms of marine cable routes or position of landside infrastructure.	The following measures are recommended (see Section 3.6): Ensure that vessels in the area of active cable laying maintain a 1.15-mile separation from the vessel laying the undersea cable. Mark all temporary waterway obstructions with flashing yellow lights for the protection of navigation. Equip all vessels with radar reflectors. Provide appropriate notices and publications prior to commencement of the undersea cable-laying process. Coordinate with the appropriate DoD branch to avoid impacting military undersea, shore or land operations, functions, transportation routes, or exercises (classified or unclassified).

Potential Environmental Impacts	Recommended Conservation and Construction Measures
MARINE/BENTHIC SPECIES AND HABITAT	
General Description of Impact Types Impacts associated with the construction and deployment of cables include direct destruction of seafloor habitat by the trenching required to bury the cable, direct burial of organisms from side-casted or trenched sediment, and associated generation of sediment plumes that would be transported to adjacent locations and that could result in additional burial or clogging of the feeding or respiratory organs of benthic or pelagic organisms. Noise generated by the cable-laying process and the ships themselves could harm or otherwise disorient marine mammals, turtles, or fish. In the event the route selected includes UXO on the seafloor, these hazards would need to be safely removed prior to cable installation. Postconstruction impacts of the cable itself could include thermal or nearfield EMF effects on benthic and nektic organisms.	The following measures are recommended (see Section 3.7): During cable-laying activities, employ observers to watch for marine mammal and turtles. Identify sensitive deep-water coral communities before construction so that they can be avoided. Avoid or minimize damage to sensitive marine habitats known to be in the vicinity. Develop detailed topographic and habitat maps to ensure that sensitive habitats are identified and avoided.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
	Comply with provisions to protect humpback whales in the HIHWNMS.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
NATURAL HAZARDS, HAZARDOUS WASTE, AND MUNITIONS AND EXPLOSIVES OF CONCERN	
Description of Impact types **Natural Hazards – Terrestrial** All of Hawai‘i is susceptible to some risk of earthquakes. In general, potential development locations in all of the landing site areas on the various islands would be subject to some degree of flood risk due to the location near the shore and the need for the undersea cable to connect with terrestrial converter stations on a relatively large, flat site. These locations along shorelines also make them susceptible to tsunami, hurricane, and tropical storm damage. Neither construction nor operation of future projects is expected to affect the incidence rate of a natural hazard, with the exception of an increased potential for wildfires associated with use of vehicles and electrical equipment during the construction phase and in future operations in the landing site areas. Hazardous material associated with installation, construction, and support components for the converter station and undersea cable would include fuels, lubricants, and hydraulic fluids contained in or used in ships and construction equipment and vehicles. Impacts from accidental spills, accidental fuel releases, and releases of solid debris are expected to be minor if appropriate management practices are followed. Garbage and sanitary waste generated onboard the vessels and barges would be returned to shore for disposal. Future developments may be proposed in areas of environmental contamination or that currently contain either known or unknown hazardous materials. Accessible public records were reviewed to evaluate the potential likelihood of encountering MEC within the footprint of the SOEST surveyed areas. In addition to the SOEST study, the HUMMA also provided pertinent data on the areas south of O‘ahu. The results of this review indicated that potential areas for encountering MEC and areas to be avoided within the footprint of the SOEST surveyed areas are generally limited to the waters off the south shore of O‘ahu. Future developments on land may be proposed in areas of where MEC may be present.	The following measures are recommended (see Section 3.8): Select project locations outside FEMA flood zones, where possible and practicable. If on O‘ahu, comply with building codes; seismic regulations; and design, fire safety, or emergency response requirements imposed by the City and County of Honolulu. If in Maui County, comply with building codes; seismic regulations; and design, fire safety, or emergency response requirements imposed by the County of Maui. For military sites, comply with location, siting, and construction requirements of the DoD and military base. Locate projects outside designated tsunami inundation/evacuation zones, where possible and practicable. Seek to develop landing site areas with minimal slope and no known geological hazards. Design and maintain the site to reduce hazards. Avoid placing undersea cables in or near marine areas of known geologic instability. Assess potential properties for contamination. Implement recycling and waste diversion. Evaluate the potential for proposed construction to result in exposure or release of existing contamination to the environment. Avoid areas of MEC. Develop and implement site-specific mitigation measures, including procedures for

Potential Environmental Impacts	Recommended Conservation and Construction Measures
	hazardous material storage, handling, and staging; spill prevention and response; waste disposal; and good housekeeping.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
NOISE AND VIBRATION	
<u>Description of Impact Types</u> **Terrestrial** Noise criteria would be applied consistently regardless of island or island area. However, noise limit standards do vary based on proximity to certain land uses and land use designations. Intermittent elevated noise levels from certain types of construction activities are inevitable. However, noise is expected to be short term and minor and would coincide with the construction phase both on land with the converter station and in the ocean and shore-side with the cable laying. The noise generated from the construction equipment would need to comply with HIOSH regulations for temporary construction. Once the facility is operational, noise levels at the property line would need to comply with state laws and rules. **Marine** Potential noise impacts associated with undersea cables would occur during the construction phase and in connection with maintenance or repair. The construction activities considered include installation of new support structures and cables, and trenching and backfilling. Noise impacts may arise from operation of vessels or machinery during the cable-laying process, but those noise impacts would be temporary. If alternating current cables are used as part of future developments, possible long-term vibration and noise emissions from the cable may occur.	The following measures are recommended (see Section 3.9): Provide timely public notice to each affected community of the upcoming construction phasing and activities. Properly equip and maintain mufflers on all equipment with an internal combustion engine. Take steps to reduce noise from construction equipment. Eliminate or minimize impact pile driving operations where possible. Schedule construction work to comply with noise regulations. Monitor noise and vibration levels. Conduct preconstruction and postconstruction structural surveys of adjacent and nearby structures.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
PUBLIC HEALTH AND SAFETY	
<u>Description of Impact Types</u> Once operational, the public's exposure to various risks may increase in proportion to geographical proximity to the landing site area/converter station site(s). Any public health risks from future projects in the various landing site areas may be amplified in proportion to the mix of surrounding land uses and the density and sensitivity of those uses. The following potential impacts could apply to any location in the site study area regardless of landing site or specific individual project scope being considered. **Construction and Transportation Accidents** Members of the public as well as workers could be impacted by activities associated with construction, transportation, maintenance, operation, and decommissioning of future developments. **Fire, Chemical, and Electrical Hazards** The presence of electrical generating equipment and electrical cables, along with various oils (lubricating, cooling, and hydraulic), does create the potential for fire. Other possible future specific project activities could create the potential for a fire	The following measures are recommended (see Section 3.10): Develop a health and safety program to protect workers during construction, operation, and decommissioning of a project. Conduct all construction, operation, and decommissioning activities in compliance with applicable federal and state occupational safety and health standards. Provide documentation of training and establish a mechanism for reporting

Potential Environmental Impacts	Recommended Conservation and Construction Measures
or medical emergency because of the storage and use of diesel fuels, lubricating oils, and hydraulic fluids. Storage and use of these substances may occur at the converter station, at the cable landing site areas, and during the construction phase. **Electromagnetic Fields (EMFs)** Power lines, like the energized components of electrical motors, home wiring, lighting, and all other electrical appliances, produce EMF or EMR. Electric fields around transmission power lines are produced by electrical charges on the energized conductor. Safety considerations in the immediate vicinity of electric power lines include the potential for electric shock, the clearance of the power lines aboveground, measures to prevent unauthorized climbing of the poles, and the proximity of the transmission lines to other utilities such as oil wells and pipelines. The electric field created by a high-voltage transmission line extends from the energized conductors to other conducting objects such as the ground, towers, vegetation, buildings, vehicles, and persons. Magnetic field strength increases as current flow increases and diminishes when moving farther from the conductors. Exposures to ELF EMF from natural and anthropogenic sources are so ubiquitous concern has been expressed about potential adverse health effects from residential and occupational exposures. Because EMF is generated by distribution lines, EMF would be present in the vicinity of the proposed converter station infrastructure where it provides a connection to the electrical grid. A number of epidemiological and biological research studies have generally concluded that no scientific basis exists to support a finding of adverse human health effects from EMF although others have found a possible association between EMF and certain diseases. The NIEHS concluded that “the scientific evidence suggesting that ELF-EMF exposure poses any health risk is weak.” **Intentional Destructive Acts** With Hawai‘i’s smaller-scale stand-alone electrical network (which currently does not connect the various islands into one statewide electrical grid), it is unlikely that the Hawai‘i electrical grid network would be a primary target of an organized sabotage effort. Development of an undersea cable landing site area and converter station on or near military installations may result in an increased threat of targeting for sabotage. Conversely, a facility’s presence at a secured, hardened, and publicly inaccessible military location may lessen its vulnerability to sabotage success. Possible security issues associated with locating a converter station near strategic and/or populous centers would be analyzed as part of selecting a project location.	serious accidents to appropriate agencies. Design electrical systems to meet all applicable safety standards. Require workers to comply with standards for the safe use of explosives and blasting agents. Incorporate appropriate security measures and setbacks. Consult with local planning authorities regarding increased traffic during the construction phase; address specific issues in a traffic management plan. Comply with FAA regulations, including lighting requirements, height limits in flight corridors, occupancy standards, and any other potential safety issues. If located on a military base, implement appropriate military installation security measures. Where necessary and appropriate, provide fencing or a wall at the property line(s) to limit access. Minimize EMI (e.g., impacts to radar, microwave, television, and radio transmissions) and comply with FCC regulations. Reduce occupational EMF exposures. Design the submarine cable with proper electrical shielding and burial.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
PUBLIC SERVICES/INFRASTRUCTURE	
<u>Description of Impact Types</u> **Police, Fire, Medical** Accidents or incidents during the construction or operational period may occur that require police, fire, or medical attention. If the uniformed police or fire police are not able to provide immediate responses, the protection needs of the community and the project may not be met. This would be a potential impact to the existing public services. Similarly, an impact would occur if a project is located so far from a service area that, while tending to the needs of the project, services cannot be made available to the residents. **Electrical, Potable Water, Wastewater System, Telecommunication, Gas Supplies, and Solid Waste Facilities** Interruption of service, exceedance of capacity, or needs in areas where services	The following measures are recommended (see Section 3.11): Coordinate with city, county, state, and federal government agencies and public utilities in regard to safety and emergency support; transportation plans; emergency preparedness; and infrastructure requirements, limitations, potential exceedances, timing, logistics, easements, mapping, and

Potential Environmental Impacts	Recommended Conservation and Construction Measures
are unavailable could occur, particularly during the construction phase.	scheduling. Increase the quantity and the quality of public services if necessary. If adequate facilities are not available, the contractor should provide his own services for the duration of construction.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
RECREATION	
<u>Description of Impact Types</u> Generally speaking, short-term impacts would be related to construction activities (e.g., HDD, cable lay, converter station construction); long-term impacts would be those associated with the operations of a project (e.g., energy transmission via cables and converter station operation). Two criteria would be applied to determine if a project would have an impact on recreational resources: (1) Would the project impede access to recreational resources? (2) Would the project displace recreational resources or users? The following assumptions are applied: almost all public recreational resources discussed in the report are under the stewardship of a government (county, state, or federal); access to these resources is already provided and would likely be on public property. During construction, related equipment could be staged in an area that may cause users to take detours to a recreational resource. Construction activities could block access to the resource; however, during the operational period, no impact would occur to access of recreational resources.	The following measures are recommended (see Section 3.12): Ensure adequate continuous access to significant natural and cultural resources. Provide coastal recreational opportunities available to the public. Protect public beaches for public use and recreation. Minimize development, which would reduce the size of any beach or other area usable for public recreation. Minimize development, which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management areas, and the mean high tide line where there is no beach.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE	
<u>Description of Impact Types</u> **Population, Housing, and Economics** Increased socioeconomic activity may occur in the immediate four-island area during construction phases of cable system implementation. This increased socioeconomic activity is expected to be short term, however, and would likely involve local labor to the maximum extent practicable. The indirect and induced economic impacts would result in additional employment in the region, which may induce a small amount of short-term growth. Reduced volatility of electricity prices is expected to have a positive economic impact over the longer term. <u>Population</u> The total number of new jobs created by the short-term construction activities	The following measures are recommended (see Section 3.13): Site the project to not displace existing residential or commercial land uses, create boundaries within communities, or otherwise create physical and/or social barriers to community interaction. If residential/commercial land uses will be displaced, provide detailed analyses and prioritize

Potential Environmental Impacts	Recommended Conservation and Construction Measures
would likely be filled by existing residents, and the total number of new residents moving into the study area to fill open employment positions would be negligible. It is anticipated that the existing labor force would be utilized to the maximum extent practicable, and the number of in-migrants to the region for operations/maintenance employment would be few, if any. The impacts are considered beneficial since the labor market will likely remain depressed from the recent recession and its aftermath for some time. A population increase exceeding the historical growth rate is not expected to occur. Population may be affected if there are changes in land use. <u>Housing</u> It is anticipated that the existing labor force would be utilized and that the number of in-migrants to the region would be negligible and would not result in a substantial increase in housing demand. Population may be affected if changes occur in land use. <u>Economics</u> Changes in regional economic output and employment were analyzed for construction and operations/maintenance phases of the cable system. The outputs were used to inform the population and housing impact analyses. Estimates of the economic impacts were derived from the IMPLAN input-output economic model. Construction of the cable system would create a temporary, positive impact on the local economic base and fiscal resources. Construction employment wages and salaries would provide additional income to the area, as would expenditures within the state for construction materials and services. Payroll would be approximately $8.3 million annually and capital expenditures on construction materials and equipment would be approximately $22.8 million annually over 24 months. Project construction is expected to directly create an average of 139 annual full-time employees of 24 months. This direct employment would create both indirect and induced secondary employment in the region. Total estimated beneficial economic impacts within the state of Hawai‘i would be $38,100,000 per year during the 24-month construction phase. Staff needs for operations and maintenance of the converter stations are anticipated to be 34 full-time employees, with an additional four indirect and 22 induced jobs. The annual estimated economic impacts from the operation of the converter stations would be $20,100,000.	relocation within the same community whenever feasible. Enter into agreements with local labor organizations to provide construction/ operations staffing from local communities. Provide adequate public notice regarding the construction of the cable system, including construction timeline, labor agreements in place, economic benefits, and environmental impacts. Implement CCMs related to aesthetics, air quality, noise, and other environmental impacts. Consult extensively with commercial, recreational, and subsistence fishermen; publish cable awareness charts; notify fishermen of nearbeach and at-sea phases of cable installation operations. Align the cable route to avoid damaging fishery resources. For environmental justice areas, perform targeted, sustained outreach. Ensure the involvement of disadvantaged businesses and local business enterprises during construction to the maximum extent feasible.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
TERRESTRIAL/COASTAL BIOLOGICAL RESOURCES, SPECIES, AND HABITAT	
<u>General Description of Impact Types</u> Potential impacts related to building the converter stations and placement and drilling of the cable are categorized as follows: • **Construction** – Impacts that occur during the building of the converter stations and placement of the cable. Construction-related impacts are often short term; however, the effect of the impact could be long lasting. Construction-related impacts include habitat damage, sediment resuspension and deposition, hydroacoustics, ship strike, and anchor damage. • **Operational** – Impacts related to the operation of the converter stations and the cable. Potential construction and operational impacts to both terrestrial and coastal resources are discussed below for the landing sites: **Terrestrial Resources** <u>Construction Impacts</u>	The following measures are recommended (see Section 3.14): Control sediment erosion and turbidity discharges. Determine if threatened and endangered plants or vegetation or habitats used by protected fauna are within or adjacent to the site. If present, construction plans should be evaluated to minimize impacts. Investigate alternative landing site areas for presence of wetlands or threatened and endangered species and their

Potential Environmental Impacts	Recommended Conservation and Construction Measures
Habitat Damage If the build footprint occurs in an undeveloped parcel, existing habitats would be permanently damaged. Impacts to biological resources could be caused by: • Clearance and/or disturbance by construction and construction equipment resulting in terrestrial vegetation removal; • Shading of adjacent habitats; • Wildlife disturbance from construction noise; • Air pollution; and • Artificial lighting that could disrupt wildlife. The conversion of natural areas to man-made development would result in the permanent net loss of ecological resources within the development footprint. *Sediment Resuspension and Deposition* Construction in terrestrial areas could lead to the erosion and transport of soil by wind or rain to nearby water bodies and wetlands. The sedimentation and ultimate deposition could result in impacts to these environments through burial of habitats and lowering of water quality. In addition, disturbance of site soils may release potential chemical contaminants present in soil due to historical releases. Hawai‘i's freshwater fish species are highly specialized, and increased sedimentation and burial of benthic habitats could result in impacts to these species. *Acoustic* During construction, noise generated by vehicles and machines would result in a short-term perturbation of wildlife species not adapted to urban environments. *Contaminated Soils – Potential Ecological Stressors* Due to the level of development within the landing site areas, soils and sediments may contain chemical contamination. Disturbance of these soils may introduce chemical contaminants into the environment. <u>Operational Impacts</u> *Habitat Fragmentation* The bifurcation of a habitat lowers the ecological value of the habitat. With respect to interconnected habitat complexes, the impacts to one habitat may result in impacts to adjacent habitats through the altering of wildlife travel corridors and changes in hydrology. The construction of a converter station may result in disruption to wildlife movement and/or vegetation communities. *Electromagnetic Fields* Transmission cables between the cable landing site area and converter station may generate the potential for impacts to terrestrial organisms. For example, raising the temperature of terrestrial soil may potentially affect plants, soil invertebrates, and the higher level trophic birds and mammals that forage on these organisms, particularly plants and ground-dwelling and/or feeding birds. **Coastal Resources** It is envisioned that from the 100-ft depth contour to a location above the high tide line, the cable would be installed by HDD. The HDD cable, if placed sufficiently below a coral reef or other benthic habitat, should not compromise the structural integrity of corals, coral reef, or other benthic communities in water depths less than 100 ft. The “connection point” location (i.e., areas where the cable exits the sea bed) would impact the benthic resources within an approximate 10-ft diameter area. From the 100-ft depth contour seaward, the cable would lay on the bottom, which could result in dislodgement, fragmentation, and injury/death to coral and other sessile marine organisms. Also, the periodic shifting from currents or storm events after installation may further damage marine organisms. <u>Construction Impacts</u>	habitat. Avoid impacts to wetlands or habitats for threatened or endangered species. Avoid dredging, the placement of fill in open waters, or altering drainage courses. Give preference to landing site areas in developed areas or locations where the vegetation has been disturbed. During the cable installation, any slack cable should be secured so cables do not sweep across the bottom. Also, vessel and barge anchorages should be considered over locations where live-bottom habitat does not occur. Reduce potential impacts from directional drilling operations. In Hawai‘i, many coral species spawn in the summer months, usually during or within 1 week of a new moon. Avoid activities that may affect the surface of benthic habitats less than 200 ft in depth in the warmer months of the year. Select cable routes that minimize impacts to reef systems. After the cable has been laid, divers should adjust cables to free pinned soft corals and limit the abrading of hard corals. Any corals that were dislodged should be reattached to suitable substrate. Limit offshore cable-laying activities during the time period from December through April. Avoid monk seal haulout areas. Prior to construction activities, an area should be investigated for pupping activities. If pupping occurs within proximity to construction, consideration should be given to altering the time of year when disturbance would occur. In potential sea turtle nesting beaches, no construction, operation, transportation, or storage of material/equipment should occur seaward of the existing dune crest during the marine turtle nesting season

Potential Environmental Impacts	Recommended Conservation and Construction Measures
Sediment Resuspension And Deposition The resuspension of sediment poses threats to a variety of marine organisms. Long-term and/or acute increases in sedimentation could alter migratory patterns, affect foraging ability, or even result in mortality of organisms through burial. Coral reefs and hard-bottom communities may be negatively impacted, if the sedimentation is in excess of natural processes. Impacts from sedimentation and deposition may result in burial of the sessile organisms, attenuation of sunlight penetration reducing photosynthetic activity, and covering of hard substrates thereby reducing recruitment of corals and other sessile organisms. *Hydroacoustic* The generation of underwater noise can impact marine species. The impacts can range from minor behavioral disruptions to mortality. It is anticipated that construction-generated noise would not occur at a level high enough to cause injury or mortality to marine fauna; however, generated noises could result in behavioral impacts to marine species. *Contaminated Sediments – Potential Ecological Stressors* Once introduced into the harbor, wetlands, or open coast nearshore habitats, chemicals may be deposited into and accumulate in sediments. As a result, sediment in harbors, wetlands, and open coastal nearshore subtidal habitats act as a natural trap or sink for chemicals from diverse sources that may have been released over a period of years or decades. *Directional Drilling* The term hydrofracture, also known as a “frac-out,” refers to an accident during HDD when drilling fluid leaks into a patch of unconsolidated sediments or a fault or crack in the geology above a boring and breaks out at the surface. Typical HDD lubricant consists of water mixed with bentonite clay. Certain forms of bentonite are highly expansive with a pH higher than sea water. If hydrofracture occurs during drilling, coral reefs and other marine habitats in the vicinity of the hydrofracture could be smothered and the increased turbidity could potentially alter the local water quality. *Cable Placement in Open Water* During cable installation, the cable would extend from the seafloor to cable-laying ship. The presence of an approximately 4- to 10-inch-diameter cable would not pose a significant risk or obstacle for fish movement. Sea turtles and marine mammals do risk coming into contact with the cable. However, given the thin diameter of the cable and sheer size of the coastal ocean, contact between sea turtles and marine mammals and the cable is anticipated to be minimal, if at all. It is assumed that cable routes would occur in the open ocean and/or in nonconfined coastal waters, which would permit the marine organisms to transit around the cable. <u>Operational-Related Impacts</u> *Habitat Fragmentation* Given the complex habitats on the seafloor, especially corals and coral reefs, the addition of an approximately 4- to 10-inch-diameter cable is not likely to cause an impact to marine organisms if appropriate avoidance measures are used. *Electromagnetic Fields* The potential adverse effects to marine life generated by undersea power transmission cables would be primarily caused by EMFs from the proposed electrical cables that increase the potential exposure for marine habitats and fauna. Transmission cables between the cable landing site area and converter site may also generate potential EMF impacts to coastal wetlands, freshwater streams, and terrestrial wildlife. In addition to EMFs, the loss of energy from power transmission cables in the form of heat is expected to raise the temperature of the seafloor in the vicinity of the cable potentially affecting benthic species and biological processes. Similarly,	(April through October). No temporary lighting of the construction area visible from any part of the beach should be conducted at any time during marine turtle nesting season. Boats should have lookouts to lessen the chance of marine mammal strike, especially October through March. Where possible, directional drilling under a protected biological resource should be considered. For all sites, benthic habitats below 100 ft should be investigated for the presence of corals and other fauna. Limit the amount of sediment resuspension to the greatest extent possible. Limit foreign materials and fluids from entering the marine habitat. Avoid wetlands associated with designated critical habitats for waterbirds and moth. Within Kahului Harbor and a large area north of the harbor, the benthic habitat is mapped as sand or mud; consideration should be given to utilizing areas devoid of corals. FMAs within the harbor should be avoided.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
raising the temperature of terrestrial soil may potentially affect plants, soil invertebrates, and the higher level trophic birds and mammals that forage on these organisms, particularly plants and ground-dwelling and/or feeding birds.	

Potential Environmental Impacts	Recommended Conservation and Construction Measures
VISUAL RESOURCES	
Description of Impact Types Short-term impacts would be associated with the installation of the undersea power cable system; long-term impacts would be related to operations associated with cable system implementation—energy transmission via cables and converter station operation. A specific project may cause impacts to existing visual resource if found to: • Substantially alter the views or scenic quality associated with particularly significant and/or publicly recognized vistas, viewsheds, overlooks, or features. Is the visual relationship or quality between a cable system and specific elements of its surroundings altered? Are there contrasts? Do cable system components block views? • Substantially decrease the visual quality of the environment. Do cable system visual characteristics decrease the visual quality of the environment (landing site area)? • Substantially change the light, glare, or shadows within a given area. A cable system would be thought to create impact to the existing setting if, for example, as the result of cable system implementation, shadow effect would increase (e.g., new buildings with excessive heights). Conversely, a cable system that would result in the replacement of tall structures with buildings with lower heights would result in increased light—a beneficial impact.	The following measures are recommended (see Section 3.15): Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources. Provide incentives to maintain and enhance historic, cultural, and scenic amenities. Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
WATER RESOURCES	
General Description of Impact Types **Terrestrial** All of the landing site areas on the various islands encompass various types of water resources. Water resource impact types are not localized to one island project location or a specific type of water resource. In general, the leeward locations of islands tend to be drier, with fewer terrestrial water resources and less precipitation. Since no location in Hawaiʻi is more than 30 miles from the shore, coastal and marine resources are especially vulnerable to human activities that occur inland. Stream channelization, loss of riparian vegetation, and paving in lowland and coastal areas contribute to a higher than normal volume and velocity of freshwater being delivered to the ocean with the resulting low salinity levels. These low levels of salinity, combined with the reduced quality and increased turbidity of the runoff, can adversely affect the sensitive coral reef ecosystems. Most estuaries in Hawaiʻi are within embayments that generally are not subject to rapid and efficient flushing. Sediment and other pollutants in runoff can accumulate in estuaries and degrade water quality. Future construction of converter stations as well as the landings for undersea cables will most likely require excavation, land clearing, and grading activities regardless of the proposed location. These activities could affect adjacent surface water features or groundwater resources and may particularly result in point source discharge that exceeds state water quality standards, cause substantial erosion or downstream sedimentation, and/or affect groundwater quality and	The following measures are recommended (see Section 3.16): Locate facilities as far as practicable from natural drainages. Designate on-site material delivery and storage areas near construction entrances and away from watercourses. Implement storm water planning, design, and construction elements. Develop plans that ensure protection of workers and proper disposal of contaminated groundwater and saturated soil, if encountered. Provide training on proper material delivery and storage practices and procedures.

Potential Environmental Impacts	Recommended Conservation and Construction Measures
quantity. Additionally, the water bodies at some of the proposed future development sites may be listed on the CWA Section 303(d) list of impaired waters. **Federal Waters** BOEM Jurisdiction BOEM lease and ROW jurisdiction would depend on where corridors are proposed for an undersea cable route. BOEM has the authority to issue ROW grants for offshore transmission lines linking renewable energy installations in the OCS. However, BOEM specifically does not have the authority to grant energy leases or ROWs in NMSs. If a leasable area, not within HIHWNMS jurisdiction, were found, the proposal to place a cable in the OCS would trigger the preparation of a NEPA environmental review, which would be submitted as part of the BOEM ROW application. Impacts to marine waters would be analyzed as part of that process. NOAA Jurisdiction Avoidance of the NMSs may drive the design, location, and placement of cable corridors and landings, and the alternatives to each. This area is best avoided for cable-laying as BOEM cannot issue an ROW permit within HIHWNMS boundaries and a process for securing approval from NOAA for the laying of a cable and/or granting of a ROW has not been codified at this time. If NOAA defines a future process for the permitting of cables in the NMSs, like BOEM, a NEPA environmental review would be required to analyze the full range of marine impacts from this type of development.	Disclose issues related to groundwater quality, including disposal options and associated regulatory requirements for dewatering. Minimize impacts to receiving waters. Submit a SWPPP to identify appropriate CCMs to control and minimize erosion at the construction site and postconstruction CCMs to stabilize soils when construction is complete. Limit clearing and grading of native vegetation. Implement a material and waste management program. Install stormwater and erosion controls. Cover stockpiles of soil and concrete material, and/or surround stockpiles with straw wattles or gravel bags; protect slopes. Phase grading to limit soil exposure and minimize potential sediment transport; revegetate finished areas. Protect storm drain inlets and stabilize construction entrances and laydown areas. Construct sedimentation basins where appropriate; control drain rate and runoff velocities.

CHAPTER 1.0
INTRODUCTION

The State of Hawaiʻi's Department of Business, Economic Development and Tourism (DBEDT), has the lead role for the State in energy planning and policy initiatives to benefit Hawaiʻi's economy and inhabitants. DBEDT and the United States (U.S.) Department of Energy (USDOE) entered into a Memorandum of Understanding (MOU) in January 2008 to institute a fundamental and sustained transformation of the way in which renewable energy resources are planned and used in the state. Through this agreement, known as the Hawaiʻi Clean Energy Initiative (HCEI), a number of actions have been taken to help the state attain its goal of 70 percent clean energy by 2030. In addition to the formation of working groups, completion of projects, numerous outreach activities, and funding of in-depth analytical work on topics ranging from efficiency to transportation to renewables, the comprehensive and integrated approach of the HCEI program includes several projects to further evaluate the feasibility, costs, and potential of interisland transmission of electricity.

This Hawaiʻi Interisland Renewable Energy Program (HIREP) environmental analysis (programmatic review) provides information and analysis for use in environmental review, at a programmatic level, of implementation of a renewable energy generation program and the interisland transfer of generated power through one or more undersea cables in the State of Hawaiʻi. The term "programmatic review" refers to the activities defined in the Notice of Intent (NOI) for the programmatic review and the Environmental Impact Statement Preparation Notice (EISPN) developed for the State of Hawaiʻi. For example, scoping comments were submitted or made with respect to the "programmatic review."

Funds for this project were provided under the American Recovery and Reinvestment Act of 2009 (ARRA), Public Law (P.L.) 111-5, award number DE-EE0000216.

1.1 BACKGROUND

The consulting firm AECOM was retained to assist in the preparation of the environmental review documents for wind energy generation on one or more Maui County islands with transmission via submarine cable to Oʻahu.

DBEDT and USDOE initiated a scoping process to assist in determining the issues to be addressed in the HIREP: Wind Programmatic Environmental Impact Statement (Hawaiʻi Wind EIS or EIS). On November 24, 2010, an Environmental Assessment/Environmental Impact Statement Preparation Notice was delivered to the Hawaiʻi Office of Environmental Quality Control (OEQC). It stated the following:

Description of the Proposed Action

This Environmental Assessment/EIS Public Notification (EISPN) evaluates the environmental impacts associated with a proposed wind energy generation, transmission, and delivery program. The proposed action is for a programmatic coordinated overview of potential environmental effects associated with wind energy development on Maui County islands and associated transmission to the City and County of Honolulu. This action would implement the Hawai‘i Interisland Renewable Energy Program: Wind (HIREP) in support of the objectives of the Hawai‘i Clean Energy Initiative (HCEI).

Alternatives to be analyzed in the HIREP Wind EIS include the proposed action, which would provide for the implementation of an oversight program to develop up to 400 MW of wind energy on the Maui County islands of Maui, Lāna‘i, and/or Moloka‘i and transmission of that energy to O‘ahu. A range of wind development projects could be pursued under the proposed action, and include varying power capacities and configurations amongst the islands, undersea cable corridors and routes, and locational criteria for landing sites. The HIREP Wind EIS will address scenarios under the proposed action that consider a programmatic approach to all wind energy deriving from a single island in Maui County, i.e., Lāna‘i, Moloka‘i or Maui, and all wind energy deriving from a combination of generation on two or more of the islands in Maui County, along with associated programmatic approaches to cable corridors and routes and landing site locations.

As part of the HIREP Wind EIS evaluation, the wind energy development program would establish policies and best management practices (BMPs) to effectively and efficiently address the consideration of wind energy development activities and would identify minimum requirements for mitigation measures. These programmatic policies and BMPs would be applicable to future wind energy development projects on areas covered by this HIREP Wind EIS; however future tiered-off site specific projects would require their own environmental review. Site-specific concerns and the development of additional mitigation measures would be addressed in project-specific reviews, as required. This approach will also permit consideration of cultural landscapes over a broader range of areas rather than focusing and limiting cultural considerations on specific areas.

DBEDT, on behalf of the State of Hawai‘i as its energy coordinator, has the lead role for the State in energy planning and policy initiatives to benefit the state economy and its inhabitants. In furtherance of its partnership with DOE in implementing the goals of the HCEI, DBEDT has determined that significant adverse impacts could result in the implementation of the HIREP and is therefore participating in the preparation of this HIREP Wind EISPN as the state lead agency. It is also the joint lead agency with DOE in the federal National Environmental Policy Act (NEPA) document (Programmatic EIS). This joint effort

will ensure that the evaluations and presentations contained in the HIREP Wind EIS will comply with the requirements of the State's environmental review process set forth by the Hawai'i Revised Statutes (HRS) Chapter 343. Because the HIREP Wind EIS requires substantial involvement and approval of more than one agency at both the federal, state, and local levels, the decision was made to prepare a single joint EIS that follows the procedural and substantive guidelines and requirements of both the Hawai'i Environmental Policy Act (HEPA) and NEPA.

Discussion of Alternatives

At this time, there is one alternative to the proposed action (and the scenarios described therein) being analyzed in the HIREP Wind EIS: the no-action alternative, as described below.

No-Action Alternative

Under the no-action alternative, DBEDT would continue administering wind energy development authorizations and approvals in accordance within existing federal, state, and local statutes and requirements. A coordinated overview of potential environmental effects associated with wind energy development would not be developed. Analysis and review of wind energy development applications, including National Environmental Policy Act analyses, HRS 343 analyses, and development of required mitigation measures, would be conducted on a project-by-project basis. As required, individual land use plan amendments, right-of-way (ROW) grant applications, and other approvals would occur on a project-by-project application basis without the benefit of the overarching, comprehensive analysis provided as envisioned by the HIREP Wind EIS. Under the no-action alternative, it is less likely that the same level of comprehensive and consistent planning, consultation, and mitigation measures would be implemented on a project-specific basis. Follow-on proposed project-specific wind projects would not necessarily be implemented in a consistent manner, potentially making achievement of renewable energy goals addressed by an interisland wind energy program less efficient or feasible.

Conclusions

It is anticipated that the establishment of this program and the subsequent tiered off project-specific proposed wind projects may result in significant impact to the human and/or natural environment. Therefore, in accordance with HRS Chapters 201N and 343, and Hawai'i Administrative Rules § 11-200, the Applicant intends to prepare an EIS to ensure that any tiered off project-specific proposed wind projects follow the guidelines specified in the Final HIREP Wind EIS so that consistent analyses on those wind projects can be conducted in the future.

A Notice of Intent (NOI) that USDOE would prepare an EIS as the lead federal agency, with DBEDT as the State of Hawai‘i co-lead, was published in the Federal Register on December 14, 2010 (75 Federal Register 239). The NOI described the proposed action as follows:

> *DOE announces its intention to prepare a Programmatic EIS with the State of Hawai‘i as joint lead agencies pursuant to the National Environmental Policy Act (NEPA) of 1969 and the Hawai‘i Environmental Policy Act. The Hawai‘i Interisland Renewable Energy Program: Wind Programmatic Environmental Impact Statement (hereinafter referred to as the Hawai‘i Wind EIS or the EIS) will assess the foreseeable environmental impacts which may arise from wind energy development under the Hawai‘i Interisland Renewable Energy Program (HIREP). Hawai‘i proposes to facilitate the development of wind-generated electric energy and the required improvements to the existing electric transmission infrastructure in Hawai‘i. This EIS is the first phase of a programmatic environmental review of developing and increasing renewable energy technologies in Hawai‘i.*

A programmatic approach was selected because the review would not be for a specific project on a single island, but rather an action to implement a larger program addressing renewable power generation and delivery on a regional scale between two or more islands as described previously.

Additional background information on the program and the informal public outreach and community involvement is provided in the *Background Information* document.

The EISPN and NOI, the scoping meetings, and the received public comments are detailed in AECOM (2011).

1.2 PURPOSE OF THE REFERENCE INFORMATION

The purpose of this HIREP reference is to provide information developed to date for DBEDT.

Chapter 2 of this document presents assumptions and descriptions used in the programmatic analysis of potential facilities and infrastructure that could be constructed to implement renewable energy-generated power transfers between islands. These assumptions and descriptions are conceptual and were developed only as the basis for discussions of potential environmental impacts to resources in the areas considered.

Chapter 3 presents discussions for specific resource areas including the following:

- Affected environment (existing setting and conditions)
- Potential impacts associated with cable system implementation

- Conservation and construction measures recommended to avoid or minimize potential impacts.

A total of 16 different resource areas are discussed. The specific resources and the order of discussion are as follows:

- Air quality and climate change
- Cultural resources
- Geology and soils
- Land transportation
- Land use
- Marine transportation
- Marine/benthic species and habitat
- Natural hazards, hazardous waste, and munitions and explosives of concern
- Noise and vibration
- Public health and safety
- Public services/infrastructure
- Recreation
- Socioeconomics and environmental justice
- Terrestrial/coastal biological resources, species, and habitat
- Visual resources
- Water resources

Chapter 4 provides a list of document preparers. Chapter 5 provides a list of references cited.

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CHAPTER 2.0
CABLE SYSTEM IMPLEMENTATION – ACTIVITY DEFINITION

2.1 GENERAL DESCRIPTION

The essential elements of the proposed HIREP undersea power cable system are inherent in the acronym used to identify it—the program is envisioned as a transfer, between islands, of power generated from renewable energy to meet Hawaiʻi's goals defined by the HCEI. The assumption for the extent of the cable system evaluated under this effort was an undersea power cable to transfer power between islands, bounded by power converter stations at each end. One converter station would receive power (typically alternating current [AC] power) from whatever renewable energy generation source was developed and convert that power to a form most conducive with efficient transfer (typically direct current [DC] power). The power would then be transferred via undersea cable to the recipient island where a second converter station would convert the power to a form compatible with the receiver's existing electrical grid (typically AC power). A programmatic evaluation of the potential effects of implementation of these components on the natural environment of the islands requires at least some definition of the types of facilities and activities that could be implemented under the program.

This description of assumed facilities and implementation activities is essential to:

- Defining the potential cable routing, landing site areas, and configuration of the converter stations.
- Defining the environmental setting in areas potentially affected by the cable system implementation.
- Identifying the potential environmental impacts and recommended conservation and construction measures to avoid or minimize environmental effects.

The description below addresses the interisland transmission of renewable energy (RE)-generated power between islands, and addresses the power exchange system of an undersea power cable between two converter stations on the sending and recipient islands.

The "cable system" assumed for this evaluation would run along the representative School of Ocean and Earth Sciences and Technology (SOEST) surveyed areas, from Maui to Lānaʻi to Molokaʻi and to Oʻahu (SOEST 2010). The discussion assumed power generation could occur on each of the other three islands (although this is not a requirement for the "system" to function) and transmission would take place through the entire system to Oʻahu. Power received from another island would be "combined" with locally generated RE power and transmitted to the next node in the "system." Oʻahu was assumed as the final recipient; however, any system

developed will likely be capable of having power generated and transmitted in either direction along the line. System facilities approximations were sized based on these assumptions.

This evaluation addresses only the undersea cable portion of the system, bounded by the converter stations.

The evaluation includes the following assumptions:

- The system may encompass up to four Islands–Lānaʻi, Maui, Molokaʻi, and Oʻahu.
- Potential undersea power cable corridors are defined by the mapping generated by SOEST during their marine surveys for the DBEDT renewable energy program (SOEST 2010). SOEST used a prescreening approach to define potential suitable cable corridors; and considered bottom type, hazards, slope, and geologic features [canyons, faults, etc.] before routes were defined and mapping activities commenced.
- This evaluation assumed a cable alignment from Maui to Lānaʻi to Molokaʻi to Oʻahu to minimize cable lengths, minimize the amount of trenching needed during cable installation, and minimize the converter station space requirements. The evaluation assumed delivery from Maui to Lānaʻi of 200 megawatts (MW) of RE power; Lānaʻi to Molokaʻi 400 MW of total RE power delivered; and Molokaʻi to Oʻahu 600 MW of total RE power delivered.

These assumptions are not indicative of how such a system would be configured or sized, but are adopted as a basis for the resource impact discussions below. Specific routes for future proposed cable projects and converter stations would be chosen by the cable developer in the subsequent “project implementation” phase. The definition of the types of equipment that could be deployed, including cable types, is presented in Navigant (2011).

Other assumptions regarding the potential locations and configurations of cable system components included the following:

- The University of Hawaiʻi’s SOEST conducted a number of studies to assess and recommend route options for undersea transmission cables between the islands of Molokaʻi, Lānaʻi, Maui, and Oʻahu (SOEST 2010).
- Landing site areas were defined by using a “zone” definition of potential landing site areas to fit with the programmatic approach, matching up the defined SOEST surveyed areas and known Hawaiian Electric Company (HECO) substation locations, as well as suitable renewable resource areas on the Maui County islands (Appendix A).
- The evaluation assumed the use of horizontal directional drilling (HDD) to cross beach areas and extend the undersea cable reach beyond the shallow inshore and coral reef

habitats, to minimize environmental effects, and permitting and construction requirements.

- "Suitable" landing site areas were defined by the shoreline length crossed by an arc from the known cable corridor terminus (Figures 2-1 and 2-2), extending shoreward for 10,000 feet (the assumed extent of horizontal direction drilling [HDD] technology reach).

[Specific landing site locations would be chosen by the cable developer in the subsequent "project implementation" phase.]

- Converter stations were assumed to be located within 1 km of the beach, within the defined landing site areas, for purposes of defining the affected area and determining potential environmental impacts (Navigant 2011). These areas were mapped for the various islands in Figures 2-3 through 2-9.
- The converter station appearance is illustrated in Figures 2-10 and 2-11.
- Converter stations could have "combiner capability" to integrate RE power generated locally with RE power in transmission from other islands. This capability would have no effect on station size or configuration.

[The specific converter station locations and configurations would be identified in the subsequent "project implementation" phase.]

2.2 ASSUMED GENERAL CABLE SYSTEM CONSTRUCTION ACTIVITIES

For the purpose of assessing potential environmental impacts, the general construction activities assumed for implementation of an undersea power cable system included the following:

- Cable Lay
  - Cable Characteristics (Table 2.2-1)
    - Two-cable dipole package that can be laid individually or as a bundled "package"
    - A 400 MW cable package is estimated to be 10" diameter
    - Weight of the cable package – see Table 2.2-1
  - Cable Laying
    - Lay rate: 2–3 knots in good conditions.

- The cable is laid on the seabed utilizing a cable-laying ship. A large cable reel located at the back of the cable-laying ship pays out the cable onto the ocean floor utilizing a Global Positioning System (GPS).
- The ship approaches the connection point (terminus of the HDD bore) and pays out the cable utilizing floats, pontoons, or a barge to position the cable for attachment to the anchor point. Once the cable has been anchored, the pontoons are removed and the cable is lowered to the ocean floor, the ship moves along its designated path, and the cable is continuously lowered to the ocean floor.
- Once the ship approaches the terminus of the cable route, the cable on the ship is attached to the pontoons to enable the cable to be pulled to shore and the shore connection.
- Before the final connection is made to on the shore side, the cable is buried, usually 3 to 5 feet under the ocean floor surface. An underwater robotic cable installation machine or remotely operated vehicle (ROV) is sent from the mother ship to lock onto the cable and commence the embedding of the cable. Cables can be installed below the seabed at cable lay time or later after the cable has been laid on the ocean floor surface.
- There may be a need for subsea cables to cross seabed obstructions, especially in areas that are congested with subsea pipelines and other cables. Methods for subsea crossings of seabed obstructions include:
    - Concrete mattresses to support cable over obstructions
    - Use of protective cable sleeves over the obstruction
- Cable-laying speed is faster in shallow waters than deeper waters, because it is easier to control the cable-laying direction; the greater the depth, the slower the ship can travel to ensure proper cable installation location.
- Shallow waters tend to hamper the movement of the ship, requiring that the cables be moved to shore using smaller, shallow draft vessels such as tugs and barges to pull the cables to the connection point, depending on the water depth at connection.
- Cables placed and installed at the same time employ a larger robotic cable installer using a plow located at the front of the machine, which simultaneously plows a trench ahead of the cable and lays the cable into the plowed trench.
- Cables placed onto the ocean floor surface and installed later after the cable is positioned use a remotely operated water jet installer, which is

usually smaller and quicker to deploy. The robotic cable installer travels along the cable and lifts it up while high-pressure water jets excavate a trench, just wide enough for the cable. The installer machine then lays the cable back down in the trench as it propels itself along. The trench fills itself in over a short period of time due to natural wave and sediment movement along the ocean floor.

- If large rocks or formations are encountered by the cable installation machine, it sends a signal back to the mother ship and halts installation.
- Cable is laid in the ocean to the designated endpoint, then pulled through the HDD bore onto land and connected at the converter station.
- Endpoint locations are generally “armored” with rock or concrete covering to protect the emergence point of the cable.

- Shore Crossings
  - HDD is assumed to extend beyond nearshore coral zones and reach the defined cable corridor endpoint.
  - HDD bore diameter will be approximately twice the cable diameter.
  - HDD is a method of drilling an underground hole from a surface location along a prescribed bore path, suitable for the installation of pipes and conduits. This technology was developed and utilized extensively by the oil and gas industry, making its use for an undersea cable landing safe and tested. Knowledge of the geology along the proposed bore route is extremely important for successful drilling.
  - HDD boring equipment requires a relatively short set-up time and a directional drilling rig can be set up and begin boring within a very short time. Labor requirements are minimal, as it only takes a small crew to operate a directional drilling rig. The land requirement for a directional drilling setup is approximately 1 acre and there is only a temporary disturbance to the land as a result of the use of this technology.
  - The process starts with the positioning of the drilling rig at the desired start point and a small pilot hole is drilled. The directional drill rig then pushes a small-diameter bore head connected to a hollow steel drill pipe into the ground at an angle, where the rotating drill bit starts to drill. As each section of drill pipe is pushed into the ground a new section is added behind it. This process continues until the drill has reached its destination point.
  - The drilling machine pumps a high-pressure jet of drilling slurry or boring fluid, which is generally a mixture of bentonite clay and water through the pipe to the drill head. Selection of the drilling fluid varies based upon the soil conditions and geology of the region. Drilling is accomplished through the cutting action of the

rotating drill bit and the high-pressure fluid jet. The drilling slurry performs several tasks, cutting the soil, lubricating and cooling the rotating drill pipe, sealing the inner surface of the bore hole, and removing the suspended solids from the drill head and returning them to the drilling machine where they are removed from the fluid and returned back into the drill pipe.

- The most commonly used equipment for determining the location of the bore head is a transmitter and receiver system, with the transmitter located behind the bore head and the receiver box located above grade or in a small surface support boat. The transmitter registers the drill bit angle, rotation, magnetic direction, and the temperature data and sends an encoded signal to the surface where the receiver decodes the steering directions and relays them back to the operator for adjustment of the boring head. Divers can be used to position a remote antenna over the drill head to send signals back to the surface.
- When the drill bit reaches the desired exit point, the drill bit is removed and a hole-reaming bit is installed and pulled backwards toward the drill, rotating the drill pipe with as many passes as required to open up the correct diameter of the hole to allow the main conduit pipe to be installed. Drilling rates for smaller pilot holes can range from 100 to 300 feet per day depending on how well the location and depth of the drill head can be monitored by divers and how hard the undersea soil or rock conditions are. The longer the hole, the heavier the drill fluid is required to seal and lubricate the drill shaft. Collection, holding, and disposal of drilling muds and cuttings extracted from the bore are assumed.
- Cable conduit is usually made of high density poly ethylene (HDPE) pipe. Once the correct size of the bore hole has been reached for the cable conduit to be installed inside it, the reamer bit is removed and the conduit is reeled out from the ship and attached to the end of the drill pipe by divers, and then the assembly with the HDPE conduit attached is pulled back through the hole toward the drill rig. Throughout this process, bore fluid is being continually pumped into the hole to ensure that the hole is sealed with no void being left between the HDPE pipe and the native soil.

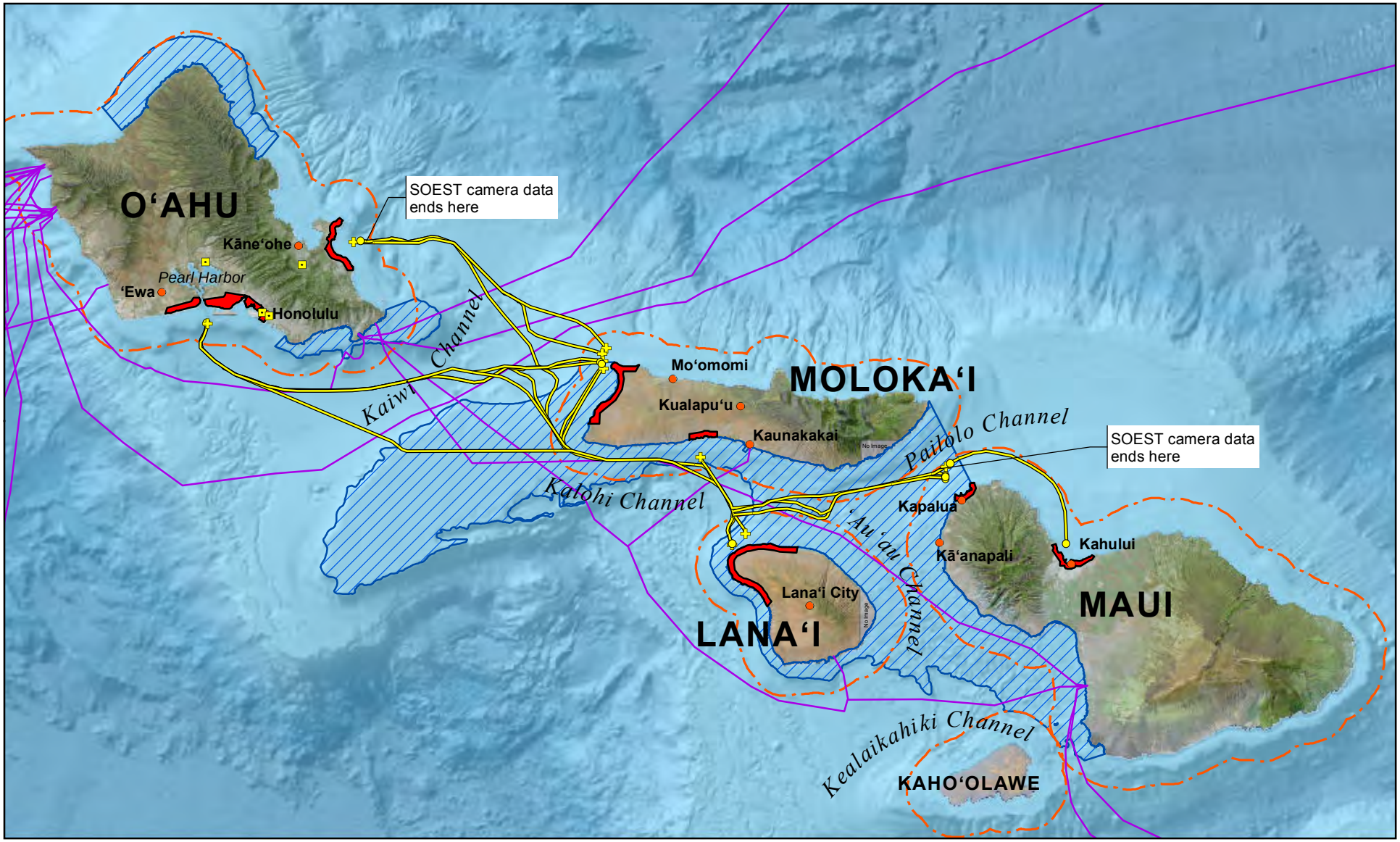
- Converter Stations
  - Assumed size is 200 MW each on Maui County islands (the RE “source” stations) and 600 MW on Oʻahu (the “receiver” station). However, power can likely be transferred in either direction. Specific MW values will be determined by the actual RE projects implemented.
  - Assumed footprint: “source” stations – 3 acres, plus 3 acres for laydown/future expansion – total 6 acres (Maui, Lānaʻi, Molokaʻi).
  - Assumed footprint: “receiver” station – 6 acres, plus 6 acres for laydown/future expansion – total 12 acres (Oʻahu).

- Substation-type appearance.
- Building height 40 feet; shielded to minimize electromagnetic interference; sound insulated to minimize off-site noise (see Figures 2-10 and 2-11 for converter station example schematic drawings).
- Construction period 24 months.
- Typical amount of labor required:
    - Grading and foundation work: 20 crew members
    - Building erection: 10–15 crew members
    - AC and DC electrical installation: 20 crew members

Table 2.2-1. Cable Characteristics

Area	Ampacity		80 kV Cable Bipole				150 kV Cable Bipole				300 kV Cable Bipole			
Con-doctor	Close laying	Spaced laying	Close laying	Spaced laying	Weight per cable	Diam. over cable	Close laying	Spaced laying	Weight per cable	Diam. over cable	Close laying	Spaced laying	Weight per cable	Diam. over cable
mm^2	Amps	Amps	MW	MW	kg/m	mm	MW	MW	kg/m	mm	MW	MW	kg/m	mm
95	282	338	45	54	4,7	42	85	101	8,5	60	169	203	15	90
120	323	387	52	62	5,5	44	97	116	9,4	61	194	232	16	91
150	363	436	58	70	6,7	47	109	131	10	63	218	262	17	93
185	411	496	66	79	7,4	49	123	149	11	64	247	298	18	95
240	478	580	76	93	8,4	52	143	174	12	67	287	348	20	99
300	544	662	87	106	9,4	56	163	199	13	69	326	397	22	102
400	626	765	100	122	11	61	188	230	16	75	376	459	24	105
500	722	887	116	142	13	66	217	266	18	78	433	532	26	108
630	835	1030	134	165	15	71	251	309	21	83	501	618	30	114
800	960	1187	154	190	17	76	288	356	24	88	576	712	33	118
1000	1092	1355	175	217	21	81	328	407	26	96	655	813	37	122
1200	1188	1474	190	236	24	85	356	442	29	100	713	884	40	126
1400	1297	1614	208	258	27	89	389	484	32	103	778	968	43	130
1600	1397	1745	224	279	30	92	419	524	35	107	838	1 047	47	133
1800	1490	1860	238	298	32	97	447	558	38	110	894	1 116	50	137
2000	1589	1987	254	318	35	99	477	596	41	113	953	1 192	53	140
2200	1676	2086	268	334	40	103	503	626	45	118	1 006	1 252	58	145
2400	1764	2198	282	352	42	106	529	659	48	121	1 058	1 319	61	148
2600	1848	2307	296	369	45	109	554	692	51	123	1 109	1 384	63	150
2800	1927	2401	308	384	48	111	578	720	54	126	1 156	1 441	67	152
3000	2007	2512	321	402	50	114	602	754	57	128	1 204	1 507	70	155

Sea soil: Temperature 28 deg. C, Burial 1.0 meter, Thermal resistivity 1.2 K x W / m
Cable: Copper conductor, HVDC polymer insulation, Steel wire armor



UH-SOEST Surveyed Area Alternatives and HIREP Study Analysis Areas

- Route with camera data *
- Route without camera data **
- Identified O‘ahu Substation Locations
- Selected Cities & Communities
- Known Existing Underwater Cables
- UH-SOEST Cable Routes
- HIREP Study Analysis Area
- State Jurisdictional Waters (3 nautical miles)
- Humpback Whale National Marine Sanctuary
- Open Water

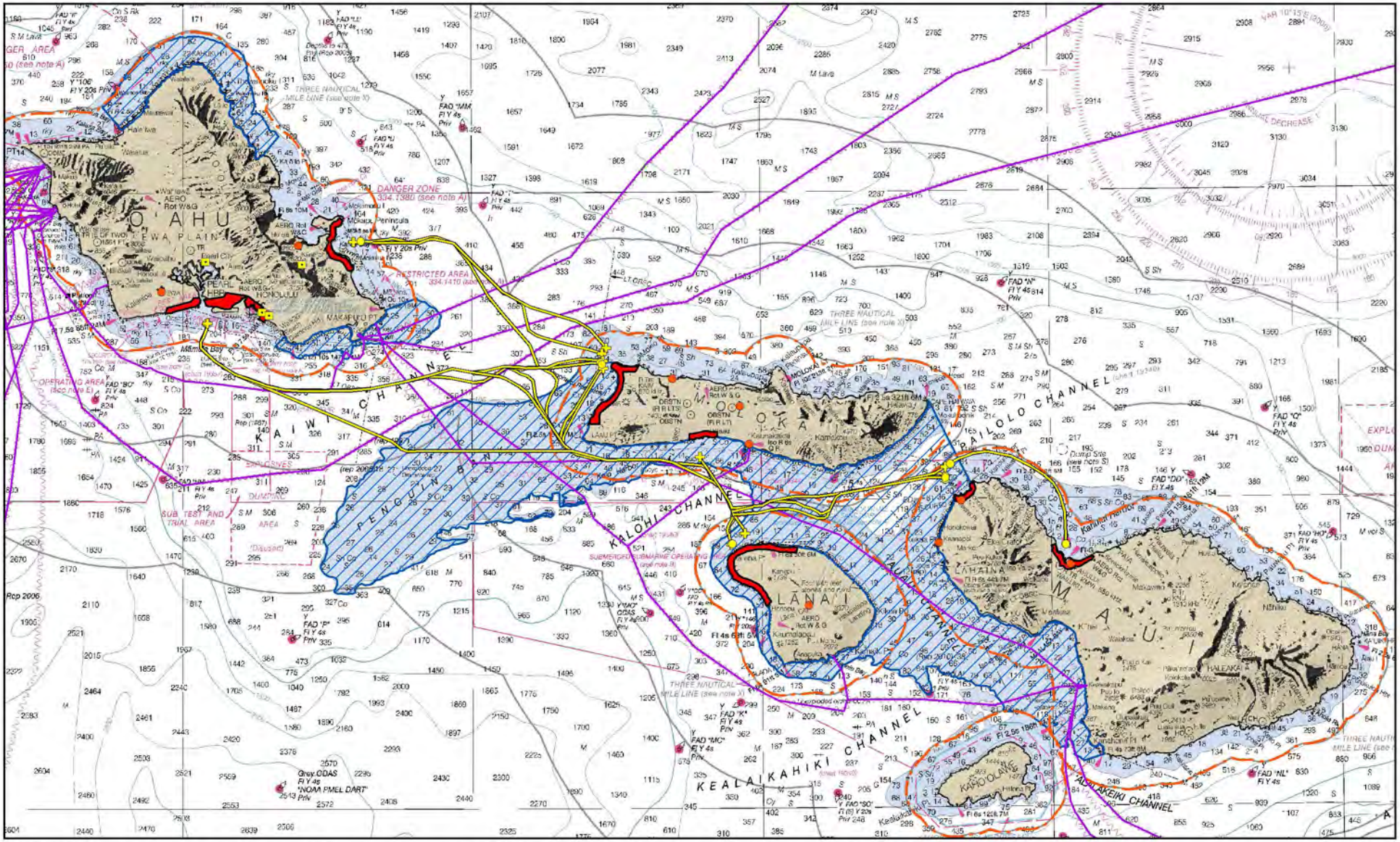
N

0 5 10 Miles

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 8/9/2012
Data Sources: HI-DBEDT, NOAA, UH-SOEST, AECOM, 2012

Figure 2-1



UH-SOEST Surveyed Area Alternatives and HIREP Study Analysis Areas on NOAA Nautical Chart

- Route with camera data *
- Route without camera data **
- Identified O'ahu Substation Locations
- Selected Cities & Communities
- UH-SOEST Cable Routes
- Known Existing Underwater Cables
- HIREP Study Analysis Area
- State Jurisdictional Waters (3 nautical miles)
- Humpback Whale National Marine Sanctuary

Background Map - NOAA Nautical Chart - May 2006

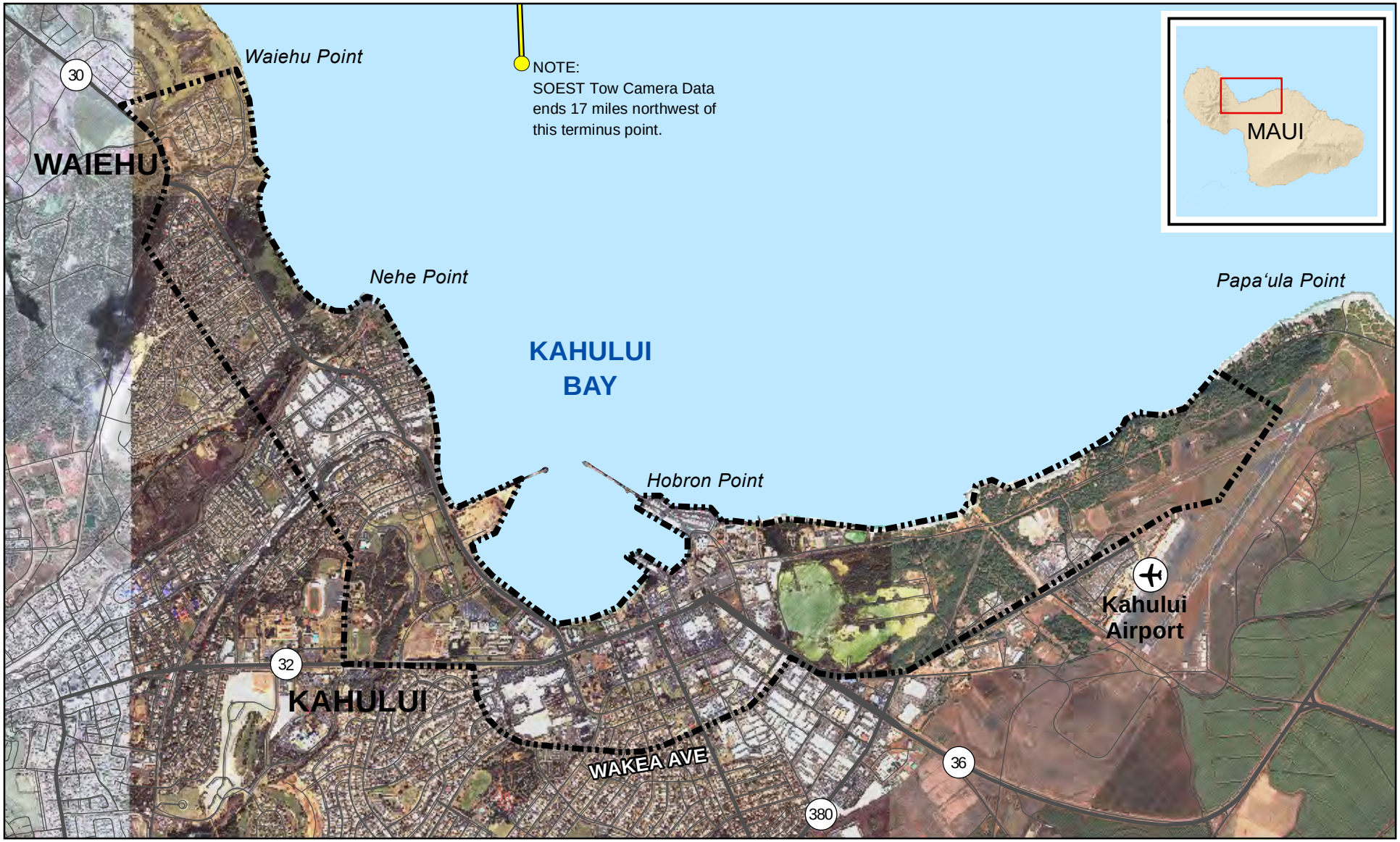
N

0 5 10 Miles

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 8/9/2012
Data Sources: HI-DBEDT,NOAA, UH-SOEST, AECOM, 2012

Figure 2-2



Kahului Maui Landing Site Area

- Route with camera data *
- Route without camera data **
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Open Water

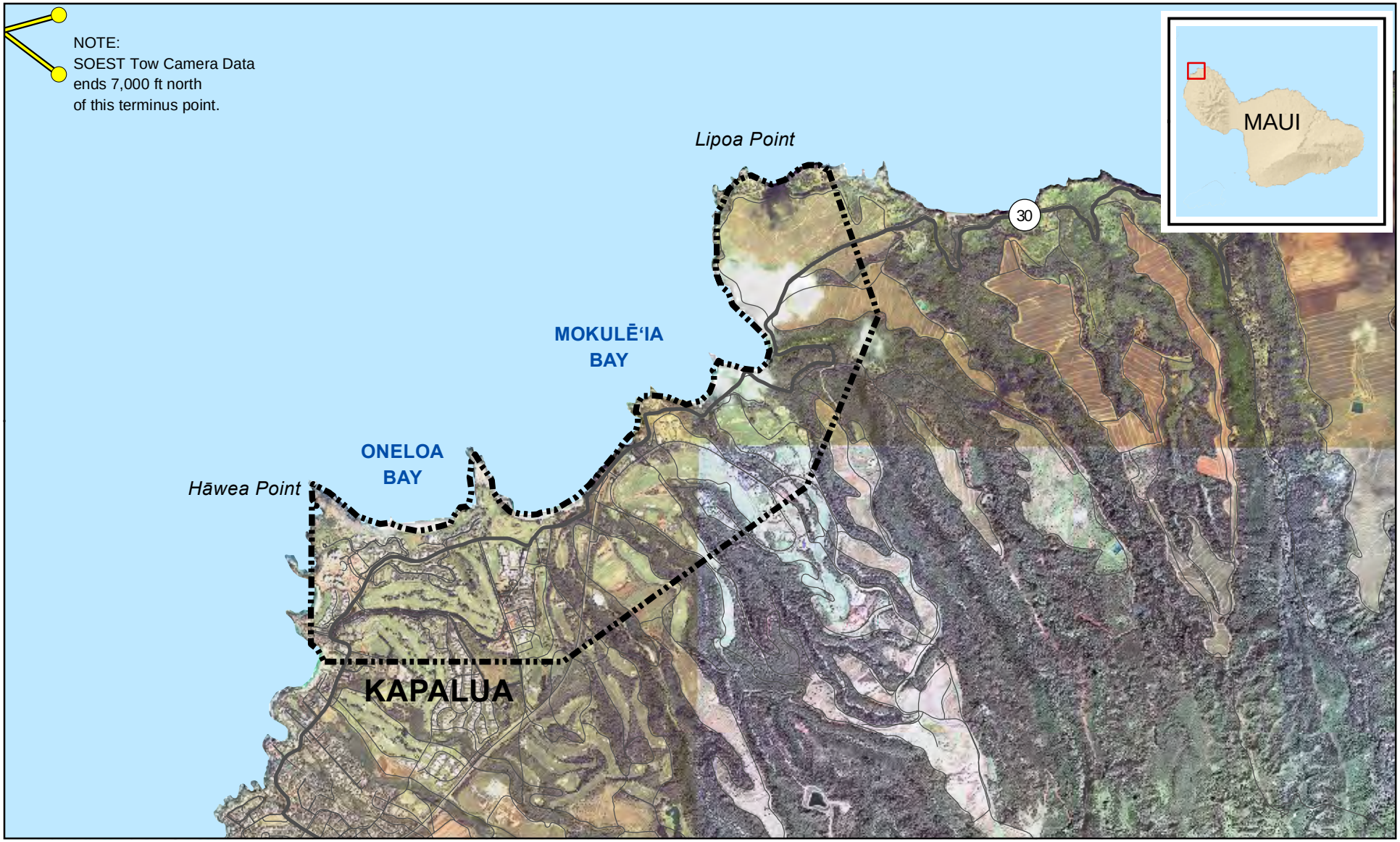
N

0 2,500 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, UH-SOEST, AECOM, 2012

Figure 2-3



West Maui Landing Site Area

- Route with camera data *
- Route without camera data **
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Open Water

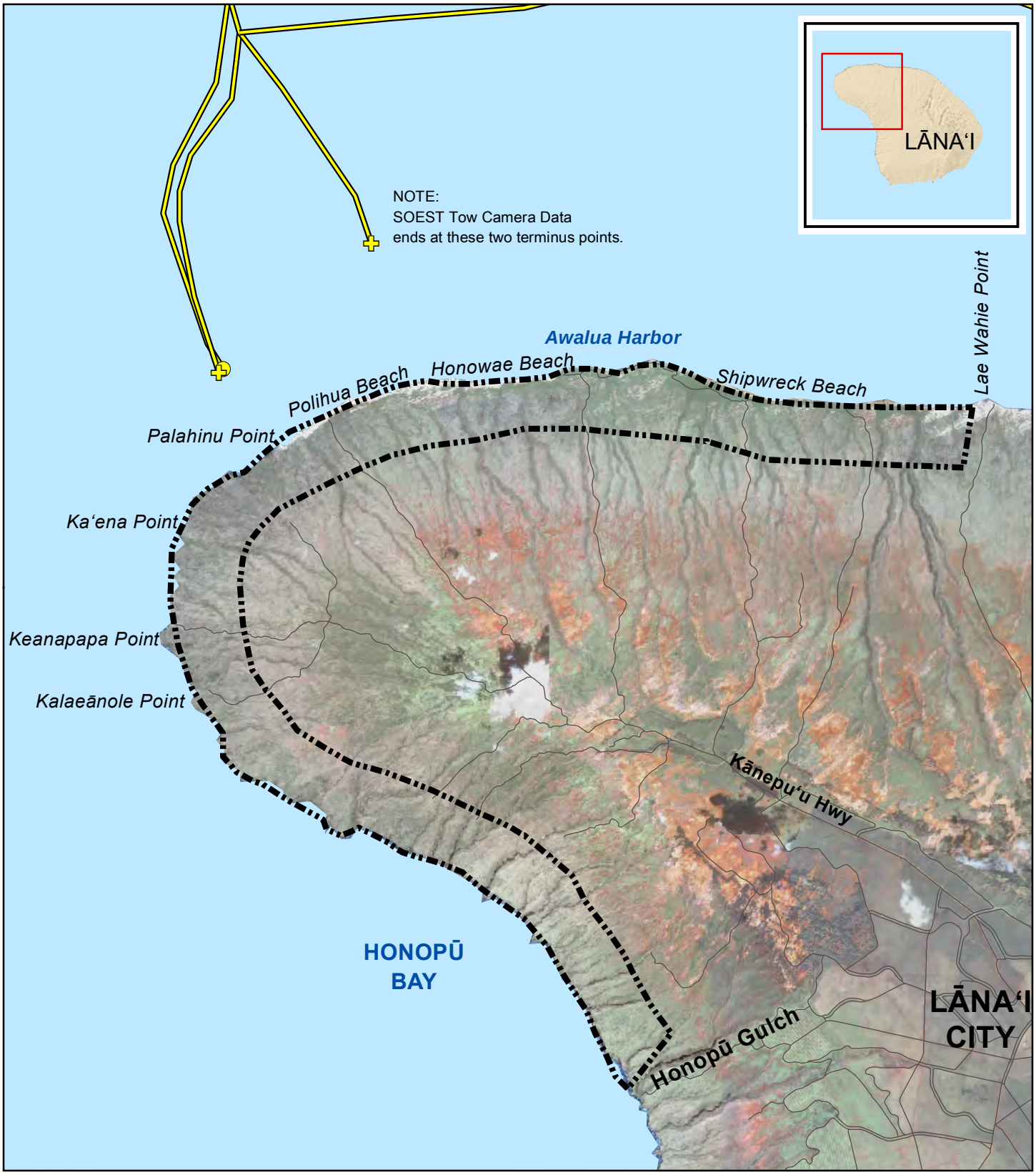
N

0 2,500 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, CCH, UH-SOEST, AECOM, 2012

Figure 2-4



Lānaʻi Landing Site Area

- Route with camera data *
- Route without camera data **
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Open Water

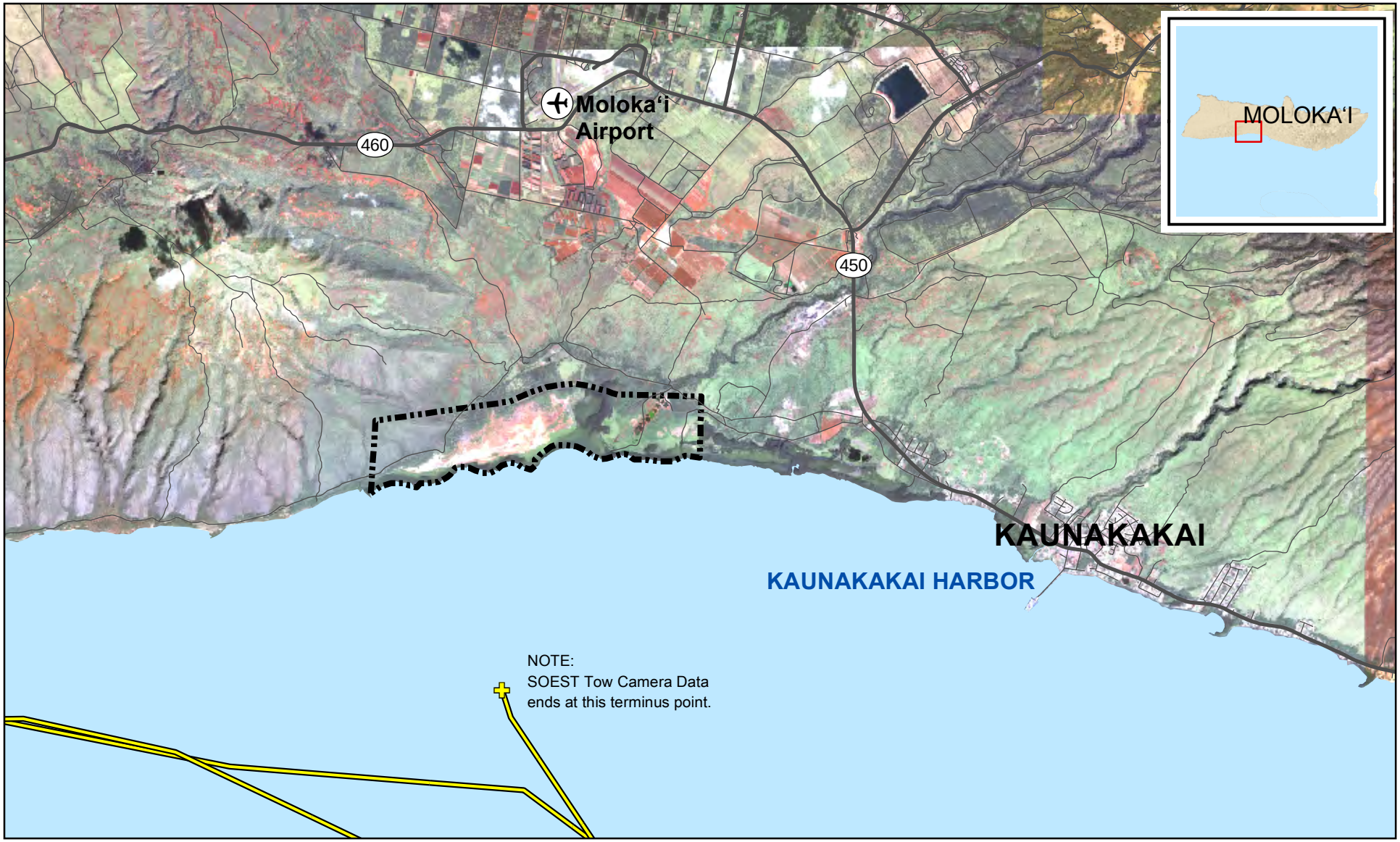
N

0 5,000 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, CCH, UH-SOEST, AECOM, 2012

Figure 2-5



South Moloka‘i Landing Site Area

- Route with camera data *
- Route without camera data **
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Open Water

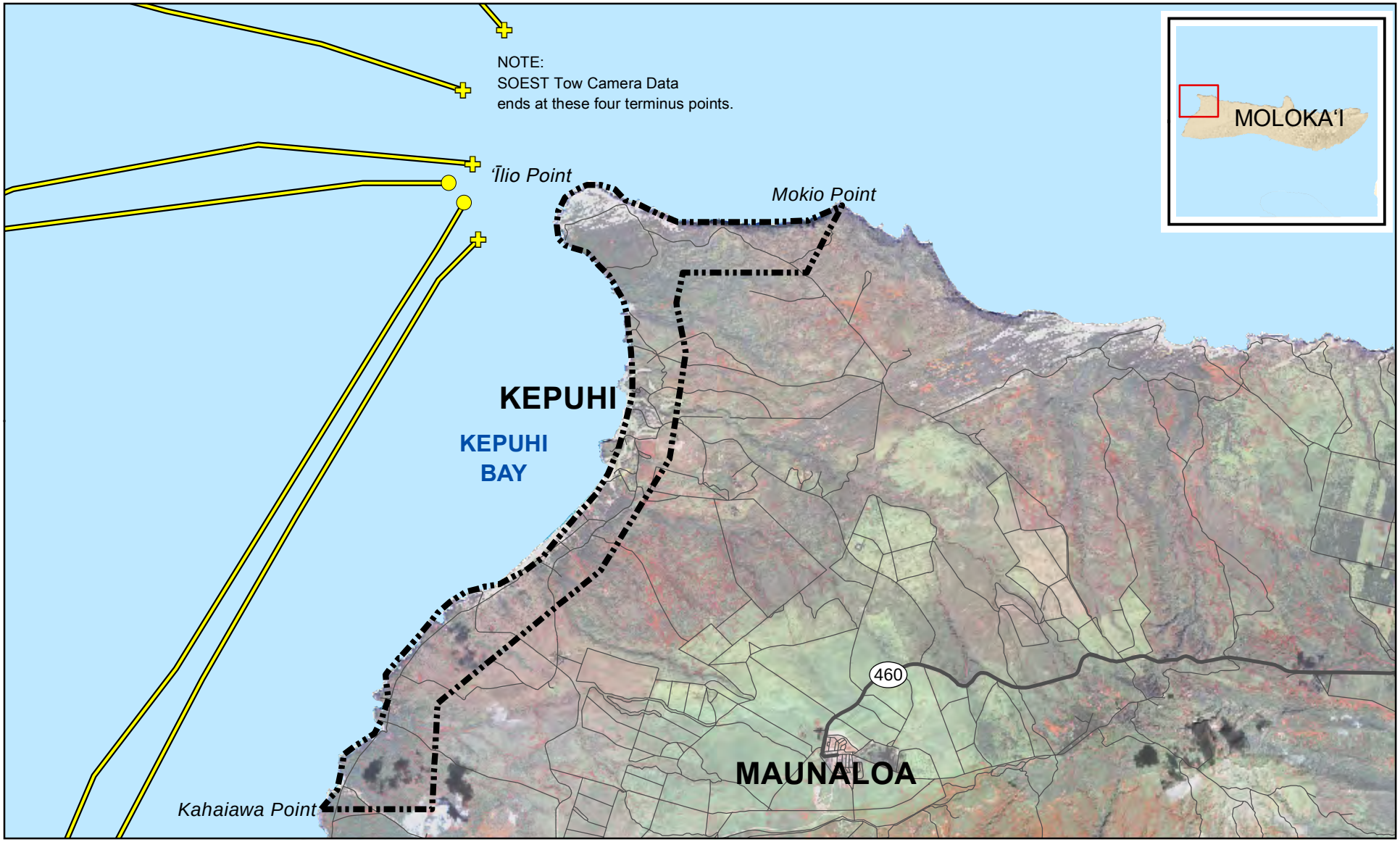
N

0 5,000 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, UH-SOEST, AECOM, 2012

Figure 2-6



West Moloka'i Landing Site Area

- Route with camera data *
- Route without camera data **
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Open Water

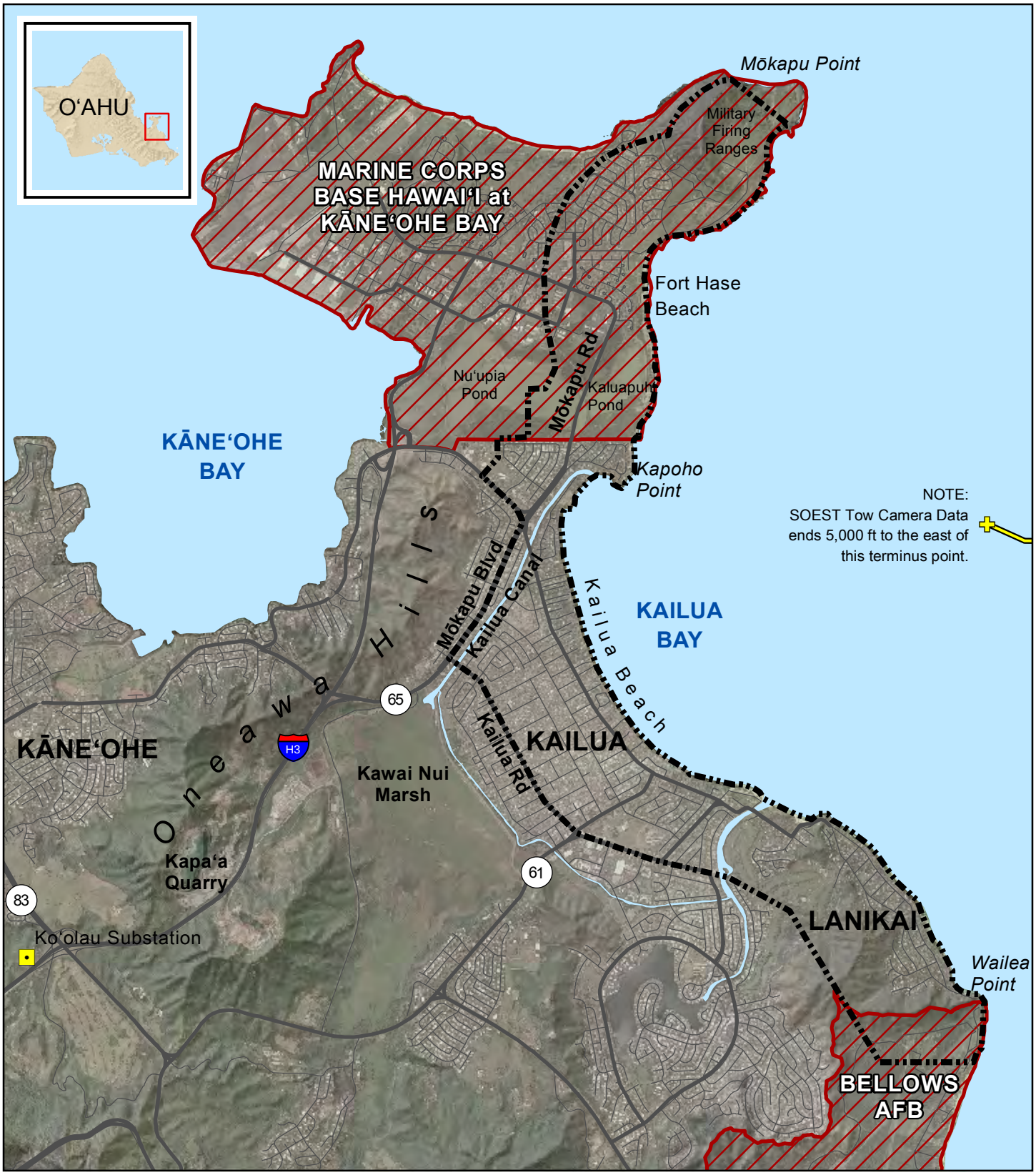
N

0 5,000 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, UH-SOEST, AECOM, 2012

Figure 2-7



Kāne'ohe Landing Site Area

- Route with camera data *
- Route without camera data **
- Identified O'ahu Substation Location
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Federally Owned Lands
- Open Water

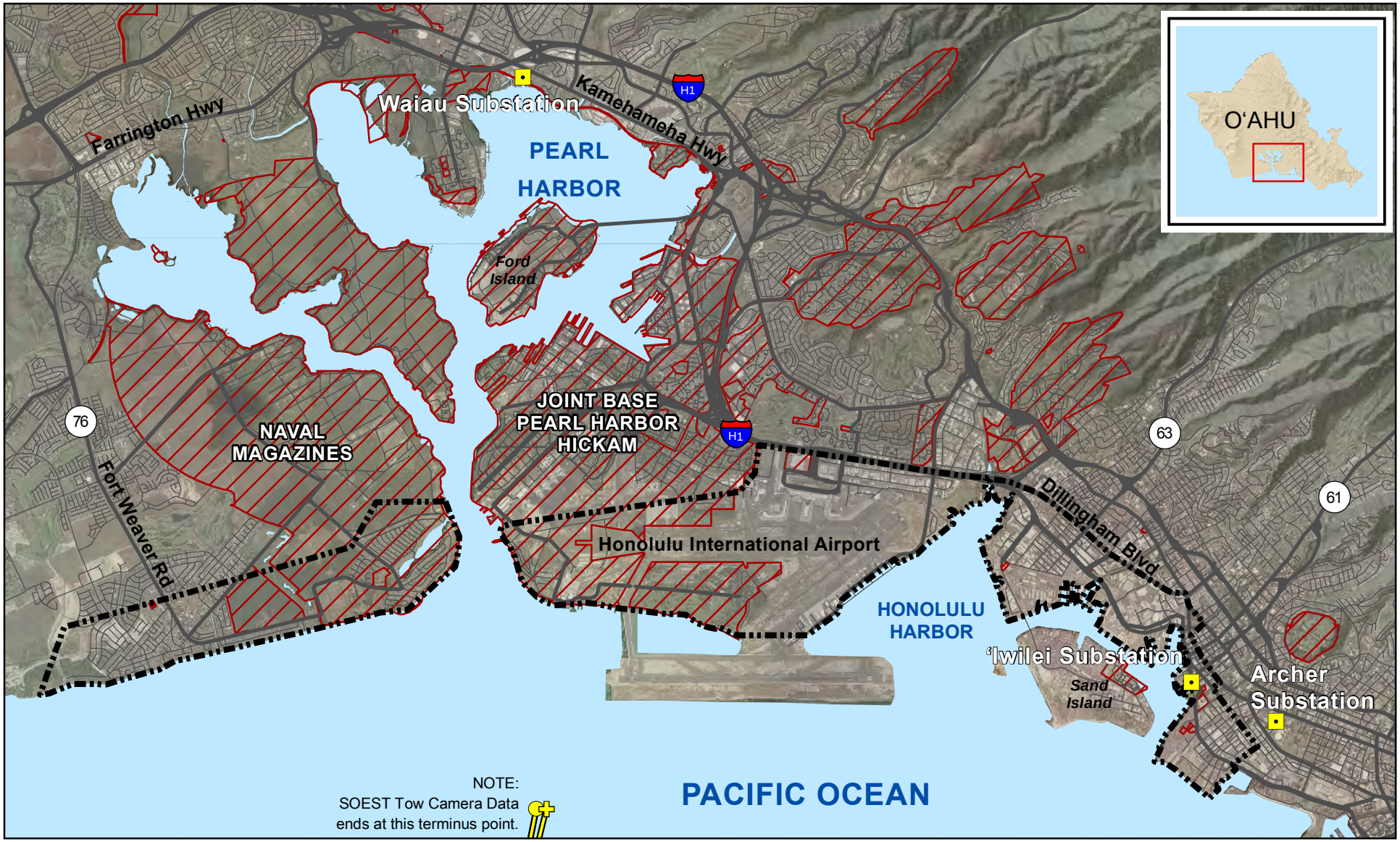
N

0 2,500 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, CCH, UH-SOEST, AECOM, 2012

Figure 2-8



Pearl Harbor Landing Site Area

- Route with camera data *
- Route without camera data **
- Identified O'ahu Substation Locations
- Highways & Major Roads
- Other Roads
- SOEST Cable Routes
- HIREP Study Analysis Area
- Federally Owned Land
- Open Water

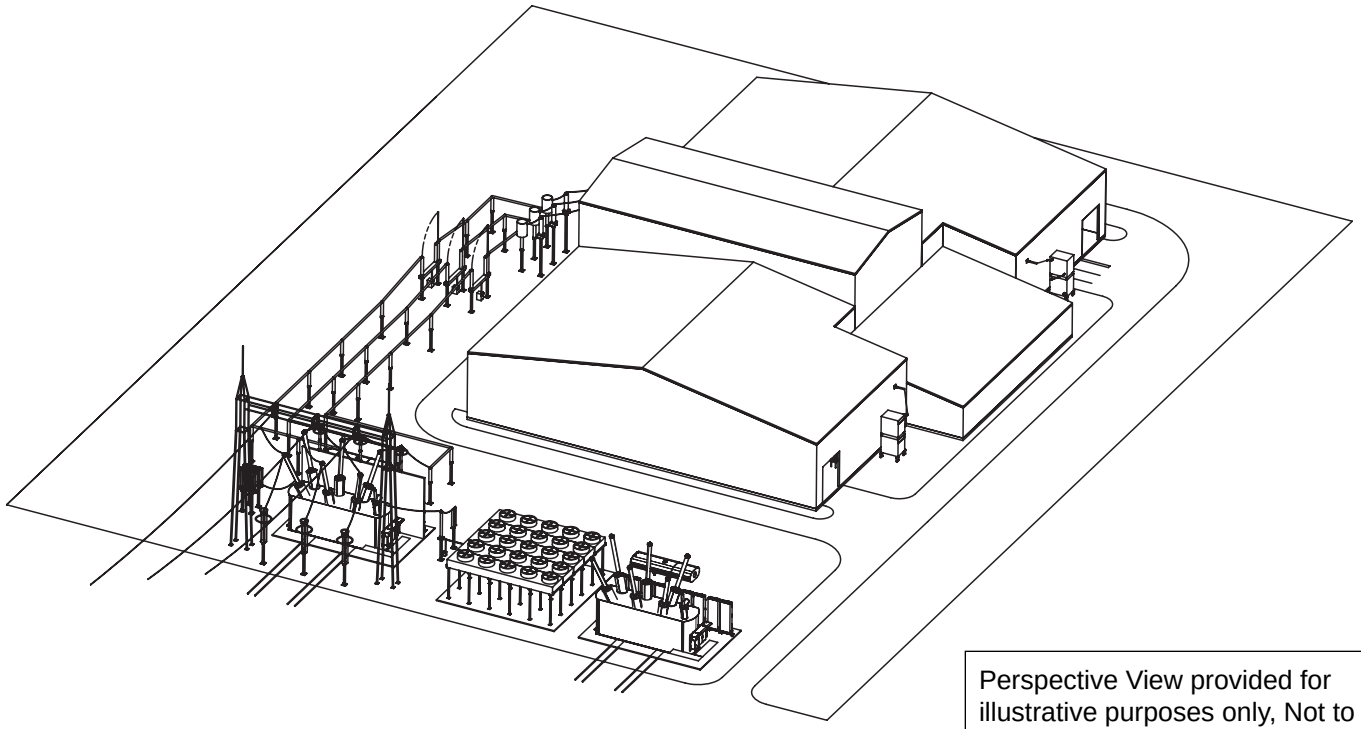
N

0 5,000 Feet

* Symbol denotes shoreward extent of tow camera data for cable route (unless otherwise noted).
** Symbol denotes shoreward approach of cable route without tow camera data.

Date: 4/26/2012
Data Sources: HI-DBEDT, CCH, UH-SOEST, AECOM, 2012

Figure 2-9



Perspective View provided for illustrative purposes only, Not to Scale. See text for additional detail.

Based on:		Project name: Example	
Prepared: Bastman, Linus 2010-03-09			
Approved:			
Title: Station layout +/- 150 kV, 200 - 400 MW	Status: Tender	Item designation	
	Resp dept: PSG/DC/ODM	Rev ind	Language
ABB AB - HVDC	Document number: 1JNL100313-523		Sheet/of: 1 / 5

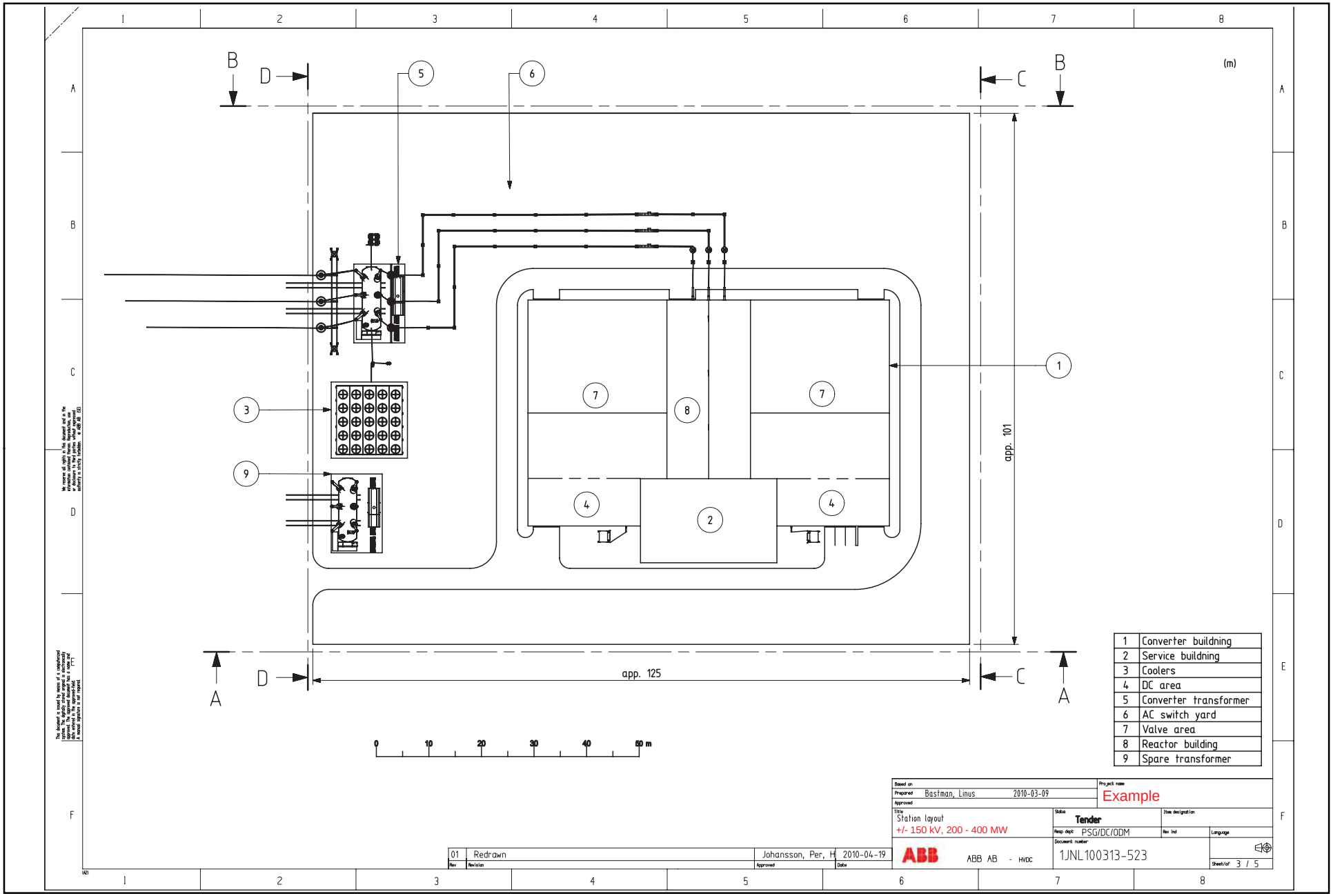
Rev	Revision	Approved	Date
01	Redrawn	Johansson, Per, H	2010-04-19

Converter Station Example Schematic Drawing Perspective View

DRAFT

Date: 4/15/2012
Data Sources: ABB, 2012

Figure 2-10



Converter Station Example Schematic Drawing Overhead Plan View

DRAFT

Date: 4/15/2012
Data Sources: ABB, 2012

Figure 2-11

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