Hawaiian Electric Company, Inc.

East O‘ahu Transmission Project
46kV Phased Project

DRAFT ENVIRONMENTAL ASSESSMENT

Volume 1 of 2
REPORT

August 2004

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Prepared by Belt Collins Hawaii Ltd.

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Executive Summary

EXECUTIVE SUMMARY

Proposed Action

Hawaiian Electric Company, Inc. (HECO) is proposing to reconfigure and connect existing 46 kilovolt (kV) circuits from Pūkele Substation at the end of HECO's Northern 138kV Transmission Corridor with existing and new 46kV circuits at Archer Substation and Kamoku Substation in HECO's Southern 138kV Transmission Corridor. This action is planned in two independent phases. The estimated completion dates are mid-2007 for Phase 1 and early 2009 for Phase 2.

Phase 1 involves the installation of 0.5 mile of new underground ductline[1] for 46kV subtransmission lines and related work at eight existing substations. Underground 46kV lines would be installed in the Ala Moana, McCully, Mōʻiliʻili, and Kapahulu areas in the new ductline and in approximately 0.4 mile of existing underground ductline. Existing 46kV and 12kV lines would be removed from the existing ductline. Phase 2 involves the installation of 1.9 miles of new underground ductline for 46kV subtransmission lines and related work at one substation. Three underground 46KV lines would be installed in the new ductline in the Kakaʻako, Makiki, and McCully areas, predominantly along King Street.

Along various sections of the Phase 1 and Phase 2 alignments, construction activities would include trenching, installation of new underground ductline and circuits, removal of existing circuits and installation of new circuits using existing underground ductlines, and repaving of trenched areas. For Phase 2, directional drilling is an optional installation method along the segment of King Street between the intersection of King and Cooke Streets and Punahou Street. Open trenching would still be required in conjunction with the directional drilling option.

Purpose and Need

The Proposed Action would allow electrical loads in the East Oʻahu Service Area (from downtown to Hawaii Kai and from Makapuʻu Point to Kahuku), currently being served exclusively via Koʻolau Substation and Pūkele Substation at the end of the Northern 138kV Transmission Corridor, to be augmented from Kamoku and Archer Substations in the Southern 138kV Transmission Corridor. For the western part of Oʻahu, the two corridors are linked by transmission lines between power plants and substations, but no similar connection exists to provide reliable power to

1 A ductline is an underground corridor that houses multiple ducts or pipes encased in concrete. One duct could be used to contain one cable or multiple cables, depending on the size of the ducts and cables.

the eastern part of the island, which represents 56 percent of HECO's total load. The purpose of the Proposed Action is to address four problems relating to the 138kV transmission system in the East Oʻahu area: (1) Pūkele Substation Reliability Concern, (2) Koʻolau/Pūkele Overload Situation, (3) Downtown Substation Reliability Concern, and (4) Downtown Overload Situation.

The line overload situations increase the risk of catastrophic power outages. A catastrophic outage has the potential to take down the entire island system for many hours. Restarting generation facilities is a very complex and time-consuming process; therefore, a significant number of customers could be without power for many hours until the system can be restored. The substation reliability concerns could be characterized as localized outage problems. Although the latter are limited to a certain area, certain localized power outages are of significant concern because of the number and critical nature of the customers affected and the potential duration of the outages.

Alternatives Evaluated

In addition to the Proposed Action, HECO considered alternative alignments that would route the two new 46kV circuits away from certain residential areas as much as practical by using Kapiʻolani Boulevard. The two alternative alignments are variations of Phase 1 of the Proposed Action, each involving installation of new ductline. Using Kapiʻolani, a major thoroughfare, would result in more inconvenience for a greater number of residents and others, at a substantially higher cost to all HECO customers on Oʻahu. Compared to the Proposed Action, the alternative alignments would eliminate the opportunity to use existing ductlines for about half the length. The number of days that traffic would be affected would be substantially less with the use of existing ductlines.

This Environmental Assessment also evaluated the No Action Alternative, which assumes that the improvements described to address the potential substation reliability and transmission line overload problems would not be implemented and the problems described above would not be addressed.

Potential Impacts and Actions Taken to Avoid or Minimize Impacts

No significant construction-related or operational impacts would be associated with the Proposed Action or the alternative alignments. Impacts during construction would be temporary, with no area affected longer than two months and, in most cases, less than a month. Appropriate management actions will be implemented during construction to minimize impacts relating to traffic, noise, air quality, emergency response, and potential loss of revenue by businesses in the project area. Actions to minimize impacts may include conducting work during specific hours, for example, at night when possible in commercial areas, and during non-peak traffic hours; providing flagmen and signs to help direct traffic and to assure pedestrian and vehicular access to businesses, and communicating with residents and businesses prior to and during construction.

At the request of the City and County of Honolulu, horizontal directional drilling technology was evaluated as a construction option to minimize impacts. While temporary impacts of directional drilling would not be significant, noise levels and particularly traffic disruption would be greater than those under the open trenching option. Because directional drilling equipment needs to remain in the road 24 hours a day until work is completed (approximately three to four weeks per drill segment), unlike open trenching, peak hour traffic would be affected. During the afternoon commuting period at Kalākaua Avenue and King Street, directional drilling could result in the formation of traffic queues, long delays, and diversion of several hundred vehicles per hour to parallel routes such as Kapi‘olani Boulevard and the H-1 Freeway. For these reasons, horizontal directional drilling is not a preferred option.

Unrecorded human burial sites may be inadvertently encountered during excavation in the King Street right-of-way fronting the Catholic Cemetery between Cooke Street and Ward Avenue. Generally, any subsurface archaeological features encountered during construction, and any inadvertent burials found, will be treated in accordance with the law.

There is no evidence of traditional cultural practices in the project area. Properties listed on the State and National Register of Historic Places would not be affected by construction activities.

No threatened or endangered species or their habitats are known to exist in the project area.

Management actions would minimize impacts on other infrastructure. HECO would research available records and conduct surveys to verify that the proposed alignment of the subtransmission lines would not conflict with existing and planned utilities.

With regard to solid waste, the construction and demolition landfill serving O‘ahu has the capacity to accommodate excavated material not recycled or reused. Hazardous waste is not anticipated; any excavated material found to contain contaminants would be handled in accordance with applicable government requirements.

If required, HECO will obtain an NPDES construction stormwater permit and will implement best management practices to prevent runoff of pollutants from the construction site to surface waters. Dewatering may be required during trenching but would have only localized and temporary effects on groundwater levels.

No significant adverse socioeconomic impacts would be associated with the Proposed Action or alternative alignments. Positive effects would include construction-related jobs and income, and state revenues associated with construction. Management measures would assure access to businesses in the project area during construction and minimize loss of revenue. Upon completion of the project, if the Public Utilities Commission approves the costs as part of a separate, future rate case, a rate increase for HECO averaging about $1 a month for a typical residential electric bill, can be expected as a result of the Proposed Action. Implementation of the City and County of Honolulu's curb-to-curb repaving policy would increase total construction cost of the Proposed Action by an estimated $5.3 million, which could translate into a higher rate increase.

Regarding electric and magnetic fields (EMF) associated with transmission lines and other electrical facilities; the difference in projected magnetic field levels between the existing and proposed power line configurations under 2009 forecasted loading can decrease slightly, remain unchanged, or increase depending upon the project area. In addition, if the project is implemented, the proposed underground circuits would have little effect on EMF near the project area, and EMF would be in the range of common everyday levels. Scientific studies conducted on the health impacts of exposure to EMF have been inconclusive. Because of this, HECO looks to the State of Hawai'i Department of Health's position of "prudent avoidance" for guidance. Prudent avoidance consists of taking reasonable, practical, simple, and relatively inexpensive actions to reduce exposure to EMF around low-frequency sources such as electrical appliances and power lines. Reduction in EMF can be achieved for multiple circuit power lines with similar loads by optimizing cable placement and phasing arrangement within the cable ducts. HECO studied a variety of cable placement and phasing arrangements and considered the routing of the proposed lines as well as engineering design of the ductlines to reduce EMF. HECO will continue to identify and implement actions to reduce EMF wherever possible, including analyzing selected segments of proposed alignments where circuits may be configured to achieve magnetic field cancellation with new underground circuits.

No significant cumulative impacts have been identified for any of the resource or issue areas evaluated. New underground subtransmission lines may constrain the availability of underground space for future utility lines. With respect to other utilities, HECO would coordinate scheduling with those agencies to minimize construction in the same area at the same time. Likewise, HECO would coordinate with the City and County of Honolulu and implement management measures to reduce cumulative project impacts. Cumulative impacts on noise, air quality, soils, and water resources due to multiple construction projects in the same area would be managed through coordination and compliance with applicable permit requirements. Most of the excavated material would be reused or recycled, minimizing cumulative solid waste generation impacts. No cumulative socioeconomic impacts are expected during construction or operations. No significant changes to EMF are anticipated, nor will there be any significant cumulative impacts from EMF.

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Acronyms and Abbreviations

AAQS	Ambient Air Quality Standards
ADPV	average delay per vehicle
bgs	below ground surface
BLNR	Board of Land and Natural Resources
BMP	best management practices
BOE	Board of Education
BRT	Bus Rapid Transit
BWS	Board of Water Supply
CDP	Census Defined Place
CDUP	Conservation District Use Permit
CEIP	Campbell Estate Industrial Park
CFR	Code of Federal Regulations
CHP	combined heat and power
CIA	Cultural Impact Assessment
CIP	Campbell Industrial Park
circuits	underground subtransmission lines
CMU	concrete masonry units
dB	decibel
dBA	A-weighted sound level in decibels
DG	distributed generation
DOE	Department of Education
DOH	Department of Health
DOT	Department of Transportation
DP	City and County of Honolulu’s Development Plan
DPP	Department of Planning and Permitting
DPR	Department of Parks and Recreation
DSM	demand side management
DTS	Department of Transportation Services
EA	Environmental Assessment
EIS	environmental impact statement
ELF	extremely low frequency
EMF	Electric and Magnetic Fields
EMS	Energy Management System
EOTP	East O‘ahu Transmission Project
EPA	United States Environmental Protection Agency
F	Fahrenheit

FHWA	Federal Highway Administration
GIS	gas insulated switchgear
HAR	Hawai‘i Administrative Rules
HCDA	Hawai‘i Community Development Authority
HDD	horizontal directional drilling
HECO	Hawaiian Electric Company, Inc.
HFD	Honolulu Fire Department
HIOSH	Hawai‘i Occupational Safety & Health Administration
hp	horsepower
HPD	Honolulu Police Department
HPFF	high pressure fluid filled
HPP	Honolulu Power Plant
HRS	Hawai‘i Revised Statutes
Hz	Hertz
IARC	International Agency for Research on Cancer
kcmil	A unit of measure where one kcmil is equal to 1,000 circular mils. A circular mil is the area of a circle with a diameter of one thousandth (0.001) of an inch.
kV	kilovolt
LM	load management
LOS	levels of service
LUO	Land Use Ordinance
LW	live working
mg	milligram
mG	milligauss
MS4	municipal separate storm sewer system
msl	mean sea level
MSW	municipal solid waste
MTBE	methyl tertiary butyl ether
MUZ-c	mixed-use zone commercial emphasis
MVA	megavolt ampere
MW	megawatts
NA	not available
NAAQS	National Ambient Air Quality Standards
NERC	North American Electric Reliability Council
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NPDES	National Pollutant Discharge Elimination System

NRC	National Academy of Sciences National Research Center
NTP	National Toxicology Program
OEQC	Office of Environmental Quality Control
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
Proposed Action	46kV Phased Project
PUC	Public Utilities Commission
RAPID	Research and Public Information Dissemination
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
ROH	Revised Ordinances of Honolulu
ROW	right-of-way
SOP	standard operating procedure
TCLP	Toxicity Characteristic Leaching Procedure
TCP	Traditional Cultural Practices
TPC	transmission planning criteria
TPH	total petroleum hydrocarbons
UIC	underground injection control
USC	United States Code
USDA	United States Department of Agriculture
USGS	United States Geological Survey
V/C	volume-to-capacity
VPD	vehicles per day
WWTP	wastewater treatment plant
XLPE	cross-linked polyethylene

Chapter 1

Introduction

CHAPTER 1
INTRODUCTION

1.1 PROPOSED ACTION

Hawaiian Electric Company, Inc. (HECO) is proposing to reconfigure and connect existing 46 kilovolt (kV) circuits from Pūkele Substation at the end of HECO's Northern 138kV Transmission Corridor with existing and new 46kV circuits at Archer Substation and Kamoku Substation in HECO's Southern 138kV Transmission Corridor. This action is planned in two independent phases. Because the project would be implemented in two phases, the Proposed Action is referred to as the East O‘ahu Transmission Project (EOTP) 46kV Phased Project. Figure 1-1 shows the locations of the proposed subtransmission lines and affected substations.

Phase 1 involves the installation of 0.5 mile of new underground ductline for 46kV subtransmission lines and related work at eight substations, to interconnect three 46kV circuits out of the Pūkele Substation, at the end of HECO's Northern 138kV Transmission Corridor, to four 46kV lines connected to HECO's Southern 138kV Transmission Corridor. Phase 1 includes: (1) the installation of underground 46kV lines in the Ala Moana, McCully, Mō‘ili‘ili, and Kapahulu areas, (2) a 138kV/46kV transformer installation at the existing Kamoku Substation with associated protective relaying, (3) a 46kV/12kV transformer installation at the existing Makaloa Substation with associated switchgear, (4) various switching and reconnections on the existing 46kV and 12kV systems near Makaloa and McCully Substations, (5) the removal of existing 46kV and 12kV cables between Makaloa and McCully Substations, (6) the removal of an existing 46kV/12kV transformer and associated switchgear from the McCully Substation, and (7) modifications of various existing distribution substations in the Honolulu area.

Phase 2 involves the installation of 1.9 miles of underground ductline for 46kV subtransmission lines and related work at one substation, to interconnect four out of the five remaining 46kV circuits out of the Pūkele Substation to three other 46kV lines connected to HECO's Southern 138kV Transmission Corridor. Phase 2 includes: (1) the installation of three underground 46kV lines in the new ductline in the Kaka‘ako, Makiki, and McCully areas, predominantly along King Street, and (2) a 138kV/46kV transformer installation at the existing Archer Substation with associated protective relaying.

The estimated project completion dates are mid-2007 for Phase 1 and early 2009 for Phase 2. Implementing the proposed project in two phases has been proposed to address near-term transmission problems, such as Koʻolau/Pūkele Overload Situation (discussed in Chapter 2), and part of the Pūkele Substation Reliability Concern (discussed in Chapter 2) which includes Waikīkī, in a more timely manner.

The timely implementation of Phase 1 is particularly important, as it addresses in substantial part the on-going Pūkele Substation Reliability Concern, and fully addresses the Koʻolau/Pūkele Overload Situation (which is expected to start in 2005). The importance of the implementation of Phase 1 was reemphasized by the outage of Pūkele Substation on March 3, 2004, which could have been significantly mitigated if Phase 1 were in place.

1.2 BACKGROUND

Various studies have identified several problems with HECO's 138kV transmission system in the eastern part of Oʻahu. The purpose of the EOTP is to address several transmission problems that can affect system reliability, including the following:

- **Pūkele Substation Reliability Concern.** This involves the reliability of the Pūkele Substation located at the end of HECO's Northern 138kV Transmission Corridor. Pūkele Substation serves 16 percent of Oʻahu's power demand, which includes critical loads such as Waikīkī, State Civil Defense, the Hawaiʻi Army and Air National Guard Headquarters, and University of Hawaiʻi.
- **Koʻolau/Pūkele Overload Situation.** This involves potential transmission line overloads in HECO's Northern 138kV Transmission Corridor starting in 2005.
- **Downtown Substation Reliability Concern.** This involves the reliability of Archer Substation, Kewalo Substation and Kamoku Substation located at the end of HECO's Southern 138kV Transmission Corridor. These substations serve critical loads such as the Honolulu Police Department (HPD) Headquarters, and Hawaiʻi Convention Center.
- **Downtown Overload Situation.** This involves potential transmission line overloads in HECO's Southern 138kV Transmission Corridor starting after 2020.

HECO has considered a number of alternatives to address these problems. A few of the alternatives are summarized below.

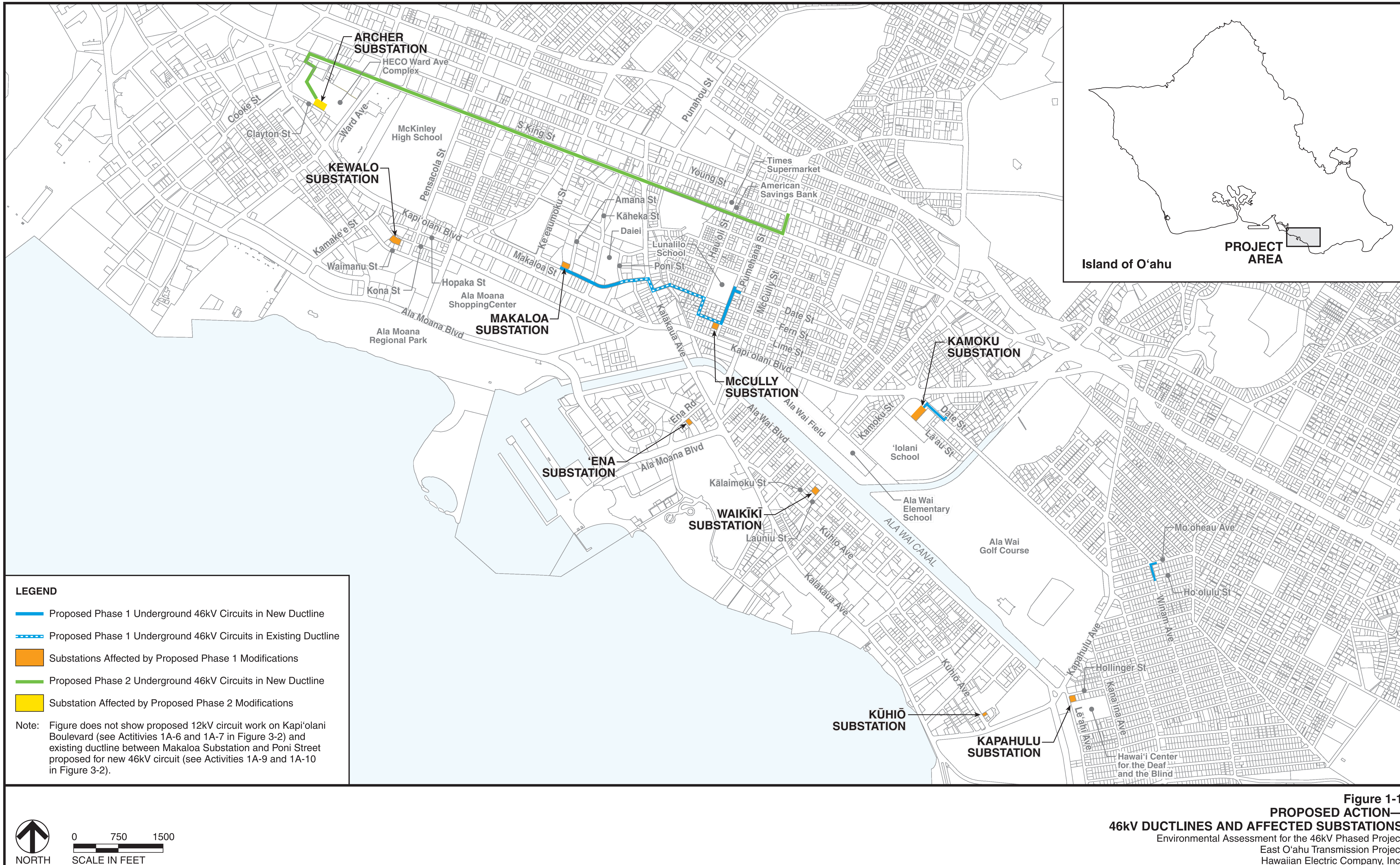


Figure 1-1
PROPOSED ACTION—
46kV DUCTLINES AND AFFECTED SUBSTATIONS
Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

1.2.1 Kamoku–Pūkele 138kV Transmission Line (via Wa‘ahila Ridge)

HECO’s preferred alternative to address the transmission problems was a partial underground, partial overhead 138kV transmission line connecting Kamoku Substation to Pūkele Substation via Wa‘ahila Ridge, called the Kamoku–Pūkele 138kV Transmission Line. After an extensive public input process, environmental impact statement (EIS) process and contested case hearing to secure a Conservation District Use Permit (CDUP) for the project, the State Board of Land and Natural Resources (BLNR) denied HECO’s permit request in June 2002. Therefore, the Kamoku–Pūkele 138kV Transmission Line was no longer a viable option.

1.2.2 46kV Phased Project

After the Kamoku–Pūkele 138kV Transmission Line was no longer a viable option, past alternatives considered during the EIS process were reevaluated and new alternatives were identified to address the transmission problems. A number of alternatives were evaluated and screened out for various reasons. Subsequently, HECO identified three transmission system alternatives that could address the transmission problems in varying degrees: (1) Kamoku–Pūkele 138kV Underground Alternative (an all-underground 138kV transmission line connecting Kamoku Substation to Pūkele Substation using existing public right-of-ways); (2) Kamoku 46kV Underground Alternative (this alternative is equivalent to Phase 1 of the EOTP); and (3) Kamoku 46kV Underground Alternative–Expanded (this alternative is equivalent to Phases 1 and 2 of the EOTP, assuming both phases are implemented at the same time). These alternatives were presented to the community as part of an extensive public input process. The findings of the public input process are detailed in a report entitled *East O‘ahu Transmission Project: A Report on Public Input Collected in June and July 2003* (3Point September 2003).

These alternatives were evaluated based on considerations such as effectiveness, timeliness, cost, and public sentiment. Balancing all the issues, the Kamoku 46kV Underground Alternative–Expanded was selected over the other alternatives. It was also recommended that the selected alternative be implemented in two independent phases (currently referred to as the 46kV Phased Project or the Proposed Action).

1.3 PURPOSE OF THIS DOCUMENT

The purpose of this environmental assessment (EA) is to inform decision makers and the public of environmental effects of the Proposed Action. HECO's decision to voluntarily prepare this EA was in response to requests made at the McCully/ Mōʻiliʻili neighborhood board meeting, continued public interest in HECO's Proposed Action, and the history of events leading up to this proposal, as discussed in Section 1.2.

Chapter 2

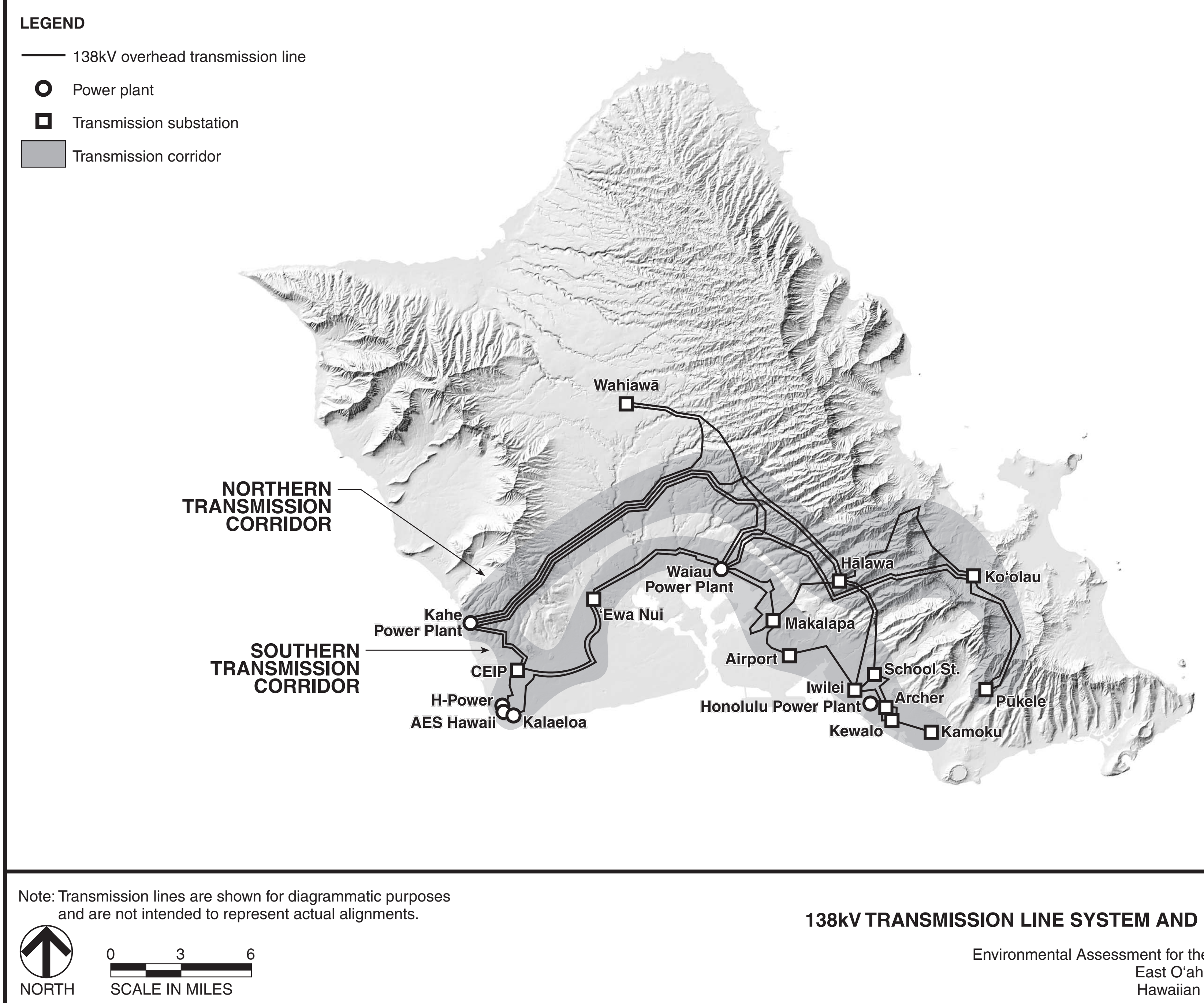
Purpose and Need

CHAPTER 2
PURPOSE AND NEED

HECO is proposing to reconfigure and connect existing 46kV circuits from Pūkele Substation at the end of HECO's Northern 138kV Transmission Corridor with existing and new 46kV circuits to Archer Substation and Kamoku Substation in HECO's Southern 138kV Transmission Corridor (Figures 2-1 and 2-2). As background, bulk power from leeward O‘ahu power plants is transmitted to the East O‘ahu Service Area (Figure 2-3) over two major transmission corridors. HECO's Northern 138kV Transmission Corridor extends from Kahe Power Plant to the Hālawa Substation, Ko‘olau Substation, and the Pūkele Substation where it currently ends (Figure 2-1). With the completion of the two Waiau-Campbell Industrial Park (CIP) 138kV transmission lines in 1995, HECO's Southern 138kV Transmission Corridor was extended from the Kahe Power Plant to the Waiau Power Plant and Iwilei, School Street, and Archer Substations. HECO's Southern 138kV Transmission Corridor was recently extended to the Kamoku Substation through the installation of two 138kV transmission lines from Archer Substation to Kewalo Substation and the installation of a 138kV transmission line from Kewalo Substation to Kamoku Substation (Figure 2-1).

In West O‘ahu, the two corridors are linked together by transmission lines between power plants and substations connected to the Northern and Southern Corridors (Figure 2-1). However, no similar connection exists to provide reliable power to the East O‘ahu Service Area. HECO's plan has been to build upon existing facilities installed to serve the local load growth through the Archer–Kewalo and Kewalo–Kamoku projects and close the existing gap between the Northern 138kV Transmission Corridor and the Southern 138kV Transmission Corridor on the east side of O‘ahu, providing added reliability to the eastern and windward parts of O‘ahu, which represent 56 percent of HECO's total load.

The purpose of the Proposed Action is to address the following transmission problems concerning O‘ahu's 138kV transmission system in the East O‘ahu Service Area: (1) Pūkele Substation Reliability Concern; (2) Ko‘olau/Pūkele Overload Situation; (3) Downtown Substation Reliability Concern, and (4) Downtown Overload Situation.



Note: Transmission lines are shown for diagrammatic purposes and are not intended to represent actual alignments.

Figure 2-1
138kV TRANSMISSION LINE SYSTEM AND POWER PLANTS

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

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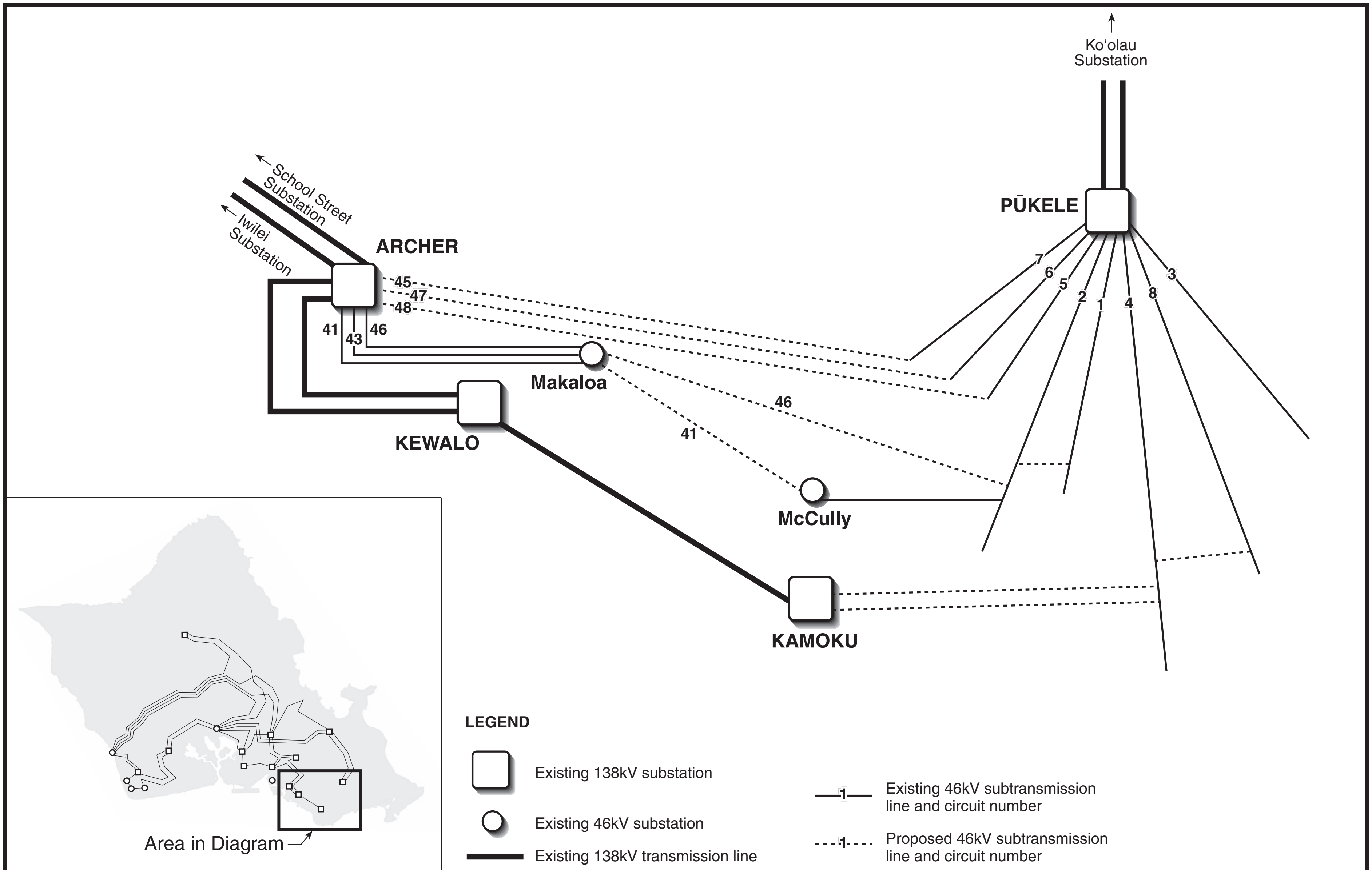

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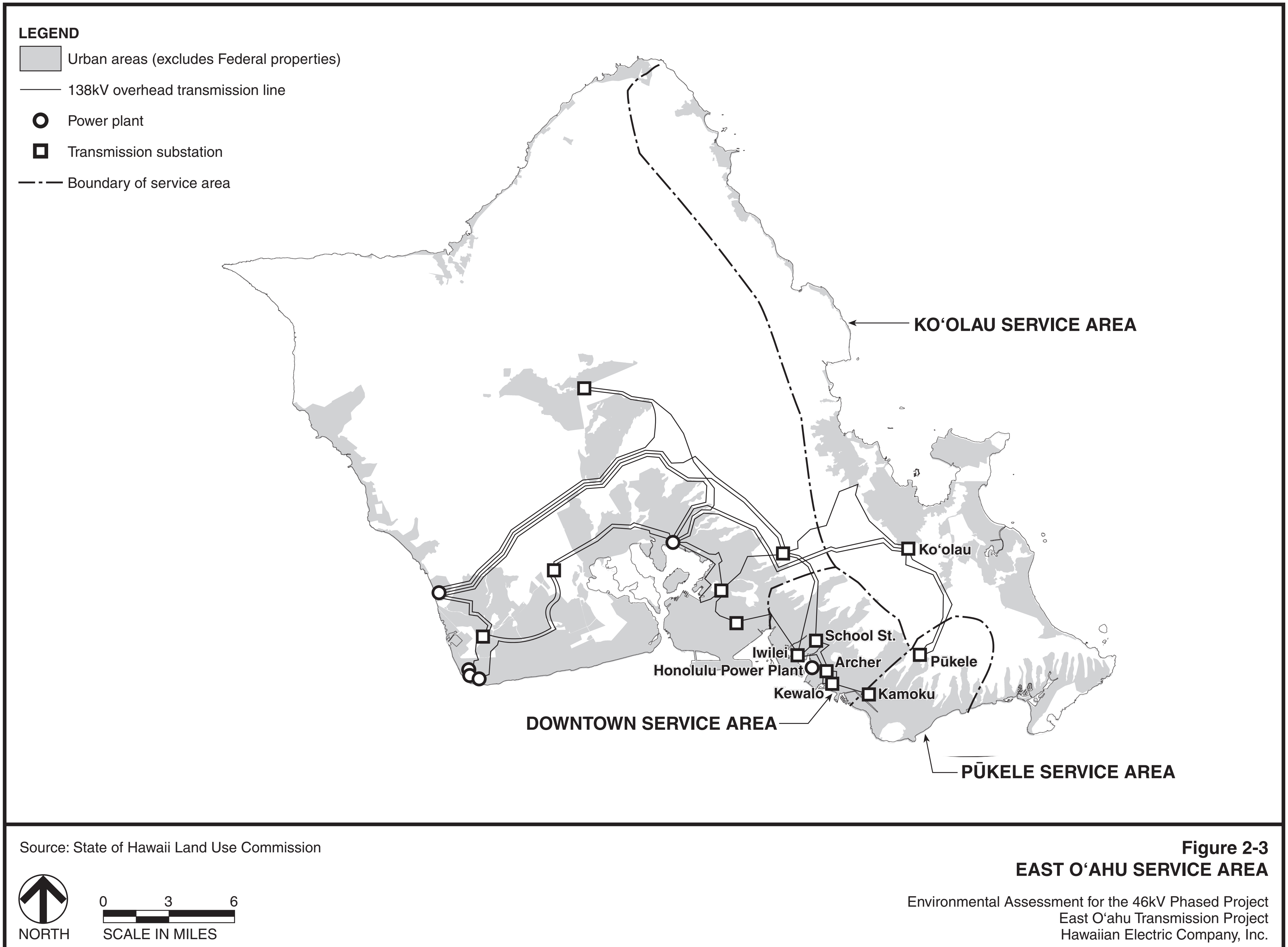
Figure 2-2
PROPOSED 46kV SUBTRANSMISSION CONNECTIONS

DIAGRAM NOT TO SCALE

Environmental Assessment for the 46kV Phased Project
East Oʻahu Transmission Project
Hawaiian Electric Company, Inc.



Source: State of Hawaii Land Use Commission

Figure 2-3
EAST OʻAHU SERVICE AREA

Environmental Assessment for the 46kV Phased Project
East Oʻahu Transmission Project
Hawaiian Electric Company, Inc.

The East Oʻahu Service Area includes (1) the Downtown area, served by power generated from leeward Oʻahu power plants which is transmitted to and through HECO's Iwilei and School Street Substations, as well as by power generated from the Honolulu Power Plant (HPP) in downtown Honolulu, and (2) the Koʻolau/Pūkele area, served by power generated from the leeward Oʻahu power plants which is transmitted to the Koʻolau and Pūkele Substations (Figure 2-3).

The four transmission problems identified can be categorized as either (1) problems that increase the risks for catastrophic power outages or (2) localized outage problems. A catastrophic power outage has the potential for taking down the entire system for many hours. If the entire system becomes too unstable after system disturbances, generation facilities will eventually shut down, as designed, to protect vital equipment from long-term or permanent damage. The restart of generation facilities is a very involved, complex, and time consuming process. Therefore, a significant number of customers could be without power for many hours until the system can be restored.

A localized outage is limited to a certain area and is unlikely to cause the entire system to become unstable and cause loss of generation. Certain localized power outages are of significant concern because of the number and critical nature of customers affected and the potential duration of the outages.

The Koʻolau/Pūkele Overload Situation and Downtown Overload Situation could be characterized as problems that increase the risks for catastrophic type power outages. The Pūkele Substation Reliability Concern and Downtown Substation Reliability Concern could be characterized as localized outage problems. The four transmission problems are discussed below.

2.1 PŪKELE SUBSTATION RELIABILITY CONCERN

Two 138kV transmission lines currently feed the Pūkele Substation from the Koʻolau Substation in Kāneʻohe, on the windward side of Oʻahu (Figure 2-2). The two 138kV lines cross the Koʻolau Mountain Range to connect the Pūkele Substation to the rest of the HECO system. The power transported from these two lines is stepped down to the subtransmission voltage (46kV) and transported over eight 46kV feeders that branch out from Pālolo Valley to distribution substations in Kāhala, Kaimukī, Mānoa, Makiki and Waikīkī.

The Pūkele Substation is the most heavily loaded 138kV substation in the HECO system. Based on 2002 Day Peak load conditions, the Pūkele Substation supplied electricity to about 16 percent of the Oʻahu load (or approximately 192 megawatts [MW] of the daytime peak load).

If the two lines providing power to the Pūkele Substation are both out of service, 93 percent of the customers in the area serviced from the substation, which extends from Makiki to Waikīkī and from Ko'olau to Kaimukī, would be out of power until one of the two 138kV transmission lines could be restored to service (Figure 2-4). (The remaining customers would experience a service interruption of up to six seconds as their service is automatically transferred to Archer and Ko'olau Substations.) While many parts of the two lines have been renewed and upgraded, the two Ko'olau–Pūkele 138kV transmission lines are more than 40 years old. Typically, a transmission line experiences an increase in forced (unplanned) outages as the line ages. Even with visual inspections and maintenance on the Ko'olau–Pūkele 138kV transmission lines, forced outages will occur. These lines are subject to extreme weather conditions due to the high winds, heavy rains, and salt laden marine air that are prevalent in the coastal Ko'olau Mountain Range.

The Pūkele Substation Reliability Concern was heightened earlier this year. On March 3, 2004, one of the two transmission lines serving the Pūkele Substation was out for scheduled maintenance when the second transmission line went out of service and resulted in a power outage. Approximately 40,000 customers in the Honolulu/East O'ahu area, including Waikīkī, lost power. Approximately 39,000 customers were without power for 45 minutes to 2 hours; approximately 1,000 customers were without power for almost 4 hours. (Prior to March 3, 2004, HECO had been fortunate that the second of the two 138kV lines to Pūkele Substation had not tripped out of service while the other line was out for maintenance or out of service due to a forced outage.) The sustained outage would have been prevented if the Proposed Action had been completed. Many of the customers affected on March 3, 2004 would not have seen any interruption in service, while the other affected customers would have experienced a momentary interruption of service lasting only seconds.

The Waikīkī area includes large hotels and commercial shopping areas, and an extended power interruption to these loads could have a major impact on the local and state economies. A prolonged blackout of Waikīkī could be reported around the world creating a "third world" image for Hawai'i's main resort area at a time when Hawai'i is positioning itself as a safe, secure domestic destination for relaxation and rejuvenation. In addition, many facilities essential to Hawai'i's safety and security, such as the State Civil Defense, are in this service area, as well as the University of Hawai'i at Mānoa and Kapi'olani Community College. A blackout at the University of Hawai'i could impact research and experiments involving millions of dollars. A blackout that incapacitates the Hawai'i National Guard and Civil Defense facilities at Diamond Head could have a serious effect on Hawai'i's safety and security.

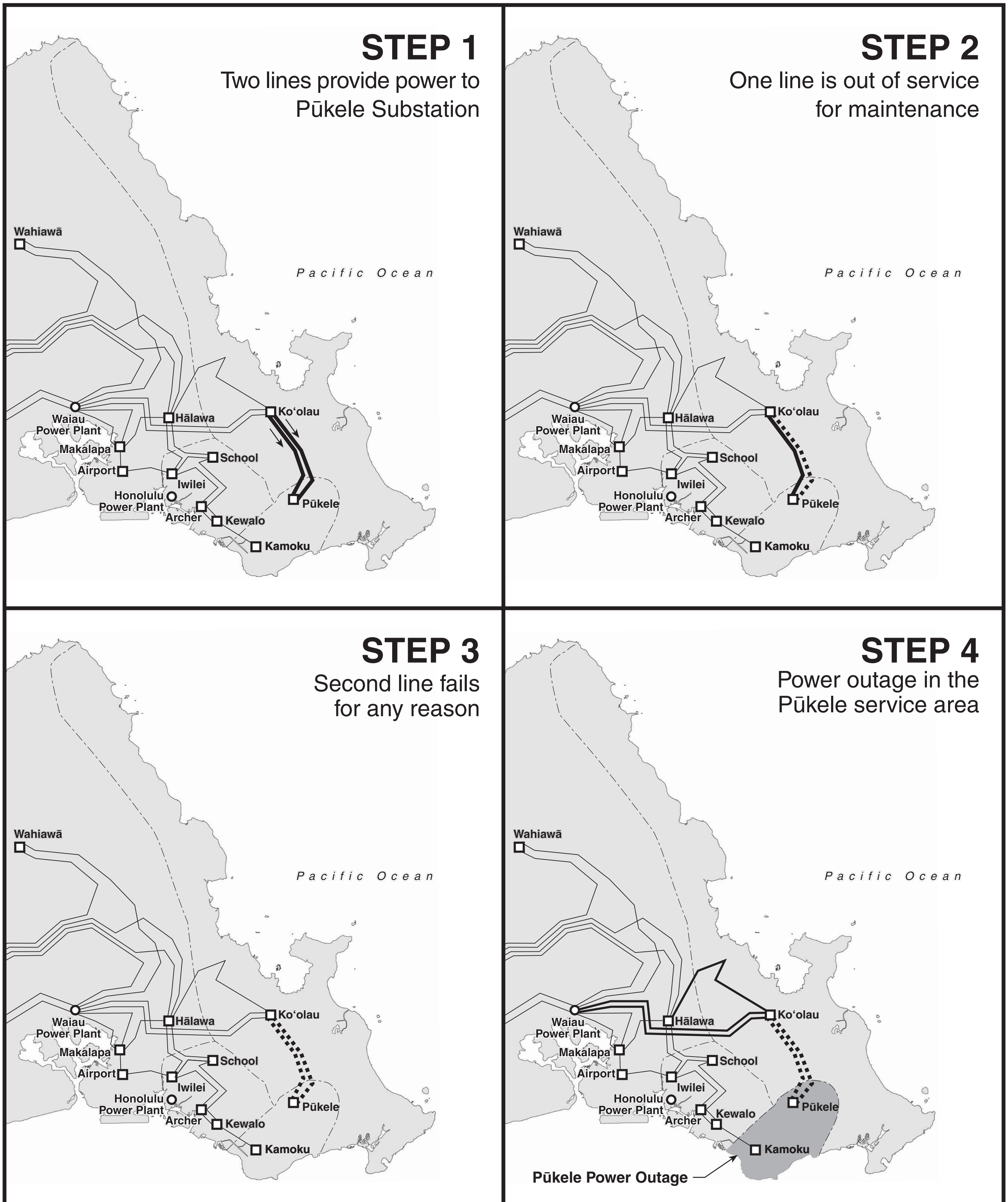


Figure 2-4
PŪKELE SUBSTATION RELIABILITY CONCERN

Environmental Assessment for the 46kV Phased Project
East Oʻahu Transmission Project
Hawaiian Electric Company, Inc.

Some customers with emergency generators on site may be able to meet limited power needs during an area blackout. However, typical emergency generators (at a hotel, for example) serve only critical loads such as elevators and emergency lighting. Ultimately the vast majority of customers within the Pūkele Service Area, including most of Waikīkī, would be without power until at least one of the two 138kV lines to the Pūkele Substation was restored to service.

The duration of a forced outage of the Koʻolau-Pūkele lines would depend on the severity of the damage to the line. The duration could be instantaneous or within a minute as seen with the 1994 flashover incidents on the Koʻolau–Pūkele lines, or could last days as in the case of the April 5, 2003 outage on the Koʻolau-Pūkele Number 1 line. The Koʻolau–Pūkele Number 1 138kV transmission line experienced a continuous outage (including the Evening Peak period) for 4.5 days due to structure damage. Severe weather conditions could also cause a prolonged outage that could take weeks to repair.

In the case of a prolonged interruption of power to the Pūkele Substation, most of the customers served by the substation would continue to experience an outage for the duration of the power interruption. The load in certain segments of the Pūkele Service Area could be manually switched to other 46kV back up circuits receiving power from the Koʻolau Substation. Based on 2002 Day Peak load conditions, about 20 percent of the total electricity demand of the Pūkele Service Area could be restored to service after manual switching operations on the existing 46kV system were implemented. These customers would experience a 2- to 4-hour outage until all the switching could be done to transfer them to these back up circuits.

2.2 KOʻOLAU/PŪKELE OVERLOAD SITUATION

There are three 138kV transmission lines providing power to the Koʻolau Substation. There are two 138kV transmission lines from the Koʻolau Substation that provide power to the Pūkele Substation. Together these two substations provide power to 30 percent of the load served by HECO on Oʻahu, at the time of the 2002 Day Peak load. HECO typically has two peaks. One peak typically occurs around 1:00 P.M., and is referred to as the "Day Peak." A second peak typically occurs between 6:30 P.M. and 7:00 P.M. in the evening, and is referred to as the "Evening Peak." The Day Peak is used for transmission planning studies, even though it is lower than the Evening Peak. Based on load flow analyses using the load growth projections in HECO's August 2002 load forecast, with one 138kV transmission line to the Koʻolau Substation out of service for maintenance, if a second 138kV Koʻolau transmission line becomes unavailable for any reason, the current flowing through the third 138kV Koʻolau transmission line is projected to exceed its emergency current carrying capacity rating during daytime peak load conditions in the year 2005 (Figure 2-5).

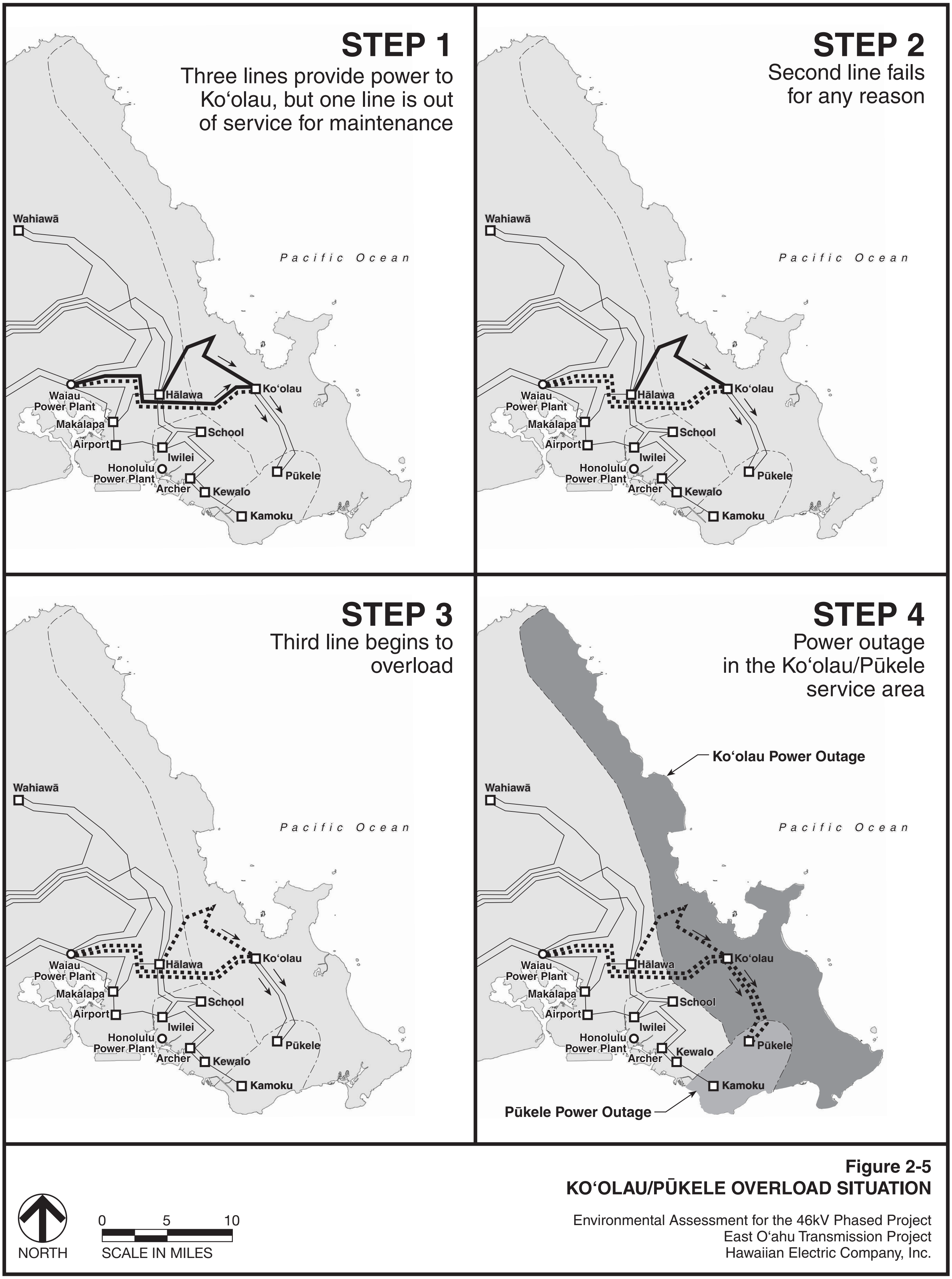


Figure 2-5
KO'OLAU/PŪKELE OVERLOAD SITUATION

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This would be in violation of HECO's Transmission Planning Criteria (TPC), which provides that no transmission component shall exceed its emergency rating with one generating unit on overhaul, one transmission line out for maintenance and loss of a second transmission line. If the current flowing through the remaining 138kV transmission line exceeds the emergency rating of the line, the conductor will heat up beyond normal operating parameters and could possibly break down and the line could suddenly be lost. Loss of the third 138kV transmission line feeding the Koʻolau/Pūkele area would result in loss of electricity service to 30 percent of HECO's customers, including subtransmission substations that feed communities such as Kailua, Kāneʻohe, Kāhala, McCully and Waikīkī. The damage caused to the failed transmission line from the overload could lead to a continuous prolonged outage of the line in order to perform the repairs, placing HECO at risk of an additional overload situation.

In the event of a possible overload situation, HECO's Energy Management System (EMS) program would automatically shed load at the Koʻolau and Pūkele Substations in pre-selected blocks in a pre-selected order associated with the most overloaded transmission line. The program is activated by an overcurrent protection scheme, which will shed load if the current flowing through the Koʻolau 138kV lines goes above 1,640 amps, the emergency rating of the Koʻolau 138kV transmission lines. Once load is shed, currents are rechecked to see if they have returned to normal, and if the current is still above 1,640 amps, additional circuits will be shed. The amount of load that HECO would have to shed during a line overload situation would vary, since the load in the Koʻolau/Pūkele area varies throughout the day. The emergency rating of the conductor is an engineering value based on conductor size, material, and design wind conditions, but does not account for other factors in the field such as: actual weather conditions, the number of conductor splices, the age and condition of conductors, the accuracy of current transformers in the overcurrent protection scheme, and the terrain where the line is installed. Therefore, designated HECO operational personnel may, at their discretion, take precautionary measures and intervene before the overcurrent protection scheme is activated, to avoid larger outages or maintain system integrity. Designated HECO operational personnel have the ability to shed individual 12kV and 46kV distribution feeders in the Koʻolau/Pūkele area to decrease the current flow until there is no longer an overload situation.

While the load-shedding process can prevent overload conditions, remedial action schemes such as load shedding should not be relied upon as a long-term solution to line overloading conditions, especially on an island utility system where there are no interconnections. In addition, relying on load shedding would not address other issues that are described such as the Pūkele Substation Reliability Concern or the Downtown Substation Reliability Concern. Relying on remedial measures also would increase the risk for more significant transmission events to occur on the system. For example, if a relay were to operate improperly, triggering other transmission lines to trip and causing a cascading sequence of events (including the shutting down of generating facilities, as designed, to protect vital equipment from long-term or permanent damage), this could lead to major outages and possibly an island-wide blackout. HECO has experienced several instances where multiple line outages occurred that resulted in island-wide blackouts or loss of service to nearly the entire island.

2.3 DOWNTOWN SUBSTATION RELIABILITY CONCERN

There are three Downtown area substations with only two 138kV transmission feeds including the Archer and the Kewalo Substations; the Kamoku Substation has only one 138kV transmission feed (Figure 2-6).

The Archer Substation is one of the newer transmission substations on the HECO system, and is fed from the Iwilei and School Street Substations by two underground 138kV transmission lines. These underground lines are relatively new and considered relatively reliable; however, a catastrophic underground duct bank failure could result in loss of power to the Archer Substation for some time depending on the severity of the failure. Installing a third line to the substation would increase the reliability of the substation.

The Kewalo Substation is also one of the newest transmission substations and is located on Kona Street. Two 138kV underground transmission lines supply power to Kewalo Substation. Kewalo serves customers at the distribution voltage of 25kV in the Kaka‘ako area. A catastrophic failure to the underground duct bank could result in loss of power to the Kewalo Substation. A third 138kV transmission line to Kewalo Substation would increase the reliability of the substation.

The Kamoku Substation is the newest transmission substation and is located on the corner of Date Street and Kapi‘olani Boulevard. Kamoku Substation is fed from one 138kV underground transmission line, which brings the power from Archer Substation via Kewalo Substation to Kamoku. The entire Kamoku Substation has a 25kV back up system. If the 138kV transmission line feeding the substation should fail, then the Kamoku Substation load would be transferred to Kewalo Substation.

If the two 138kV feeds to Kewalo Substation experience an outage, then both the Kewalo and Kamoku Substations would be unable to serve the load. The Kewalo and Kamoku Substations provide service to portions of Ala Moana Shopping Center, several high-rise luxury condominiums in the area and the Hawai‘i Convention Center. A second 138kV transmission line to Kamoku Substation would increase the reliability of the substation and provide a second 138kV feed and a third path of electricity for the substation.

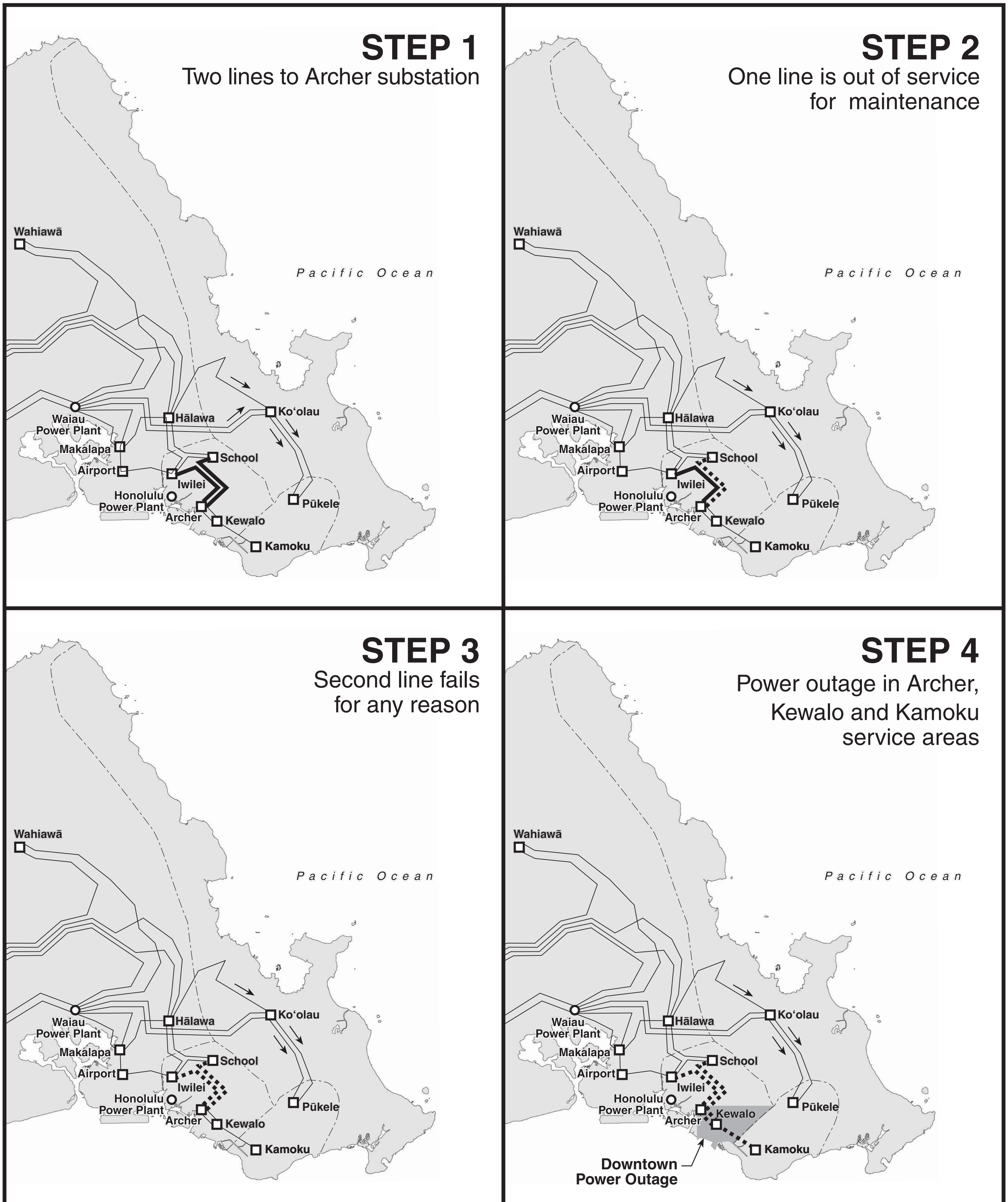

Figure 2-6
DOWNTOWN SUBSTATION RELIABILITY CONCERN

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The concerns regarding the reliability of the three downtown substations are not as critical as the concerns regarding the Koʻolau/Pūkele Overload Situation and the Pūkele Substation Reliability Concern. The underground lines serving the substations are relatively new, the line segments between the substations are shorter than the Koʻolau/Pūkele 138kV lines (which reduces the exposure to outages), and the substations are not as heavily loaded as the Pūkele Substation. Also, the two transmission lines serving the Pūkele Substation cross the Koʻolau Mountains. The difficult access to the lines, their exposure to corrosive marine air, and the location of the two lines on a common right-of-way causes the Pūkele transmission lines to be at a relatively higher risk for an extended outage than the transmission lines in other areas of the island.

2.4 DOWNTOWN OVERLOAD SITUATION

There are two 138kV transmission substations serving the Downtown area, including the Iwilei Substation and the School Street Substation. Power to serve the Downtown area can also come from the HPP, when it is on line (Figure 2-7). Together, these two substations and the HPP (when on-line) provided power to 26 percent of the load served by HECO at the time of the 2002 Day Peak load.

These two transmission substations are fed from three 138kV transmission lines providing power from the Hālawa Substation via the Hālawa–Iwilei 138kV transmission line and the Hālawa–School Street 138kV transmission line, and from Makalapa Substation via the Makalapa-Airport-Iwilei 138kV transmission line. If one of the three 138kV transmission lines to Iwilei or School Street Substation is taken out of service for maintenance, and a second Downtown 138kV transmission line becomes unavailable, then the current flowing through the remaining Downtown 138kV transmission line is forecast to exceed the emergency current carrying capacity rating during daytime peak load conditions after the year 2020, assuming the HPP is available. Again, this would result in a violation of HECO's Transmission Planning Criteria, because the current flowing through the third 138kV transmission line feeding the downtown substations would exceed the emergency rating of the line.

The availability of HPP defers the overload problem. When HPP is operating, power from the plant feeds the neighboring areas and decreases the demand for power from the west side of Oʻahu, which decreases the current flowing through the three 138kV transmission lines feeding School Street and Iwilei Substations. If HPP was not operating, the Downtown Overload Situation would be accelerated to 2006.

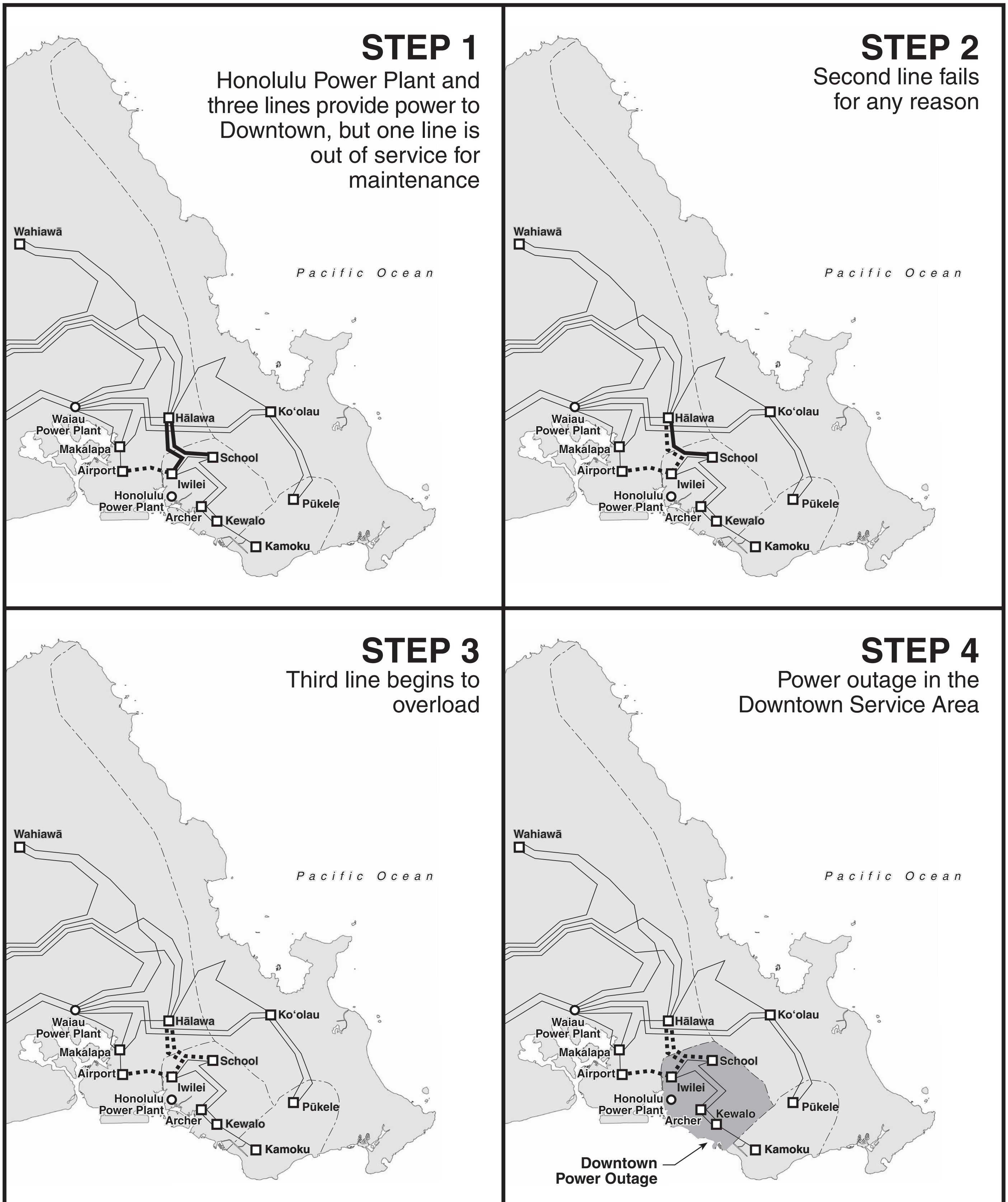

Figure 2-7
DOWNTOWN OVERLOAD SITUATION

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

If the current flowing through the third remaining 138kV transmission line exceeds the emergency rating of the line, the conductor could heat up and could possibly break down and the line could suddenly be lost. Loss of the third 138kV transmission line feeding the Downtown area would result in loss of electricity service to 26 percent of HECO's customers. The damage caused to the failed transmission line from the overload could lead to a continuous prolonged outage of the line in order to perform the repairs, placing HECO at risk of an additional overload situation. The Hālawa–Iwilei, Hālawa–School Street and the Makalapa–Airport–Iwilei 138kV transmission lines feeding the Downtown area 138kV substations do not have overcurrent protection schemes in place. Similar to the Koʻolau/Pūkele Overload Situation, designated HECO operational personnel may, at their discretion, take precautionary measures and intervene by shedding load using 12kV and 46kV distribution feeders in the Downtown area to decrease the current flow through the remaining line to a level that does not exceed the emergency rating of the line.

2.5 EAST OʻAHU SERVICE AREA LOADS

The Pūkele and Downtown Substation Reliability Concerns already exist. The Koʻolau/Pūkele and Downtown Overload Situations are forecast to occur in 2005 and after 2020, respectively, based on forecast loads for the Koʻolau/Pūkele and Downtown Service Areas.

Maintenance on a transmission line usually is scheduled during the day, where the 138kV transmission line is taken out of service at about 9:00 A.M. and is returned to service by 2:00 P.M. or prior to the Evening Peak. The Koʻolau/Pūkele and Downtown Overload Situations occur during the contingency where one 138kV transmission line is out for maintenance and HECO loses a second 138kV transmission line.

At the time of the 2002 Day Peak (which occurred on July 30, 2002), the load for the Koʻolau/Pūkele area was 346 MW (or 30 percent of the load served by HECO), and the load for the Downtown area was 304 MW (or 26 percent of the HECO service load). The Koʻolau/Pūkele area load of 346 MW included 192 MW (or 16.4 percent of the HECO service load) served by Pūkele Substation, and 154 MW (or 13.2 percent of the HECO service load) served by Koʻolau Substation.

Several changes have occurred since July 2002 to the 46kV subtransmission system (and an additional change is planned in 2004), and a 25kV distribution system has been installed from the Kewalo and Kamoku Substations, which have changed (and will further change) how the Pūkele, Koʻolau, Archer, Kewalo, and Kamoku Substations were loaded in 2002. Some of the changes described were completed prior to the 2003 Day Peak, and the change expected to be implemented in 2004 will be implemented prior to Phase 1 of the project. (The 2004 changes will have the effect of shifting about 6 MW of load from Pūkele Substation to Archer Substation.) These are normal changes in the subtransmission (46kV) and distribution (12kV and below) system configurations that are made from time-to-time as a result of distribution planning to better balance circuit and transformer loads, address circuit reliability issues, and optimize use of the utility grid. In many instances, the changes are made by manually opening or closing existing circuit switches.

At the time of the 2002 Day Peak (as adjusted for the foregoing changes), the load for the Ko‘olau/Pūkele area was 342 MW (or 29 percent of the load served by HECO), and the load for the Downtown area was 309 MW (or 26.5 percent of the HECO service load). The Ko‘olau/Pūkele area load of 342 MW included 196 MW (or 17 percent of the HECO service load) served by Pūkele Substation, and 146 MW (or 12.5 percent of the HECO service load) served by Ko‘olau Substation.

At the time of the 2003 Day Peak (as adjusted for the changes), the load for the Ko‘olau/Pūkele area was 352 MW (or 30 percent of the load served by HECO), and the load for the Downtown area was 297 MW (or 25 percent of the HECO service load). The Ko‘olau/Pūkele area load of 352 MW included 209 MW (or 18 percent of the HECO service load) served by Pūkele Substation, and 143 MW (or 12 percent of the HECO service load) served by Ko‘olau Substation.

To project the service area Day Peak loads for the 2003 transmission planning studies supporting the need for the 46kV Phased Project, the service area loads at the time of (i.e., coincident with) the system Day Peak for 2002 (which occurred on July 30, 2002) were projected to grow at the forecast growth rates for the system Day Peak in HECO's latest long-term forecast at the time (the August 2002 Long-Term Sales and Peak Forecast).

Actual load growth rates may differ from those forecast for a number of reasons, such as changes in the population growth, economic growth and customer electricity consumption factors that drive electricity load growth. Changes in load growth rates from those forecast may impact the timing of the Downtown Overload Situation, but will *not* impact the Pūkele and Downtown Substation Reliability Concerns (which result from the number of lines serving the substations, rather than the growing loads on the lines), and are unlikely to defer the Ko‘olau/Pūkele Overload Situation (due to the loads already experienced on the lines serving the area).

The adjusted loads for the Ko‘olau/Pūkele Service Area were 342 MW in 2002 and 352 MW in 2003. (The unadjusted loads were higher.) The overload level is 362 MW. Also, HECO's latest Long-Term Sales and Peak Load Forecast, completed in February 2004 as part of its integrated resource planning process, forecasts higher, not lower, growth rates in the near-term. While it may be possible to slow the rate of load growth in the area through the use of energy conservation measures and distributed generation (which are reflected to varying degrees in the load forecasts), it is not expected that these measures will eliminate load growth.

Based on the 2002 Day Peak loads and the August 2002 projected load growth rates for the Day Peak, the Downtown Overload Situation was forecast to occur in 2023 with HPP operating, and 2006 without HPP. The 2002 load for the Downtown area, if the subsequent 46kV configuration changes and 25kV distribution circuit additions had already been implemented, would have been higher by 5 MW. If the forecast loads for the Downtown area were based on the adjusted 2002 load (which was 5 MW higher) and the same projected load growth rates, then the forecast overload years for the Downtown Overload Situation would move up to 2021 with HPP operating and 2005 without HPP.

Chapter 3

Proposed Action and Alternatives

CHAPTER 3 PROPOSED ACTION AND ALTERNATIVES

3.1 DESCRIPTION OF PROPOSED ACTION

HECO's Proposed Action would be implemented in two independent phases, Phase 1 and Phase 2. As shown in Figure 3-1, Phase 1 involves the installation of 0.5 mile of underground ductline[1] for 46kV subtransmission lines, and related work at eight substations, in order to interconnect three 46kV circuits out of the Pūkele Substation, at the end of HECO's Northern 138kV Transmission Corridor, to four 46kV lines connected to HECO's Southern 138kV Transmission Corridor. Phase 1 includes: (1) the installation of six underground 46kV lines in the Ala Moana, McCully, Mōʻiliʻili, and Kapahulu areas, (2) a 138kV/46kV transformer installation at the existing Kamoku Substation with associated protective relaying, (3) a 46kV/12kV transformer installation at the existing Makaloa Substation with associated switchgear, (4) various switching and reconnections on the existing 46kV and 12kV systems near Makaloa and McCully Substations, (5) the removal of existing 46kV and 12kV cables between Makaloa and McCully Substations, (6) the removal of an existing 46kV/12kV transformer and associated switchgear from McCully Substation, and (7) modifications of various existing distribution substations in the Honolulu area

As shown in Figure 3-1, Phase 2 involves the installation of 1.9 miles of underground ductline for 46kV subtransmission lines, and related work at one substation, in order to interconnect four out of the five remaining 46kV circuits out of the Pūkele Substation to three other 46kV lines connected to HECO's Southern 138kV Transmission Corridor. Phase 2 includes: (1) the installation of three underground 46kV lines in the Kakaʻako, Makiki, and McCully areas, and (2) a 138kV/46kV transformer installation at the existing Archer Substation with associated protective relaying.

[1] The term "ductline" is used to describe the underground corridor that houses multiple ducts or pipes encased in concrete. One duct could be used to contain one cable or multiple cables, depending on the size of the ducts and cables. Three cables make up one 46kV "circuit."

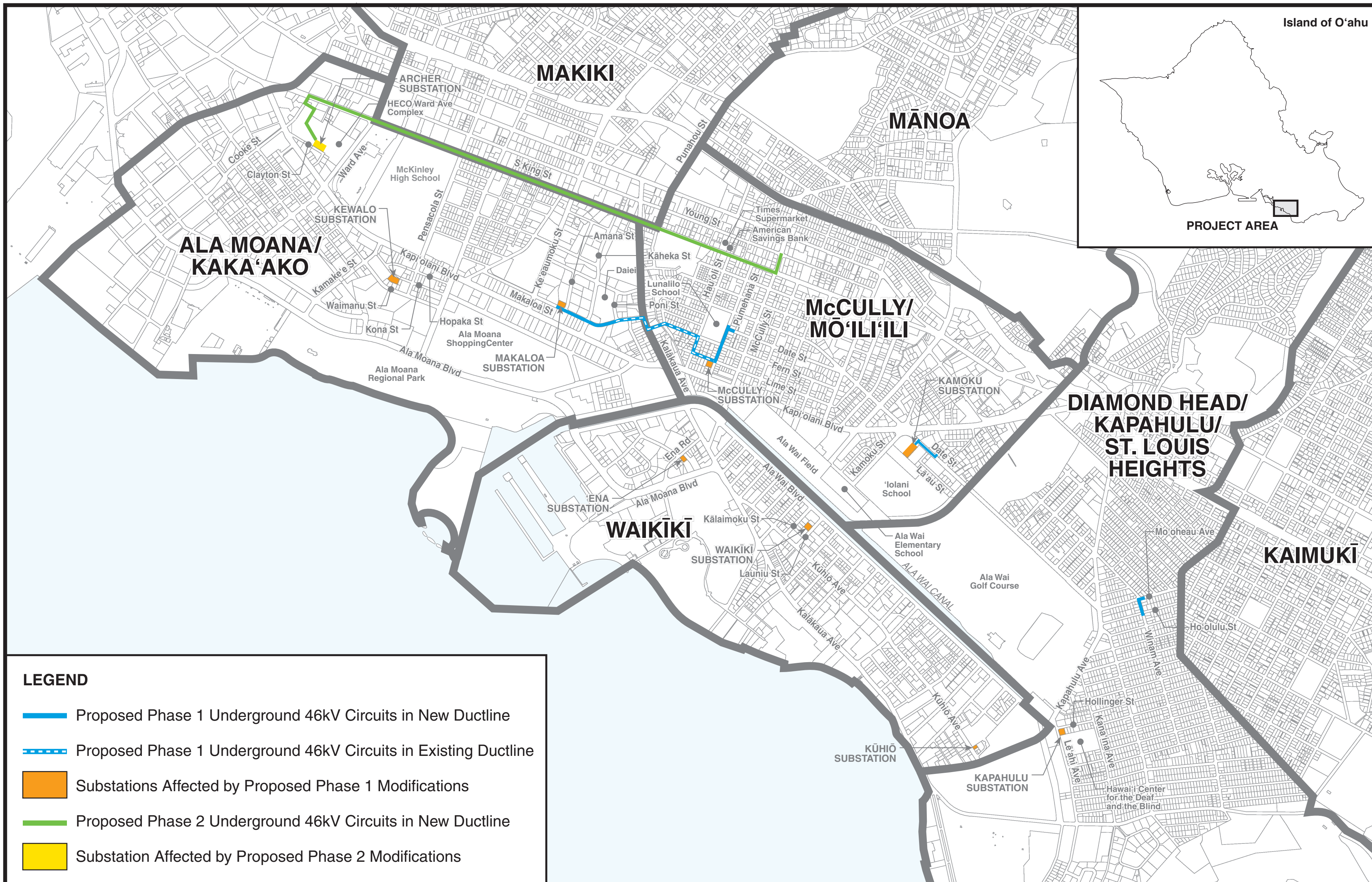

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Figure 3-1
PROJECT AREA AND NEIGHBORHOODS

Environmental Assessment for the 46kV Phased Project
East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

3.1.1 Phase 1 Construction Activities

Phase 1 construction activity locations are illustrated in Figure 3-2. Table 3-1 describes these activities and provides their approximate durations, affected times of the day and work zones.

Text descriptions of ductline and circuit installations and substation modifications are presented in Section 3.1.1.1, followed by descriptions of construction methods and equipment in Section 3.1.1.2 and the construction schedule in Section 3.1.1.3.

3.1.1.1 Ductline, Circuit, and Substation Installations and Modifications

3.1.1.1.1 Ductlines and Circuits

Phase 1 would involve the installation of six new underground 46kV circuits. To install the new underground circuits, concrete encased ductlines and manholes[2] are required. Typical views and cross-section of these underground facilities are shown in Figure 3-3. The general descriptions of the new underground 46kV circuit installations follow.

Activities 1A-4, 1A-10, 1E-1, and 1G

One circuit is required to connect the existing Archer 46 underground 46kV circuit at Makaloa Substation with the existing Pūkele 2 overhead 46kV circuit near McCully Substation. This would be accomplished by installing this circuit in an existing ductline[3] between Makaloa and McCully Substations. Another circuit is required to connect the existing Archer 41 underground 46kV circuit at Makaloa Substation to the McCully Substation. This would be accomplished by installing this circuit in a new ductline from Makaloa Substation to Poni Street, which would transition into the existing ductline at Poni Street and continue in the existing ductline all the way to McCully Substation. The route of the existing ductline begins at Makaloa Substation on Makaloa Street near Ala Moana, continues in the Koko Head direction through Kalākaua Avenue, Fern Street, Hauʻoli Street, and

2 For the purposes of this EA, the term "manhole" is used to identify the underground vault that contains the cable splice locations and line maintenance access.

3 The existing ductline between Makaloa and McCully Substations contains three existing 46kV circuits and three existing 12kV circuits. Each circuit, which is comprised of three cables, occupies a single duct in the ductline. The two new 46kV circuits between Makaloa and McCully Substations would replace the three existing 46kV circuits by utilizing higher current-carrying capacity cables. These higher current carrying capacity cables are larger in diameter than the existing cables. Thus, each duct would contain one new cable due to the larger diameters as opposed to three cables. The 12kV circuits would also be removed from the ductline from Poni Street to McCully Substation to free up ducts for the new 46kV circuits.

Lime Street, then terminates at McCully Substation on the corner of Lime Street and Pumehana Street in McCully. The route of the new ductline follows the existing ductline on Makaloa Street from Makaloa Substation to Poni Street. At Poni Street, the new ductline would be connected to the existing ductline. Overhead reconnections of existing overhead 46kV circuits in and around McCully Substation are also required, which includes the replacement of an existing wood pole with a new wood pole in the same location. See Table 3-1 and Figure 3-2.

Activities 1C-1, 1C-2, and 1E-2

One circuit is required to connect the new Archer 46 underground 46kV circuit near McCully Substation with the existing Pūkele 2 overhead 46kV circuit at the intersection of Date Street and Pumehana Street in McCully. An underground ductline would be constructed from the existing manhole fronting McCully Substation to a new wood pole (which replaces an existing wood pole in same location) on Date Street carrying the existing Pūkele 2 overhead 46kV circuit. See Table 3-1 and Figure 3-2.

Activities 1B-1, 1B-2, and 1E-4

Two circuits are required in separate ductlines to connect the new 138kV/46kV, 80 MVA transformer at Kamoku Substation (described in Section 3.1.1.1.2) to the existing Pūkele 4 overhead 46kV circuit on Date Street fronting Kamoku Substation in Mōʻiliʻili. Existing ductlines in Kamoku Substation would be utilized to route the circuits out of the enclosed substation. Once outside of the enclosed substation, new ductlines would be constructed to new wood poles (which replace existing wood poles in the same location) carrying the Pūkele 4 overhead 46kV circuit on Date Street fronting the Kamoku Substation. The existing span of 46kV overhead conductors between these two wood poles would be removed. See Table 3-1 and Figure 3-2.

Activities 1D-1, 1D-2, and 1E-3

One circuit is required to connect the existing Pūkele 4 overhead 46kV circuit on Moʻoheau Avenue with the existing Pūkele 8 overhead 46kV circuit near the intersection of Moʻoheau Avenue and Winam Avenue in Kapahulu. An underground ductline would be constructed from a new wood pole (which replaces an existing wood pole in the same location) on Moʻoheau Avenue that carries the existing Pūkele 4 overhead 46kV circuit to a new wood pole (which replaces an existing wood pole in the same location) on Winam Avenue carrying the existing Pūkele 8 overhead 46kV circuit. See Table 3-1 and Figure 3-2.

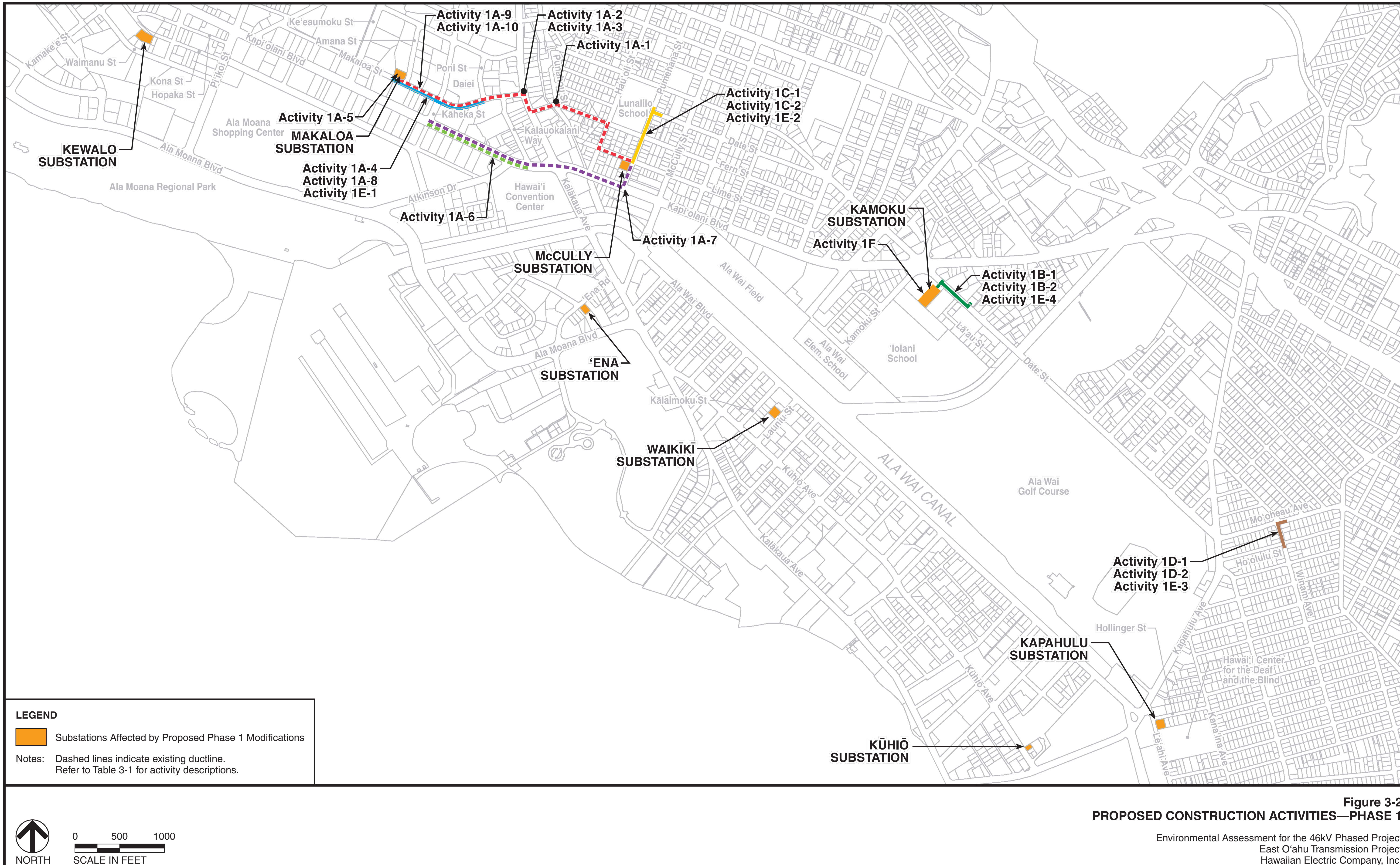


Figure 3-2
PROPOSED CONSTRUCTION ACTIVITIES—PHASE 1

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

Table 3-1. Phase 1 Construction Activities

Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
1A-1	Fern Street – intersection with Punahou Street	Replace existing wood pole (Pole 4) at the Koko Head/makai corner of Fern and Punahou. Install 12kV switch on pole (relocated from Pole 43 on Kalākaua – See Activity 1A-2).	One week.	Daytime.	**Work Zone:** One lane by 100 feet, inclusive of staging. **Transition Zone:** 150 feet 'Ewa side of work zone.
1A-2	Kalākaua Avenue – intersection with Makaloa Street	Replace existing wood pole (Pole 43) at the Koko Head/mauka corner of Kalākaua and Makaloa, and install double riser on pole. Relocate overhead 12kV switch from Pole 43 to Pole 4.	One week, concurrent with Activity 1A-3.	Nighttime.	**Work Zone:** One lane by 100 feet, inclusive of staging. **Transition Zone:** 150 feet makai of work zone.
1A-3	Kalākaua Avenue – intersection with Makaloa	Hand-trench and construct approximately five feet of new underground ductline in sidewalk at the Koko Head/mauka corner of Kalākaua and Makaloa.	One week, concurrent with Activity 1A-2.	Daytime.[3]	**Work Zone:** 20 feet of sidewalk detour.
1A-4	Makaloa Street – Makaloa Substation to Poni Street	Trench and construct 250 feet of new underground ductline from inside Makaloa Substation to existing manhole P2 fronting the substation. Trench and construct approximately 1,000 feet of new underground ductline from manhole P2 to intersection of Makaloa and Poni, where it would be connected to existing underground ductline.	Two months of work (trenching), assuming an average of 60 lineal feet per shift progress.[4]	Evaluate both nighttime and daytime.[5]	**Work Zone:** Two lanes by 300 feet (150 feet of active construction, 150 feet for staging). **Transition Zone:** 300 feet, direction depending on work zone location.
1A-5	Makaloa Substation	Install new 46kV/12kV transformer and associated equipment at Makaloa Substation.	Eight weeks, with one day of activity outside the substation.	Daytime.	**Work Zone:** Two lanes by 150 feet in front of substation (from Amana, 150 feet in 'Ewa direction), inclusive of staging, for one day. **Transition Zone:** 300 feet.

Footnotes are located on page 3-11.

Table 3-1. Phase 1 Construction Activities *(continued)*

Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
1A-6	Kapiʻolani Boulevard – Kalauokalani Way to Kāheka Street	Remove existing 12kV circuit using existing manholes in mauka lane of Kapiʻolani. Access will be through a maximum of six manholes along mauka side of Kapiʻolani.	One week.	Nighttime.	**Work Zone:** One lane by 100 to 150 feet during pulling and 50 to 100 feet during splicing, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.
1A-7	Pumehana Street and Kapiʻolani Boulevard – Pumehana to Kāheka	Install 12kV circuit from McCully Substation to manhole on Kapiʻolani at Kāheka using existing underground ductlines.[6] Access will be through a maximum of 13 manholes along mauka side of Kapiʻolani.	One week (approximately one work day at every other manhole).	Nighttime.	**Work Zone:** One lane by 100 to 150 feet during pulling, and 50 to 100 feet during splicing, centered around manholes, inclusive of staging. **Transition Zone:** 150 feet.
1A-8	Makaloa Street – manholes P2, P3, P4	Reconnect 12kV circuits in existing underground ductline.[6] Access will be through manholes P2 (located in front of Makaloa Substation), P3 (at the intersection of Makaloa and Kāheka), and P4 (at the intersection of Makaloa and Poni).	One week.	Daytime.	**Work Zone:** One lane by 50 feet, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.
1A-9	Makaloa Substation to McCully Substation along Makaloa, Kalākaua, Fern, Hauʻoli, and Lime	Remove existing 46kV circuits from existing underground ductline. Remove a portion of existing 12kV circuits from existing underground ductline from Poni to McCully Substation using existing manholes.	Three weeks.	Nighttime.	**Work Zone:** One lane by 100 feet, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.
1A-10	Makaloa Substation to McCully Substation along Makaloa, Kalākaua, Fern, Hauʻoli, and Lime	Install new 46kV circuits from Makaloa Substation to Makaloa/Poni intersection.[6] One circuit would be installed in existing ductline, the other in newly constructed underground ductline (Activity 1A-4). Both circuits would then join into one existing ductline from Makaloa/Poni intersection to McCully Substation.	Pulling – one workday at every other manhole (maximum of six); splicing – three workdays at every other manhole (maximum of six).	Nighttime.	**Work Zone:** One lane by 100 to 150 feet during pulling and 50 to 100 feet during splicing, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.

Table 3-1. Phase 1 Construction Activities *(continued)*

Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
1B-1	Date Street	Trench and construct new underground ductline from Kamoku Substation on the makai side of Date to two new manholes constructed in Date – one in front of substation (approximately 50 feet) and one in Koko Head direction (approximately 330 feet). Construct new underground ductline from the two manholes to poles on the mauka side of Date. Replace wood poles.	Five weeks.	Daytime.[7]	**Work Zone:** Makai lanes – two lanes by 100 feet, staging at substation; center lanes – two lanes by 350 feet, staging between manholes; mauka lanes – two lanes by 150 feet at each location, inclusive of staging. **Transition Zone:** 300 feet.
1B-2	Date Street	Install two 46kV circuits in one underground duct bank from Kamoku Substation to new manhole fronting substation. Connect one circuit to existing overhead circuit on mauka side of Date fronting substation (Pole 39), connect one to second manhole, and from there to existing overhead circuit in Koko Head direction on Date (Pole 42). Remove section of 46kV overhead line between Pole 39 and Pole 42.	Three weeks,[6] includes pulling and splicing.	Daytime.	**Work Zone:** One lane by 350 feet, close area around both manholes at once, staging between manholes. **Transition Zone:** 150 feet.
1C-1	Pumehana Street	Trench and construct new underground ductline, approximately 720 feet long, between McCully Substation and intersection of Date and Pumehana. Construct two new manholes – one at intersection of Pumehana and Fern, one at intersection of Pumehana and Date. Replace wood pole.	Two months, with consideration given to Lunalilo School schedule.[8]	Daytime.	**Work Zone:** All lanes by one block (approximately 300 feet) at a time, inclusive of staging. Open to local traffic.
1C-2	Pumehana Street	Install new 46kV circuit in new underground ductline from McCully Substation to existing overhead 46kV circuit near intersection of Date and Pumehana.[6]	Two weeks.	Daytime.	**Work Zone:** One lane by 100 to 150 feet pulling and 50 to 100 feet splicing, centered around manhole inclusive of staging. **Transition Zone:** 150 feet.

Table 3-1. Phase 1 Construction Activities *(continued)*

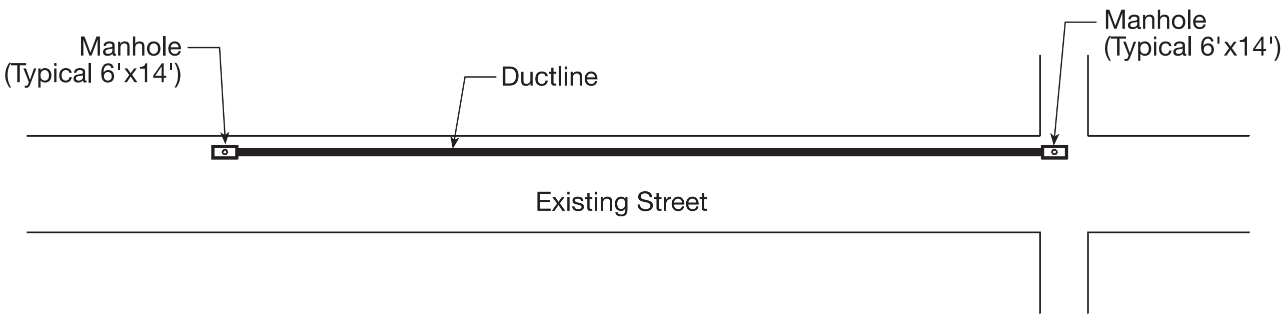
Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
1D-1	Winam Avenue	Trench and construct new underground ductline, approximately 420 feet long, along Winam from Hoʻolulu onto Moʻoheau. Construct two new manholes.	One month.	Daytime.	**Work Zone:** All lanes by one block (approximately 300 feet) at a time, inclusive of staging. Open to local traffic.
1D-2	Winam Avenue	Install one new 46kV circuit, approximately 420 feet long, in a new ductline between an existing overhead 46kV circuit on Winam and an existing overhead 46kV circuit on Moʻoheau.[6]	Two weeks.	Daytime.	**Work Zone:** One lane by 100 to 150 feet pulling and 50 to 100 feet splicing, centered around manhole inclusive of staging. **Transition Zone:** 150 feet.
1E-1	Makaloa Street	Pave trenched areas of Makaloa.	Three days (600 to 800 lane-feet per day).	Evaluate both daytime and nighttime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 300 feet.
1E-2	Pumehana Street	Pave trenched areas of Pumehana.	Two days (600 to 800 lane-feet per day).	Daytime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 300 feet.
1E-3	Winam Avenue	Pave trenched areas of Winam.	One day (600 to 800 lane-feet per day).	Daytime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 300 feet.
1E-4	Date Street	Pave trenched areas of Date.	One day (600 to 800 lane-feet per day).	Evaluate both daytime and nighttime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 300 feet.
1F	Kamoku Substation	Install new 138kV/46kV transformer and associated equipment.[9]	12 months, with three to five days of work outside the substation.[9]	Daytime.	**Work Zone:** Most work conducted inside substation building, with three to five days of single lane closure on makai side of Date Street to unload equipment.

Table 3-1. Phase 1 Construction Activities *(continued)*

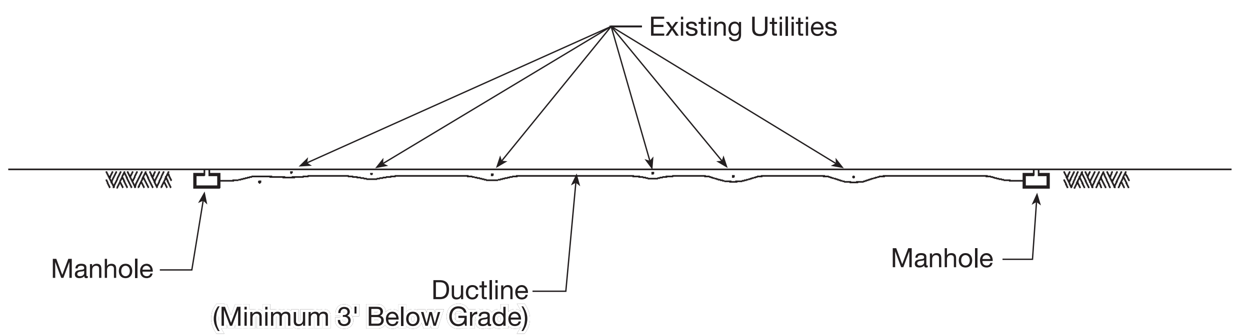
Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
1G	Various	Proposed substation modifications at McCully (including wood pole replacement), Kewalo, Kūhiō, Waikīkī, ʻEna, and Kapahulu Substations.	Duration varies, one day to two weeks.	Daytime.	Not applicable.

Notes:

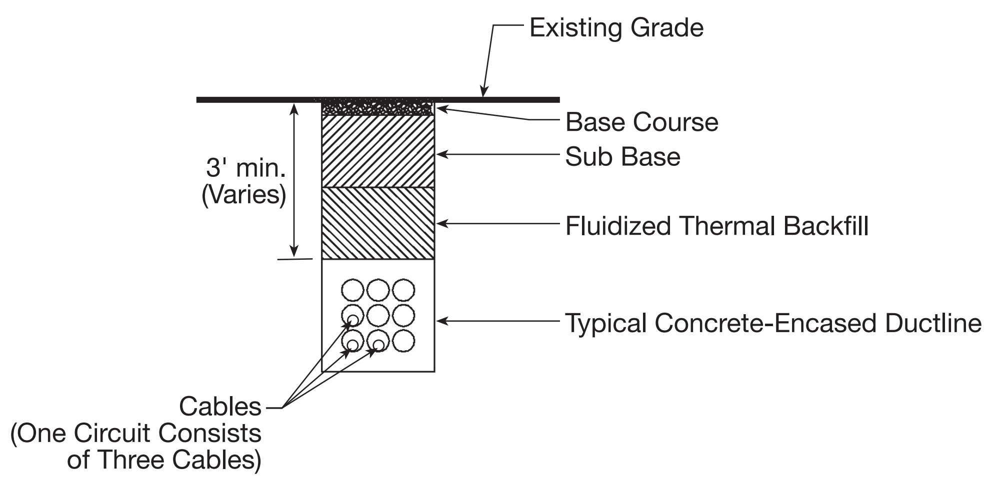
1. The activities would proceed in the order presented. Activity number shows the phase (first digit), activity grouping (second letter), and order within activity group (third digit).
2. Daytime hours are from 9:00 A.M. to 3:00 P.M., nighttime hours are 8:00 P.M. to 5:00 A.M.
3. Hand-trenching at the Kalākaua-Makaloa intersection would occur during the day because a jackhammer may be required.
4. Average of 60 lineal feet per day includes two-week period for preparation activities (e.g., expose existing utilities, harden sewer lines).
5. Night work preferred for Makaloa Street trenching, except for Makaloa-Amana intersection where presence of residential high-rise condominiums may make obtaining a noise variance difficult.
6. Circuit installation, to occur after installation of new ductline and reconnection, consists of pulling and splicing.
7. Date Street trenching and ductline construction would occur during the day because of the high-density residential neighborhood.
8. Work on Pumehana Street would occur one block at a time to minimize disruption from street closure.
9. Equipment installation work at Kamoku Substation would occur concurrently with the rest of the Phase 1 activities.



PLAN VIEW



PROFILE VIEW



TYPICAL CROSS-SECTION

Figure 3-3
TYPICAL DUCTLINE WITH CIRCUITS AND TYPICAL MANHOLE

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Hawaiian Electric Company, Inc.

Phase 1 also involves changing sources and reconnecting existing 12kV circuits in and around the Makaloa and McCully Substations and their respective service areas. This would allow the removal of existing 46kV underground circuits from the existing ductline between Makaloa and McCully Substations, 12kV underground circuits from Poni Street to McCully Substation, and other ductlines in service areas of these substations. The general description of this work follows.

Activities 1A-1, 1A-2, and 1A-3

Existing 12kV circuits in ductlines between Makaloa and McCully Substations would be rerouted to make the ductlines available for new 46kV circuits. In order to ensure that 12kV vaults on Kalākaua Avenue are still served when the 12kV circuits are rerouted, an existing 12kV switch would be relocated from an overhead pole on Kalākaua Avenue to an overhead pole on Fern Street at the intersection with Punahou Street. The existing poles would be replaced with slightly thicker poles, and approximately five feet of new underground ductline would be constructed in the sidewalk on Kalākaua Avenue to link the overhead circuits and the underground vaults. See Table 3-1 and Figure 3-2.

Activities 1A-5 and 1A-9

Currently, a 12kV circuit originating from the McCully Substation, known as the McCully Substation Shopping Center 12kV circuit, serves loads in and around Ala Moana Shopping Center, including parts of Ke‘eaumoku Street, Kapi‘olani Boulevard and Kona Street. This circuit would be removed from the existing ductline to make room for the new 46kV circuits. In order to serve the loads currently served by this 12kV circuit, a new 46kV/12kV transformer and switchgear would be installed at the Makaloa Substation (described in Section 3.1.1.1.2) as the new source of the McCully Substation Shopping Center 12kV circuit. See Table 3-1 and Figure 3-2.

Activities 1A-6 and 1A-7

An existing 12kV circuit originating from McCully Substation is known as the Kona Street 12kV circuit. The route of the Kona Street 12kV circuit currently proceeds from the McCully substation in the ‘Ewa direction along Lime Street, mauka on Hau‘oli Street, then ‘Ewa on Fern Street, and mauka on Kalākaua Avenue to Makaloa Street where it proceeds to Kāheka Street. At Kāheka Street, the circuit turns makai on Kāheka and then ‘Ewa on Kapi‘olani Boulevard. At Ke‘eaumoku Street the line heads makai and then both Koko Head and ‘Ewa on Kona Street. A second section of the circuit exits McCully Substation on Pumehana Street and heads makai until Kapi‘olani Boulevard. It continues on Kapi‘olani Boulevard until it turns makai on Atkinson Drive. This 12kV circuit would be rerouted in available spare ducts along Pumehana Street and Kapiʻolani Boulevard. An idle section of circuit would be removed along Kapiʻolani Boulevard from Kalauokalani Way to Kāheka Street to make this section of duct available (Activity 1A-6, dotted green line in Figure 3-2), and the new 12kV circuit would be installed from a manhole on Pumehana Street fronting the McCully Substation to a manhole in Kapiʻolani Boulevard at Kāheka Street (Activity 1A-7). This would be the new route for the Kona Street 12kV circuit (purple line in Figure 3-2).

Activities 1A-8 and 1A-9

Three 46kV circuits and 12kV circuits currently occupy a ductline between the Makaloa and McCully Substations (dotted red line in Figure 3-2). To prepare for removal of these existing 46kV and 12kV circuits, a 12kV circuit would be reconnected in the existing underground manholes along Makaloa Street (Activity 1A-8). The existing 12kV and 46kV circuits would be removed from the ductline between Makaloa and McCully Substations (Activity 1A-9).

Activities 1E-1 through 1E-4

Paving associated with trenching activities, as required by City and County of Honolulu Ordinance, would occur after completion of ductline construction. However, it should be noted that the City Managing Director, with the concurrence of the Mayor, issued a curb-to-curb repaving policy for trench work by utilities (memo dated January 27, 2004). The curb-to-curb repaving requirements are much more extensive than what the Ordinance requires. Since issuance of the policy, a task force consisting of City and County of Honolulu personnel and utilities has been formed to evaluate the practicality of the policy and recommend changes.

3.1.1.1.2 Substations

Phase 1 also involves the substation modifications described as follows:

Makaloa Substation (Activity 1A-5)

Activity 1A-5 involves work at the existing Makaloa Substation located on Makaloa Street near Ala Moana. This activity includes the installation of one 46kV/12kV, 10/12.5 megavolt ampere (MVA), low sound level transformer; one 15kV two circuit switchgear; one 6 foot by 14 foot handhole; and one set of 46kV interrupters. Site development work includes installation of approximately 250 feet of three 5-inch concrete-encased ducts all within the substation property (also see Activity 1A-4).

Kamoku Substation (Activity 1F)

Activity 1F involves work at the existing Kamoku Substation located on Date Street in Mōʻiliʻili, which is an enclosed facility. This activity includes the installation of one 138kV/46kV, 80 MVA, standard sound level transformer with cooling equipment; 138kV circuit breakers; protective relaying; 46kV gas insulated switchgear (GIS); and control cables. Site development work includes one 24 foot by 39 foot transformer pad, 126 linear feet of 22-foot high transformer vault walls, one 18.5 foot by 21 foot switchgear pad and 250 feet of 5-inch ducts all within the substation property.

Other Substations (Activity 1G)

Activity 1G involves modifications (all within the respective substation property) at the following existing distribution substations:

1. McCully Substation – This work involves the replacement of three existing 46kV switches (4684, 4909, 4794) with new switches rated at 46kV, 800 amperes, the replacement of existing 4/0 bus sections between switches 4794 and 4752 with 750 kcmil[4] aluminum conductors to achieve a continuous bus rating of 800 amperes, and the installation of a termination structure complete with 46kV terminators and lightning arrestors under switch 4909. This work also involves the removal of the existing McCully #4 46kV/12kV, 10/12.5 MVA transformer and two-circuit 15kV switchgear.
2. Makaloa Substation (in addition to Activity 1A-5) – This work involves the replacement of existing 4/0 bus sections between switches 4498 and 5405 and switches 4928 and 6089 with 750 kcmil aluminum conductors to achieve a continuous bus rating of 800 amperes, and installation of three new three-phase 46kV group operated switches with associated steel work.
3. Kewalo Substation – This work involves the installation of 750 kcmil aluminum conductors between switches 4919 and 5311 to achieve a continuous bus rating of 800 amperes.
4. Kūhiō Substation – This work involves the replacement of three existing hydraulic operators with new motor operators including all associated control duct installations, battery banks, cabinets, and wiring, and the installation of one 46kV switch interrupter.
5. Waikīkī Substation – This work involves the replacement of six existing hydraulic operators with new motor operators including all associated

[4] kcmil is a unit of measure where one kcmil is equal to 1,000 circular mils. A circular mil is the area of a circle with a diameter of one thousandth (0.001) of an inch.

control duct installations, battery banks, cabinets, and wiring, and the installation of two 46kV switch interrupters.

6. 'Ena Substation – This work involves the replacement of seven existing hydraulic operators with new motor operators including all associated control duct installations, battery banks, cabinets, and wiring, and the installation of three 46kV switch interrupters.

7. Kapahulu Substation – This item involves the replacement of nine existing hydraulic operators with new motor operators including all associated control duct installations, battery banks, cabinets, and wiring and three 46kV switch interrupters.

3.1.1.2 Construction Methods and Equipment

Proposed construction methods and typical equipment used to perform this work are described herein. Construction equipment is listed in Table 3-2.

Table 3-2. Typical Equipment for Phase 1 Construction Activities

Activity Type[1]	Typical Equipment
Pole Replacement Activity 1A-1, 1A-2, 1B-1, 1C-1, and 1G	Flatbed boom truck with crane Truck with "cherry picker" bucket Concrete mixer (or ready-mix truck)
Hand Trenching Activity 1A-3	Jackhammer Hand tools Dump truck
Ductline Construction and Installation Activity 1A-4, 1B-1, 1C-1, 1D-1	Flatbed boom trucks Backhoe Crane Pavement cutter Excavator Ready-mix concrete trucks Dump truck
Manhole Installation Activity 1A-4, 1B-1, 1C-1, 1D-1	Pre-cast manholes Excavating equipment Dump truck

Table 3-2. Typical Equipment for Phase 1 Construction Activities *(continued)*

Activity Type[1]	Typical Equipment
Substation Modification Activity 1A-5, 1F, 1G	Flatbed truck Utility vans Crane Ready-mix concrete truck
Circuit Removal Activity 1A-6, 1A-9	Cable cutting equipment Pickup trucks Cable-reel trailers Self propelled cable trailers Line truck with winch
Circuit Installation Activity 1A-7, 1A-8, 1A-10, 1B-2, 1C-2, 1D-2	Pickup trucks Cable-reel trailers Self-propelled cable trailers Line truck with winch
Paving Activity 1E-1, 1E-2, 1E-3, 1E-4	Drum roller planer Tractor with power broom attached to the front Rubber-tire backhoe Tack coat oil truck Paving machine Dump trucks Roller compactor

Notes:
[1] See Table 3-1 for more detailed activity descriptions.

3.1.1.2.1 Pole Replacement

Pole replacement (Activities 1A-1, 1A-2, 1B-1, 1C-1, and 1G) would be conducted by removing the existing pole from the ground, holding it in the air with a crane while the new pole is secured in its place, and transferring the circuits and associated equipment from the existing to the new pole. The old pole would be cut into four-foot lengths and hauled to HECO's base yard for proper disposal at a landfill.

Construction equipment for pole replacement would include a flatbed boom truck to transport and lift the poles, a truck with a "cherry picker" bucket to allow work on the pole, and a concrete mixer (or ready-mix truck) to pour concrete into the hole to stabilize the pole.

3.1.1.2.2 Trenching and Ductline Installation

Construction equipment for hand trenching (Activity 1A-3) would include a jackhammer, hand tools, and a dump truck. Construction equipment for trenching (Activities 1A-4, 1B-1, 1C-1, and 1D-1) would include the following equipment:

- 30 horsepower (hp) gas-powered circular saw (pavement cutter),
- 75 to 80 hp rubber-tire backhoe loader for light to medium digging (to depths of about five feet),
- 110 to 150 hp track type excavator for medium to heavy digging,
- dump trucks to hold excavated material,
- flatbed boom trucks to haul and handle material, and
- hydraulic breaker/jackhammer to break rock encountered during trenching.

Construction equipment for ductline installation (Activities 1A-4, 1B-1, 1C-1, and 1D-1) would include flatbed boom trucks, cranes, ready-mix concrete trucks, and other typical construction equipment.

Prior to trenching, HECO would coordinate with other utility companies to locate and mark existing underground utilities along the proposed alignment. During construction, vehicular and pedestrian traffic would be diverted around the construction site, in accordance with a City and County of Honolulu-approved traffic management plan. Construction hours would be determined prior to the commencement of activities in accordance with required permits (such as street usage, noise permits or variances).

Hand trenching would be conducted by jackhammering and/or digging through the ground where the five-foot section of ductline would be installed. The ductline would be encased in concrete and covered, and the ground surface would be restored to the original condition.

The trench alignment in the roadway would be marked and the work area prepared with traffic cones, signs, and staging areas. The pavement in the work area would be broken using a pavement cutter, and the pieces of broken pavement hauled away. A backhoe loader and/or track-type excavator would be used to dig the trench. Typical trench dimensions would be three to four feet wide by three to five feet deep. Approximately 150 feet of trench length would be open at a given time for ductline installation prior to paving. Trucks would be used to haul away excavated material. Steel plates would be securely placed and welded together over any exposed or unfinished section of trench during non-working hours to allow vehicles to travel over the excavated area. If work occurs below the water table, dewatering may be required to keep the trench clear of water so that ductlines can be installed. Dewatering effluent would be contained in a holding tank or receiving pit located near the work area and discharged back into the trench, or in accordance with applicable permits.

The ductline would be laid in the excavated trench, encased in concrete, set, and backfilled with a fluidized thermal backfill,[5] which would be poured into the trench and left to cure. The trench area would be graded and compacted to near the surface of the asphalt roadway, base course would be added and compacted, and the construction area would be temporarily paved. This sequence would continue until the length of the new ductline is installed and connected to the existing ductline.

3.1.1.2.3 Manhole Installation

HECO typically uses pre-cast manholes, 6 feet wide by 14 feet long and 7.5 feet high, as shown in Figure 3-3. The area would be excavated, the manholes shored in place, and the excavated area set, backfilled, and graded. This process is described in the previous section on trenching and ductline installation.

3.1.1.2.4 Substation Modifications

The majority of work at substations would involve equipment replacement or upgrades and associated control and relay wiring. Section 3.1.1.2 describes the equipment modifications at the substations. New transformers would be installed at Makaloa and Kamoku Substations. Construction equipment associated with this activity would include a flatbed truck, crane, ready-mix concrete truck, and utility vans.

3.1.1.2.5 Removal of Existing Circuits

Construction equipment associated with removing circuits would include cable cutting equipment, pickup trucks, cable-reel trailers, self-propelled cable trailers, and a line truck with a winch.

3.1.1.2.6 Installation of New Circuits

Construction equipment associated with installing new circuits would include much of the same equipment as removal of existing circuits.

After installation of the new ductline and removal of existing circuits to free up existing ductline, HECO would pull segments of the new cables into the ductline

5 Fluidized thermal backfill is a concrete mixture with low thermal resistivity properties. It is used in lieu of native soil to backfill a trench because its heat dissipation properties allow the cables to operate at lower temperatures than native soil. Lower temperatures increase the current carrying capacity of the cables and reduce risk of overheating and damage.

and splice them together at vaults along the route. Large cable-reel trailers would be brought along the alignment, and temporary shelters would be erected as needed over exposed cable and pulling lines to prevent damage. The cables would be prevented from touching the ground and would be visually inspected as they are pulled into the ducts. Weatherproof caps would be placed on the end of the cables to prevent moisture from entering prior to splicing. Splicing, or cable connection, would occur according to manufacturer's specifications, with emphasis on preventing contamination from moisture, dust, or other contaminants. Cables would be connected in manholes along the route according to the maximum pulling tension of the cables specified by the manufacturer.

3.1.1.2.7 Paving

Trenched areas would be repaved as required by City and County of Honolulu Ordinance, after completion of ductline construction. As explained above, the City and County of Honolulu's curb-to-curb repaving policy for trench work by utilities is being evaluated by a task force consisting of City and County of Honolulu personnel and utilities.

Paving equipment would include a drum roller planer to prepare the adjoining surfaces, a small tractor with a power broom attached to the front, rubber-tire backhoe, tack coat oil truck, paving machine, dump trucks to haul in the asphalt, and a roller compactor.

3.1.1.3 Construction Schedule

Phase 1 construction is planned to begin in 2006, and estimated to take 12 months to complete. Figure 3-4 shows the schedule of activities for Phase 1. The construction schedule is approximate; actual duration of activities may vary.

3.1.2 Phase 2 Construction Activities

Proposed construction activity locations for Phase 2 are illustrated in Figure 3-5. Table 3-3 describes these activities and provides their approximate durations, affected times of the day, and work zones.

Text descriptions of ductline and circuit installations and substation modifications are presented in Section 3.1.2.1, followed by descriptions of construction methods and equipment in Section 3.1.2.2, and the construction schedule in Section 3.1.2.3.

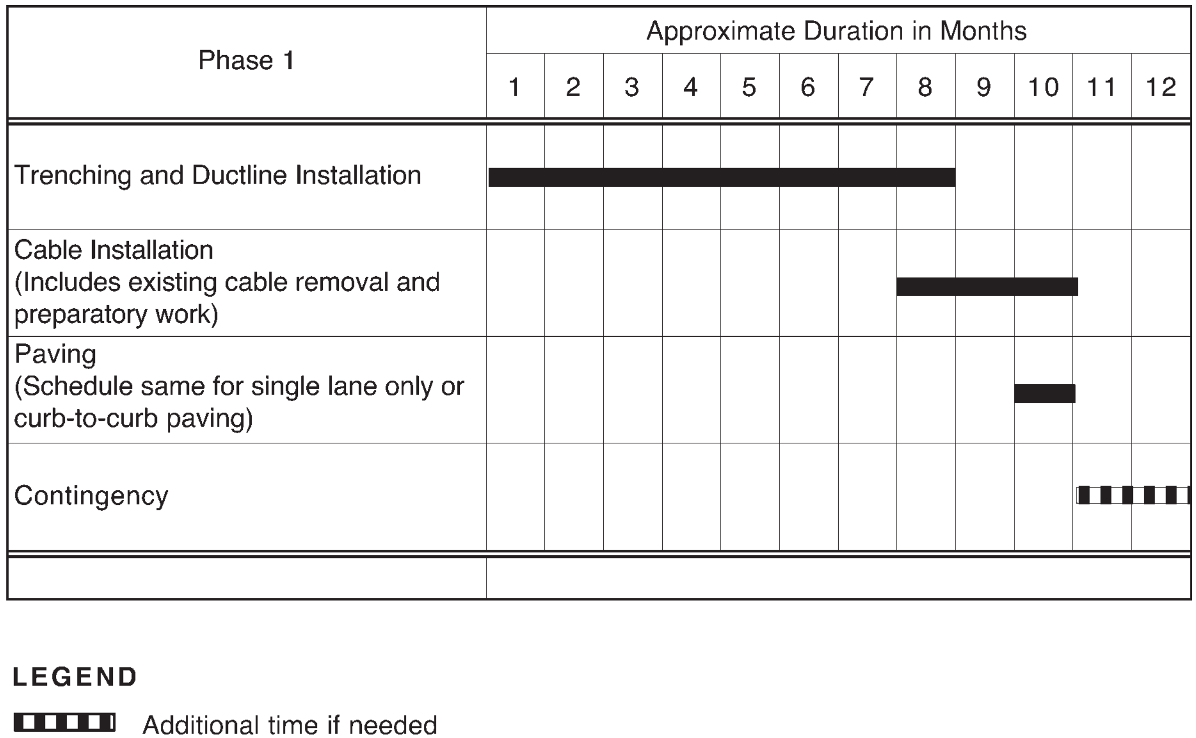

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Figure 3-4
PHASE 1 CONSTRUCTION SCHEDULE

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East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

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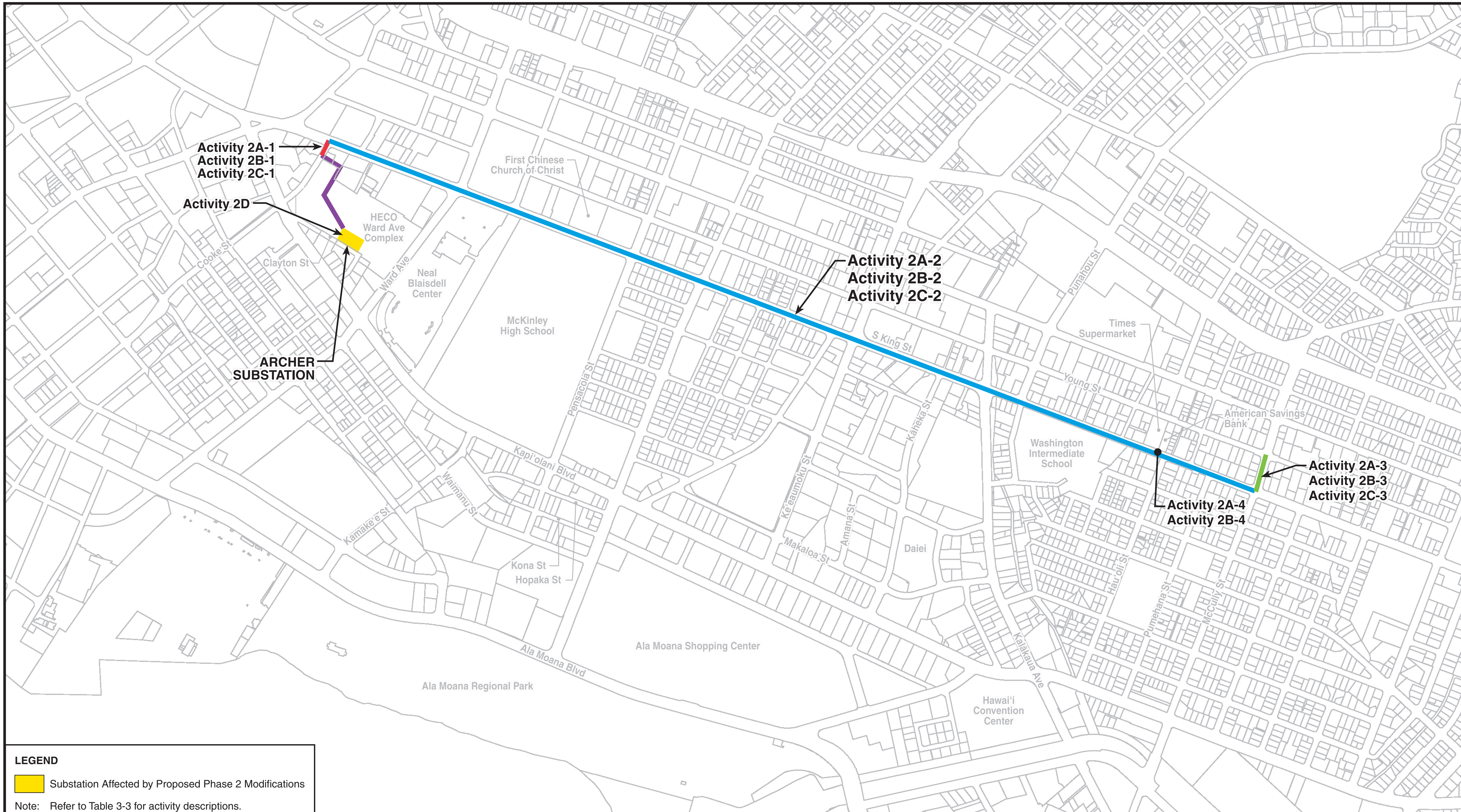


LEGEND

Substation Affected by Proposed Phase 2 Modifications

Note: Refer to Table 3-3 for activity descriptions.

NORTH

0 200 400
SCALE IN FEET

Figure 3-5
PROPOSED CONSTRUCTION ACTIVITIES—PHASE 2

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

Table 3-3. Phase 2 Construction Activities

Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
2A-1	Cooke Street	Trench and construct new underground ductline from Archer substation to the intersection of Cooke and King.	One month.	Nighttime.	**Work Zone:** Two lanes by 300 feet, inclusive of staging. **Transition Zone:** 300 feet.
2A-2	King Street	**Trenching option in specific areas (preferred):** Trench and construct underground ductline along King from Cooke to McCully.	Six months.	Evaluate both nighttime and daytime.*	**Work Zone:** Two lanes by 300 feet inclusive of staging. **Transition Zone:** 300 feet. Average progress of 60 lineal feet per day (including preparation activities, e.g., spot survey and manhole preparation).
	King Street	**Directional drilling option:** Drill and install ductline along King from Cooke to Punahou Street using directional drilling; trench remainder to McCully.	Approximately 28 weeks (seven months) for drilling (three to four weeks at seven manholes); six weeks for trenching remaining sections.	Evaluate both nighttime and daytime, and consider school schedules.*	**Work Zone:** Two traffic lanes (second and third makai lane) by 100 feet, and 500-foot laydown for ductline (at next manhole), close curb lane for one hour to move ductline in position. **Transition Zone:** 300 feet for all areas. Assume 24-hour per day closure in vicinity of staging areas for directional drilling.
2A-3	McCully Street	Trench and construct new underground ductline along McCully from manhole in King to pole on Young. Replace wood pole.	One month.	Evaluate both nighttime and daytime.	**Work Zone:** One lane and sidewalk by 200 feet, inclusive of staging. **Transition Zone:** 150 feet.

* Nighttime work preferred on King Street.

Table 3-3. Phase 2 Construction Activities *(continued)*

Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
2A-4	King Street	Trench and construct new underground ductline from manhole in King to poles fronting McCully Times Supermarket and American Savings Bank on King. Replace wood poles.	One month.	Evaluate both nighttime and daytime.	**Work Zone:** Two lanes by 300 feet, inclusive of staging. **Transition Zone:** 150 feet.
2B-1	Cooke Street	Install 46kV circuits in new underground ductline from Archer substation to the intersection of Cooke and King.[3]	Two weeks.	Evaluate both nighttime and daytime.	**Work Zone:** One lane by 100 to 150 feet during pulling and 50 to 100 feet during splicing, centered around manhole. **Transition Zone:** 150 feet.
2B-2	King Street	Install 46kV circuits in new underground ductline along King from Cooke to McCully.[3]	Two months.	Evaluate both nighttime and daytime.	**Work Zone:** One lane by 100 to 150 feet pulling and 50 to 100 feet splicing, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.
2B-3	McCully Street	Install 46kV circuit in new underground ductline along McCully from King to Young.[3]	Two weeks.	Evaluate both nighttime and daytime.	**Work Zone:** One lane by 100 to 150 feet pulling and 50 to 100 feet splicing, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.
2B-4	King Street	Install 46kV circuits in new underground ductlines from manhole in King to existing overhead poles fronting McCully Times Supermarket and American Savings Bank.[3]	One week.	Evaluate both nighttime and daytime.	**Work Zone:** One lane by 100 to 150 feet pulling and 50 to 100 feet splicing, centered around manhole, inclusive of staging. **Transition Zone:** 150 feet.

Table 3-3. Phase 2 Construction Activities *(continued)*

Activity No.[1]	Segment	Activity	Approximate Duration	Time of Day[2]	Work Zones
2C-1	Cooke Street	Pave trenched areas of Cooke.	One day (600 to 800 feet per day).	Evaluate both nighttime and daytime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 150 feet.
2C-2	King Street	Pave trenched areas of King.	Two weeks (1,000 lane-feet per day).	Evaluate both nighttime and daytime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 150 feet.
2C-3	McCully Street	Pave trenched areas of McCully.	One day (600 to 800 lane-feet per day).	Evaluate both nighttime and daytime.	**Work Zone:** Two lanes, maximum 500 feet. **Transition Zone:** 150 feet.
2D	Archer Substation[4]	Install new 138kV-46kV transformer and associated equipment.	12 months.	Daytime.	Not applicable, all work would be conducted inside substation.

Notes:

1 The activities would proceed in the order presented. Activity number shows the phase (first digit), activity grouping second letter), and order within activity group (third digit).

2 Daytime hours are from 9:00 A.M. to 3:00 P.M., nighttime hours are 8:00 P.M. to 5:00 A.M.

3 Circuit installation, to occur after installation of new ductline, consists of pulling and splicing.

4 Completion of work at Archer Substation should coincide with all other Phase 2 work.

3.1.2.1 Ductline, Circuit, and Substation Installations and Modifications

3.1.2.1.1 Ductlines and Circuits

Phase 2 involves the installation of three new underground 46kV circuits. To install the new underground circuits, concrete-encased ductlines and manholes are required. Typical views and cross-section of these underground facilities are shown in Figure 3-3. The new underground 46kV circuits (Archer 45, Archer 47, and Archer 48) would interconnect a new 138kV/46kV, 80 MVA transformer at Archer Substation (described in Section 3.1.2.1.2) to three existing 46kV circuits (Pūkele 7, Pūkele 6, and Pūkele 5) terminating at the Pūkele Substation. A general description of the new 46kV circuit installations follow:

Activities 2D and 2B-1

New cable trays in Archer Substation would be installed to route the circuits out of the enclosed substation located on HECO's Ward Avenue facility near the corner of Cooke Street and King Street in Kakaʻako. See Table 3-3 and Figure 3-5.

Activities 2A-1, 2A-2, 2B-1, 2B-2, 2C-1, and 2C-2

Once outside of the enclosed substation, a new ductline carrying the three new underground 46kV circuits (Archer 45, Archer 47, and Archer 48) would be constructed and routed through HECO's property onto Cooke Street. On Cooke Street, the ductline proceeds mauka until King Street then proceeds in the Koko Head direction on King Street until Hauʻoli Street. See Table 3-3 and Figure 3-5.

Activities 2A-4, 2B-4, and 2C-2

Near the King Street and Hauʻoli Street intersection, the Archer 48 underground 46kV circuit branches off into a separate ductline that terminates at a new wood pole (which replaces an existing wood pole in the same location) located on King Street fronting the McCully Times Supermarket parking lot. The wood pole would carry the existing Pūkele 5 overhead 46kV circuit, which would be connected to the new Archer 48 circuit at this point. See Table 3-3 and Figure 3-5.

Activities 2A-4, 2B-4, and 2C-2

Also near the King Street and Hauʻoli Street intersection, the Archer 47 underground 46kV circuit branches off into a separate ductline that terminates at a new wood pole (which replaces an existing wood pole in the same location) located on King Street fronting American Savings Bank. The wood pole would carry the existing Pūkele 5 overhead 46kV circuit, which would be connected to the new Archer 47 circuit at this point. See Table 3-3 and Figure 3-5.

Activities 2A-3, 2B-3, and 2C-3

The Archer 45 underground 46kV circuit continues in the Koko Head direction on King Street in a separate ductline until McCully Street then proceeds in the mauka direction until Young Street. At Young Street, the ductline would terminate at a new wood pole (which replaces an existing wood pole in the same location) carrying the existing Pūkele 7 overhead 46kV circuit, which would be connected to the new Archer 45 circuit at this point. See Table 3-3 and Figure 3-5.

Activities 2C-1, 2C-2, and 2C-3

Paving associated with trenching activities, as required by City and County of Honolulu Ordinance, would occur after completion of ductline construction. However, it should be noted that the City Managing Director, with the concurrence of the Mayor, issued a curb-to-curb repaving policy for trench work by utilities (memo dated January 27, 2004). The curb-to-curb repaving requirements are much more extensive than what the Ordinance requires. Since issuance of the policy, a task force consisting of City and County of Honolulu personnel and utilities has been formed to evaluate the practicality of the policy and recommend changes.

3.1.2.1.2 Substations

Phase 2 also involves substation modifications at Archer Substation located on HECO's Ward Avenue facility near the corner of Cooke Street and King Street in Kaka'ako (Activity 2D). This activity includes the installation of one 138kV/46kV, 80 MVA, standard sound level transformer; redundant air handling equipment; 138kV circuit breakers; protective relaying; and control cables. Site development work includes knocking out a concrete masonry unit (CMU) wall at Archer Substation to install the transformer and then replacing the wall, one 12 foot by 18 foot transformer pad, 485 cubic yards of rock fill, 35 feet of six 5-inch ducts and 50 feet of three 3-inch ducts.

3.1.2.2 Construction Methods and Equipment

Proposed construction methods and typical equipment used to perform this work are described herein. A list of construction equipment is included in Table 3-4.

Table 3-4. Typical Equipment for Phase 2 Construction Activities

Activity Type[1]	Typical Equipment
Pole Replacement Activity 2A-3 and 2A-4	Flatbed boom truck with crane Truck with "cherry picker" bucket Concrete mixer (or ready-mix truck)
Ductline Construction and Installation – Conventional Trenching Activity 2A-1, 2A-2, 2A-3, 2A-4	Flatbed boom trucks Backhoe Crane Pavement cutter Ready-mix concrete trucks Excavator Dump truck
Ductline Construction and Installation – Directional Drilling Activity 2A-2	Drilling rig Crane Bentonite mud handling truck Rollers Vacuum extractor truck Dumpster/dump truck
Manhole Installation Activity 2A-1, 2A-2, 2A-3, 2A-4	Pre-cast manholes Excavating equipment Dump truck
Circuit Installation Activity 2B-1, 2B-2, 2B-3, 2B-4	Pickup trucks Cable-reel trailers Self-propelled cable trailers Line truck with winch
Paving Activity 2C-1, 2C-2, 2C-3	Drum roller planer Tractor with power broom attached to the front Rubber-tire backhoe Tack coat oil truck Paving machine Dump trucks Roller compactor
Archer Substation Modification Activity 2D	Flatbed truck Utility vans Crane Ready-mix concrete truck

Notes:
[1] See Table 3-3 for more detailed activity descriptions.

3.1.2.2.1 Trenching and Ductline Installation

Conventional open trenching methods proposed would be the same as those described in Section 3.1.1.2.

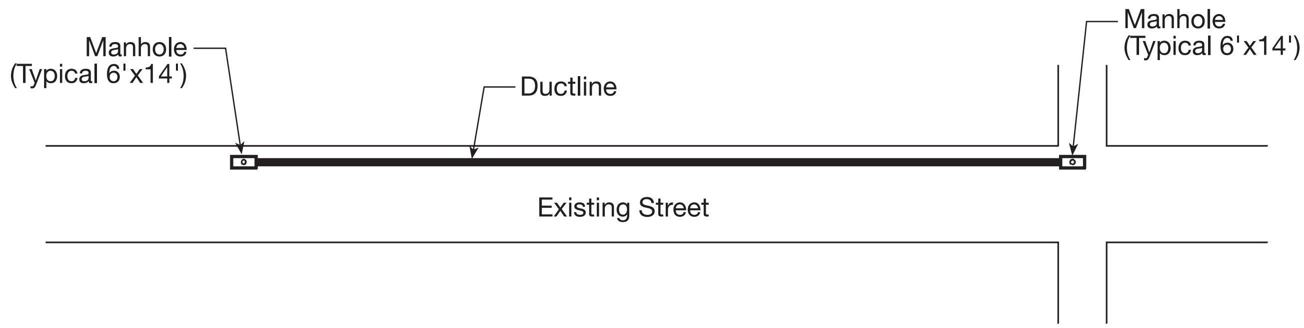
3.1.2.2.2 Horizontal Directional Drilling and Ductline Installation

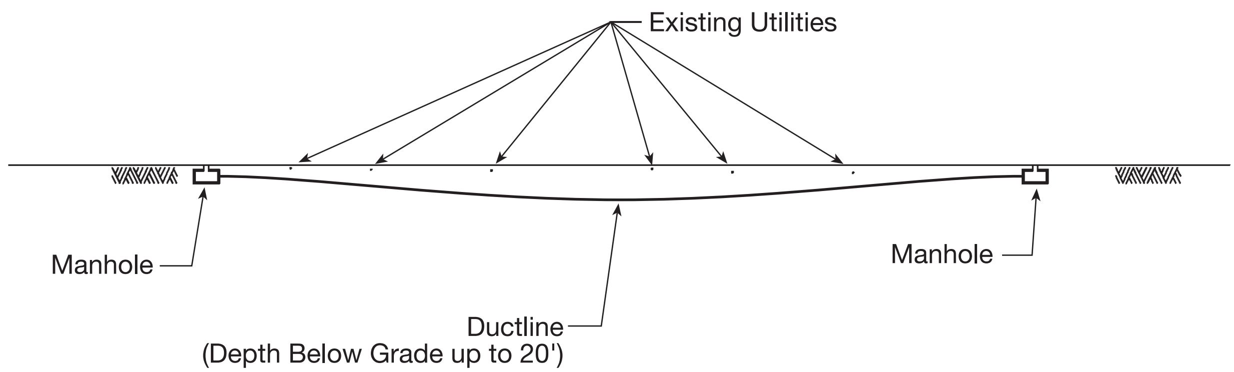
At the request of the City's Facility Maintenance Department, horizontal directional drilling (HDD) was considered as an optional installation method. *The Hawaiian Electric Company, Inc., East O'ahu Transmission Project Phase 2–46kV Lines, Horizontal Drilling Feasibility Study* (Power Engineers 2004) was prepared to evaluate the feasibility of installing three 46kV circuits in King Street from Cooke Street to McCully Street using HDD technology (Appendix A).

HDD is a construction method that uses a drill rig to install underground pipes or casings. Drilling would follow a pre-planned underground profile, which would be designed to avoid conflicts with existing utilities and known sensitive areas below the ground surface. Therefore, drilling profiles would typically be designed to be deep enough to avoid any known potential conflicts. Figure 3-6 illustrates typical views and a cross-section of the directional drilling option. When HDD is used, trenching is typically limited to areas where the drill enters and exits the ground and areas of a project where drilling is not feasible. Heavy equipment is required at both the entry and exit pits located at each end of the drilling bore, and this equipment must generally remain in position while the installation progresses to completion.

Some of the major technical factors that must be evaluated for the use of HDD include:

- Conducive soil conditions that would allow heat from the cables to dissipate sufficiently. The ampacity, or the magnitude of electric current, that an underground electrical cable can carry is affected by the ability to dissipate heat from the cable. The ampacity of a cable decreases the hotter a cable gets. Typically, directional drilling profiles are deeper than conventionally trenched ductline installations to avoid conflicts with subsurface obstacles, such as existing utilities. A consequence of having the cables installed deeper underground is that heat dissipation is reduced, thereby decreasing the cable ampacity. With the greater depth of installation for HDD ductlines, soil conditions become a more significant factor and play a critical role in the heat dissipation process.





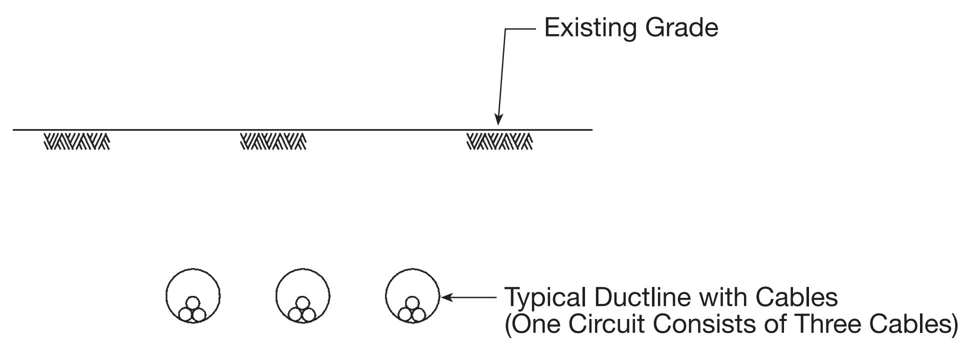


Figure 3-6
TYPICAL DUCTLINE AND CIRCUITS FOR DIRECTIONAL DRILLING OPTION

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East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

- Conducive geological conditions that would allow the drilling to be controlled. If the project area has "mushy" soil conditions or there are underground caverns present, it is difficult to control the direction of the drill head. This is critical when known subsurface obstacles to be avoided are in the project area.
- Availability of work areas for drilling equipment and pipe assembly. The work area required for drilling equipment typically ranges from 12 feet by 100 feet for a small to medium size HDD drill rig, up to 100 feet by 150 feet for a large drill rig, depending on the set-up configuration of the HDD drilling equipment. Pipe assembly space depends on the drill lengths required. For example, if the drill length is 1,000 feet, approximately that amount of linear workspace is needed to lay down that length of pipe in preparation to be pulled into the bore.

In applying the above factors for Phase 2, the following determinations were made:

- From a heat dissipation perspective, the soil conditions on King Street near Punahou Street are not conducive for dissipating the heat from the proposed circuits. As a result, the last 25 to 30 feet from the ends of the bores to the manhole locations, where the drills near the surface, should be trenched and the native soil replaced with fluidized thermal backfill
- HDD techniques require nearly straight sections. In the Archer Substation/Cooke Street area, numerous bends are required to route the cables from the substation located within HECO's Ward Avenue facility, onto Cooke Street and then around the corner onto King Street and therefore this segment should be conventionally trenched.
- From a workspace requirements perspective, in the area Koko Head of Washington Middle School to McCully Street, there is insufficient workspace and lay down areas to consider HDD.
- From a drilling perspective, the soil conditions appear to be conducive for drilling.

Given the above determinations, HDD could only be considered for King Street, from Cooke Street to Punahou Street. The remaining sections of Phase 2 would require conventional trenching for the proposed circuit installations.

Drilling would proceed in 500-foot segments along King Street from Cooke Street to Punahou Street. For each segment of directional drilling, equipment set up in one area would remain in place for the duration of the construction activity. An entrance pit and exit pit would be located at each end of the 500-foot segment to be drilled. The drill head would be guided electronically underground from the entrance pit, sloping beneath the surface to depths of approximately 20 feet below ground surface (bgs) before being directed toward the surface to the exit pit. Progressive passes with a larger reamer would increase the size of the borehole; a total of three reams are planned. The borehole would be kept open and the drill head lubricated by application of a bentonite mud slurry injected through the drill pipe into the borehole. The drilling process is estimated to take approximately two days for each bore. High Density Polyethylene (HDPE) pipe casing (rather than concrete encased ductline used with open trenching) would then be assembled. This process is expected to take about ten to twelve hours and would require an additional 500 feet of the lane to be blocked off beyond the exit pit. To avoid blocking cross traffic on major cross streets, such as Kalākaua Avenue, it would be necessary to install the product pipeline in a shallow trench that is plated to provide "storage" area for the assembled casing.

Once assembled, the HDPE pipe casing would be pulled back through the borehole from the exit pit toward the entrance pit where the drilling rig is located, a process that is estimated to take 10 hours. The overall process of drilling, pipe casing assembly, and pipe casing pullback is repeated six times at each drill rig set up, three in each direction. On King Street from Cooke Street to Punahou Street, it estimated that the drill rig would be set up at seven different locations.

HDD equipment would be set up at the entrance and exit areas, with the majority of the equipment set up at the entrance pit. This set up would include the following equipment:

- 30,000 to 50,000 pound drill rig,
- drill pipe to run the length of the alignment,
- a crane to lift the drill pipe to the attachment point,
- a mud mixing truck,
- a control unit with a power plant to control the equipment and guide the drill head underground,
- vacuum extractor truck to remove excess mud,
- rollers to lay the assembled ductline prior to installation, and
- dumpster or dump truck.

Additional staging would be required for pipe and equipment storage. Possible staging locations include McKinley High School, Washington Middle School, and the HECO property at Cooke Street.

In summary, the HDD alternative offers no significant advantages over conventional trenching for Phase 2. The cable ampacity impacts, workspace limitations, and traffic disturbances are significant constraints in utilizing HDD on King Street. Furthermore, the uncertainty in securing needed permits and approvals for allowing the equipment and the pipe assembly to remain on the roadway around the clock until the drilling and pulling operations are complete for a given segment does not support further consideration of this alternative.

3.1.2.2.3 Manhole Installation

Manhole installation would be similar to that described in Section 3.1.1.2.

3.1.2.2.4 Substation Modifications

Modifications to the Archer Substation would be similar to those for the Kamoku Substation described in Section 3.1.1.2.

3.1.2.2.5 Installation of New Circuits

The installation of new circuits would be similar to that described in Section 3.1.1.2. For directional drilling, the length of the circuit pulling would extend approximately 500 feet from the entrance pit to the exit pit, where a manhole would be installed and the circuits connected. Figure 3-6 shows the typical configuration of circuits and ductlines using directional drilling, including a conceptual plan and profile view of the segments.

3.1.2.2.6 Paving

Paving activities would be similar to those described in Section 3.1.1.2. Paving would only be required in the sections that are trenched and where the entrance and exit pits are located.

3.1.2.3 Construction Schedule

The Phase 2 construction schedule is flexible and would be coordinated with City and County of Honolulu agencies so as not to conflict with other projects along King Street. City and County of Honolulu projects are scheduled for as early as 2004 and as far as 2015. Figure 3-7 shows the schedule of activities for Phase 2. The construction schedule is approximate; actual duration of activities may vary.

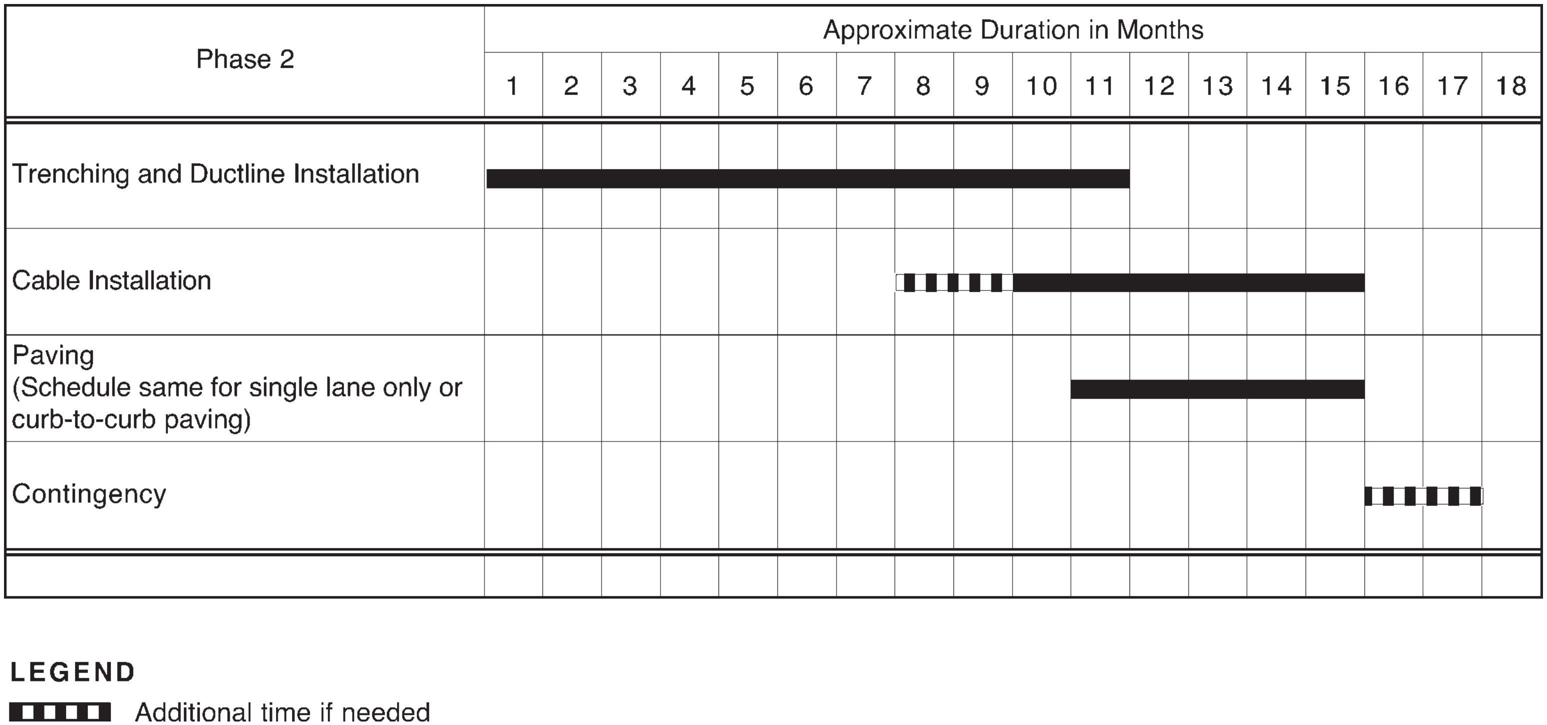

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Figure 3-7
PHASE 2 CONSTRUCTION SCHEDULE

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Hawaiian Electric Company, Inc.

3.1.3 Operational Activities

This Section addresses how the reliability concerns and overload situations identified in Chapter 2 would be addressed by the Proposed Action. The implementation of the 46kV Phased Project would allow electrical loads currently being served exclusively from Pūkele Substation, located at the end of the Northern 138kV Transmission Corridor, to also be served from Kamoku Substation and Archer Substation, located in the Southern 138kV Transmission Corridor. Essentially, this project allows load to be shifted among the three substations using 46kV lines, and also allows the substations to back up each other. These operating features will address the four transmission problems in varying degrees.

- First, some of Pūkele Substation's existing electrical load would be shifted to Archer Substation and Kamoku Substation with the implementation of the project. This will reduce the overall Ko'olau/Pūkele Service Area load, which will relieve the potential overload situation of the 138kV transmission lines transporting power to the area for the 20-year study period.
- Second, most of the loads transferred from Pūkele Substation to Archer Substation and Kamoku Substation as a result of the implementation of this alternative, plus some existing load currently served by Archer Substation (through the Pi'ikoi Distribution Substation), could temporarily be shifted to Pūkele Substation when a transmission line providing power to the Downtown Service Area is taken out of service for maintenance. This would reduce the load in the Downtown Service Area while the line is out of service, and avoid accelerating the overload situation. This load shift would only be done when there is a possibility that the overload situation would occur. After the line taken out for maintenance has been restored to service, load would be shifted back from Pūkele Substation to the Downtown Service Area.
- Third, some of Pūkele Substation's existing electrical load would be shifted to Archer Substation and Kamoku Substation with the implementation of this project. Therefore, if the two 138kV transmission lines serving Pūkele Substation were to be lost, the loads that were transferred to Archer Substation and Kamoku Substation because of this alternative would not experience an outage. The loads that continue to be served by Pūkele Substation even after the implementation of this alternative would experience a momentary outage (approximately six seconds) as these loads are automatically transferred to Archer Substation and Kamoku Substation (as well as to Ko'olau Substation).
- Fourth, if the two 138kV transmission lines that serve Archer Substation are lost, some of the loads served by Archer Substation, Kewalo Substation and Kamoku Substation would experience an outage, but other Archer

Substation loads would experience a momentary outage (approximately six seconds) as these loads are automatically transferred to Pūkele Substation.

Table 3-5 summarizes the operational activities made possible with the completion of Phase 1 and Phase 2 construction activities.

Table 3-5. Summary of Operational Activities

Problem	Phase 1	Phase 2
Pūkele Substation Reliability Concern (Date problem is anticipated: present)	• Shifts about 80 MW of existing load from the Northern Corridor (Pūkele) to the circuits from substations on the Southern Corridor (Archer and Kamoku). • In the event of an outage, automatically transfers the load from some Pūkele circuits to Kamoku Substation circuits.	• In the event of an outage at Pūkele Substation, additional 46kV feeder connections between Archer, Kamoku, and Pūkele Substations would provide connections to back up some of the power. • In the event of a substation outage, allows remaining load from Pūkele to be shifted to Archer, Kamoku and Koʻolau Substations.
Koʻolau/Pūkele Overload Situation (Date problem is anticipated: 2005)	• Shifts about 80 MW of existing load from Pūkele to Archer and Kamoku Substations, which reduces Pūkele load below the 362 MW overload threshold.	• No effect. Phase 1 operational activities would eliminate Koʻolau/Pūkele Overload for 20-year period studied.
Downtown Substation Reliability Concern (Date problem is anticipated: present)	• In the event of downtown substation outages, 38 MW, or 39 percent of the load served by downtown substations, could be served by Pūkele Substation via 46kV subtransmission lines.	• Addition of circuits between Archer and Pūkele Substations would increase the likelihood of transferring entire Archer load to Pūkele.
Downtown Overload Situation (Date problem is anticipated: 2023)	• In the event that one of the three 138kV transmission lines is taken out of service, about 71 MW of Pūkele load previously transferred from Pūkele to Downtown could be shifted back temporarily. • In addition, 14 MW of load from Piʻikoi Distribution Substation (served from Archer) could be shifted temporarily to Pūkele.	• No effect.

Note:
The loads reflected in this table and in Section 3.1.3 are based on the loads at the time of the 2002 Day Peak, as adjusted for the 46kV and 25kV configuration changes identified in Section 2.5.

3.1.3.1 Pūkele Substation Reliability Concern

Phase 1 would transfer approximately 80 MW (approximately 41 percent of demand in the existing Pūkele Service Area) of load from Pūkele Substation to Archer and Kamoku Substations (Figure 3-8), leaving the remaining 116 MW or 59 percent of the demand in the existing area without instantaneous back-up. Hence, should both of the 138kV transmission lines between Koʻolau and Pūkele become unavailable, the areas receiving the transferred 80 MW of electricity would not be affected. For the remaining 116 MW, approximately 63 MW, representing 32 percent of the existing Pūkele Service Area, would be automatically transferred at various distribution substations to Archer, Kamoku, and Koʻolau 46kV feeders. Automatic transfers would require brief interruption of power lasting up to six seconds.

The last approximately 53 MW, representing 27 percent of the existing Pūkele Service Area, would be manually switched to 46kV lines from the Koʻolau Substation if there is an extended outage of the Pūkele Substation. Manual transfers would require HECO personnel to go to various locations to manually switch the loads, which is estimated to take up to two to four hours. Manual transfers would take place inside the substations and on switches on overhead poles outside the substations.

Phase 2 would provide back-up feeds to areas that would continue to be served primarily from Pūkele Substation after Phase 1 is implemented (Figure 3-9). Should both 138kV transmission lines between the Koʻolau and Pūkele Substation be unavailable, back-up sources would be automatically initiated (Figure 3-9). During this transfer of electrical loads, the areas served by Pūkele Substation, after Phase 1 is implemented, would experience no more than a six-second outage while the other areas transferred to Archer and Kamoku Substations would not be affected. Table 3-6 summarizes the anticipated effects of the automatic transfer of electrical load should both 138kV transmission lines become unavailable after Phases 1 and 2 of the Proposed Action are implemented. This would resolve the Pūkele Substation Reliability Concern (described in Section 2.1), although some customers could still have interruptions of up to six seconds.

Table 3-6. Operational Impacts Under Pūkele Substation Reliability Concern

Distribution Substation	No Interruption	Six-second Interruption	Two- to Four-hour Outage
Phase 1			
McCully	X		
ʻEna (portion)	X	X	
Waikīkī (portion)	X	X	
Kapahulu (portion)	X	X	
Kapiʻolani (portion)	X	X	

Table 3-6. Operational Impacts Under Pūkele Substation Reliability Concern *(continued)*

Distribution Substation	No Interruption	Six-second Interruption	Two- to Four-hour Outage
Phase 1 *(continued)*			
Kaimukī (portion)	X	X	
Kūhiō	X		
Aina Koa (portion)		X	
Mōʻiliʻili		X	
Kāhala			X
Waiʻalae			X
Pūkele			X
Mānoa			X
Woodlawn			X
UH-Quarry			X
East-West Center			X
% of Existing Pūkele Service Area	41	32	27
Phase 2			
McCully	X		
ʻEna (portion)	X	X	
Waikīkī (portion)	X	X	
Kapahulu (portion)	X	X	
Kapiʻolani (portion)	X	X	
Kaimukī (portion)	X	X	
Kūhiō	X		
Aina Koa (portion)		X	
Mōʻiliʻili		X	
Kāhala		X	
Waiʻalae		X	
Pūkele		X	
Mānoa		X	
Woodlawn		X	
UH-Quarry		X	
East-West Center		X	
% of Existing Pūkele Service Area	41	59	0

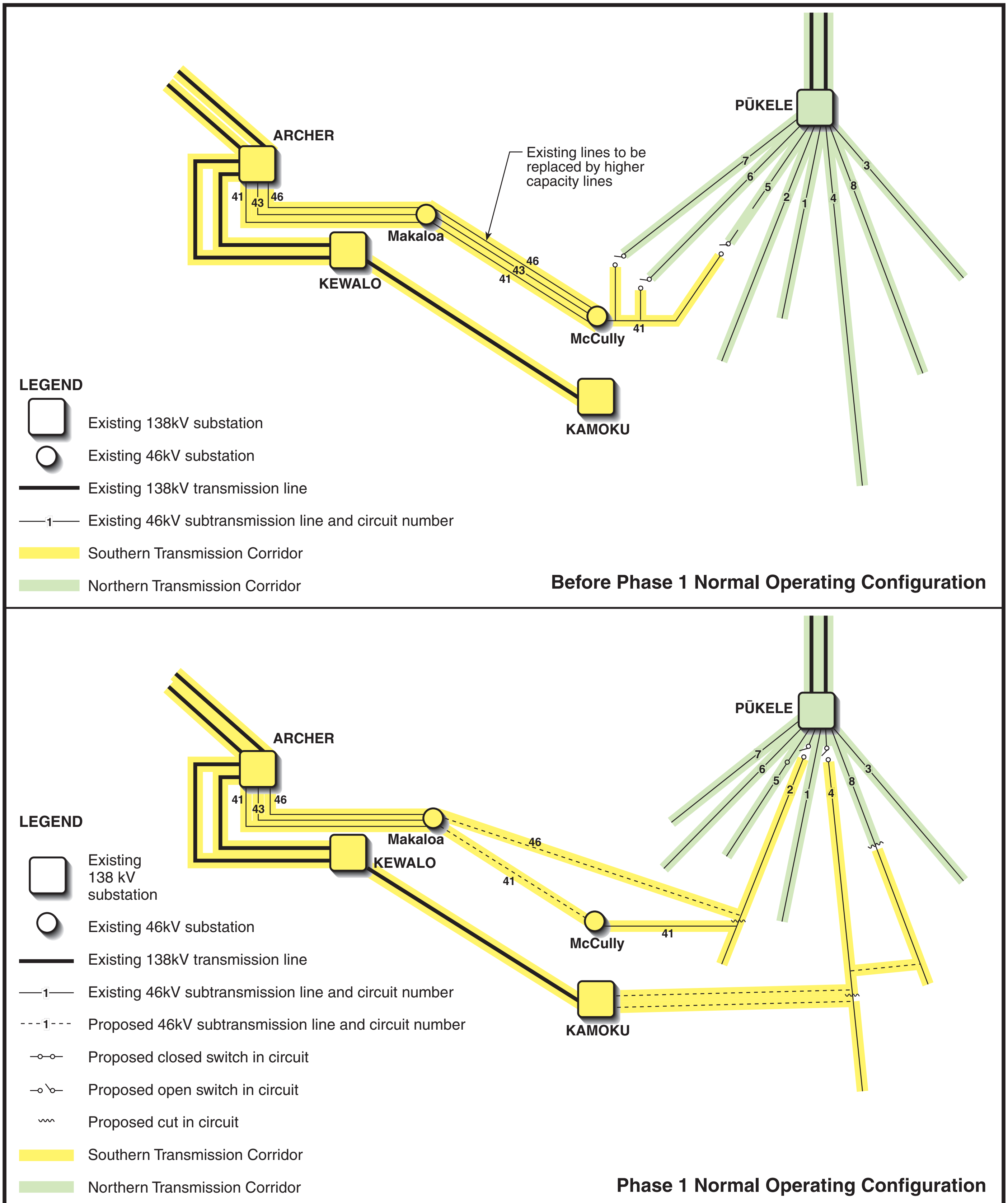

Figure 3-8
DIAGRAM OF OPERATIONAL CAPABILITY—PHASE 1

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Hawaiian Electric Company, Inc.

DIAGRAM NOT TO SCALE

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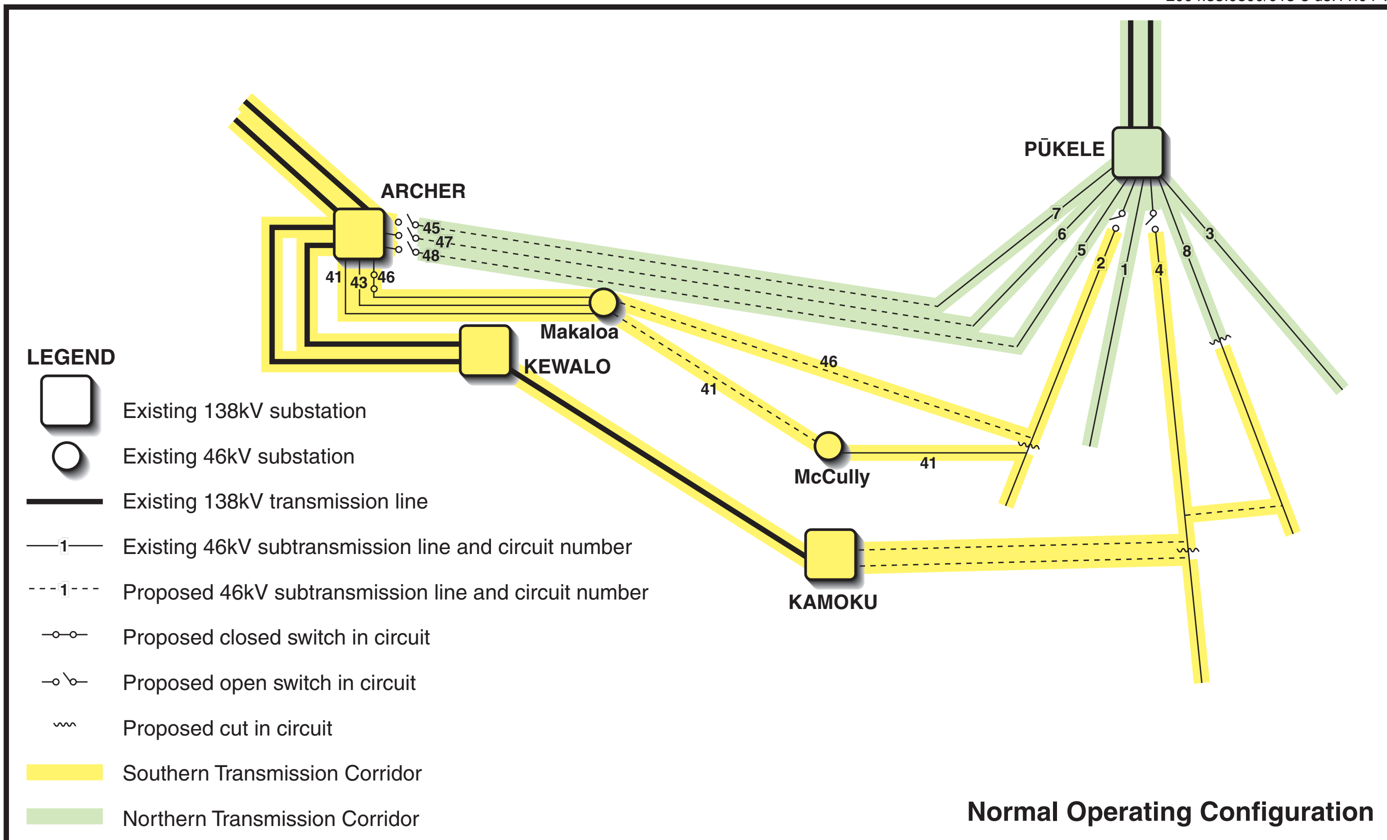

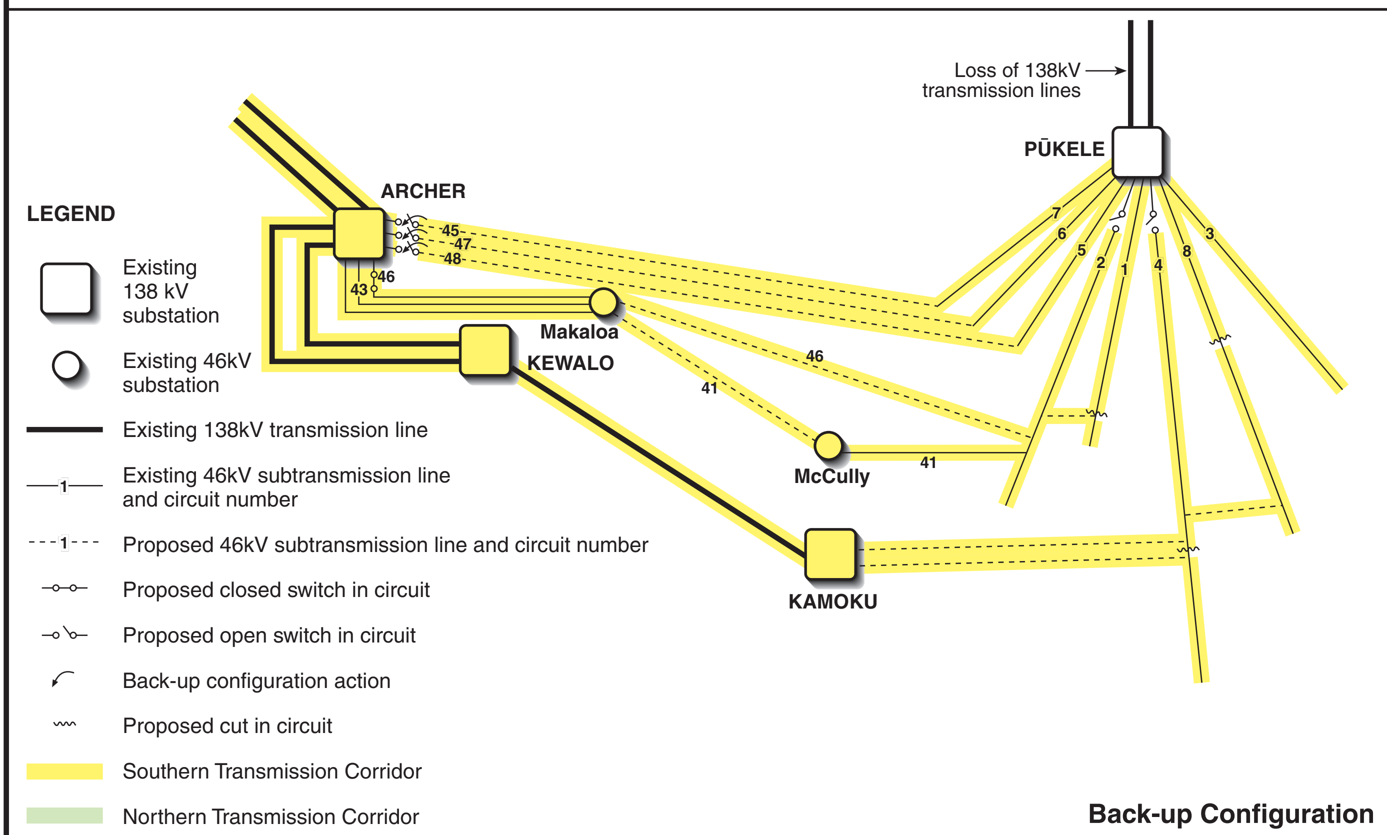

Figure 3-9
DIAGRAM OF OPERATIONAL CAPABILITY—PHASE 2

Environmental Assessment for the 46kV Phased Project
East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

DIAGRAM NOT TO SCALE

3.1.3.2 Koʻolau/Pūkele Overload Situation

Phase 1 would allow substations in the Southern 138kV Transmission Corridor to provide service to some areas currently being served by Pūkele Substation (Figure 3-8). Specifically, 80 MW of electrical load would be transferred from the Koʻolau/ Pūkele area (Figure 3-8 Existing Conditions) to the Archer and Kamoku Substations (Figure 3-8 Phase 1 Normal Operating Configuration). The load shift is expected to remain in this configuration under normal operating conditions and would reduce the combined load at the Koʻolau and Pūkele Substations to a level below 362 MW, which is the amount of combined load that triggers an overload condition on the remaining line to Koʻolau Substation. The reduction in combined load with the implementation of Phase 1 would resolve the Koʻolau/Pūkele Overload Situation (described in Section 2.2) for the 20-year period studied.

Phase 2 would have no additional effect on the Koʻolau/Pūkele Overload Situation, as Phase 1 activities would resolve the concern.

3.1.3.3 Downtown Substation Reliability Concern

Phase 1 (Figure 3-8 Phase 1 Normal Operating Configuration) would partially resolve the Downtown Substation Reliability Concern (described in Section 2.3). It would provide a backup to about 38 MW, representing 39 percent of the load served by downtown substations (Archer, Kewalo, and Kamoku Substations) via 46kV subtransmission lines from Pūkele Substation if Archer Substation loses its two 138kV transmission line feeds. A momentary outage would occur while the load is automatically transferred to the Pūkele Substation. Under Phase 1, 61 percent of the load served by the downtown substations would not be served, resulting in outages in the affected areas.

Under Phase 2, it would be technically feasible to transfer all or most of the load served by Archer Substation to Pūkele Substation based on the current estimated loading at Archer Substation and the capacity of the Pūkele transformers. With this load transfer, however, there may be low voltage situations on the 46kV systems, and further analysis is needed to determine whether further steps should be taken to allow the complete transfer of the load at Archer Substation to Pūkele Substation. In the event of a catastrophic failure to the Archer 138kV duct line, HECO could consider transferring the Archer load to the Pūkele Substation by transferring load by feeders, ensuring that low voltage and overload situations do not occur on the 46kV system, until the Archer 138kV duct line and/or cables can be repaired.

3.1.3.4 Downtown Overload Situation

The Downtown Overload Situation (described in Section 2.4) is not forecast to occur until 2021. If the 80 MW transferred to Archer and Kamoku Substations continues to be served by these substations in situations in which two out of the three downtown 138kV transmission lines could be out of service, the Downtown Overload Situation will be accelerated. However, with the installation of the project, it is HECO's plan to shift load back to the Pūkele Substation if one of the downtown 138kV lines is taken out of service for maintenance, or experiences a prolonged forced outage.

After the installation of Phase 1, not all of the 80 MW of load shifted from Pūkele Substation to downtown substations can be transferred back to Pūkele Substation when maintenance is being performed on one of the downtown transmission lines. This is due to limitations on the load that can be carried by the 46kV circuits (taking into account the substation transformer loads normally served by the circuits, plus the additional loads that the circuits must be able to serve as a result of automatic load transfers due to outages of other circuits). Based on the planned circuit configuration, approximately 9 MW originally served by the Pūkele Substation would not be transferred back from the Archer Substation. The remaining 9 MW of load, which cannot be shifted, can be replaced by temporarily shifting 14 MW additional load from the Piʻikoi Substation (located between the Archer and Pūkele Substations, and served from the Archer Substation) to the Pūkele Substation. These actions would restore the load to the 2004 level prior to the planned transfer of load in 2004 from Pūkele Substation to Archer Substation as described in Section 2.5, and avoid accelerating (or even deferring) the Downtown Overload Situation.

If the Downtown Overload Situation continues to develop as projected, HECO could create the flexibility (with minor circuit modifications that are not currently planned) to shift additional load to Pūkele Substation when a Downtown Area transmission line is taken out of service for maintenance, which could further defer the line overload situation for up to a few years.

Phase 2 activities would not provide additional relief from this situation.

3.2 DESCRIPTION OF ALTERNATIVES

3.2.1 Background

HECO, with assistance from utility experts, has identified and evaluated a wide variety of options to address East Oʻahu transmission problems (identified in Section 1.2 and discussed in Chapter 2) during the past 10 years. This section describes the alternatives to the Proposed Action that are evaluated in this EA, including the No Action alternative, and the alternatives that were considered but eliminated from further analysis.

3.2.2 Alternatives Evaluated In This EA

3.2.2.1 Alternative Alignments Between Makaloa and McCully Substations

Alternative alignments are being considered based on requests made subsequent to the public input process of 2003. These alternative alignments would route the two new 46kV circuits away from certain residential areas as much as practical by using Kapiʻolani Boulevard. The alternative alignments are variations on the Proposed Action; each would require installation of new ductlines along the entire length from the Makaloa Substation to the McCully Substation. The paths of these alignments all begin at the Makaloa Substation and proceed as shown in Figure 3-10, and as described in the following subsections.

3.2.2.1.1 Alternative Alignment 1

From the Makaloa Substation, the circuits in new ductline would exit the substation to Makaloa Street, proceed in the Koko Head direction until Kāheka Street, continue on Kāheka Street in the makai direction to Kapiʻolani Boulevard and proceed in the Koko Head direction on Kapiʻolani Boulevard to Pumehana Street. At Pumehana Street, the circuits in new ductline would then proceed in the mauka direction to Lime Street at the McCully Substation. This alignment is depicted by the purple line in Figure 3-10.

3.2.2.1.2 Alternative Alignment 2

From the Makaloa Substation, the circuits in a new ductline would exit the substation to Makaloa Street, proceed in the Koko Head direction to Kalauokalani Way, continue on Kalauokalani Way in the makai direction to Kapiʻolani Boulevard, and proceed in the Koko Head direction on Kapiʻolani Boulevard to Pumehana Street. At Pumehana Street, the circuits in new ductline would then proceed in the mauka direction to Lime Street at the McCully Substation. This is depicted by the red line in Figure 3-10.

3.2.2.2 No Action

No Action is an option inherent in all decision-making. No Action means that the activities described to address the potential overload and reliability issues at the Koʻolau, Pūkele and Downtown Substations, along with their associated transmission and subtransmission lines (circuits), would not occur.

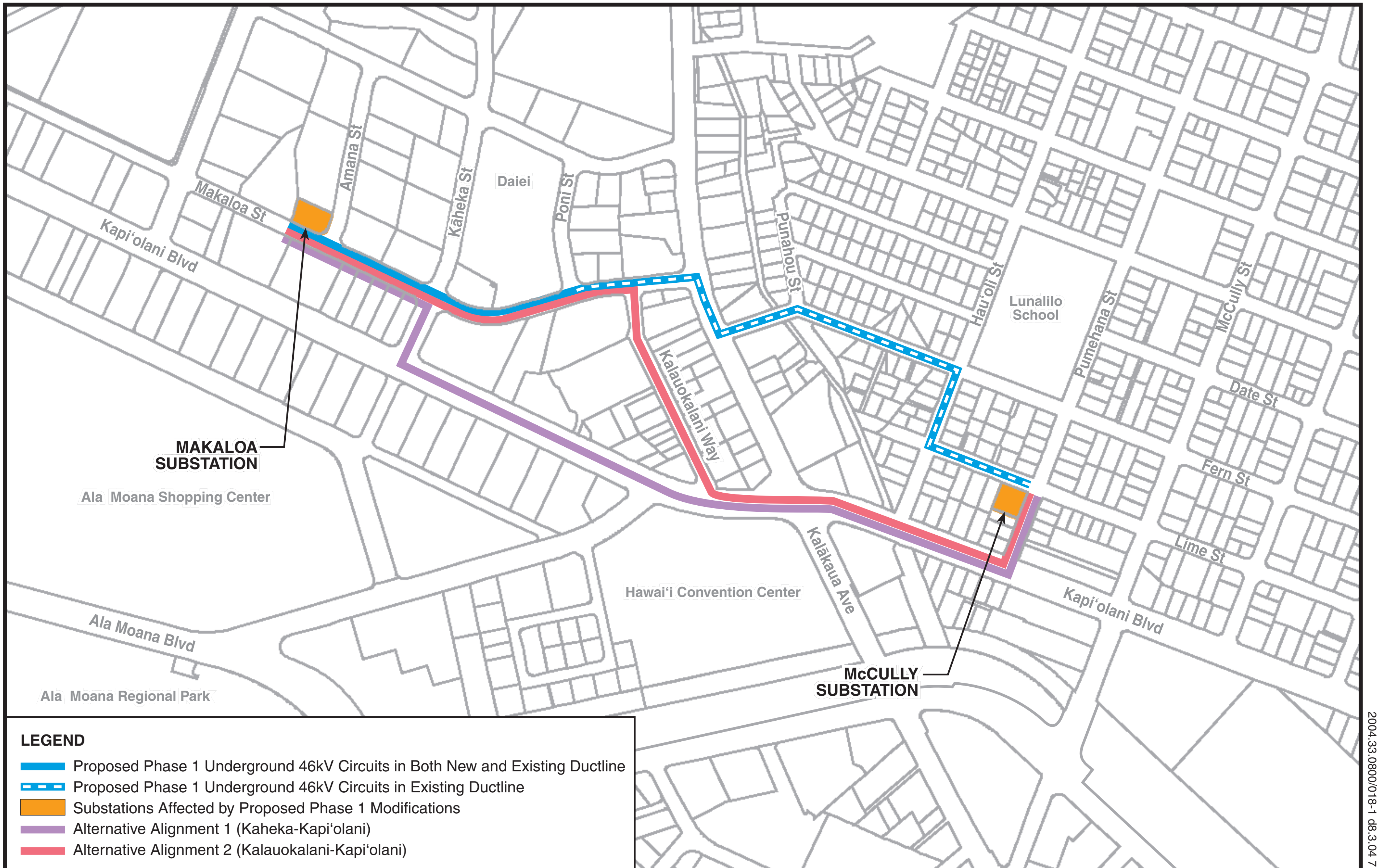

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Figure 3-10
ALTERNATIVE ALIGNMENTS

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

3.2.3 Alternatives Considered and Eliminated from Further Analysis

Alternatives considered by HECO and eliminated from further analysis in this EA are summarized herein.

3.2.3.1 Kamoku–Pūkele 138kV Transmission Line

Early on in the project, HECO identified fourteen 138kV and two 46kV transmission system alternatives to address the transmission problems. The preferred alternative was a partial underground, partial overhead 138kV transmission line connecting Kamoku Substation to Pūkele Substation via Wa‘ahila Ridge called the Kamoku–Pūkele 138kV Transmission Line. After an extensive public input process, EIS process and contested case hearing to secure a CDUP for the project, the State BLNR denied HECO’s permit request on June 28, 2002. Therefore, the Kamoku–Pūkele 138kV Transmission Line is no longer a viable option.

3.2.3.2 Other Line Alternatives

The following transmission alternatives were evaluated but were eliminated from further analysis in this EA for various reasons.

School Street–Pūkele 138kV Alternative

This alternative involves the installation of an underground 138kV transmission line between the School Street Substation in Liliha and the Pūkele Substation and an underground 138kV transmission line between the School Street and Kamoku Substations. This alternative effectively addresses all the East O‘ahu transmission problems. The facilities required are much more extensive than the Kamoku–Pūkele 138kV Underground Alternative (discussed below), which provides similar effectiveness in addressing the transmission problems. Thus this option is not considered further in this EA.

Hālawa–Pūkele 138kV Alternative

This alternative involves the installation of an overhead 138kV transmission line between the Hālawa Substation in Hālawa Valley and the Pūkele Substation and an underground 138kV transmission line between the School Street and Kamoku Substations. This alternative effectively solves all the East O‘ahu transmission problems except for the Downtown Overload Situation in the event the HPP is not operational in the near future. The facilities required for this alternative are much more extensive than the Kamoku–Pūkele 138kV Underground Alternative (discussed below), which better addresses the transmission problems. Thus, this option is not considered further in this EA.

Hālawa–Koʻolau-Pūkele 138kV Alternative

This alternative involves the installation of an overhead 138kV transmission line between the Hālawa and Koʻolau Substations, an overhead 138kV transmission line between the Koʻolau and Pūkele Substations, and an underground 138kV transmission line between the School Street and Kamoku Substations. This alternative effectively solves all the East Oʻahu transmission problems except for the Downtown Overload Situation in the event the HPP is not operational in the near future. The facilities required for this alternative were much more extensive than the Kamoku–Pūkele 138kV Underground Alternative (discussed in Section 3.2.3.3), which better addresses the transmission problems. Thus, this option is not considered further in this EA.

Network 46kV Alternative

This alternative involves the installation of a partial overhead/partial underground 138kV transmission line between the Hālawa and School Street Substations, eight underground and overhead 46kV lines in the Mōʻiliʻili and Kaimukī areas, and four transformers at the Kamoku Substation. This alternative solves all the East Oʻahu transmission issues except that it only partially addresses the Downtown Substation Reliability Concern. This alternative requires facilities that are much more extensive than the Kamoku–Pūkele 138kV Underground Alternative (discussed in Section 3.2.3.3), which better addresses the transmission problems. Thus, this option is not considered further in this EA.

Radial 46kV Alternative

This alternative involves the installation of six underground 46kV lines, two transformers at the Kamoku Substation, one transformer at the Archer Substation, four 46kV circuit breakers at the Pūkele Substation and modifications to the control house at the Pūkele Substation. This alternative solves the Koʻolau/Pūkele Overload Situation, can defer the Downtown Overload Situation (which is not expected to occur until after 2020 if HPP is operating), and fully addresses the Pūkele Substation and Downtown Substation Reliability Concerns. If the HPP is not operational in the near future, this alternative would not be able to address the Downtown Overload Situation. This alternative is similar in effectiveness to the proposed project, but the cost of this alternative is higher than the proposed project and involves the installation of one more 138kV/46kV transformer, with marginal benefits. Thus, this option is not considered further in this EA.

3.2.3.3 Summer 2003 Public Participation Alternatives

Kamoku–Pūkele 138kV Underground Alternative

The Kamoku-Pūkele 138kV Underground Alternative via Pālolo involves the installation of an underground 138kV transmission line between Kamoku Substation and Pūkele Substation, approximately 3.6 miles in length. There are two technologies that could be utilized for the 138kV underground transmission line: High Pressure Fluid Filled (HPFF) cables or Cross-Linked Polyethylene (XLPE) cables. For the HPFF technology, a pumping facility would be needed in Pālolo Valley due to the elevation difference between Kamoku Substation and Pūkele Substation. The effect of this alternative is to add (1) a fourth 138kV transmission line into the Ko'olau/Pūkele area via the Kamoku Substation and into the downtown area via Pūkele Substation, (2) a third 138kV transmission line to feed Pūkele via Kamoku Substation and to the Archer and Kewalo Substations, and (3) a second 138kV feed to the Kamoku Substation. This addresses all of the transmission overload and reliability issues for the Pūkele and Downtown areas. From an engineering standpoint, this is the best alternative to fully address all the transmission problems effectively in the long-term, and the duration of its effectiveness would be longer. It would not address the existing Pūkele Substation Reliability Concern or the Ko'olau/Pūkele Overload Situation (expected to occur in 2005) in the near-term, however, due to the estimated time to implement this alternative (2010), and it appears to have the highest degree of schedule uncertainty due to the permits and approvals required. This alternative also has a substantially higher capital cost at approximately $110 million (XLPE) to $122 million (HPFF). The 46kV alternatives described below can be installed sooner, appear to have less schedule uncertainty and are less costly to implement when compared to this alternative. Thus, this alternative is not considered further in this EA.

Kamoku 46kV Underground Alternative

This alternative generally is the same as Phase 1 of the 46kV Phased Project. This alternative addresses the Ko'olau/Pūkele Overload Situation by transferring load to the downtown area. It adds a 46kV feeder to Archer and Kamoku substations via Pūkele Substation. This alternative is adequate to solve the Ko'olau/Pūkele Overload Situation, can defer the Downtown Overload Situation (which is not expected to occur until after 2020 if HPP is operating) for several years, provides partial back-up of the load served by the Pūkele Substation (although some customers would still incur a six-second outage if the second Ko'olau-Pūkele

138kV transmission line experienced a forced outage while the first Koʻolau-Pūkele 138kV line was out for maintenance), and provides partial back-up of the load served by the downtown substations. If the HPP is not operational in the near future, this alternative would not be able to address the Downtown Overload Situation. It was estimated that this alternative could be implemented as early as 2006. The advantage of this alternative is that it can be installed sooner, although the duration of its effectiveness is not as long as that of the Kamoku–Pūkele 138kV Underground Alternative.

Kamoku 46kV Underground Alternative–Expanded (Cooke Street–King Street)

This alternative generally is the same as the 46kV Phased Project, assuming both phases are implemented at the same time. This alternative effectively addresses the Koʻolau/Pūkele Overload Situation, can defer the Downtown Overload Situation (which is not expected to occur until after 2020 if HPP is operating), and fully addresses the Pūkele Substation and Downtown Substation Reliability Concerns, but would take longer to install than the Kamoku 46kV Underground Alternative. This alternative was selected with the recommendation that it be installed in two independent phases (with the first phase being the Kamoku 46kV Underground Alternative). Implementing the project in two phases would address near-term transmission problems such as the Koʻolau/Pūkele Overload Situation and a part of the Pūkele Substation Reliability Concern, which includes Waikīkī, in a more timely manner. This is the project assessed in this EA.

3.2.3.4 Phase 2 Alternatives

Phase 2, Alternative Route, Young Street

Young Street was considered as an alternative alignment to King Street for routing three new underground 46kV subtransmission lines between Archer Substation and McCully Street. The disadvantages of this alternative route included the need to prohibit parking along both sides of Young Street during construction, which would negatively impact local businesses and residents; uncertainty regarding the City and County of Honolulu's planned Young Street Boulevard Project, which may include undergrounding utilities; and proximity to residential dwellings, which would make obtaining a noise variance for night-time work difficult. Thus, this alternative is not considered further in this EA.

Phase 2, Alternative Route, Beretania Street

Beretania Street was considered as an alternative alignment to King Street for routing three new underground 46kV subtransmission lines between Archer Substation and McCully Street. The disadvantage of this alternative route was the longer distance of the alignment and resulting increase in cost. Thus, this alternative is not considered further in this EA.

3.2.3.5 Other Options Considered

In addition to the alternatives described in the sections above, other options were considered to address the transmission problems. These options can be categorized into two broad categories: (1) Options that might address all of the East Oʻahu transmission problems collectively and (2) Options that might only address the Koʻolau/Pūkele Overload Situation.

Some of the options considered to address all of the East Oʻahu transmission problems collectively are:

- **Live Line Maintenance.** This strategy, also called live working (LW), involves maintenance work on and sometimes replacement of distribution and transmission facilities without de-energizing the lines. Since the Koʻolau Overload Situation and Pūkele Reliability Concern generally arise when a transmission line has to be taken out of service for maintenance, this strategy could help to address both issues, and an evaluation of the applicability and practicability of LW was conducted (EDM International, Inc., December 2003). In the case of HECO's 138kV system as it is currently configured, LW has, at best, very limited applicability, particularly for the lines serving the Koʻolau and Pūkele Substations, due to constraints imposed by climate, terrain, and facility conditions. These constraints render LW impracticable for all but a very small percentage of the needed maintenance activities. The very frequent occurrence of rain and periods of fog, high humidity and unpredictable winds will prevent the safe use of LW. Remote structures, particularly in the Koʻolau mountain areas, cannot be accessed by heavy equipment and/or do not have sufficiently large flat areas for use of heavy equipment such as insulated aerial devices with outriggers. Helicopter use is often hindered by fog, rain and strong winds. Many structures lack sufficient mechanical strength to support additional loading posed by climbing and conductor supports (strain sticks) needed for removal of insulators, and would need to be refurbished before LW could be attempted. Few of HECO's lines were designed with the goal of facilitating LW. In particular, none of the lines serving the Koʻolau and Pūkele Substations, which are more than 40 years old, were designed for

LW. For this reason, LW is not possible in many situations without retrofitting the existing lines. Taking the lines out of service to retrofit the structures would place the Pūkele Service Area at risk of the double outage that LW would be attempting to avoid. Also, in most cases LW on HECO's system will be more time consuming and costly than de-energized maintenance. Thus, this option is not considered further in this EA.

- **Renewable Resources.** This involves development of renewable resource generating plants (e.g., wind, solar). In general, the 1995 CH2MHILL Alternatives Study, as updated in 2000, found that renewable resource generating plants were not a viable alternative due to the lack of suitable sites, the large land requirements, the non-firm nature of wind and solar resources, and the costs and need for interconnection lines if suitable sites could be found and battery energy storage systems were added to firm up the resources. Thus, this option is not considered further in this EA.
- **Distributed Generation (DG).** DG refers to the installation of small generating units located at or near the load demands. Various technologies such as internal combustion engines (ICE) (which in Hawaii are often diesel generators), fuel cells, micro-turbine generators, and renewable energy generators (wind and photovoltaic) are often suggested for DG applications. The purpose of the DG Alternatives Study completed by HECO in March 2000 was to review the suitability of using DG as an alternative to the installation of the Kamoku–Pūkele 138kV transmission line. In principle, installation of DG resources can defer the need for new transmission and distribution (T&D) capacity by providing customers with a nearby redundant source of electricity that otherwise would have been provided by T&D upgrades. For DG to provide the same reliability improvements as the Kamoku–Pūkele line, it was estimated that at least 200 MW of distributed generation would have to be installed up front in the neighborhoods of Mānoa, Pālolo, Wai‘alae/Kāhala, Kaimukī, Kapahulu, McCully/Mō‘ili‘ili, and Waikīkī (of which 39 MW was already assumed to be installed). The review concluded that DG was not a suitable alternative to the Kamoku–Pūkele line due to the cost of this option, as well as uncertainties with land, fuel supply, interconnection, and permitting with the installation of small generating units in the Pūkele Substation Service Area. Thus, this option is not considered further in this EA.
- **Demand Side Management (DSM) and Load Management (LM).** HECO has implemented DSM programs targeting commercial and residential clients; these encourage energy conservation and efficiency using financial incentives such as subsidies for solar water heaters. LM programs target peak load reductions rather than energy conservation, and HECO has filed applications to implement residential and commercial LM

programs. The 1995 CH2M HILL Alternatives Study, as updated in 2000, indicated that the transmission overload problems might be deferred for a few years by even more aggressive (but not necessarily cost-effective) DSM programs, but the problems would only reappear due to overall load growth in the service areas, the customer mix, and the already high saturation goals for the approved DSM programs. The study also recognized that DSM and LM programs could not address the Pūkele Reliability Concern, since these resources could not provide the Pūkele Substation with a reliable and cost-effective source of electricity equivalent to its peak load, or eliminate all of the customer load in the Pūkele Service Area. Thus, this option is not considered further in this EA.

Some of the options considered to address the Koʻolau Overload Situation only were:

- **Increased Conductor Capacity Options.** Increasing conductor capacity involves the implementation of various techniques, materials, and equipment to increase the line capacities of the existing transmission lines. The options to increase the current carrying capacity of transmission lines can be problematic and would place the HECO system at an increased risk of experiencing an overload situation. For example, the re-conductoring option would require installation of new conductors to replace the existing conductors on the three 138kV transmission lines serving the Koʻolau Substation, and various structure and poles supporting the conductors may have to be strengthened or replaced. The process would be time consuming, difficult, and expensive, particularly given the logistics of stringing new conductors in the mountainous areas traversed by the lines. The work would necessitate prolonged outages of the lines, which would increase the possibility of an overload occurring if a second line serving the Koʻolau Substation becomes unavailable for any reason. This option was not considered viable to address the Koʻolau/Pūkele Overload Situation and is not considered further in this EA.
- **Reduced Demand Options.** Reduced Demand involves the implementation of initiatives and programs such as DSM programs to reduce power demand at customer sites. This option relies on targeted market penetration of DSM and LM initiatives and programs in the Koʻolau/Pūkele Service Area. At this time, there is not enough reliable data to determine whether an adequate market exists for these programs to be effective for the overload situation. This option was not considered viable to address the Koʻolau/Pūkele Overload Situation and is not considered further in this EA.

- **DG Options.** Due to uncertainties discussed above under DG (i.e., land, fuel supply, interconnection, and permitting), these options were not considered viable to address the Koʻolau/Pūkele Overload Situation and are not considered further in this EA.
- **Combined Heat and Power (CHP) Options.** CHP systems are a form of DG that utilize waste heat from the power generation process as energy (heat or steam) for heating or cooling purposes. The advantage of a CHP system over conventional electric generating units is the increased efficiency obtained when the captured waste heat is put to useful purposes. HECO filed an application requesting approval of its proposed CHP programs in 2003. Even if it was assumed that all of the forecasted CHP installations occurred in the Koʻolau/Pūkele area, the installations would still be inadequate to resolve the Koʻolau/Pūkele Overload Situation. As CHP options were not considered viable to address the transmission overload situation, they were not considered further in this EA.
- **Combined Alternatives.** In theory, it might be possible to defer, but probably not eliminate, the Koʻolau/Pūkele Overload Situation through some combination of targeted DSM, DG, and CHP installations in the Koʻolau/Pūkele Service Area. However, there would be substantial uncertainty as to whether the objective could be achieved, given the practical problems with substantially increasing the amount of DSM, DG and/or CHP installed in the area in the near-term, particularly in light of the fact that the overload problem could occur in 2004 during daytime peak periods, and is already at risk of occurring during evening peak periods. The total cost of deferring the overload problem using such measures would probably exceed the cost of the Proposed Action (which will fully address the Pūkele Substation Reliability Concern, with the exception of the customers that will still incur six-second interruptions). And, the DSM, DG and CHP option would not address the Pūkele Substation Reliability Concern (with the possible exception of the customers with on-site DG or CHP, assuming their loads could be islanded), or help with the Downtown Overload Situation if the Honolulu Power Plant is unavailable for any reason. Total costs associated with combined alternatives to defer the overload situation would likely be greater than the cost of the Proposed Action. Neither DSM, nor CHP (and DG), nor renewable resources can eliminate or cost effectively address the East Oʻahu transmission problems. Thus they will not be considered further in this EA.

Chapter 4

Affected Environment and Environmental Consequences

CHAPTER 4
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter describes the affected environment within the study area for the proposed 46kV Phased Project (Proposed Action) and alternatives, evaluates possible environmental consequences that could occur from the Proposed Action and alternatives, and identifies possible management and design measures to minimize or avoid impacts. Direct impacts are analyzed in this chapter. Secondary and cumulative impacts are addressed in Chapter 5.

4.2 LAND USE

4.2.1 Existing Conditions

Land use designations for the Proposed Action and alternatives were identified by reviewing the state land use district designations,[1] the Hawai‘i Community Development Authority (HCDA) Mauka Area Plan and Mauka Area Rules,[2] the Primary Urban Center Development Plan,[3] and the City and County of Honolulu Land Use Ordinance (LUO).[4]

The project area is within the state-designated Urban District and within the City and County of Honolulu’s Primary Urban Center. Affected neighborhoods include:

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1 State of Hawai‘i. Office of Planning. 2004. Hawai‘i Statewide GIS Program Internet Website, http://www.state.hi.us/dbedt/gis/. Accessed June 2004.

2 Hawai‘i Community Development Authority. August 1999. *Mauka Area Plan Kakaako Community Development District Honolulu, Hawai‘i.* Unofficial Compilation. http://www.hcdaweb.org/images/maukaareaplan_a383.pdf Accessed June 10, 2004.

3 City and County of Honolulu. Department of Planning and Permitting. July 1999. *Primary Urban Center Development Plan.*

4 City and County of Honolulu. Department of Planning and Permitting. 2004. Honolulu Land Information System (HOLIS) Website, http://gis.hicentral.com. Accessed in May and June 2004.

Ala Moana/Kakaʻako, McCully/Mōʻiliʻili, Waikīkī, and Diamond Head/Kapahulu/ St. Louis Heights.[5] Land uses in the project area include: residential, business, parking, gas station, grocery store, office, retail, restaurants, and vacant units. Table 4-1 summarizes the sections of the project area that are within Special Districts and lists the associated zoning. Figure 4-1 illustrates the location of the Special Districts; Figure 4-2 shows the associated zoning within the Kakaʻako Community Development District. Sections of the project area that are not within Special Districts are classified in one of the following zoning districts: P-2 General, BMX-3 Community, AMX-3 High Density, A-2 Apartment, or A-3 Apartment (shown on Figure 4-3).

Table 4-1. Summary of Special Districts and Associated Zoning

Section of Project Area	Special District	Zoning
Kewalo Substation, Archer Substation, and connecting activity	Kakaʻako Community Development District, under the authority of the State through the Hawaiʻi Community Development Authority Figure 4-1	Mixed-use zone commercial emphasis (MUZ-C)
South King Street between Cooke and Kealamakai Streets	Hawaiʻi Capital Special District	BMX-3 Community
South King Street between Kealamakai and Pensacola Streets	Thomas Square Special District	BMX-3 Community
ʻEna Substation	Waikīkī Special District	Resort Commercial Precinct
Waikīkī Substation and Kūhiō Substation	Waikīkī Special District	Apartment Precinct
Kapahulu Substation	Diamond Head Special District	R-3.5 Residential

Source: City and County of Honolulu. 2004. Department of Planning and Permitting. HOLIS Internet Website, http://hicentral.com.

4.2.2 Potential Impacts and Actions to Minimize Impacts

Potential impacts to land use were evaluated by comparing the Proposed Action and alternatives to the relevant State and City and County of Honolulu policies and controls.

5 State of Hawaiʻi, Department of Business, Economic Development and Tourism. *State of Hawaiʻi Data Book 2001*. Website, http://hawaii.gov/dbedt/db01/sec01.html. Accessed on June 7, 2004.

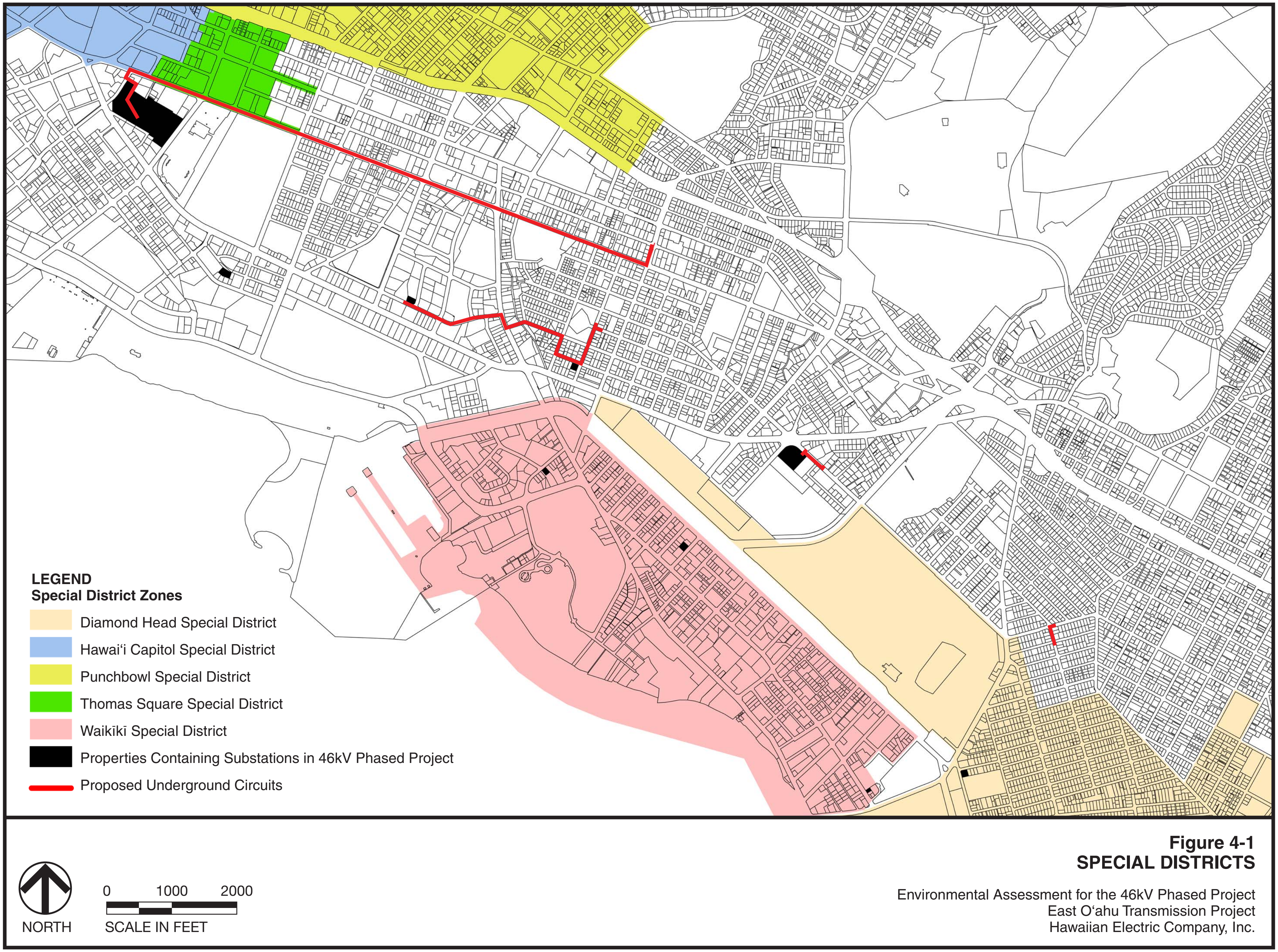

Figure 4-1
SPECIAL DISTRICTS

Environmental Assessment for the 46kV Phased Project
East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

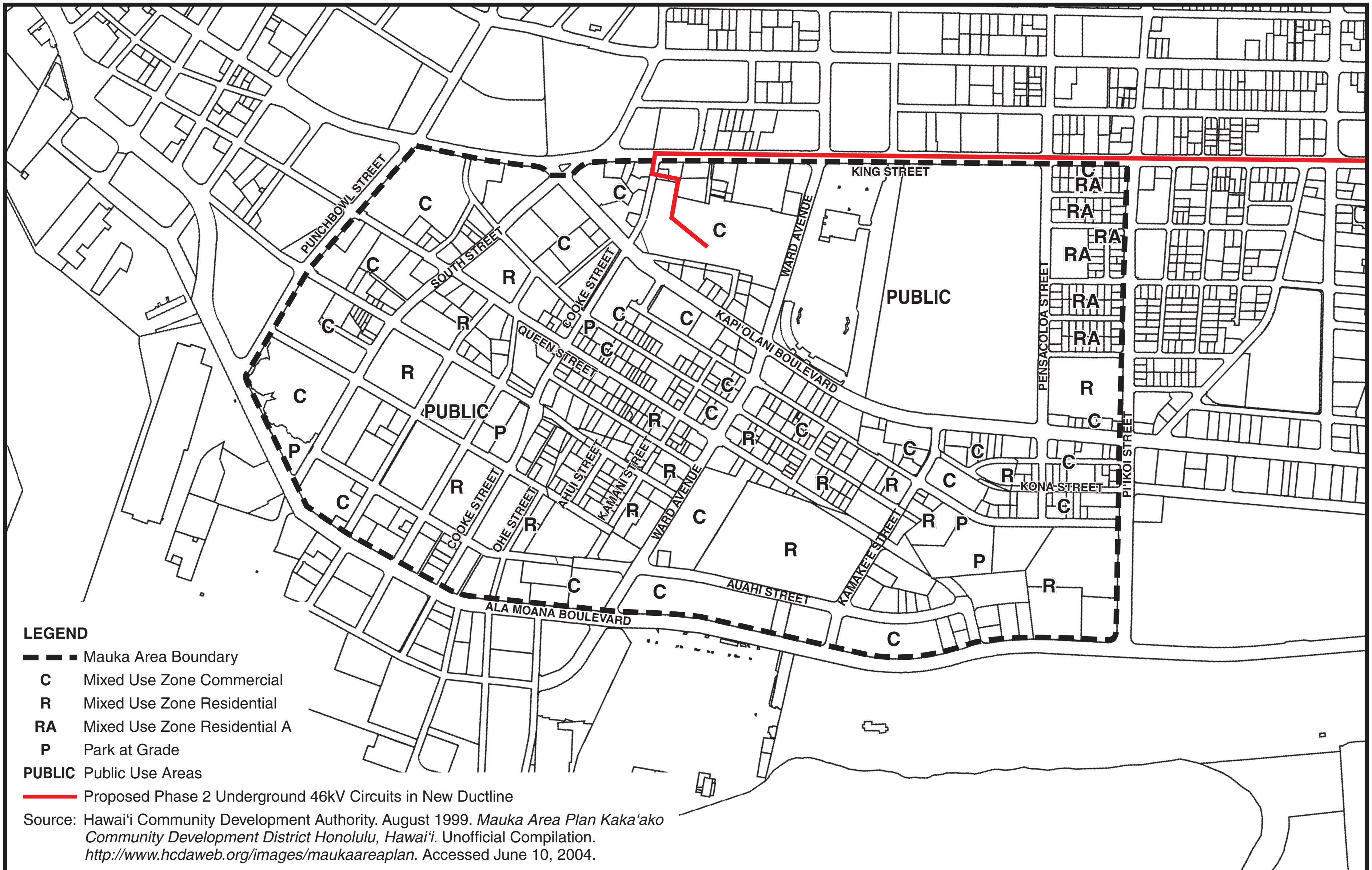

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Figure 4-2

LAND USES IN KAKA'AKO COMMUNITY DEVELOPMENT DISTRICT

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

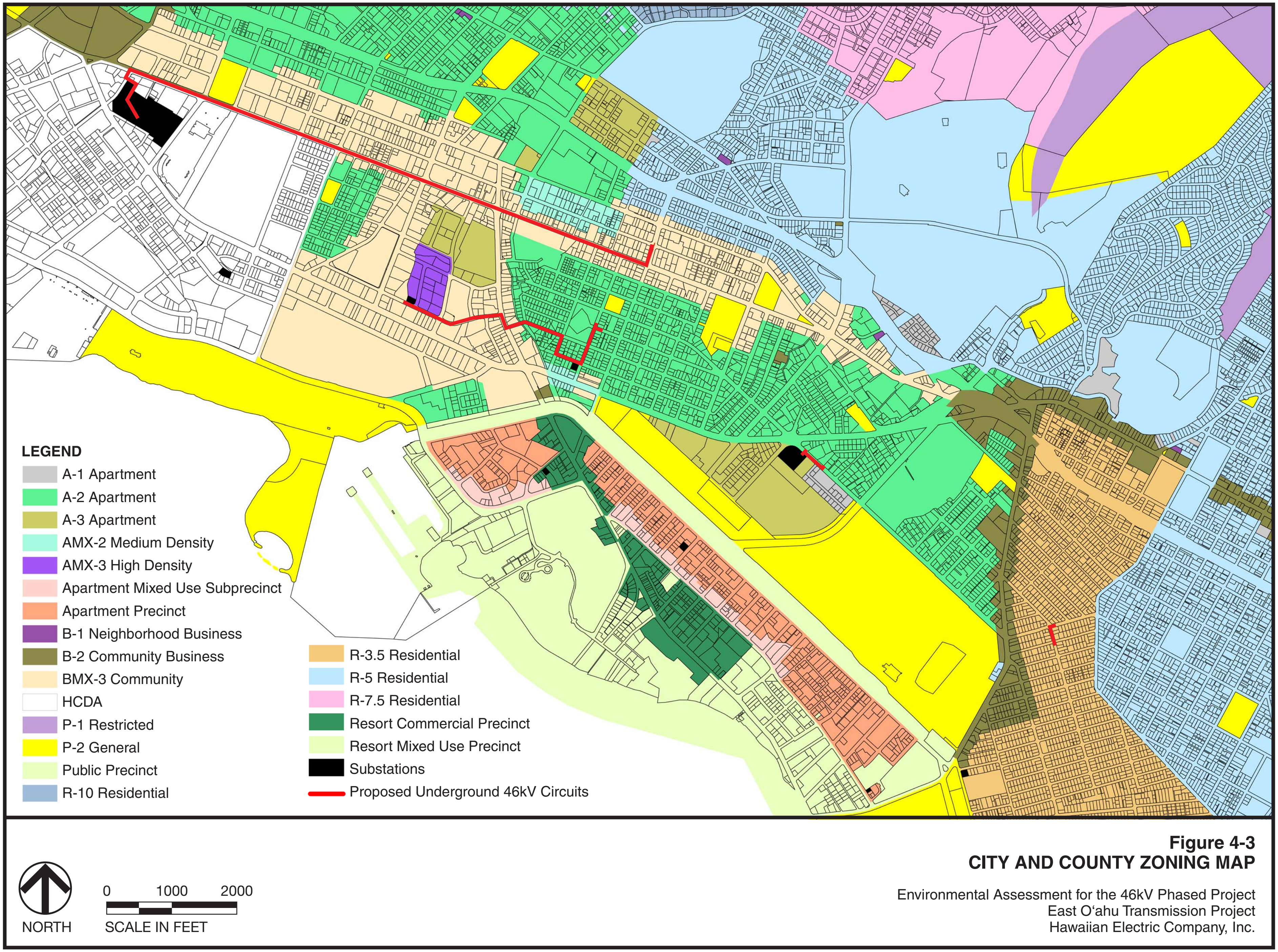

Figure 4-3
CITY AND COUNTY ZONING MAP

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

4.2.2.1 Proposed Action

Construction

The Proposed Action would have no significant impact on land use; it would support and be consistent with the State and County plans described as follows.

HCDA. The Proposed Action would be evaluated with HCDA to determine whether the activities can be accommodated within the existing development permits or as an amendment to the existing permit, or whether HCDA would require a new base zone or planned development permit. The Kewalo Substation activity is limited in scope and is unlikely to require a permit from HCDA. No impacts to land use are anticipated, as the appropriate HCDA permit or amendment would be obtained prior to construction.

City and County of Honolulu General Plan. The long-term policies and objectives for the growth and development of the island set forth in the General Plan include maintaining a high level of service to all utilities by: (1) maintaining existing utility systems in order to avoid major breakdowns, (2) providing improvements to utilities in existing neighborhoods to reduce substandard conditions, (3) planning for the timely and orderly expansion of utility systems, and (4) maintaining an adequate, dependable, and economic supply of energy to O'ahu residents. The Proposed Action supports the General Plan's objectives and policies as it is proposed, in part, to prevent major breakdowns of the existing utility system and would serve to provide an adequate, dependable, and economical supply of energy to O'ahu residents.

Approved Primary Urban Center Development Plan. On June 4, 2004, the City Council approved the Primary Urban Center Development Plan (Bill 74, Council Draft 2); the Plan is included in the Revised Ordinances of Honolulu (ROH) at Section 24-2.3. Sections of the Development Plan relevant to the Proposed Action are presented herein.

Guidelines from Section 24-1.8, *Identification of Public Buildings, Public or Private Facilities for Utilities, Terminals and Drainage,* include: giving energy efficiency a priority consideration in selection of sites for public and private utilities, and allowing local electrical lines (46kV and below) in any land use district. The Proposed Action is consistent with the Primary Urban Center Development Plan principles for utility facilities.

Section 24-2.1, *Area Description,* states that Waikīkī shall continue to be maintained as Hawai'i's primary visitor destination area (with emphasis on improving the quality of the environment). This section advocates promoting a more pleasing and attractive urban setting and maintaining a strong sense of the nearness of open space and nature through the establishment of mauka-makai view corridors. The Proposed

Action is consistent with the Primary Urban Center Development Plan because it (1) increases the reliability of the utility system needed to continue supporting Waikīkī as Hawai‘i’s primary visitor destination area, and (2) promotes the attractiveness of the urban setting through the preservation of view corridors because no new overhead lines are proposed as part of this project.

Section 24-2.2, *Urban Design Principles for the Primary Urban Center,* includes maintaining public views. The Proposed Action is consistent with the Primary Urban Center Development Plan principle to maintain public views because no new overhead lines are proposed as part of this project.

1990 LUO, as amended. The zoning districts are implemented by the LUO, which identifies permitted uses and structures, development standards, and height controls for twelve zoning districts. Underground transmission lines are generally not regulated at the zoning level by the Department of Planning and Permitting (DPP).[6] The LUO defines two types of utility installations: Type A and Type B. The majority of the Proposed Action would be Type A, those with minor impacts on adjacent land uses that typically include 46kV transmission substations. Type A utility installations are a permitted use within residential zoning districts and permitted in the respective apartment mixed use zoning districts subject to additional requirements for restricting public access. The Makaloa, McCully, and Kapahulu Substations are included within the definition of a Type A utility installation. The Kamoku Substation is a 138kV to 46kV transformer installation, and the associated work would be considered a Type B utility installation. The Kamoku Substation is located within the apartment zoning district (A-3), where Type B utility installations are permitted subject to a Conditional Use Permit – minor. No impacts to land use are anticipated as appropriate permits would be obtained prior to initiating work.

Article 9 of the LUO regulates Special Districts and implements design controls to preserve prominent views and the urban design architectural character of O‘ahu’s distinctive neighborhoods. Proposed Action activities within the Hawai‘i Capital, Thomas Square/Honolulu Academy of Arts, and Waikīkī Special Districts are exempt from the requirements for Special District permits. Therefore, no land use impacts are anticipated from utility upgrades in the Special Districts.

Construction activities within roadways, construction site offices, and construction staging areas are not typically regulated within the LUO. Approval of temporary uses and structures is determined by the Planning Director on a case-by-case basis and may include the imposition of conditions. Such conditions, based on the impacts on the surrounding areas, may cover hours of operation, duration of activity, and general manner of operation (including minimization of impacts from noise, dust, etc.). The Proposed Action would include coordination with the Planning Director so that no significant impacts on land use would occur.

6 City and County of Honolulu, Department of Planning and Permitting. April 22, 2004. Personal communication with Ms. Kathy Sokugawa and Belt Collins Hawaii.

City and County of Honolulu Ordinance (Section 14-22.1, ROH). This ordinance requires public utility companies to place their utility lines and related facilities underground whenever certain streets, including King Street, are improved under certain circumstances. Portions of King Street (e.g., from Cooke Street to McCully Street) were improved years ago (e.g., public right-of-way improved, including placing overhead lines underground). Such improvements may have been done at the City and County of Honolulu's initiative under the improvement district ordinances in which both public and private funds are spent for improvements of the public right-of-way, including utility funds for the placement of overhead lines underground. The proposal to place the new circuits on King Street underground would be consistent with Section 14-22.1 of the City and County of Honolulu's ordinance.

Operation

Operation of the upgraded electrical infrastructure would not result in land use changes within the project areas.

4.2.2.2 Alternative Alignments

The analysis of potential construction and operational impacts and land use for the alternative alignments is the same as for the Proposed Action. The alternative alignments would have no significant impact on land use and would support and be consistent with State and County plans described above.

4.2.2.3 No Action Alternative

Under the No Action Alternative, the utility upgrade would not take place and there would be no impact on land use. To the extent State and County land use plans assure the availability of adequate electrical power to accommodate their objectives, there may be an adverse impact if the EOTP is not in place.

4.3 INFRASTRUCTURE

4.3.1 Electrical

Electrical infrastructure consists mainly of power generating facilities, electrical circuits, and substations. HECO is the major provider of electricity on O‘ahu.

4.3.1.1 Existing Conditions

Power generated at leeward power plants is distributed across the island of O'ahu through the 138kV transmission line system as described in Chapter 2. Power from the 138kV transmission line system is stepped down by 46kV substations for regional power distribution through the 46kV subtransmission line system.

There are three 138kV transmission lines providing power to the Ko'olau Substation. Two 138kV overhead transmission lines currently feed the Pūkele Substation from the Ko'olau Substation in Kāne'ohe, on the windward side of O'ahu. The two 138kV lines cross the Ko'olau Mountain Range to connect the Pūkele Substation to the rest of the HECO system. The power transported from these two overhead lines is stepped down to the subtransmission voltage and transported over eight 46kV feeders that branch out from Pālolo Valley to distribution substations in Kāhala, Kaimukī, Mānoa, Makiki and Waikīkī. While many parts of the two overhead lines have been renewed and upgraded, the two Ko'olau–Pūkele 138kV transmission lines are more than 40 years old.

In the Southern 138kV Transmission Corridor, two 138kV transmission substations serve the Downtown area, including the Iwilei Substation and the School Street Substation. Power to serve the Downtown area can also come from the HPP when it is online.

These two transmission substations are fed from three 138kV transmission lines providing power from the Hālawa Substation via the Hālawa–Iwilei 138kV transmission line and the Hālawa–School Street 138kV transmission line, and from Makalapa Substation via the Makalapa–Airport–Iwilei 138kV transmission line.

There are three downtown substations including the Archer, Kewalo, and Kamoku Substations.

The Archer Substation is one of the newer transmission substations on the HECO system, and is fed from the Iwilei and School Street Substations by two underground 138kV lines.

The Kewalo Substation is also one of the newer transmission substations and is located on Kona Street. Two 138kV underground transmission lines supply power to Kewalo Substation. Kewalo serves customers at the distribution voltage of 25kV in the Kaka'ako area.

The Kamoku Substation is the newest transmission substation and is located on the corner of Date Street and Kapi'olani Boulevard. Kamoku Substation is fed from one 138kV underground transmission line, which brings the power from Archer Substation via Kewalo Substation to Kamoku. The entire Kamoku Substation has a 25kV back up system. If the 138kV transmission line feeding the substation should fail, then the Kamoku Substation load would be transferred to Kewalo Substation.

4.3.1.2 Potential Impacts and Actions to Minimize Impacts

4.3.1.2.1 Proposed Action

Construction

No significant adverse impacts to electrical infrastructure would occur with the Proposed Action during construction. Construction activities in most areas would not impact electrical service because there are redundant electrical feeders. The Proposed Action could result in brief interruptions of a few seconds in some areas during electrical disconnections and connections. Potentially affected customers would receive prior notification regarding construction activities.

Operation

No significant adverse impacts to electrical infrastructure would occur with the Proposed Action during operation. The Proposed Action would guard against a catastrophic power outage, where disturbances on the system could potentially throw the entire system into instability, and a localized power outage, where the outage affects a limited area of the island.

One issue associated with the operation of underground power lines is the potential for underground circuits to ignite trapped gases within the system, potentially causing manhole covers to lift and fires to start. To minimize the potential of gas buildup, HECO would install vented manhole covers that allow underground gases to dissipate. These vented manhole covers allow storm water and runoff to flow into the underground vaults and manholes, potentially increasing the amount of maintenance required on the transmission line.

Completion of the Proposed Action would provide additional pathways to shift electrical loads within the 46kV Subtransmission System during critical conditions when peak loads or transmission line failures could result in line overloads and substation overloads. This flexibility would improve the reliability of electrical power service to East Oʻahu.

4.3.1.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to electrical infrastructure from the alternative alignments is the same as for the Proposed Action. No significant adverse impacts to electrical infrastructure would occur during construction or operation.

4.3.1.2.3 No Action Alternative

Under the No Action Alternative, no construction or operational activities would occur, and the following transmission problems would not be addressed: (1) the Pūkele Substation Reliability Concern; (2) the Ko‘olau/Pūkele Overload Situation; (3) the Downtown Substation Reliability Concern, and (4) the Downtown Overload Situation.

4.3.2 Potable Water

The Honolulu Board of Water Supply (BWS), a semi-autonomous agency of the City and County of Honolulu, constructs, operates, and maintains the potable and firefighting water system on O‘ahu. This system includes supply wells, reservoirs, pumping stations, and pipelines. Currently, BWS maintains 163 reservoirs with 169 million gallons of capacity, and 1,842 miles of pipeline to distribute water resources island-wide.[7]

4.3.2.1 Existing Conditions

According to BWS drawings dated between 1987 and 1990, BWS potable waterlines are present within the roadways of both the Phase 1 and Phase 2 proposed alignments.[8] In the proposed project area, the drawings identify 8-inch waterlines between Makaloa and McCully Substations and within Cooke Street, a 6-inch waterline in Pumehana Street, 2-inch waterlines along Fern and Hau‘oli Streets, a 1.25-inch waterline along Lime Street, and 12-inch waterlines along Kapi‘olani Boulevard and King Street. Planned upgrades to BWS waterlines are discussed in the cumulative impacts section in Chapter 5.

In addition to the BWS waterlines identified above, a 12-inch waterline is present along Kāheka Street within the Alternative Alignment 1, and 8-inch and 4-inch waterlines are present along Kalauokalani Way within the Alternative Alignment 2.

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[7] Honolulu Board of Water Supply Website, http://www.hbws.org/ea_wat_resource/ea01_ct01_mainpage.htm. Accessed May 21, 2004.

[8] BWS Half Size Plans, Numbers 31 (12/20/1989), 38 (12/5/1989), 39 (8/3/1987), 44 (12/4/1989), and 45 (9/26/1990).

4.3.2.2 Potential Impacts and Actions to Minimize Impacts

4.3.2.2.1 Proposed Action

Construction

No significant adverse impacts on the potable water infrastructure would occur with the Proposed Action during construction. Coordination between HECO and BWS would minimize the risk of damage to the BWS waterlines, particularly during Phase 2 when new BWS projects are planned within the project area. The locations of existing waterlines would be confirmed as closely as possible, and the alignment of the new ductline would be designed to avoid these lines. Plans would be submitted to BWS for review prior to construction. The construction contractor would exercise caution to avoid damage to existing utilities. Waterlines encountered during construction would be protected using construction methods appropriate to the situation. Activities conducted within existing ductlines, accessed by HECO manholes, are not expected to impact BWS waterlines as the infrastructure is already in place.

In summary, HECO, or its consultant, would research available records and conduct surveys to verify that the proposed alignment of subtransmission lines would not conflict with existing and planned utilities.

Operation

No significant adverse impacts to potable water infrastructure would occur from operation of the Proposed Action. Upon completion of new ductline construction, the infrastructure would be in place to conduct standard maintenance using manholes and other access routes. HECO and BWS maintenance access systems are separate; therefore, access to electrical lines through manholes or other vaults would not impact the BWS waterlines. In the case of emergency repairs to HECO lines that involve construction, coordination procedures similar to those discussed above would be carried out.

4.3.2.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to water infrastructure from the alternative alignments is the same for the Proposed Action. No significant adverse impacts on the potable water infrastructure would occur during construction or operation.

4.3.2.2.3 No Action Alternative

No impacts on potable water infrastructure would occur under the No Action Alternative. To the extent that the existing potable water system relies on electrical power from HECO, the reliability concerns discussed in Chapter 2 may have an impact if the EOTP is not in place.

4.3.3 Wastewater

4.3.3.1 Existing Conditions

The existing City and County of Honolulu sewer system consists of a network of buried pipes that convey wastewater to the Sand Island Wastewater Treatment Plant (WWTP) for treatment and disposal. Most of the sewers in the vicinity of the Proposed Action convey wastewater via gravity flow in the westward direction to the Ala Moana Wastewater Pumping Station, where it is then pumped to the Sand Island WWTP. Sewers within the area of the Proposed Action largely consist of concrete, vitrified clay or plastic pipes.

Most of the Phase 1 alignment and the Phase 2 alignment between Ke‘eaumoku Street and McCully Street parallels 6-inch diameter gravity sewer mains. The remaining portion of the Phase 2 alignment is parallel to a gravity interceptor sewer that decreases in size from 21 inches in diameter at Cooke Street to 14 inches in diameter at the intersection of King Street and Ke‘eaumoku Street. The proposed Phase 1 alignment at the Kamoku Substation would cross a 30-inch diameter gravity sewer in Date Street. The proposed Phase 1 alignment in Winam Avenue would cross an 8-inch diameter gravity sewer in Ho‘olulu Street.

4.3.3.2 Potential Impacts and Actions to Minimize Impacts

4.3.3.2.1 Proposed Action

Construction

No significant impacts on wastewater infrastructure would occur from the Proposed Action. The proposed subtransmission lines would be constructed either over or under the existing buried sewers with proper clearances as specified by the City and County of Honolulu. HECO would follow the same procedures described in the previous section to minimize the risk of damage to sewer lines, including submittal of plans to the City and County of Honolulu for review prior to construction. HECO would research available records and conduct field explorations to verify that the proposed alignment of subtransmission lines would not conflict with existing and planned utilities.

Operation

Operation of the Proposed Action would not impact the wastewater system.

4.3.3.2.2 Alternative Alignments

The analysis of potential construction and operational impacts on the wastewater system from the alternative alignments is the same for the Proposed Action. No significant impacts on wastewater infrastructure would occur from construction or operation.

4.3.3.2.3 No Action Alternative

There would be no construction and operational impacts on the sewer system under the No Action Alternative. To the extent that the existing wastewater system relies on electrical power from HECO, the reliability concerns discussed in Chapter 2 may have an impact if the EOTP is not in place.

4.3.4 Drainage

4.3.4.1 Existing Conditions

The existing drainage system consists of open waterways and buried drainage conduits that ultimately convey surface water runoff to the ocean. The drainage ways are typically oriented parallel to the slope from higher ground toward the coastline. As the drainage tributaries combine in the downstream direction, the drainage ways are progressively larger. The upper reaches of the open waterways are natural streams, while the lower reaches pass through inhabited areas and are channelized for increased flow capacity. Smaller buried drainage conduits typically consist of reinforced concrete pipes (RCP). Larger buried drainage conduits are typically rectangular-cross section concrete box culverts.

The alignments of the proposed electrical feeders would cross a number of drainage ways. The major drainage ways are summarized in the following table.

Table 4-2. Major Drainage Features

Phase	Location	Diameter or Width x Height (feet)	Type
1	Amana Street	1.5	RCP
	Amana Street	1.5	RCP
	Kāheka Street	6 x 8	Box Culvert
	Kāheka Street	6 x 8	Box Culvert
	Kalauokalani Way	3 x 1	Box Culvert
	Malanai Street	20 x 15	Stream
	Hauʻoli Street	6 x 3	RCP
	Pumehana Street	1.5 x 1.2	Box Culvert
	Date Street	2	RCP
2	Ward Avenue	8 x 4	Box Culvert
	Pensacola Street	6	RCP
	Piʻikoi Street	7 x 3	Box Culvert
	Sheridan Street	4 x 1.83	Box Culvert
	Sheridan Street	4	RCP
	Kalākaua Avenue	12 x 8	Box Culvert
	Hauʻoli Street	3 x 2	Box Culvert
	Pumehana Street	1.5	RCP
	McCully Street	5.5 x 3	Box Culvert
Additional crossings – Alternative Alignments			
	Kapiʻolani Blvd.	10 x 2	Box Culvert
	Kapiʻolani Blvd.	1.5	RCP
	Kapiʻolani Blvd.	2	RCP
	Kapiʻolani Blvd.	3 x 9	Box Culvert
	Kapiʻolani Blvd.	1.5	RCP

Source: City and County of Honolulu. 2004. Department of Planning and Permitting. HOLIS Website, http://gis.hicentral.com.

4.3.4.2 Potential Impacts and Actions to Minimize Impacts

4.3.4.2.1 Proposed Action

Construction

No significant impacts on drainage infrastructure would occur from the Proposed Action. The proposed subtransmission lines would be constructed either over or under the existing drainage conduits with proper clearances as specified by the City and County of Honolulu. HECO would follow the same procedures described in the previous section to minimize the risk of damage to drainage conduits, including submittal of plans to the City and County of Honolulu for review prior to construction. HECO would be responsible for researching available records and conducting field explorations to verify that the proposed alignment of the subtransmission lines would not conflict with existing and planned utilities.

Operation

Operation of the Proposed Action would not impact the drainage system.

4.3.4.2.2 Alternative Alignments

The analysis of potential construction and operational impacts on the drainage system is the same as for the Proposed Action. No significant impacts on drainage infrastructure would occur from construction and operation.

4.3.4.2.3 No Action Alternative

There would be no construction and operational impacts on the drainage system under the No Action Alternative.

4.3.5 Communications

4.3.5.1 Existing Conditions

Wired communications infrastructure consists of telephone, low-speed data, broadband data, and television cables and lines. High-capacity communication transmission systems utilize underground fiber optic cable lines. Local communication lines use conventional copper wire lines that are typically located in the same alignment corridor with low-voltage, local electrical distribution lines, and thus can be located underground or overhead. Both high-capacity and local communication lines are located in the Phase 1, Phase 2, and alternative alignment areas.

Verizon is currently the sole public utility provider of wired telephone, low-speed data, and broadband data for O'ahu. Time Warner Oceanic Cable is the sole non-military, public utility provider of wired television and broadband data for O'ahu. The City and County of Honolulu Department of Transportation Services (DTS) also has underground wired data communication systems between its traffic signal control boxes located at most street intersections.

4.3.5.2 Potential Impacts and Actions to Minimize Impacts

4.3.5.2.1 Proposed Action

Construction

No significant adverse impacts to communication systems would occur from construction of the Proposed Action. Construction of the new ductline for the underground 46kV circuits would be coordinated with the utility providers so that its path would not conflict with any underground communication systems. HECO, or its consultant, would research available records and conduct surveys to verify that the proposed alignment of the subtransmission lines would not conflict with existing and planned utilities.

Operation

No significant adverse impacts to communications infrastructure would occur from operation of the Proposed Action. Upon completion of new ductline construction, the infrastructure would be in place to conduct standard maintenance using manholes and other access routes. In the case of emergency repairs to HECO lines that involve construction, coordination similar to those discussed above would be carried out.

4.3.5.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to communications infrastructure from the alternative alignments is the same for the Proposed Action. No significant adverse impacts to communication systems would occur from construction or operation.

4.3.5.2.3 No Action Alternative

No construction or operational impacts to communications systems would be associated with the No Action Alternative. To the extent that existing communications systems rely on electrical power from HECO, the reliability concerns discussed in Chapter 2 may have an impact if the ETOP is not in place.

4.3.6 Solid Waste

4.3.6.1 Existing Conditions

Solid waste facilities on the island of O'ahu can accommodate municipal solid waste (MSW), construction and demolition waste, petroleum-contaminated soil, and asbestos. There are no hazardous waste disposal facilities in the state, so such wastes must be shipped to the U.S. mainland for disposal.

PVT Land Company operates the one construction and demolition landfill on the west side of the island of O'ahu. The landfill, located in Nānākuli, accepts approximately 262,000 tons of waste per year (718 tons per day) and has an estimated remaining capacity of 15 years.[9] In separately permitted facilities within the PVT site, PVT accepts petroleum-contaminated soil from known sources (in their Nānākuli Soil Reclamation Facility) and asbestos waste.

Concrete and asphalt concrete may be recycled at American Hauling, Inc., Grace Pacific Corp., Resource Recovery, Ltd., R.H.S. Lee, Inc., Sphere LLC (dba Pacific Aggregate), and PVT.[10] Lead cables may be recycled at Island Demo and Hawai'i Metals Recycling.

4.3.6.2 Potential Impacts and Actions to Minimize Impacts

4.3.6.2.1 Proposed Action

Construction

No significant adverse impacts to existing solid waste facilities would occur from construction of the Proposed Action. The anticipated solid waste stream associated with the 46kV Phased Project could include: concrete, asphalt concrete, base course

[9] State of Hawai'i, Department of Health, Office of Solid Waste Management. July 2000. *Hawai'i 2000 Plan for Integrated Solid Waste Management.* and
PVT. June 25, 2004. Personal communication with Mr. Albert Shigemura and Belt Collins Hawaii.

[10] State of Hawai'i, Department of Health. May 2003. *Minimizing Construction & Demolition Waste Third Edition*.

gravel fill, excavated soil, directional drilling slurry and soil cuttings, electrical poles, lead cable, and asbestos waste from transite ductline.

Aggregate, including asphalt paving and concrete, would be segregated and transported to a facility for recycling.

The soil and base course fill excavated during Phase 1 and Phase 2 trenching would be sold for reuse. Should directional drilling be used in Phase 2, soil cuttings and a slurry of fine-grained soil from the subsurface mixed with bentonite would be generated. The mixture of slurry and soil cuttings would be dried until it passes the "paint filter test" (no free liquid flows when a sample is placed in a paint filter) and then transported to PVT for disposal. The volume of slurry and soil cuttings generated during Phase 2 is estimated to be less than 3,000 cubic yards. This equates to approximately 4,200 tons of material for disposal or less than 2 percent of the landfill's estimated annual capacity. According to the president of PVT, this volume would not constitute a significant impact to the landfill's capacity.[11]

If indications of soil contamination (e.g., staining and odors) are observed, handling and disposal would be conducted in accordance with applicable Federal and State law and guidance. Excavated petroleum-contaminated soil would be disposed of at either PVT's Nānākuli Soil Reclamation Facility or another facility, as appropriate.

Transite (asbestos cement) ductlines would be disposed of at PVT's asbestos-permitted facility in accordance with applicable Federal and State law. Lead cables would be recycled.

Electrical poles removed for disposal would be tested for creosol. Hazardous levels of creosol in the utility poles are not anticipated, but if such levels are present, the poles would be treated as hazardous waste and handled accordingly. If creosol levels are less than the level considered hazardous, the poles would be disposed of at the PVT construction and demolition landfill.

Operation

No significant impacts to existing solid waste facilities would occur from operation of the Proposed Action; wastes generated from operation of the Proposed Action and associated maintenance activities would be minimal.

4.3.6.2.2 Alternative Alignments

The analysis of potential construction and operational impacts for the alternative alignments is similar to the Proposed Action. No significant impacts to existing solid

[11] PVT. June 25, 2004. Personal communication with Mr. Albert Shigemura and Belt Collins Hawaii.

waste facilities would occur from construction or operation as most of the material would be recycled or sold for reuse.

4.3.6.2.3 No Action Alternative

Under the No Action Alternative, the utility upgrade would not take place and no solid waste would be generated.

4.4 ROADS AND TRAFFIC

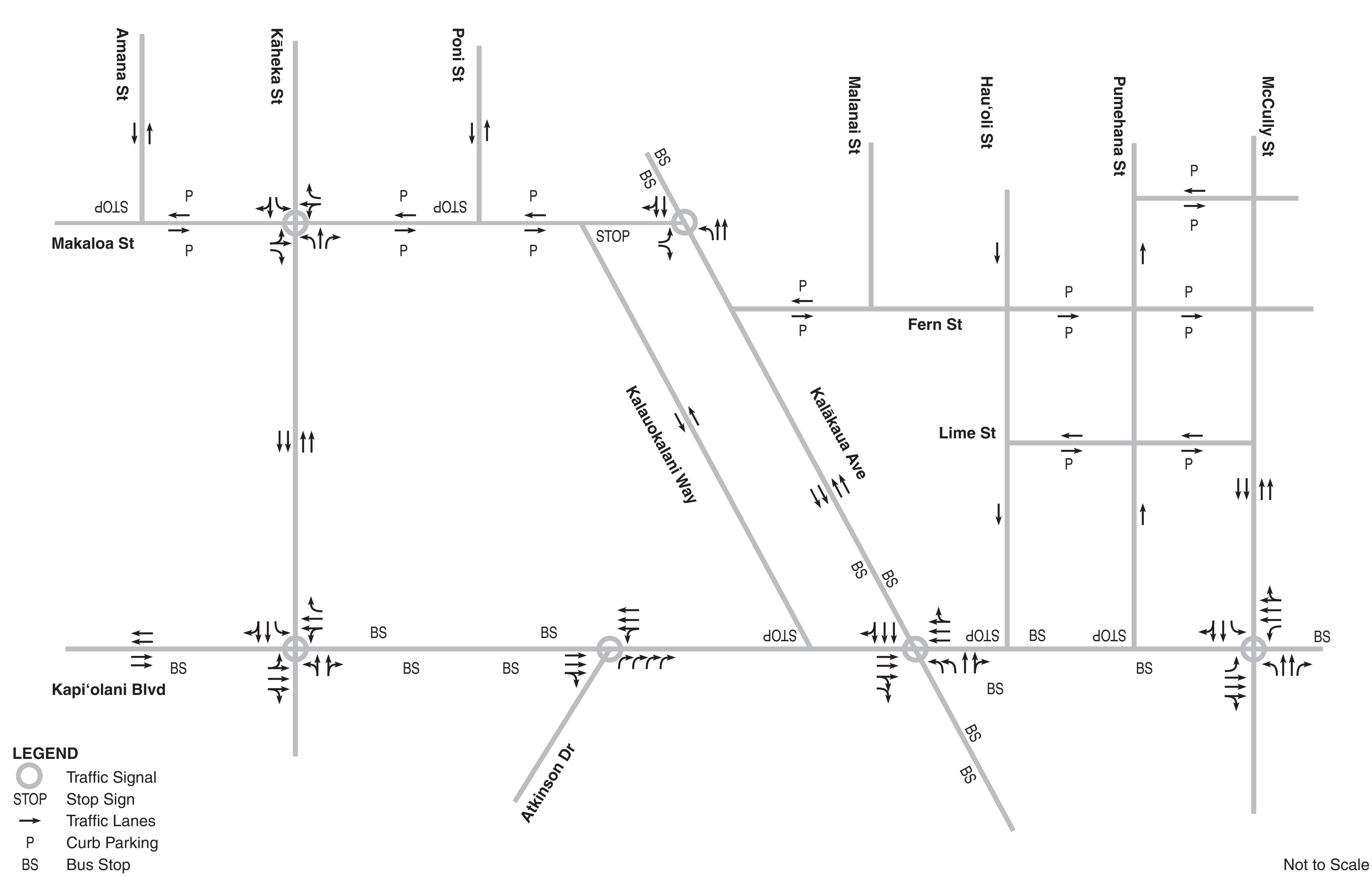
Detailed descriptions of existing conditions, impacts, and actions to minimize impacts pertaining to roadways, traffic controls, vehicular volumes, traffic conditions, public transit routes and stops, and pedestrians are provided in the *Traffic Impact Study East O'ahu Transmission Project* (Wilbur Smith Associates August 2004), presented as Appendix B. Findings are summarized herein.

4.4.1 Existing Conditions

Existing roadway intersections, curb parking, and approximate bus stop locations for the Proposed Action alignment (Makaloa Corridor) in Phase 1 are identified in Figure 4-4. This alignment follows the streets of Makaloa, Kalākaua, Fern, Hau'oli, Lime, and Pumehana. Additional information about this alignment is provided in Appendix B.

Vehicular volumes at key intersections during peak periods were obtained through traffic counts, conducted during spring of 2004 specifically for this EA, and from records obtained from the City and County of Honolulu Department of Transportation Services (DTS), unless otherwise noted in Appendix B. Based on evaluation of these data, peak periods may vary in time at different locations within the project area. These data also show that the greatest volume of vehicles during peak hours occurs along Kapi'olani Boulevard and Kalākaua Avenue. Similarly, highest daily (weekday) vehicular volumes are also found on these roadways as summarized below:

Kapi'olani Boulevard (at Hau'oli Street)	39,000 vehicles per day (VPD) entering intersection
Kalākaua Avenue (mauka of Kapi'olani Boulevard)	35,000 VPD



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Note: Midday conditions are depicted as these conditions represent the period with the least number of available lanes thoughout the day. During peak morning and afternoon commuting hours, the curb lane(s) used for parking during midday could be used for through lanes.

Source: Wilbur Smith Associates

Figure 4-4
MAKALOA CORRIDOR

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

For comparison, daily (weekday) vehicular volumes for other roads are listed below:

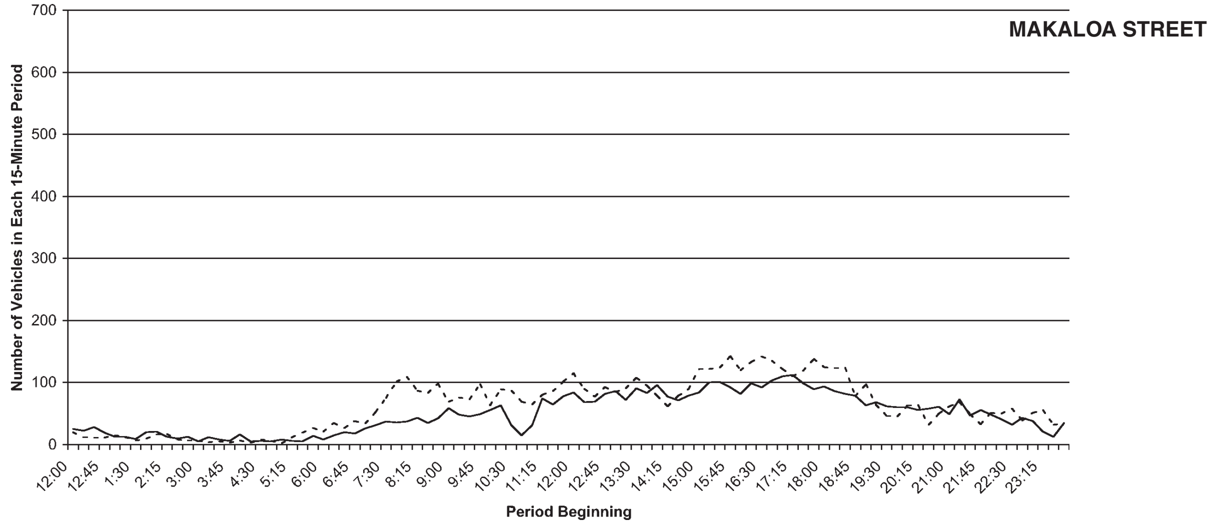
Kāheka Street	14,000 VPD
Makaloa Street	7,000 VPD
Hauʻoli Street (at Kapiʻolani Boulevard)	3,500 VPD
Fern Street (at Kalākaua Avenue)	2,000 VPD
Pumehana Street (approaching Fern Street)	2,700 VPD
Pumehana Street (approaching Lime Street)	2,900 VPD
Winam Avenue	3,650 VPD
Moʻoheau Avenue	8,220 VPD
Date Street (at Lukepane Avenue)[12]	16,200 VPD

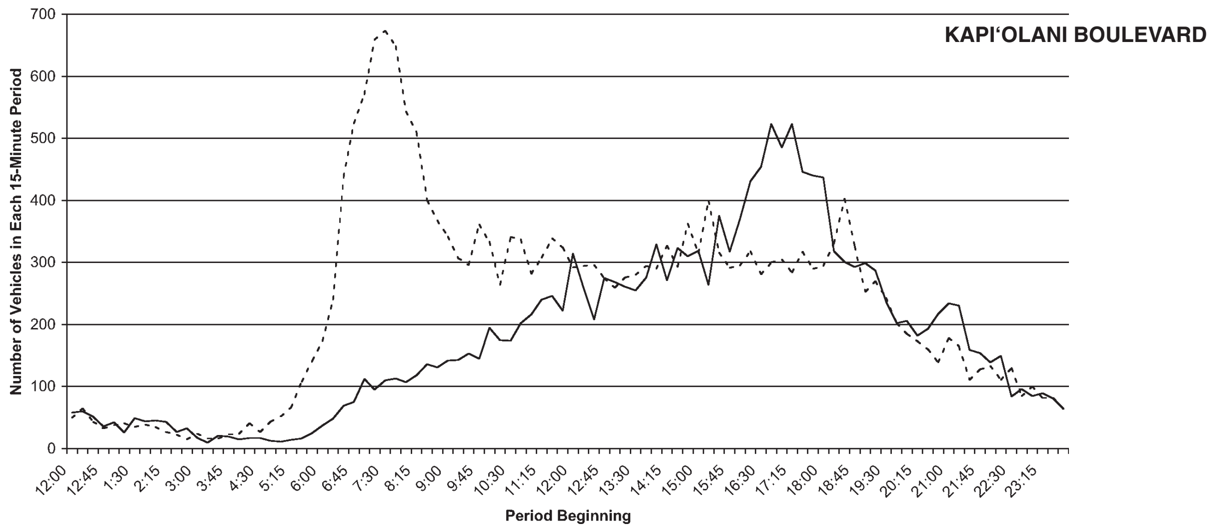
As shown in Table 4-3 and Figure 4-5, vehicular volumes and patterns vary throughout the day at any one location. Along Makaloa Street (near Poni Street), volumes remain very low through the early morning, gradually double by noon, and remain at these levels through the afternoon and evening hours. Volumes decline to very low levels late in the evening, around midnight. Along Kapiʻolani Boulevard, vehicular volumes are much greater, and directional splits[13] during morning and afternoon commute periods are pronounced. Directional splits associated with commuting and school traffic, and relatively low volumes at night, are also evident along Date Street (near Lukepane Avenue).

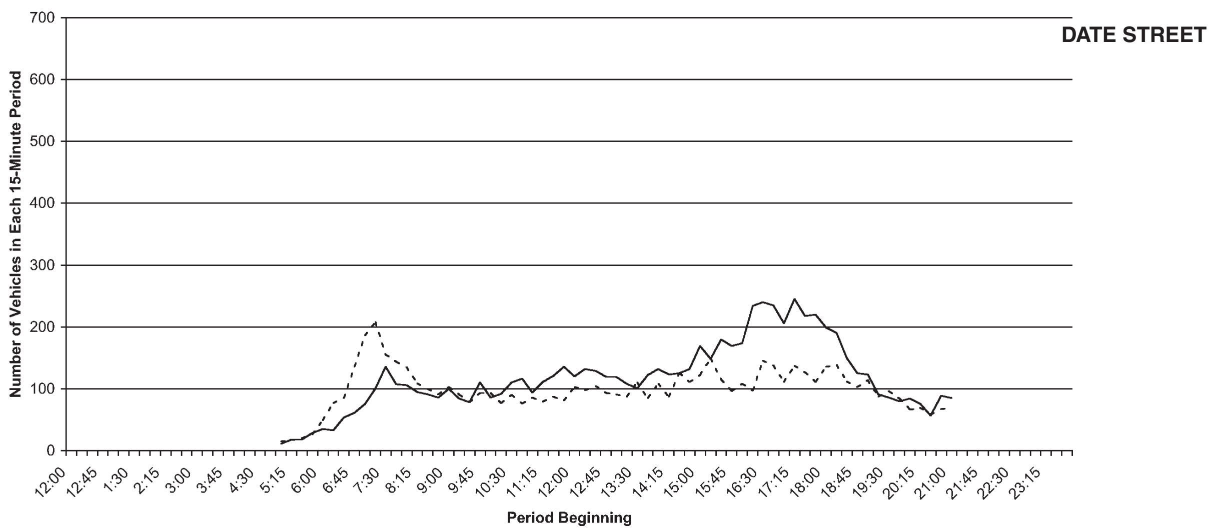
Intersection volume-to-capacity ratios (V/C) and levels of service (LOS) are indicators of how an intersection or a roadway is functioning. The V/C compares the existing or projected vehicular volumes on a roadway to the roadway's capacity, thus indicating the relative adequacy of the roadway to accommodate the traffic volumes. The LOS describes roadway traffic conditions in terms of travel delays or travel speeds at intersections. Six LOS, ranging from A to F, describe expected delays in traffic. LOS A represents little or no delay, LOS B and C represent traffic delays in the range of 5 to 25 seconds per vehicle, LOS D describes conditions where congestion is noticeable (average delay of 25 to 50 seconds), LOS E represents very long traffic delays (average delay of 40 to 60 seconds), and LOS F represents the case where the average delay exceeds 60 seconds per vehicle.

[12] Traffic volumes for Date Street are based on a 1999 traffic count, and increased by 0.75 percent per year to estimate the 2004 traffic volume.

[13] Directional splits refer to vehicular volumes that are high in one period in one direction and are high in another period in the opposite direction.







LEGEND

- - - - - - Ewa Bound

——— Koko Head Bound

Source: Wilbur Smith Associates

Figure 4-5
VEHICULAR VOLUMES BY TIME OF DAY—PHASE 1

Environmental Assessment for the 46kV Phased Project
East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

Table 4-3 summarizes the existing traffic conditions at key intersections in the vicinity of Makaloa Street and Kapi'olani Boulevard. Traffic conditions on Makaloa generally operate at a higher LOS than on Kapi'olani Boulevard. The highest V/C ratio of 0.99 occurs during the morning peak hour at Kapi'olani Boulevard and Atkinson Drive; this intersection operates at LOS C. The most congested conditions occur at the intersection of Kapi'olani Boulevard and McCully Street, where the V/C ratio is 0.96 and the LOS is E during the afternoon peak hour.

Table 4-3. 2004 Traffic Conditions
Makaloa Street–Kapi'olani Boulevard Area

Intersections	Morning Peak Hour			Midday Peak Hour			Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS	V/C	ADPV	LOS
Makaloa St.–Kāheka St.	0.27	18.1	B	0.39	19.8	B	0.66	25.3	C
Kapi'olani Blvd.–Kāheka St.	0.49	14.2	B	0.69	25.8	C	0.86	43.1	D
Kapi'olani Blvd.–Atkinson Dr.	0.99	23.6	C	0.62	20.2	C	0.63	24.5	C
Kapi'olani Blvd.–Kalākaua Ave.	0.93	49.2	D	0.80	39.0	D	0.90	43.0	D
Kapi'olani Blvd.–McCully St.	0.82	40.7	D	NA	NA	NA	0.96	57.3	E

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Available

Additionally, midday peak hour traffic volumes at the Date Street intersection with Kapi'olani Boulevard and Kamoku Street approximates 74 percent of the intersection capacity, with average traffic delays at LOS D. The highest estimated 2004 peak hour traffic volumes at Mo'oheau and Winam Avenues are 845 vehicles and 280 vehicles, respectively. A two-lane street should be able to accommodate about 1,000 vehicles in a one-hour period at LOS D. Volumes along Winam Avenue are well below this level, while Mo'oheau Avenue volumes approach this level.

As shown on Figure 4-4, bus routes are located along Kapi'olani Boulevard, Kalākaua Avenue, Makaloa Street, Kāheka Street, and McCully Street. While not shown on Figure 4-4, Mo'oheau Avenue and Date Street are also used as bus routes. The more heavily-used bus stops are at the intersection of Kapi'olani Boulevard and Kalākaua Avenue and the intersection of Kalākaua Avenue and Makaloa Street.

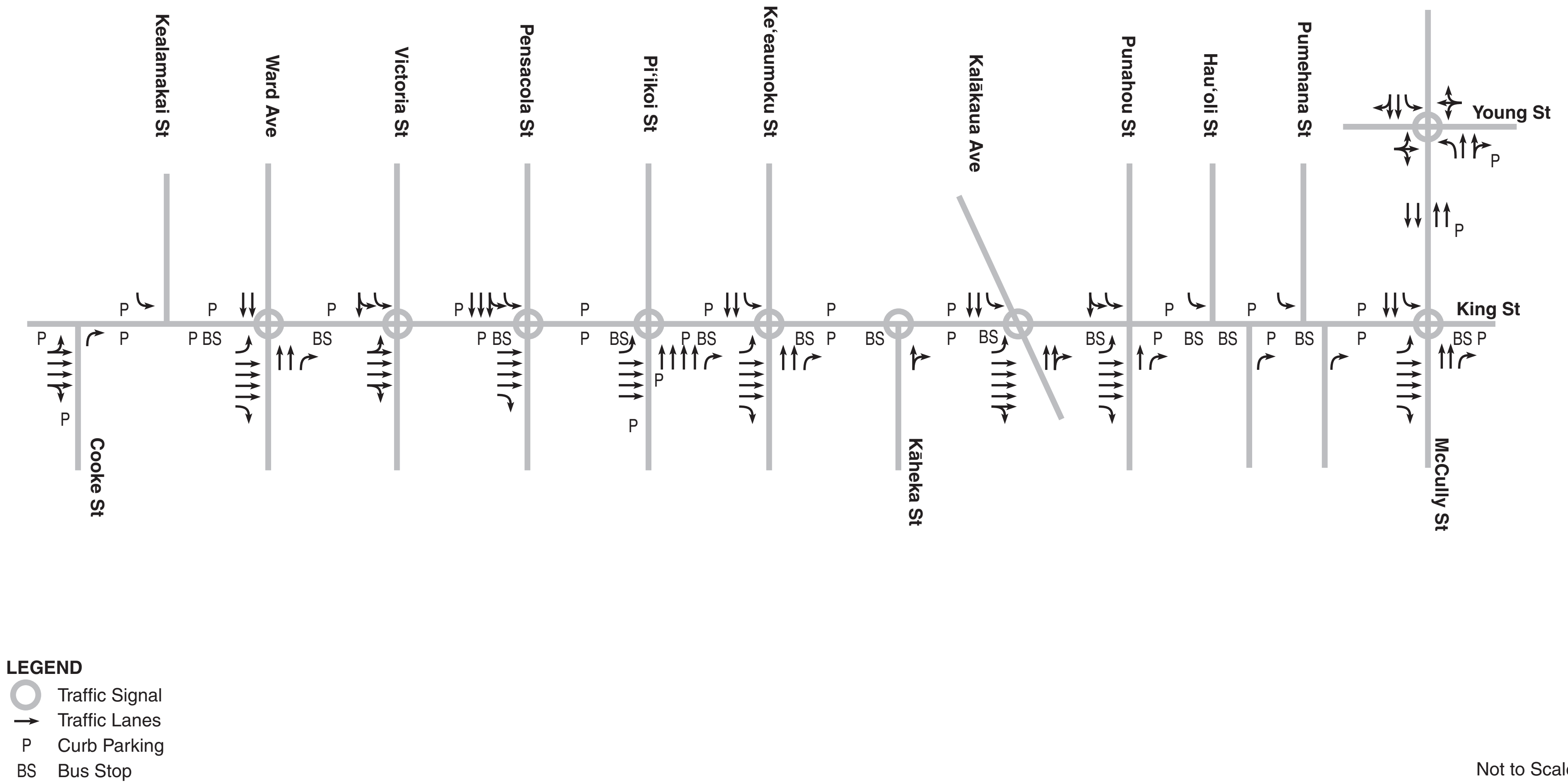
Most of the roads in the Phase 1 area have paved sidewalks for pedestrian access on both sides of the street, with the exception of sections of Pumehana Street and Winam Avenue. Although many of the blocks of Pumehana Street do not have paved sidewalks, there are marked crosswalks at the intersections.

Existing Phase 2 roadway intersections, curb parking, and approximate bus stop locations are identified in Figure 4-6. Peak-hour vehicular volumes[14] for key intersections are shown in Table 4-4. Daily (weekday) vehicular volumes at area intersections are summarized below:

Cooke Street (at Kapiʻolani Boulevard)	6,400 VPD
King Street (at Cooke Street)	29,000 VPD
King Street (ʻEwa of Punahou Street)	28,000 VPD
King Street (ʻEwa of Hauʻoli Street)	31,000 VPD
Punahou Street (mauka of King Street)	21,500 VPD

As shown in Figure 4-7, traffic volumes increased rapidly along King Street at the start of the morning commute period. Volumes generally continue to rise throughout the day, until a distinct decline at the end of the afternoon commute period (around 6 p.m.). Morning commute volumes are generally higher at the ʻEwa end of the Phase 2 alignment (King Street and Kealamakai Street) than at the Koko Head end of the alignment (King Street and Hauʻoli Street).

14 Vehicular volumes were obtained through traffic counts conducted during spring of 2004 specifically for this EA and the City and County of Honolulu Department of Transportation Services (DTS), unless otherwise noted in Appendix B.



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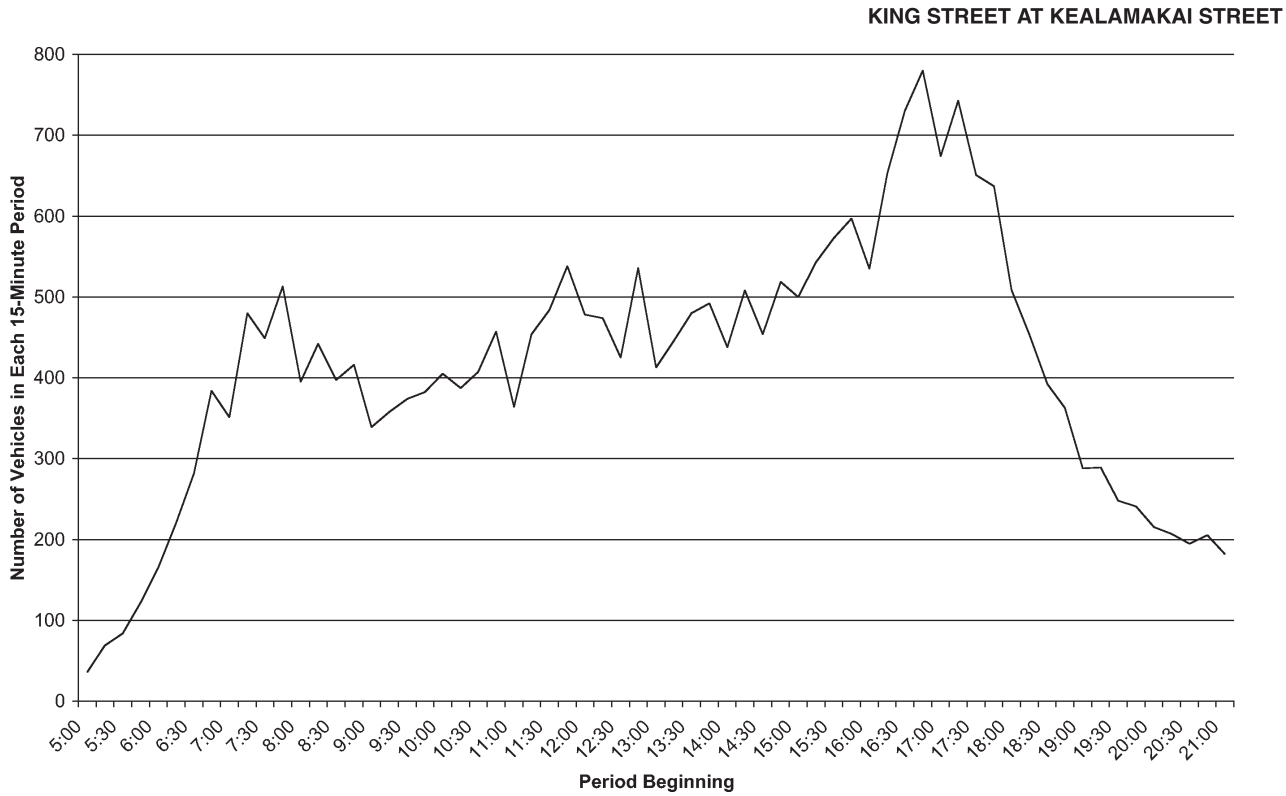
Note: Midday conditions are depicted as these conditions represent the period with the least number of available lanes thoughout the day. During peak morning and afternoon commuting hours, the curb lane(s) used for parking during midday could be used for through lanes.

Source: Wilbur Smith Associates

Figure 4-6
KING STREET CORRIDOR

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.



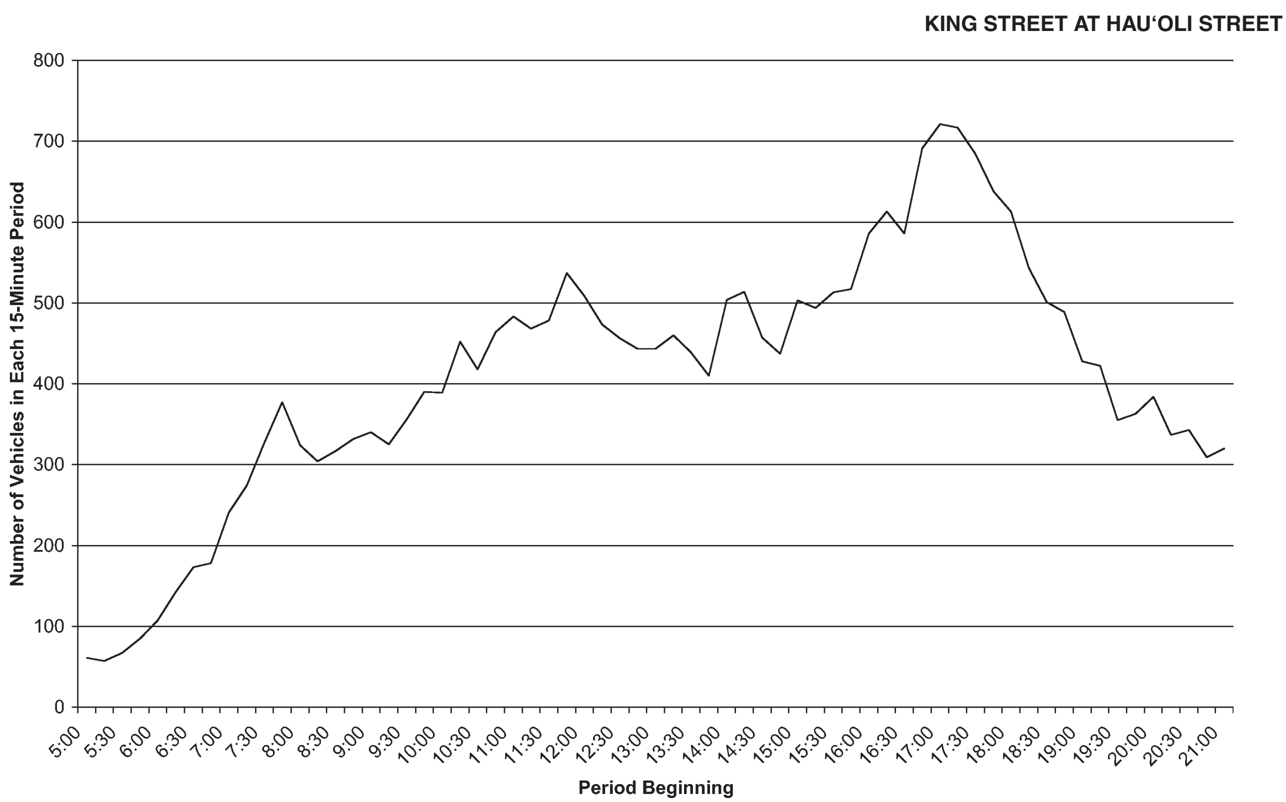


Figure 4-7
VEHICULAR VOLUMES BY TIME OF DAY—PHASE 2

Environmental Assessment for the 46kV Phased Project
East O'ahu Transmission Project
Hawaiian Electric Company, Inc.

Source: Wilbur Smith Associates

Table 4-4 summarizes the existing traffic conditions at key intersections along the Phase 2 alignment. The highest V/C ratio of 0.96 occurs during the afternoon peak hour at King and Punahou Streets; this intersection operates at LOS D with average delays of approximately 48 seconds per vehicle. All other intersections listed in Table 4-4 have lower V/C ratios and all operate at LOS C or better, with average delays less than 35 seconds per vehicle.

Table 4-4. 2004 Traffic Conditions
King Street Corridor

Intersections	Morning Peak Hour			Midday Peak Hour			Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS	V/C	ADPV	LOS
King St.– Ward Ave.	0.68	20.7	C	0.64	20.2	C	0.84	26.1	C
King St.– Pensacola St.	0.51	18.4	B	0.60	19.5	B	0.61	17.3	B
King St.– Pi'ikoi St.	0.46	17.6	B	0.56	18.7	B	0.73	20.2	C
King St.– Ke'eaumoku St.	0.60	26.0	C	0.72	31.4	C	0.84	30.0	C
King St.– Kalākaua Ave.	0.69	24.7	C	0.71	23.5	C	0.85	27.7	C
King St.– Punahou St.	0.75	37.2	D	0.75	33.7	C	0.96	47.8	D
King St.– McCully St.	0.58	24.5	C	0.74	23.3	C	0.81	29.5	C
McCully St.– Young St.	0.56	20.2	C	0.54	19.4	B	0.66	23.1	C

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.

King Street is used by a number of heavily-patronized bus routes. Several bus routes that cross King Street also service bus stops at King Street. The roads in the Phase 2 area have paved sidewalks for pedestrian access on both sides of the street, with crosswalks at major intersections.

4.4.2 Potential Impacts and Actions to Minimize Impacts

4.4.2.1 Proposed Action

Construction

Construction-related traffic impacts were evaluated using year-end 2006 to early 2007 conditions for Phase 1 and late 2008 to early 2009 conditions for Phase 2.[15] Traffic impacts from construction would not be significant as they would be short-term and temporary, affecting any one area not more than two months and, in most cases, less than a month. Potential impacts along the proposed project alignments are summarized in this section along with possible actions to minimize impacts. The Traffic Control Plan, which would be submitted for review by HECO to the City and County of Honolulu as part of the design package, would identify specific measures designed to minimize construction-related traffic impacts. The potential impacts of the City and County of Honolulu Managing Director's curb-to-curb repaving policy, relative to the existing paving requirements set forth in the City and County of Honolulu Ordinance Section 17-3(e), are also evaluated.

The Phase 1 alignment consists of the following roadway areas: Makaloa Corridor, Pumehana Street Area, Date Street Area, and Winam Avenue Area. In addition, two alternative alignments are being considered for Phase 1: Alternative Alignment 1, the Kāheka–Kapi'olani Corridor, and Alternative Alignment 2, the Kalauokalani–Kapi'olani Corridor. Potential impacts and actions to minimize impacts are summarized here. Summaries for the two alternative alignments are presented in Section 4.4.2.2.

Makaloa Corridor. As described in Chapter 3, ductline construction in this corridor would last approximately two months. During this period, daytime activities would affect traffic for about 12 to 15 days; nighttime activities would affect traffic for about 10 to 13 days. Day work would occur between 9:00 A.M. and 3:00 P.M.; night work would occur from 7:00 P.M. to 5:30 A.M. The traffic analysis evaluated both trenching at night between Amana and Poni Streets, and the daytime option.

15 Vehicular volumes were adjusted 0.75 percent per year from early 2004 data to account for growth. This growth rate was based on the average traffic growth between years 2000 and 2025 as forecast by the City and County of Honolulu for the major 'Ewa-Koko Head direction roadways at the Ward Avenue Screenline in the *Primary Corridor Transportation Project Final EIS* (City and County of Honolulu July 2003).

A summary of potential traffic impacts and actions to minimize impacts is presented in Table 4-5. The daytime activity of ductline construction from the manhole in the center of Makaloa Street (fronting Makaloa Substation) to the makai-Koko Head side of the Amana and Makaloa Street intersection has the greatest potential to affect traffic within this corridor. As trenching progresses diagonally across the intersection, there would be two days when the width on either the mauka or makai side of the street would be inadequate to maintain two traffic lanes side by side. A single-lane, flagman operation is proposed to allow traffic movement. While these operations would accommodate projected vehicular volumes, some delay to virtually all through-traffic is expected due to the alternating flow of vehicles within one lane. Possible actions to minimize impacts include conducting this activity at night when vehicular volumes are lower, as shown in Figure 4-5, or maintaining two lanes along Makaloa Street, circumventing the construction area, with turn restrictions onto and from Amana Street. The measures listed in Table 4-5 would help to minimize these short-term and temporary construction-related traffic impacts and help maintain the existing LOS described in Table 4-3.

Table 4-5. Potential Traffic Impacts and Actions to Minimize Impacts Makaloa Corridor

Potential Impacts	Possible Actions to Minimize Impacts
Delays from single-lane/flagman operation at the intersection of Makaloa Street and Amana Street during daytime. All vehicular movements at that intersection would experience delays.	• Shift construction at this crossing to nighttime when there are substantially lower vehicular volumes. OR • Maintain two lanes along Makaloa Street around the construction area with no-left-turn restrictions at Amana Street.
Blockage of Kāheka Street to through traffic for two to four nights as ductline is constructed across intersection with Makaloa.	• Stage work to leave open one lane with flagman to allow through traffic with delays, and extend work by 2 to 3 nights.
Disruption of TheBus service by blockage of Kāheka Street intersection during nighttime construction.	• (same as above) OR • Work only during hours with no bus service, which may increase the number of work nights.
Blockage of crosswalks at intersections.	• Stage work area to block only one crosswalk at an intersection at one time.
Loss of parking along the section of street in the work area and traffic transition zones, and impacts on pedestrian due to blocked crosswalks during daytime construction.	• Begin work at 8 A.M. (or 7 A.M.) to shorten construction by 1 to 2 days. OR • Shift all work to nighttime.

Table 4-5. Potential Traffic Impacts and Actions to Minimize Impacts Makaloa Corridor *(continued)*

Potential Impacts	Possible Actions to Minimize Impacts
Paving	
Loss of lane due to paving.	• Conduct paving work at night and restrict on-street parking on both sides of Makaloa Street to allow travel lanes in either direction.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Restrict parking in work area to leave single lane open to traffic, stagger paving across street to allow one lane of traffic. • Conduct paving work at night and restrict on-street parking on both sides of Makaloa Street to allow travel lanes in either direction.

Both day and night work was evaluated, and based on the traffic volumes that would be affected, night work is preferred for most of the trenching on Makaloa Street. If the section of the ductline from the ‘Ewa side of Kāheka Street to Poni Street were constructed during the day, construction activities at the intersection of Kāheka Street and Makaloa Street would have significant impacts on area traffic, and the LOS described in Table 4-3 could not be maintained. Approximately 700 vehicles per hour would need to be diverted to other streets such as Poni and Amana Streets, which would likely experience severe congestion. Other streets affected by the diverted vehicle volumes include (1) Kalākaua Avenue, which would likely experience congested conditions at the intersection with Makaloa Street, and (2) Ke‘eaumoku Street, which could experience congestion at the intersections with Kapi‘olani Boulevard and Makaloa Street. TheBus routes along Kāheka Street would also require rerouting.

In addition to the potential impacts from paving described in Table 4-5 above, the City and County of Honolulu’s curb-to-curb paving scenario would require additional work shifts (nights) to complete. As summarized below, additional work shifts required for full-street-width paving versus partial-street-width paving would more than double the duration of paving activities.

Makaloa Street from Amana to Poni, partial-street-width	2 nights
Makaloa Street from Amana to Poni, full-street-width	5 nights

Pumehana Street Area. As described in Chapter 3, daytime ductline construction in this area would last approximately two months during the hours of 9:00 A.M. to 3:00 P.M. Streets would be closed to through-traffic one block at a time; however, local access would be allowed as long as the active work area is not blocking the driveway. By 3:00 P.M., the open trench would be covered and the street opened to traffic until the next workday. A summary of potential traffic impacts and actions to minimize impacts for this daytime work is presented in Table 4-6.

Table 4-6. Potential Traffic Impacts and Actions to Minimize Impacts Pumehana Street Area

Potential Impacts	Possible Actions to Minimize Impacts
Closure of Pumehana Street to through-traffic for 33 to 35 work days, requiring diversion of about 1,000 vehicles per day to other routes.	• Restrict work area to allow through-traffic; this would extend the duration of construction from about 2 months to 3 months.
Closure of Lime Street to through-traffic for 6 to 7 work days, with 500 vehicles per day diverted to other routes.	• (same as above)
Closure of Fern Street to through-traffic for 7 work days, with 500 vehicles per day diverted to other routes.	• Construct manhole and ductline across Fern Street at night.
Closure of Date Street to through traffic for 7 work days, with 800 vehicles per day diverted to other routes.	• (same as Pumehana Street activities) • Construct manhole and ductline across Date Street at night and/or reconfigure work area to leave open lane on Date Street with flagman. OR • Extend work area along the 36-foot-wide Date Street and keep a 12-foot lane of Date Street open to traffic through the use of a flagman operation. A lane of Pumehana could also be kept open. • Shift the manhole location to reduce blockage by 2 to 3 days.
Impact on Lunalilo School traffic and parking.	• Conduct work during Lunalilo Elementary School summer break.
Restriction of on-street parking during daytime.	• If not being used by school, e.g., during summer, allow use of Lunalilo School parking lot for use by area residents.
Blockage of crosswalks.	• Stage construction to avoid blocking both sides of intersection at same time.
Paving	
Loss of lane due to paving.	• Restrict parking in work area to leave single lane open to traffic.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Restrict parking in work area to leave single lane open to traffic; stagger paving across street to allow one lane of traffic.

In addition to the potential impacts from paving described in Table 4-6 above, the City and County of Honolulu's curb-to-curb paving scenario would require additional work shifts (days) to complete. The full-street-width paving would add approximately half a day to the duration of paving.

Pumehana and Lime Streets, partial-street-width	1.3 days
Pumehana and Lime Streets, full-street-width	1.9 days

Date Street Area. As described in Chapter 3, trenching and ductline installation would occur over approximately five weeks, and work would be conducted during the day between 9:00 A.M. and 3:00 P.M. During trenching and ductline installation, one lane of traffic flow in each direction would be provided. Local access would be allowed along the mauka side of the street, as long as the active work area is not blocking the driveway. Driveway blockage would not be anticipated to exceed one day. During cable pulling and splicing activities, three lanes would be available for use. At about 3:00 P.M., the open trench would be covered and the street opened to traffic until the next workday. A summary of potential traffic impacts and actions to minimize impacts for this daytime work is presented in Table 4-7.

Table 4-7. Potential Traffic Impacts and Actions to Minimize Impacts Date Street Area

Potential Impacts	Possible Actions to Minimize Impacts
Delays to Koko Head-bound traffic by vehicles stopped to turn left into driveways or streets.	• Restrict left turns from the single Koko Head-bound lane during construction hours. Vehicles needing to turn left into the driveways on the mauka side of the street could travel mauka on Kapi'olani Boulevard and turn onto Mahi'ai Street to access Date Street and turn right into driveways.
Delays to 'Ewa-bound traffic by vehicles stopped to turn left into driveways or streets.	• Restrict left turns, with vehicles having to use alternative routes to turn right into driveways.
Delays to 'Ewa-bound traffic flow at Kapi'olani Boulevard intersection.	• Orient the work area to position the 'Ewa end of the area as far as possible from the Kapi'olani Boulevard intersection throughout the construction work. AND/OR • Avoid use of traffic cones on mauka-side of 'Ewa departure lane near the intersection of Date and Kapi'olani Boulevard. This would allow traffic to use the entire distance between the work area and intersection for stacking in both of the 'Ewa-bound traffic lanes.

Table 4-7. Potential Traffic Impacts and Actions to Minimize Impacts Date Street Area *(continued)*

Potential Impacts	Possible Actions to Minimize Impacts
Separation of traffic lane from curb bus stop during construction across Koko Head-bound lanes.	• If feasible, position traffic cones to create a bus "pull out" to access the normal bus stop. OR • Relocate bus stop location.
Blockage of crosswalk across Date Street at intersection with ʻEwa end of Lāʻau Street.	• Maintain temporary crosswalk on Date Street, crossing the ʻEwa side of Lāʻau Street. Stage the work to retain the temporary crossing location when the crossing on the Koko Head side of Lāʻau Street and Date Street is blocked by construction.
Blockage of makai sidewalk on Date Street.	• Provide temporary pathway around work area.
Paving	
Loss of lane due to paving.	• Conduct paving activities at night. Restrict parking on both sides of street to allow one travel lane in each direction.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Conduct paving activities at night. Restrict parking on both sides of street to allow one travel lane in each direction and stagger paving across width of street.

In addition to the potential impacts from paving described in Table 4-7 above, the City and County of Honolulu's curb-to-curb paving scenario would require additional work shifts (nights) to complete. As summarized below, full-street-width paving would more than double the duration of paving activities.

Date Street, partial-street-width	0.7 night
Date Street, full-street-width	1.9 nights

Winam Avenue Area. As described in Chapter 3, trenching and ductline installation would occur over approximately one month, and work would be conducted during the day between the hours of 9:00 A.M. and 3:00 P.M. For trenching and ductline installation along this narrow avenue, the street would be closed to through-traffic; however, local access would be allowed as long as the active work area is not blocking the driveway needed. During trenching and ductline installation along Moʻoheau Avenue, one lane of through-traffic would be maintained. A flagman operation would be used to direct the alternating flow of traffic through the single lane. A similar flagman operation would be used during cable pulling and splicing activities. At about 3:00 P.M., the open trench would be covered and the street opened to traffic until the next workday. A summary of potential traffic impacts and actions to minimize impacts for this daytime work is presented in Table 4-8.

Table 4-8. Potential Traffic Impacts and Actions to Minimize Impacts Winam Avenue Area

Potential Impacts	Possible Actions to Minimize Impacts
Flagman delays on Mo'oheau Avenue, affecting about 2,800 vehicles per day.	• Perform work along Mo'oheau Avenue at night to reduce the number of vehicles delayed.
Daytime closure of Winam Avenue, requiring diversion of about 1,400 vehicles per day to parallel streets.	• To maintain a single lane for through-traffic, position equipment in a narrow line and have a flagman direct alternating traffic flow. This would increase the duration of construction from 12 to 13 days (with full street closure) to 20 to 40 days, and full street closures would still be required for short periods.
Blockage of bus access to stop at Paliuli Street due to flagman operation on Mo'oheau Avenue.	• Configure work area/transition zone to avoid impact, or relocate bus stop.
Closure of Ho'olulu Street intersection, requiring diversion of traffic to other routes.	• Configure work area to leave Ho'olulu Street intersection open, except when open trench is located within intersection (1-2 days).
Paving	
Loss of lane due to paving.	• Provide flagman operation to alternate traffic flow direction in the single open lane.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Stagger paving across lanes; provide flagman operation to alternate traffic flow direction in the single open lane.

In addition to the potential impacts from paving described in Table 4-8 above, the City and County of Honolulu's curb-to-curb paving scenario would require additional work shifts (days) to complete. The different work shifts required for full-street-width paving versus partial-street-width paving are summarized below:

Winam Avenue and Mo'oheau Street, partial-street-width	0.7 day
Winam Avenue and Mo'oheau Street, full-street-width	1.1 days

King Street Area. The Phase 2 alignment consists of the following roadway areas: part of Cooke Street between the Archer Substation and King Street, King Street (from Cooke Street to McCully Street), and McCully Street (from King Street through Young Street). Two installation methods are considered: (1) open trenching and (2) open trenching and directional drilling.

Table 4-9 summarizes the potential impacts and actions to minimize impacts of nighttime construction using the conventional open trenching installation method. Open trenching activities at night are not expected to cause major traffic delays.

Table 4-9. Potential Traffic Impacts and Actions to Minimize Impacts King Street Corridor (Open Trenching Option)

Potential Impacts	Possible Actions to Minimize Impacts
Closure of Cooke Street to through traffic.	• Place signs to reroute traffic via Kapiʻolani Boulevard.
Traffic delays during special nighttime events at the Neal Blaisdell Center and other venues.	• Coordinate construction schedule and work hours with Neal Blaisdell Center and other event sites to minimize impacts.
Blockage of crosswalks by work area.	• Configure and stage movement of work area to block only one crosswalk at a time per intersection. • Provide a temporary crosswalk to replace mid-block or single crosswalks, if safety can be maintained and as appropriate.
Paving	
Loss of lane due to paving.	• Restrict parking along Cooke Street, makai side of King Street for two to three block lengths, and along McCully Street.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Stagger paving across lanes • Restrict parking along Cooke Street, makai side of King Street for two to three block lengths, and along McCully Street.

In addition to the potential impacts from paving described in Table 4-9 above, the City and County of Honoluluʻs curb-to-curb paving scenario would require additional work shifts (nights) to complete. As summarized below, full-street-width paving would double the duration of paving activities from 10.5 nights to 20.7 nights.

Cooke Street, partial-street-width	0.7 night
Cooke Street, full-street-width	1.6 nights
King Street, partial-street-width	9.3 nights
King Street, full-street-width	18.3 nights
McCully Street, partial-street-width	0.5 night
McCully Street, full-street-width	0.8 night

Night work is preferred for trenching and installation of ductline in Phase 2. If these activities were to occur during the daytime, construction across major intersections would progress at a slower pace (six to eight days versus two to three nights), and higher daytime vehicular volumes would necessitate that no parking be allowed along the curbs of King Street, within three to four blocks around the work area. Traffic delays would be likely, along with the formation of queues near the following intersections: King Street and Ward Avenue, King Street and Ke'eaumoku Street, King Street and Kalākaua Avenue, and King Street and Punahou Street.

Table 4-10 summarizes potential traffic impacts when both open trenching and directional drilling methods are used. With the addition of directional drilling, there would be less disruption to surface streets during repaving. Rather than spending approximately 11 nights to repave the areas affected by the open trenching, only about 6 nights would be needed to repave the drill entry and exit areas. However, the directional drilling option would require that drilling equipment remain within the roadway 24 hours a day throughout the installation process, affecting peak hour periods of traffic for approximately three to four weeks at each of the manholes. Lane blockage would affect commute peak-hour traffic as well as traffic in the off-peak hours. In the afternoon peak hour, up to 3,300 vehicles would pass the drill site (see Figure 4-7). These vehicles would have to merge from six lanes (550 vehicles per lane) into four lanes (825 vehicles per lane). This lane-changing would likely result in slowing of traffic speeds and formation of traffic queues upstream of the lane blockage, thereby disrupting traffic conditions at nearby intersections. At the intersection of Kalākaua Avenue and King Street, directional drilling would result in the diversion of several hundred vehicles per hour to parallel routes such as Kapi'olani Boulevard and H-1 Freeway.

Table 4-10. Potential Traffic Impacts and Actions to Minimize Impacts King Street Corridor (Partial Directional Drilling Option)

Potential Impacts	Possible Actions to Minimize Impacts
Morning and midday traffic delays on King Street, South Street, Ward Avenue, and Punahou Street at the three work areas.	• Restrict on-street parking for three to four blocks at each work area between 6:30 A.M. and 3:30 P.M.
Afternoon peak hour delays on King Street at Ward Avenue, Kalākaua Avenue, and Ke'eaumoku Street.	• Relocate drill site work area farther from the intersection, which increases the number of work sites and duration of work. OR • Restripe King Street on mauka side of work area past drill site for four nine-foot lanes.

Table 4-10. Potential Traffic Impacts and Actions to Minimize Impacts King Street Corridor (Partial Directional Drilling Option) *(continued)*

Potential Impacts	Possible Actions to Minimize Impacts
Disruption to cross street bus routes during nighttime casing assembly and pullback.	• Delay start of work until after cessation of bus service and halt work before initial bus runs in the morning, which may increase number of nights needed for tasks. AND/OR • Revise bus schedules to avoid conflicts.
Blockage of crosswalks across King Street during assembly and pullback of casing at each pullback work area.	• Construct temporary pedestrian bridge over the assembled casing path. OR • Post advance warning signs to indicate alternative routes.
Paving	
Loss of lane due to paving.	• Conduct paving at night. • Restrict parking in work areas.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Conduct paving at night. • Stagger paving across lanes to allow traffic movement.

In addition to the potential impacts from paving described in Table 4-10 above, the City and County of Honolulu's curb-to-curb paving scenario would require additional work shifts (nights) to complete. As summarized below, full-street-width paving would increase the duration of work shifts from 6.3 nights to 16.1 nights.

Cooke Street, partial-street-width	0.7 night
Cooke Street, full-street-width	1.6 nights
King Street HDD sections, partial-street-width	2.3 nights
King Street HDD sections, full-street-width	8.4 nights
King Street trench sections, partial-street-width	2.8 nights
King Street trench sections, full-street-width	5.3 nights
McCully Street, partial-street-width	0.5 night
McCully Street, full-street-width	0.8 night

Operation

The Proposed Action involves the installation of underground circuits in the public right-of-way. After installation is completed and the circuits are operational, no impacts on traffic would occur other than infrequent maintenance and emergency repairs. Potential impacts on traffic would be infrequent and temporary and, therefore, not significant.

4.4.2.2 Alternative Alignments

Construction

Construction related traffic impacts for the alternative alignments were evaluated using 2006 conditions. These impacts would not be significant as they would be short-term and temporary, no more than two months duration in any one area. In most cases, the duration would be less than one month. Relative differences in traffic impacts are apparent when the number of days that traffic may be impacted along each alignment is compared. Table 4-11 shows that the alternative alignments could impact traffic for the longest periods. The Proposed Action is expected to involve the fewest number of days, as most of the alignment would use existing ductline and not require installation of new ductline.

Potential impacts of the proposed alternative alignments are summarized in Tables 4-12 and 4-13, along with possible actions to minimize impacts. In the case of No Action, no impacts on traffic would occur.

Table 4-11. Comparison of Alternatives Based on Number of Days/Nights Traffic Impacted[a]

Alternative	Number of Days	Number of Nights	Total
Proposed Action	25 to 35[b]	10 to 13	35 to 48
Alternative 1 (Kāheka–Kapi‘olani)	55 to 65	5 to 6+	60 to 71+
Alternative 2 (Kalauokalani–Kapi‘olani)	44 to 51	18 to 19+	62 to 70+

[a] Assumes repaving performed to comply with City and County of Honolulu Ordinance Section 17-3(e). Based on HECO's past practices, the single lane affected by excavation is repaved.

[b] Based on two to three days per manhole and seven manholes, and Table S-1 in Appendix B.

Table 4-12. Potential Traffic Impacts and Actions to Minimize Impacts Alternative Alignment 1 (Kāheka–Kapiʻolani)

Potential Impacts	Possible Actions to Minimize Impacts
Same impacts along Makaloa Street as described for Proposed Action.	• Same actions as described for the Proposed Action.
Traffic at Kāheka Street intersection at 92% of capacity with increased delays.	• Schedule ductline construction work near this intersection at night.
Increase in delays at other Kapiʻolani Boulevard intersections.	• Schedule ductline construction work at night.
Blockage of bus stops along mauka side of Kapiʻolani Boulevard.	• When blocked by trench area, shift bus stop along Kapiʻolani away from trench area.
Blockage of crosswalks at Atkinson Drive and Kalākaua Avenue intersections.	• Construct ductline through this section at night when fewer pedestrians are present. AND/OR • Place advance signing to warn pedestrians of blockage and alternative routes.
Paving	
Loss of lane due to paving.	• Conduct paving at night. • Restrict parking in work area to allow additional travel lane.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Conduct paving at night. • Restrict parking in work area to allow additional travel lane. • Stagger paving across lanes.

In addition to the potential impacts from paving described in Table 4-12 above, the City and County of Honolulu's curb-to-curb paving scenario would require additional work shifts (nights) to complete. The different work shifts required for full-street-width paving versus partial-street-width paving, summarized below, show that work shifts would more than double:

Makaloa Street, partial-street-width	0.9 night
Makaloa Street, full-street-width	2.8 nights
Kāheka Street, partial-street-width	0.5 night
Kāheka Street, full-street-width	0.6 night
Kapiʻolani Boulevard, partial-street-width	2.3 nights
Kapiʻolani Boulevard, full-street-width	4.6 nights
Pumehana Street, partial-street-width	0.5 night
Pumehana Street, full-street-width	0.8 night

Table 4-13. Potential Impacts and Actions to Minimize Impacts Alternative Alignment 2 (Kalauokalani–Kapi‘olani)

Potential Impacts	Possible Actions to Minimize Impacts
Same impacts along Makaloa Street as described for Proposed Action.	• Same actions as described for the Proposed Action.
Traffic delays in constructing ductline across Poni Street–Kāheka Street intersection.	• Construct at night.
Blockage of Kalauokalani Way crosswalks.	• Provide temporary walkways to bypass construction work areas.
Paving	
Loss of lane due to paving.	• Conduct paving at night. • Restrict parking in work area to allow additional travel lane.
Loss of multiple lanes associated with curb-to-curb paving policy.	• Conduct paving at night. • Restrict parking in work area to allow additional travel lane. • Stagger paving across lanes.

In addition to the potential impacts from paving described in Table 4-13 above, the City and County of Honolulu's curb-to-curb paving scenario would require additional work shifts (nights) to complete. As summarized below, full-street-width paving would more than double the duration of paving activities versus partial-street-width paving.

Makaloa Street, partial-street-width	2.2 nights
Makaloa Street, full-street-width	6.5 nights
Kalauokalani Way, partial-street-width	1.3 nights
Kalauokalani Way, full-street-width	1.9 nights
Kapi‘olani Boulevard, partial-street-width	1.2 nights
Kapi‘olani Boulevard, full-street-width	2.3 nights
Pumehana Street, partial-street-width	0.5 night
Pumehana Street, full-street-width	0.8 night

Operation

If emergency repairs or maintenance is necessary, temporary traffic disruption would occur. No significant impacts on traffic would be associated with the alternative alignments for the same reasons provided for the Proposed Action.

4.4.2.3 No Action

The No Action alternative would have no impact on traffic. To the extent that existing traffic control systems rely on electrical power from HECO, the reliability concerns discussed in Chapter 2 may have an impact if the EOTP is not in place.

4.5 PUBLIC HEALTH AND SAFETY

4.5.1 Noise Environment

The unit commonly used to describe loudness is the decibel (dB), which is measured on a logarithmic scale to encompass the extensive range of sound intensities. To approximate how the human ear hears sound, more weight is given to frequencies that are heard more easily. The method commonly used for weighting the frequency spectrum to mimic the human ear is the A-weighted sound level in decibels, or dBA. The minimum change in sound level that can be detected by most people is 3 dBA. An increase of 10 dBA is usually perceived as a doubling in loudness. Factors to be considered in determining noise levels are (1) the sound pressure in dBA, (2) the distance of the listener from the source, (3) attenuating or propagating effects of the medium between the source and the listener, and (4) the period of exposure. An adverse effect of noise is any temporary or long-term lowering of the physical, psychological, or social functioning of humans or human organs.[16]

An adult person's ear can tolerate an occasional noise level of up to 140 dB, but for children such an exposure should not exceed 120 dB. OSHA sets permissible noise exposure limits of 90 dBA for an eight-hour period for workers in 29 C.F.R. 1910.[17] The Federal Highway Administration (FHWA) has determined that levels of highway traffic noise, typically ranging from 70 to 80 dBA at a distance of 50 feet, affect a majority of people by interrupting concentration or limiting the ability to

[16] World Health Organization. Guidelines for Community Noise website. http://www.who.int/docstore/peh/noise/Comnoise-3.pdf, accessed June 22, 2004.

[17] World Health Organization. Occupational and Community Noise website. http://www.who.int/mediacentre/factsheets/fs258/en/, accessed June 22, 2004 and
Occupational Safety and Health Administration. Occupational Safety and Health Standards - Code of Federal Regulations Chapter 29 Part 1910.

carry on a conversation. The sound generated by a conversation between two people standing three feet apart is usually in the range of 60 to 65 dBA.[18]

Title 11, Chapter 46, of the Hawai'i Administrative Rules (HAR 11-46) defines maximum permissible sound levels and provides for protection, control, and abatement of noise pollution from stationary noise sources and agricultural, construction, and industrial equipment. Noise is defined in HAR 11-46 as "any sound that may produce adverse physiological or psychological effects or interfere with individual or group activities, including but not limited to communication, work, rest, recreation, or sleep." HAR 11-46 sets maximum permissible sound levels in dBA for excessive noise sources within different zoning districts. Table 4-14 below identifies the classification of zoning districts and the maximum permissible sound levels in dBA for day and night at the property line where the activity occurs. The maximum permissible nighttime noise is 10 dBA less than daytime, except in Class C zoning. The maximum permissible sound level for impulsive noise is defined by DOH as 10 dBA above the levels specified in Table 4-14. Maximum permissible sound levels are not to be exceeded more than ten percent of the time in a 20-minute period without a permit or variance.

Table 4-14. Maximum Permissible Sound Levels in dBA

Class	Zoning	Maximum Permissible Sound Level (dBA)	
		Daytime (7 A.M. to 10 P.M.)	Nighttime (10 P.M. to 7 A.M.)
Class A	Residential, conservation, preservation, public space, open space, or similar type.	55	45
Class B	Multi-family dwellings, apartment, business, commercial, hotel, resort, or similar type.	60	50
Class C	Agriculture, country, industrial, or similar type.	70	70

Source: HAR 11-46

4.5.1.1 *Existing Conditions*

The existing noise environment in the proposed project area is typical of an urban setting. Land uses are within the Class B zoning district, as identified in Table 4-14. The primary source of noise in the area is motor vehicles. Noise levels associated with motor vehicles vary and are dependent on traffic volume, speed, and the number of trucks in the flow of traffic. Generally, the loudness of traffic noise increases with heavier traffic volumes, higher speeds, and greater number of

18 Corbisier, C. *Living with Noise in Public Roads*, Vol. 67, No. 1., July/August 2003. http://www.tfhrc.gov/pubrds/03jul/06.htm, accessed June 22, 2004.

trucks.[19] The noise level on a typical city street with automobile traffic averages 60 to 65 dBA; larger vehicles like heavy trucks and diesel buses may cause noise peaks ranging up to about 90 dBA.[20] The Phase 1 area ranges from relatively quiet residential streets like Fern Street and Hau'oli Street, which contain primarily single- and multi-family residences and residential traffic, to busy streets like Kalākaua Avenue and Kapi'olani Boulevard, which contain a mix of commercial and residential buildings and a traffic volume that includes trucks and buses. The Phase 2 area occurs primarily along South King Street, a busy street with a mix of commercial and residential buildings and heavy use by motor vehicles, including trucks and buses. Noise-sensitive areas include residences and schools.

The existing noise environment for the Alternative Alignments is similar to that of the Proposed Action. Land uses within the alternative alignments are also within the Class B zoning district. Traffic noise along the Kapi'olani Boulevard section of Alternative Alignments 1 and 2 is greater than that along Makaloa Street.

4.5.1.2 Potential Impacts and Actions to Minimize Impacts

4.5.1.2.1 Proposed Action

Construction

No significant impacts from noise would occur. Construction work would be conducted in compliance with applicable noise regulations.

Typical noise levels associated with common construction equipment can range from 80 to 95 dBA at 50 feet from the source, with some drilling equipment generating greater than 100 dBA. Noise levels would vary in location and duration and may be continuous (generator motors), fluctuating (crane operation), or impulsive (metal drill pipes banging together).[21] Noise sources associated with the types of construction activities planned, estimated duration, and methods to minimize potential impacts are identified in Table 4-15. Section 3.2.1 identifies the locations where these activities would occur.

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19 U.S. Department of Transportation Federal Highway Administration. *Highway Traffic Noise*. http://www.fhwa.dot.gov/environment/htnoise.htm, accessed June 22, 2004.

20 West Virginia Department of Highways. http://www.wvcorridorh.com/engineer/noise.html, accessed June 22, 2004.

21 Typical noise levels in dBA, at 50 feet, as identified in Table 2 of the Federal Highway Administration paper, *Effective Noise Control During Nighttime Construction.* http://ops.fhwa.dot.gov/wz/workshops/accessible/Schexnayder_paper.htm, accessed June 22, 2004.

Table 4-15. Construction Noise Sources and Actions to Minimize Impacts

Construction Activity	Noise Sources and Noise Levels[1]	Actions to Minimize Impacts
Overhead Pole Replacement	Equipment motors – 88 dBA Backup alarms – 87 or 107 dBA Human voices – 70 dBA	Reduce equipment idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Establish crew communication procedures to minimize the need to shout over equipment.
Hand Trenching	Jackhammers – 88 dBA Equipment motors – 88 dBA Human voices – 70 dBA	Daytime work only. Fit jackhammers with manufacturer-approved exhaust muffler. Reduce equipment idling when not being used. Establish crew communication procedures to minimize the need to shout over equipment.
Ductline Construction (Conventional Trenching), Manhole Installation	Pavement cutting/excavating equipment – 85 dBA Cranes – 83 to 88 dBA Backup alarms – 87 or 107 dBA Human voices – 70 dBA	Reduce equipment idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Work during the day where possible. Establish crew communication procedures to minimize the need to shout over equipment.
Ductline Construction (Directional Drilling)	Drill rig – 108 dBA (at the source) [2] Cranes – 83 to 88 dBA Diesel generators – 81 to 84 dBA Slurry and separation equipment – 100 to 110 dBA (at the source) [2]	Reduce equipment idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Work during the day where possible. Establish crew communication procedures to minimize the need to shout over equipment. Fit generators with manufacturer-approved exhaust mufflers. Fit drilling with high noise reduction mufflers. Add special sound deadening housing around drill rig.
Existing Circuit Removal	Truck motors – 88 dBA Backup alarms – 87 or 107 dBA Human voices – 70 dBA	Reduce equipment idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Establish crew communication procedures to minimize the need to shout over equipment.
New Circuit Installation	Equipment motors – 88 dBA Backup alarms – 87 or 107 dBA Human voices – 70 dBA	Reduce equipment idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Establish crew communication procedures to minimize the need to shout over equipment.

Table 4-15. Construction Noise Sources and Actions to Minimize Impacts
(continued)

Construction Activity	Noise Sources and Noise Levels[1]	Actions to Minimize Impacts
Paving	Paving equipment – 80 to 89 dBA Backup alarms – 87 or 107 dBA Human voices – 70 dBA	Reduce equipment idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Establish crew communication procedures to minimize the need to shout over equipment.
Substation Modifications	Truck motors – 88 dBA Human voices – 70 dBA Cranes – 83 to 88 dBA	Reduce truck idling when not being used. Use manually adjustable or self-adjusting backup alarms, and configure construction site to minimize the need to reverse. Establish crew communication procedures to minimize the need to shout over equipment.
Dewatering (may be needed during some trenching activities)	Pile driver (for sheet piles) – 101 dBA Human voices – 70 dBA	Install sheet piles in an active trench prior to initiating dewatering so it would not be a constant source of noise. Establish crew communication procedures to minimize the need to shout over equipment.
Transformer installation	Cement mixer – 85 dBA Human voices – 70 dBA	Fit equipment with manufacturer-approved exhaust muffler. Establish crew communication procedures to minimize the need to shout over equipment.

1 Typical noise levels in dBA, at 50 feet, as identified in Table 2 of the Federal Highway Administration paper, *Effective Noise Control During Nighttime Construction.* http://ops.fhwa.gov/wz/workshops/accessible/Schexnayder_paper.htm, accessed June 22, 2004.

2 Typical noise levels in dBA, at the source, as identified in: Power Engineers. August 4, 2004. *Hawaiian Electric Company, Inc., East Oahu Transmission Project Phase 2 – 46kV Lines, Horizontal Drilling Feasibility Study.*

Noise generated during construction activities is generally short in duration. For the construction options for both phases, contract provisions would determine acceptable work hours and identify methods to enforce compliance. Construction work would be conducted in compliance with State of Hawai‘i noise control rules. Impacts on construction workers would be minimized by compliance with OSHA construction noise standards. A telephone hotline connected directly to the job site would be established so neighbors could contact construction personnel and immediately voice concerns about the project.

No significant noise impacts on schoolchildren are expected, as work and associated noise-generating equipment would be located at least 50 feet from the nearest classrooms, which are air conditioned with closed windows. Closed windows act as a noise buffer and can reduce indoor noise levels by 15 to 25 dBA. Scheduling construction activities that occur near schools to coincide with school vacations would minimize noise impacts.

For construction activities that may produce excessive noise levels, a noise permit or noise variance, as applicable, would be obtained from the State of Hawaiʻi DOH. Approval of the permit or variance may require use of noise attenuation devices on construction equipment or further limits on construction hours and activities. Backup alarms on construction equipment may be disabled if other inaudible safety measures are used, as allowed by law. Scheduling noise-generating activities in residential areas only during the day and informing crew members about moderating voice levels would minimize noise impacts.

Operation

No significant impacts to noise receptors would occur with operation of the upgraded electrical system. The new 46-12kV transformer to be installed at the Makaloa Substation (Phase 1) would be designed and manufactured for low sound level classification and operate in compliance with State of Hawaiʻi noise control rules. The new 138-46kV transformers with associated cooling equipment to be installed at Kamoku Substation (Phase 1) and Archer Substation (Phase 2) would be designed and manufactured for standard sound level classification. Because Kamoku and Archer Substations are concrete-enclosed, transformer and cooling equipment noise is attenuated and these facilities operate in compliance with State of Hawaiʻi noise control rules.

Maintenance or emergency repair activities may generate short-term noise associated with vehicles, much like the existing vehicle traffic on roadways. No actions to minimize impacts are required.

4.5.1.2.2 Alternative Alignments

The analysis of potential construction-related noise impacts is the same for the Proposed Action. No significant impacts from noise would occur during construction or operation.

4.5.1.2.3 No Action Alternative

With no construction or operational activities under this alternative, no noise would occur.

4.5.2 Emergency Response

This section addresses potential effects on police, fire, and medical emergency responsiveness. Information is summarized from the *Traffic Impact Study East Oahu Transmission Projec*t (Wilbur Smith Associates August 2004), presented in Appendix B.

4.5.2.1 Existing Conditions

The HPD and Honolulu Fire Department (HFD) serve the entire island of Oʻahu, with stations designated to serve smaller districts.

The Proposed Action and alternative alignments are mainly located in two police districts, Districts 1 and 7. District 1 serves downtown Honolulu from Liliha Street to Punahou Street, with offices in the main police station at Alapaʻi and Beretania Streets, approximately two blocks mauka of the Cooke Street end of the Phase 2 alignment. Access to the main police station from King Street is on Kealamakai Street, near the intersection of Cooke and King Streets. Other entrances to the police station include the main entrance and parking facility on Beretania Street and an entrance from Hotel Street. District 7 serves the east side of Oʻahu from Punahou Street to the easternmost point of the island, Makapuʻu Point, excluding Waikīkī. The District 7 offices are located in the main police station. The Waikīkī area is in District 6, which encompasses Waikīkī to the eastern slopes of Diamond Head. The District 6 offices are also located in the main police station, with a substation on Kalākaua Avenue at Kaʻiulani Avenue.

The project area is served by two HFD districts, Battalions 1 and 2, with six fire stations. HFD stations that are within or very close to the project area include the Pāwaʻa Fire Station, which is adjacent to new ductline construction on Makaloa Street, and the McCully Fire Station on Date Street, approximately one block ʻEwa of the Phase 1 new ductline trenching proposed at the Kamoku Substation. Four other stations serve the project area: Central Fire Station on Beretania Street between Pali Highway and Fort Street; Makiki Fire Station on Wilder Avenue at Piʻikoi Street; Waikīkī Fire Station on Kapahulu Avenue between Paki and Lēʻahi Avenue; and Kaimukī Fire Station on Koko Head Avenue makai of Pāhoa Avenue.

Major emergency medical facilities in the project area include Straub Hospital, located on King Street at Ward Avenue, and the Honolulu Clinic of the Kaiser Permanente health maintenance organization, located on King Street between Ward Avenue and Pensacola Street. Both Straub Hospital and the Kaiser Honolulu Clinic have urgent care services. Emergency vehicle access to Straub is from Hotel Street. Emergency vehicle access to Kaiser is from Young Street.

4.5.2.2 Potential Impacts and Actions to Minimize Impacts

4.5.2.2.1 Proposed Action

Construction

No significant impacts on emergency responses are expected under the Proposed Action. HECO would coordinate with emergency responders as needed. Emergency vehicle entrances to Kaiser Honolulu Clinic and Straub Hospital are on side streets not on the proposed project route; therefore, emergency access to these facilities would not be affected. Scheduling work at night would allow construction to occur at times when traffic volumes are low, and as a result, avoid or minimize impacts on emergency responders.

Construction would extend across the driveway of the Pāwa‘a Fire Station on the northwest corner of the Makaloa Street intersection with Kāheka Street. The construction activity would be coordinated with the Fire Department to maintain the response capability of the equipment during the construction work, and access to the Pāwa‘a Fire Station would not be impeded.

Operation

No impacts on emergency responses would occur from the operation of the Proposed Action.

4.5.2.2.2 Alternative Alignments

The analysis of potential impacts to emergency response and actions to minimize impacts for the alternative alignments is the same as for the Proposed Action. No significant impacts would occur from construction or operation.

4.5.2.2.3 No Action Alternative

Under the No Action alternative, no construction or operational activities would occur, and the electrical transmission reliability concerns and overload situations would not be addressed. In the event of outages, emergency responders would need to use backup sources of electricity. During extended outages, HFD and HPD may be called more frequently to assist in areas without power. Emergency rooms at Straub and Kaiser typically have standard procedures and backup electrical systems in place to deal with temporary outages. In the case of an island-wide power outage, No Action would significantly and adversely affect emergency responders and public health and safety.

4.5.3 Schools

4.5.3.1 Existing Conditions

School schedules typically include 177 to 180 days of instruction and 187 to 190 teacher workdays. More than half of the public schools have adopted single-track year-round or modified calendars. Multi-track year-round scheduling is applied at some schools to relieve overcrowding. Students at traditional calendar schools generally begin the third week in August, while students at year-round schools generally begin four, three, or two weeks earlier.[22]

Lunalilo Elementary School, located on the ‘Ewa side of Pumehana Street between Citron and Fern Streets, is adjacent to the proposed Phase 1 project area. ‘Iolani School, a private school serving kindergarten through 12th grade, is off Date and Kamoku Street near the Phase 1 Kamoku Substation work. See Figure 3-1.

Washington Middle School, located on the makai side of King Street at the Punahou Street intersection, and McKinley High School, located on the makai side of King Street at the Pensacola Street intersection, are adjacent to the proposed Phase 2 project area. The First Chinese Church of Christ in Hawai‘i operates a preschool on its property between King Street and Young Street. See Figure 3-5.

4.5.3.2 Potential Impacts and Actions to Minimize Impacts

4.5.3.2.1 Proposed Action

Construction

No significant impacts from the Proposed Action on schools and their occupants would occur. Construction activities near Lunalilo Elementary School are likely to take place during the day to minimize noise impacts on nearby residents. However, if possible, scheduling construction activities during the summer vacation would avoid impacts to the school and occupants (the school currently operates on a traditional schedule, starting in late August and ending in early June). Should construction occur while school is in session, noise and dust impacts on building occupants would be minimized as the school buildings nearest the construction area are air conditioned and windows would remain closed.

22 State of Hawai‘i, Department of Education Website, http://doe.k12.hi.us/about/intro_calendar.htm. Accessed May 7, 2004.

On Pumehana Street, on-street parking would likely be prohibited one block at a time for the duration of trenching activities. However, vehicular access to the school would be maintained throughout the construction period. Public access to work areas would be restricted to ensure pedestrian safety during construction.

Impacts to Washington Middle School from Phase 2 activities would differ depending on whether the conventional trenching option or horizontal directional drilling option is used. The trenching option would allow vehicular access to be maintained to the teacher's parking lot off of King Street during construction hours.

For the directional drilling option, the teacher's parking lot off of King Street would have to be temporarily relocated during construction. The school's parking lot and field would be used to lay out ductline and possibly directional drilling equipment. The Boys and Girls Club of Hawai'i uses the playing fields at Washington Middle School from the end of the school day until sunset, and all day during school vacations.

The estimated duration of impacts to Washington Middle School from the directional drilling option would be approximately two to four months, including set-up time. The longest period without scheduled classes at Washington Middle School is a three-week winter break. Scheduling a portion of the work during the school break would lessen the impact of work on the school.

Impacts to McKinley High School would also differ depending on the construction option chosen. For the trenching option, work would be confined to a single lane on King Street. Vehicular and pedestrian access to McKinley High School would be maintained during construction. For the directional drilling option, land near the corner of King and Pensacola Streets would be needed for staging of materials. Slurry extracted from the drill hole would be returned to an on-site settling and containment pit. Wet cuttings would then be separated from the slurry for disposal and the remaining slurry would be recycled into the drilling rig. According to the school's principal, the proposed activities would have little impact, provided the construction work area is fenced off. The nearest school building, the Science Building, is set back from King Street. It has air conditioning, so classroom windows would not open directly on the site of the drilling activity, although other buildings, further makai and towards downtown Honolulu, do depend on natural ventilation. The equipment staging area would be fenced off during the drilling phase to prevent access to the staging area.

Operation

No impacts to schools are expected from operation of the 46kV Phased Project.

4.5.3.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to schools is the same as for the Proposed Action. No significant impacts to schools from construction and operation would occur.

4.5.3.2.3 No Action Alternative

Under the No Action alternative, no construction or operational activities would occur, so there would be no impacts on schools. To the extent that existing schools rely on electrical power from HECO, the reliability concerns discussed in Chapter 2 may have an impact if the EOTP is not in place.

4.6 SOILS AND TOPOGRAPHY

4.6.1 Existing Conditions

The island of O‘ahu was formed by the Wai‘anae and the Ko‘olau volcanoes. Following a long period of volcanic quiescence, volcanic activity produced a series of lava flows, cinder cones, and tuff cones, referred to as the Honolulu Volcanic Series.[23] The south and southwest areas of O‘ahu have extensive coastal plains, such as the Honolulu coastal plain, which includes the Phase 1 and 2 locations. Lava flows in these coastal plains are interbedded with emerged reefs, likely formed during an interglacial stage with a high water stand. The coastal plain typically consists of silty and sandy soils overlying basalt bedrock, coralline reefs, or unconsolidated lagoon and beach deposits. Bedrock becomes more common in the shallow subsurface with increasing distance from the shoreline. Sedimentary rocks in the project area include alluvium and limestone (reefs and dunes).

Soils

The general soil association for the southern coastal plain of O‘ahu is the Lualualei-Fill Land-‘Ewa association. This association is characterized as deep, nearly level to moderately sloping, well-drained soils that have fine or moderately fine textured subsoil or underlying material, and areas of fill land. More specific soil types beneath the Phase 1 and 2 areas are described in Table 4-16.

[23] Macdonald, et al. 1983. *Volcanoes in the Sea, Second Edition*. University of Hawai‘i Press, Honolulu.

Table 4-16. Soil Types

Soil Type	Location	Description
ʻEwa silty clay loam 0 to 2 percent slopes	Phase 1: Makaloa Street, along the mauka side of Kapiʻolani Boulevard and at the Kapahulu Substation. Alternative Alignment 1: Makaloa Street, Kalauokalani Way and Kapiʻolani Boulevard. Alternative Alignment 2: Makaloa Street and Kapiʻolani Boulevard.	Well-drained, developed in alluvium derived from basic igneous rock. Dark reddish-brown silty clay loam over dark reddish-brown and dark-red silty clay loam subsoil with subangular blocky structure. Moderately shallow coral limestone between 20 and 50 inches bgs. Moderate permeability, very slow runoff, erosion hazard no more than slight.
Pearl Harbor clay	Phase 1 and Alternative Alignments 1 and 2: Makaloa Substation.	Very poorly drained, developed in alluvium overlying organic material and occurs in level or nearly levels areas. Very dark gray, mottled clay over very dark gray and very dark grayish-brown, mottled clay with angular and subangular blocky structure. Muck or peat substratum at the water table, between 20 and 30 inches bgs. Very slow permeability, very slow to ponded runoff, erosion hazard no more than slight.
Kawaihāpai clay loam 0 to 2 percent slopes	Phase 1: Kalākaua Avenue, Kamoku Substation, Date Street, Kūhiō Substation. Alternative Alignment 1: Kalauokalani Way and Kapiʻolani Boulevard. Alternative Alignment 2: along a segment of Kapiʻolani Boulevard.	Well-drained, formed in alluvium derived from basic igneous rock in humid uplands. Dark-brown clay loam over very dark-brown stratified sandy loam. Stony and gravelly substratum between 22 and 32 inches bgs. Moderate permeability, slow runoff, erosion hazard no more than slight. Includes small areas of poorly drained soils and small areas of Jaucas soils. Some places subject to flooding.
Fill land, mixed	Phase 1: Kewalo Substation, along Lime and Pumehana Streets, Waikīkī Substation, ʻEna Substation, makai side of Kapiʻolani Boulevard. Alternative Alignments 1 and 2: eastern end of the Kapiʻolani Boulevard segment, Pumehana Street, and McCully Substation, Phase 2: along the eastern-most segment of the alignment, near McCully Street.	Surplus material from other areas such as ocean-dredged material, surplus excavated soils, garbage, and other material.
Molokai silty clay loam 3 to 7 percent slopes	Phase 1: Winam Avenue.	Well-drained, formed in material weathered from basic igneous rock. Dark reddish-brown silty clay loam over dark reddish-brown silty clay loam with prismatic structure. Soft, weathered rock substratum. Moderate permeability, slow to medium runoff, erosion hazard slight to moderate.

Table 4-16. Soil Types *(continued)*

Soil Type	Location	Description
Makiki clay loam 0 to 2 percent slopes	Phase 2: Along the majority of the alignment.	Well-drained, formed in alluvium mixed with volcanic ash and cinders. Dark-brown clay loam over dark-brown clay loam with subangular blocky structure with cinders and rock fragments. The depth to unweathered cinders or stony or gravelly alluvium ranges from 30 to more than 60 inches bgs. Moderately rapid permeability, slow runoff, erosion hazard no more than slight

Source: USDA, Soil Conservation Service. 1972. Soil Survey of Islands of Kaua'i, O'ahu, Moloka'i, and Lāna'i, State of Hawai'i.

A 2002 soils investigation conducted along a segment of Kapi'olani Boulevard, in the area where alternative routes were considered, consisted of one boring (drilled to 15.5 feet) and five probe holes (ranging from 11 to 27 inches in depth).[24] The subgrade soils were noted to consist of tan and grayish brown silty sand with coral fragments that extended to approximately 5 to 8.5 feet and underlain by gray silty sand with coral fragments. This is generally consistent with the soil classification data of this area, which includes shallow coral limestone. Groundwater was encountered at approximately 5 feet, and depth to groundwater is expected to vary with tidal fluctuations.

A 2004 soils investigation along the Phase 2 area, consisted of five soil borings; each extended to 30 feet in depth and exhibited horizontal variations.[25] Consistent with the USDA soil classification, fill material was found at the eastern end of the alignment, overlying clayey silt and silty sand. Soils observed between Ward Avenue and Ke'eaumoku Street included upper layers of silty sand, silty clay, and clayey silt. Coral was generally encountered between 8.5 and 15 feet. Coral varied from gravel-sized fragments with sand to silty sand with gravel to highly weathered coral. Groundwater was encountered between 10 and 15 feet below ground surface.

The sands in four borings (Ward Avenue, Pensacola Street, and Pi'ikoi Street) were classified as medium dense, dense, and very dense. The Ke'eaumoku Street sands were classified as loose to medium dense to very dense. The silty sand in the Punahou Street boring was classified as medium dense and loose. The upper layer silts and clays in the Ke'eaumoku Street and Punahou Street borings were classified as very stiff to hard.

24 Ernest K. Hirata & Associates, Inc. August 30, 2002. *Soils Investigation Rehabilitation of Streets Kapiolani Boulevard from Ward Avenue to Kalakaua Avenue Honolulu, Hawai'i*. Prepared for Engineers Surveyors Hawaii, Inc.

25 Fewell Geotechnical Engineering, Ltd. May 19, 2004. *Draft Boring Logs Directional Drilling Feasibility Study King Street, Between Ward Avenue and Punahou Street East O'ahu Transmission Line Honolulu, O'ahu, Hawai'i*.

Topography

The topography of the project area is relatively flat. The elevations of the Phase 1 area are generally between sea level and 10 feet above mean sea level (msl). The Phase 2 area elevations range from approximately 10 to 20 feet above msl. The proposed project is located in developed areas, generally within paved roadways. Asphalt and concrete, with underlying base course gravel fill, are the most likely surface materials.

4.6.2 Potential Impacts and Actions to Minimize Impacts

4.6.2.1.1 Proposed Action

Construction

No significant adverse impacts to soils and topography would occur. Construction staging areas may be established at schools or other sites where surface soils may be exposed. Potential short-term disturbance of surface soil would be minimized by implementing control measures such as: mechanical retardation and runoff control, sediment basins, and vegetation and/or mulch. Disturbances would be temporary, and existing grade and conditions would be restored as part of the project.

Excavation activities, both trenching and directional drilling, would temporarily disturb soils and affect topography. Existing grade and surfacing material would be restored with no long-term impact on erosion or soil stability. If required, HECO will submit a National Pollutant Discharge Elimination Systems (NPDES) construction stormwater permit application, and HECO will comply with all permit requirements including preparation and implementation of a best management practices (BMP) plan to address pollution prevention.

Operation

Operation of the upgraded electrical infrastructure would not impact the soils or topography within the project areas.

4.6.2.1.2 Alternative Alignments

The analysis of potential impacts to soils and topography for the alternative alignments is the same as for the Proposed Action. No significant impacts to these resources would occur during construction or operation.

4.6.2.1.3 No Action Alternative

Under the No Action Alternative, existing surface and subsurface conditions would not be modified, resulting in no impact to the soils or topography.

4.7 WATER RESOURCES

Water resources include groundwater and surface water systems in the vicinity of the Proposed Action and alternative alignments.

4.7.1 Existing Conditions

4.7.1.1 Groundwater

The project area overlies the Pālolo and Nuʻuanu aquifer systems of the Honolulu aquifer sector. These are basal aquifers, containing fresh water in contact with seawater. The Phase 1 work west of Hauʻoli Street and Phase 2 work along South King Street west of McCully overlies the Nuʻuanu aquifer system. The upper aquifer is unconfined, sedimentary, and currently used. It has no listed utility for drinking water or ecological use, is moderately saline (1,000 to 5,000 milligrams per liter chloride), replaceable, and highly vulnerable to contamination. The lower aquifer is confined (bounded by impermeable or poorly permeable formations below groundwater surface) and occurs in flank deposits (horizontally extensive lavas). It is a freshwater aquifer (salinity less than 250 milligrams per liter chloride), currently listed as being used for drinking water, and is irreplaceable with a low vulnerability to contamination.[26]

In Phase 1, work east of Hauʻoli Street overlies the Pālolo aquifer system. The upper aquifer is unconfined and sedimentary. It has potential for use but no listed utility, is moderately saline (1,000 to 5,000 milligrams per liter chloride), is replaceable, and has high vulnerability to contamination. The lower freshwater aquifer is confined and occurs in flank deposits. It is listed as currently used for drinking water, is irreplaceable, and has low vulnerability to contamination.

Most of the project area is located inland of the State of Hawaiʻi DOH-established Underground Injection Control (UIC) line, which runs along Pākī Boulevard, Ala Wai Boulevard to Kalākaua, Kapiʻolani Boulevard to South Street, and then along King Street. The UIC program was established to protect the quality of underground sources of drinking water from pollution by subsurface disposal of fluids.[27] The UIC

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[26] Mink and Lau. 1990. *Aquifer Identification and Classification for Oʻahu: Groundwater Protection Strategy for Hawaiʻi, Technical Report No. 179.*

[27] Hawaiʻi Administrative Rules, Title 11, Chapter 23. September 22, 1992.

line is the boundary between non-drinking water aquifers (generally seaward of the UIC line) and underground sources of drinking water (generally inland of the UIC line). Drinking water wells are located upgradient from the project areas in the Kaimukī, Kapahulu, and Wai‘alae Avenue areas. Numerous injection wells within the project vicinity are used for discharge of thermal effluent, carwash water, and rainwater.[28] The closest well, in the Date Street area, is upgradient from proposed work and does not have a listed major use.

On Kapi‘olani Boulevard, near the proposed activities from Makaloa Substation to Pumehana Street (Phase 1), the depth to groundwater ranges from 5.1 to 5.3 feet bgs. Groundwater here is likely affected by tidal influence.[29] The depth to groundwater along South King Street (Phase 2) is approximately 16 to 18 feet bgs. These depths are approximately equivalent to elevation above sea level.

4.7.1.2 Surface Water

The project area is within the Ala Wai, Makiki, and Mānoa-Pālolo watersheds. The Ala Wai watershed encompasses Phase 1 and Phase 2 project areas, and the Makiki and Mānoa-Pālolo watersheds intersect portions of the Ala Wai watershed.

In the Phase 2 area, Makiki Stream is underground and part of the City and County of Honolulu’s municipal separate storm sewer system (MS4) at the intersection of Kalākaua Avenue and South King Street and it emerges again within Phase 1 as open surface water at the intersections of Kalākaua Avenue with Makaloa Street and with Kapi‘olani Boulevard.[30] The stream is listed by the DOH as impaired for total phosphorus and nitrogen.[31] Flow data for this stream is not available since it is not included in the U.S. Geological Survey (USGS) monitoring program.[32]

Storm water in the project area drains to the MS4 system, which has storm drain inlets along most of the roads in the project area. MS4 storm drains in Phase 1 and 2 areas outlet to Kewalo Basin, Ala Wai Boat Harbor, Makiki Stream, and Ala Wai Canal.

Notable surface waters in the project area include the Ala Wai Canal and the Mānoa-Pālolo Drainage Canal. The Ala Wai Canal, which had maintenance dredging

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28 DLNR Commission on Water Resource Management. No Date. Well Locations, Marked On: USGS. 1983. Map O-13 (Honolulu Quadrangle) 7.2 minute series (topographic) and U.S. Department of Transportation and City and County of Honolulu, Department of Transportation Services. July 2003. *Final Environmental Impact Statement, Primary Corridor Transportation Project.*

29 Ernest K. Hirata & Associates, Inc. August 30, 2002. *Soils Investigation Rehabilitation of Streets Kapiolani Boulevard from Ward Avenue to Kalakaua Avenue, Honolulu, Hawai‘i.*

30 USGS Map, Honolulu Quadrangle, 1998.

31 Hawai‘i DOH. June 16, 2004. *2004 List of Impaired Waters in Hawai‘i. Final.*

32 USGS. 2001. *USGS Water Resources Data, Hawai‘i and Other Pacific Areas, Water Year 2000. Volume 1, Hawai‘i.* Water-Data Report HI-00-1.

completed in September 2003, is heavily used for water recreation such as paddling, kayaking, and rowing. Makiki Stream, Ala Wai Canal, and Mānoa-Pālolo Drainage Canal are classified as Class 2 inland waters, which are defined in HAR 11-54. Class 2 waters are recommended for agricultural and industrial water supply, compatible recreation, shipping, navigation, and propagation of fish and aquatic life. These waters may not receive any discharge that has not received the best degree of treatment, and no new sewage or industrial discharges are permitted in such waters.

The Ala Wai Canal has been listed by the DOH as impaired for chlorophyll a, enterococci, nitrogen, total phosphorous, and turbidity.[33] This classification indicates that the Ala Wai Canal does not presently meet applicable water quality standards nor is it expected to meet those standards despite any foreseeable implementation of potential pollution actions to minimize impacts or control measures. The DOH has issued an ongoing fish advisory against consumption of fish from the Ala Wai Canal due to contamination (i.e., lead, pesticides).

No wetlands are identified within the project area.

4.7.2 Potential Impacts and Actions to Minimize Impacts

The Proposed Action and the alternative alignments would not involve area-wide dewatering for construction and would not result in a net increase in impervious surfaces. Therefore, neither a net decrease in infiltration to groundwater nor a net increase in surface water runoff would occur.

4.7.2.1 Proposed Action

Construction

Groundwater. No significant impacts to drinking water or groundwater would result from the Proposed Action. Because drinking water wells near the project are upgradient, the closest being approximately 1,750 feet, more than 0.25 mile, from the proposed Date Street work, no significant adverse impacts on drinking water resources are anticipated. In the Phase 1 area, where groundwater is as shallow as five feet bgs, groundwater may be encountered during trenching, and construction dewatering may be required. In the Phase 2 area, where groundwater is approximately 16 to 18 feet bgs, trenching activities are not likely to encounter groundwater. Directional drilling, considered in Phase 2, would likely intersect the shallow basal aquifer.

33 Hawaiʻi DOH. June 16, 2004. *2004 List of Impaired Waters in Hawaiʻi.* Final.

Phase 1 excavations may encounter groundwater. Given the expected high permeability of the soils, excavations below groundwater would be sealed, and dewatering would take place within the sealed excavation. This would minimize the potential for area-wide groundwater subsidence, thereby reducing potential effects on structural foundations near the work area. The sealing methods for excavations below groundwater could involve the use of bentonite clay mudseals and sheetpiles.

If required, dewatering activities would be localized and water removal would be temporary and minimal, so groundwater levels would not be affected beyond the immediate project area. Water removed from construction excavation would not be discharged to storm drains or other surface waters. It would be pumped into forward trenches to allow for infiltration into the water table. No impact to groundwater would occur.

If a NPDES permit is determined to be required for construction dewatering, the appropriate application would be submitted and HECO would comply with all permit requirements.

If contaminated groundwater were encountered during dewatering, appropriate responses in compliance with state law and guidance would be implemented.

Surface Water. No significant impacts to surface water would result from the Proposed Action. Construction activities and equipment generally have the potential to introduce pollutants (e.g., erodible soil and petroleum products) to the project vicinity that could be carried by storm water runoff into the City and County of Honolulu's MS4 system. Work in the vicinity of the MS4 system would be coordinated with the City and County of Honolulu to ensure that storm drain lines and intakes are properly protected and not impacted by the HECO construction. A BMP plan would be developed to address pollution prevention for construction work as a requirement for NPDES construction stormwater permit coverage, if coverage is required.

Operation

No significant adverse impacts to groundwater or surface waters would be associated with operation of the improvements. Lines would be maintained through existing manholes and other established access points. Maintenance SOPs would address potential spills of fluids that could pollute surface waters. Groundwater and potential drinking water sources would not be exposed to maintenance activities.

4.7.2.2 Alternative Alignments

The analyses of potential construction and operational impacts to drinking water, groundwater, and surface water from the alternative alignments are the same as those discussed under the Proposed Action. No significant impacts to groundwater, drinking water, or surface water during construction or operation would occur.

4.7.2.3 *No Action Alternative*

Under the No Action Alternative, water resources would not be affected.

4.8 AIR QUALITY

4.8.1 Existing Conditions

The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS), 42 U.S. Code (USC) §7409, 40 CFR Part 50, for the following pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns in diameter (PM-10), particulate matter up to 2.5 microns in diameter (PM-2.5), ozone (O_3), and lead (Pb). NAAQS criteria, based on air monitoring data for the above pollutants, are used to designate all air regions within the U.S. into air quality categories for each pollutant: attainment, nonattainment, and unclassifiable. Regions that do not meet the NAAQS are classified as nonattainment; regions where air monitoring data results are better than the standard are classified as attainment. These standards, along with the State AAQS, provide the basis for air pollution control rules and permitting procedures. The island of O'ahu and the State of Hawai'i are in attainment of Federal and State standards.

4.8.2 Potential Impacts and Actions to Minimize Impacts

4.8.2.1 *Proposed Action*

Construction

No significant impacts to air quality would be associated with the Proposed Action. Project related emissions would be short-term and temporary. Emissions would result from fossil fuel-powered generators and motors of heavy construction equipment and fugitive dust. If required, permits for generators with the potential to affect air quality would be obtained pursuant to HAR 11.60.1. Fugitive dust would be minimized as required by HAR 11.60.1-33.

Operation

No impacts to air quality from the operation of the Proposed Action would occur.

4.8.2.2 Alternative Alignments

The analysis of potential construction impacts to air quality from the alternative alignments is the same as for the Proposed Action. No significant impacts to air quality from construction or operation would occur.

4.8.2.3 No Action Alternative

Under the No Action Alternative, there would be no impact on air quality.

4.9 CULTURAL RESOURCES

4.9.1 Archaeological Resources

Archaeological resources consist of cultural deposits, including subsurface features such as pits, pavements, or earth ovens, and human remains. Assessment of the potential for encountering archaeological resources includes conducting research into the land use history of an area and reviewing reports of previous archaeological investigations in the area. The results of the assessment are used to determine the potential of encountering archaeological sites or deposits during the course of construction. It is possible that some areas will have a low potential to contain subsurface archaeological resources, while other areas may have a higher potential to contain subsurface resources. An archaeological assessment was prepared in August 2004 by Pacific Legacy, Inc. (Appendix C1). A summary of this report is provided below.

4.9.1.1 Existing Conditions

Phases 1 and 2 of the proposed project are located on the Honolulu and Waikīkī plains which include Kalua‘Ōlohe and Kapahulu, all within the ahupua‘a of Honolulu and Waikīkī. Legendary and early historic accounts describe this area as containing habitation sites, wet and dry land agriculture, artesian freshwater springs, salt making ponds, marsh lands, and various types of fish and duck ponds. After early contact, population decrease and migration left much of this area fallow. Over time, habitation sites increased, grazing of livestock occurred, and eventually, the present urban landscape developed.

Archaeological and archival research in the vicinity of the project areas suggest the presence of subsurface archaeological resources in three areas: a buried traditional fishpond, Loko Upu, documented on historical maps as being just west of the Makaloa Substation; a complex of three fishponds possibly located on the HECO Ward Avenue property; and the area within the King Street right-of-way near the Catholic Cemetery, between Cooke Street and Ward Avenue, where it is possible that human burials may extend mauka of the current boundaries of the cemetery. The locations of the two fishponds have not been confirmed through archaeological investigation.

4.9.1.2 Potential Impacts and Actions to Minimize Impacts

4.9.1.2.1 Proposed Action

Construction

The archaeological assessment (Appendix C1) indicates that there are three areas that may have archaeological resources: the HECO Ward Avenue property (a possible complex of three fishponds); the area within the King Street right-of-way (where human burials may extend mauka of the current boundaries of the cemetery); and west of Makaloa Substation (the traditional pond Loko Upu). In the process of subsurface construction activities in these areas, subsurface archaeological resources may be encountered. Generally, any subsurface archaeological features encountered during construction and any inadvertent burials found will be treated in accordance with law.

Operation

Once the ductlines, manholes, and circuits are in place, no additional subsurface disturbance is anticipated, with the exception of potential future emergency work to replace broken sections of ductline. Emergency construction work would include trenching in the same areas that would have already been excavated as part of the Proposed Action; hence, no impacts during operation are expected.

4.9.1.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to archaeological resources from the alternative alignments is the same for the Proposed Action. No significant impacts to archaeological resources from construction or operation would occur.

4.9.1.2.3 No Action Alternative

In the absence of construction and operation of the 46kV Phased Project, there would be no impacts to archaeological resources from the No Action Alternative.

4.9.2 Traditional Cultural Practices

A Cultural Impact Assessment (CIA) was prepared in August 2004 by Pacific Legacy, Inc. (Appendix C2). State law requires that environmental assessments and environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and state. A summary of the traditional cultural practices (TCPs) identified in the Pacific Legacy report is provided below.

4.9.2.1 Existing Conditions

Phases 1 and 2 of the proposed project are located on the Honolulu and Waikīkī plains which include Kalua‘Ōlohe and Kapahulu, all within the ahupua‘a of Honolulu and Waikīkī. There is no evidence of TCPs in the project area. The Proposed Action and alternative alignments are in a developed urban area. The TCPs during pre- and early post-contact Hawai‘i ceased with the transition to the existing urban center. Legendary and historic accounts characterize the land area as having habitation sites, wet and dry land agricultural areas, freshwater artesian wells, salt making ponds, marshlands, and various types of fish ponds. An early account describes the area as wetlands, developed into a system of fishponds and taro ponds in the 15th century, and containing habitation sites with cultivated fields by the end of the 18th century. Historic accounts indicate that around 1828, the fishponds and taro pond fields were abandoned, likely due to population decline and destructive livestock foraging. In the early 19th century, the present-day King Street alignment was a footpath along which a tavern and estates with herds of goats and sheep were constructed. A house in the King Street vicinity was used as a hospital in the mid-19th century. During the years of the Great Mahele, around 1845, much of the land in the area was awarded or sold to foreign persons or Hawaiian ali‘i. As immigration increased in the 20th century, much of the land was resold in parcels of diminishing size. Characteristics of the project area for the alternative alignments are the same as those described under the Proposed Action.

4.9.2.2 Potential Impacts and Actions to Minimize Impacts

4.9.2.2.1 Proposed Action

Construction

No significant impacts on TCPs are anticipated from the Proposed Action because no TCPs have been identified in the project area. If subsurface features related to TCPs during pre- and early post-contact Hawai‘i are encountered during construction, they will be treated in accordance with law.

Operation

Once the ductlines, manholes, and circuits are in place, no additional subsurface disturbance is anticipated, with the exception of potential future emergency work to replace broken sections of ductline. Emergency construction work would include trenching in the same areas that would have already been excavated as part of the Proposed Action; hence, no impacts during operation are expected.

4.9.2.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to TCPs from the alternative alignments is the same as for the Proposed Action. No significant impacts on TCPs from construction and operation would occur.

4.9.2.2.3 No Action Alternative

No significant impacts on TCPs would occur from the No Action Alternative.

4.9.3 Historic Resources

State historic properties are identified in HAR 13-198 as any building, structure, object, district, area, or site that is significant in the history, architecture, archaeology, or culture of the state, its communities, or the nation. National historic properties meet criteria identified in 36 CFR Part 60.4. Historic sites that meet eligibility criteria may be listed on the appropriate State or National Register of Historic Places, or both. Archaeological sites are discussed in section 4.9.1. This section addresses buildings, structures, and sites other than archaeological resources that are designated as historic properties.

4.9.3.1 Existing Conditions

Three historic sites along the Phase 2 King Street alignment—Thomas Square Park, Linekona School, and McKinley High School—have been placed on the State and National Registers of Historic Places because of their local and national significance. These are described below.

Thomas Square Park, located on the northeast corner of the King Street and Ward Avenue intersection, was placed on the Hawaiʻi Register of Historic Places on March 23, 1972, and assigned identification number 80-14-9990. The park was placed on the National Register of Historic Places in 1974. Its historic significance is tied to events in 1843. After British forces overstepped their bounds by seizing government buildings in Honolulu and forcing King Kamehameha III to cede the islands to England, Queen Victoria sent Admiral Richard Thomas to the islands to restore sovereignty. Thomas Square Park is the location where, in 1843, ceremonies were held restoring the Hawaiian Kingdom.

Linekona School, located on Victoria Street across from Thomas Square, was placed on the Hawaiʻi Register of Historic Places on December 17, 1979, and assigned identification number 80-14-1339. The school was placed on the National Register of Historic Places in 1979. Linekona School does not border the Phase 2 alignment. Linekona School is historically significant as a well-preserved school complex and an example of turn-of-the-century architectural eclecticism applied to a public building in Hawaiʻi. The school is also significant in the history of education in Hawaiʻi, as it was for a number of years the only public school in Hawaiʻi offering instruction in English.

McKinley High School, located on the makai side of King Street at the intersection with Pensacola Street, was placed on the Hawaiʻi Register of Historic Places on May 3, 1980, and assigned identification number 80-14-9926. It was placed on the National Register of Historic Places in 1980. The leading public school in Hawaiʻi in the 1920s and 1930s, McKinley High School offered the public a level of education that, at the time, was generally only available at private schools. It is also architecturally significant as an example of Spanish Colonial revival architecture in Hawaiʻi.

4.9.3.2 Potential Impacts and Actions to Minimize Impacts

4.9.3.2.1 Proposed Action

Construction

No significant impacts to historical resources from the Proposed Action would occur. Construction activities would take place within public rights-of-way or substations. For the directional drilling option considered for Phase 2, the sidewalk and grassy area along King Street in front of McKinley High School was evaluated as a staging site for the drilling materials. This activity would not affect the school buildings, and the site sidewalk and grassy area would be restored to its original condition after completion of construction.

Operation

No significant impacts to historic properties are expected from operation of the 46kV Phased Project.

4.9.3.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to historic resources from the alternative alignments is the same as for the Proposed Action. No significant impacts to historic resources from construction or operation would occur.

4.9.3.2.3 No Action Alternative

No significant impacts to historic properties would occur from the No Action Alternative.

4.10 VISUAL AND AESTHETIC RESOURCES

4.10.1 Existing Conditions

Visual resources include scenic vistas, scenic overlooks, unique topography, or visual landmarks having scenic value. Mature trees, discussed in Section 4.11, can be contributing elements to this resource. The City and County of Honolulu's Development Plan (DP) defines public views as "views along streets and highways, mauka-makai view corridors, panoramic and significant landmark views from public places, views of natural feature, heritage resources, and other landmarks, and view corridors between significant landmarks."[34] Impacts to visual resources are based on the degree and duration of disturbance to the visual quality of an area.

The proposed project area consists of existing streets in a mixed-use urban setting. Building types range from single-family homes to high-rise residential and commercial buildings. Roadways are from two to six lanes in width. The wider, busier roads, including King Street, Kapiʻolani Boulevard, Date Street, and Makaloa Street, generally run in the ʻEwa–Koko Head or east-west direction. Many of the mauka-makai streets, including Pumehana Street, Winam Avenue, and Cooke Street, are smaller, residential streets. Landscaping along the roadways is inconsistent. A grassy median strip with trees is present on Kalākaua Avenue. Open spaces are present along sections of the roadways as parks, such as Thomas Square, school grounds (McKinley High School), and areas associated with large buildings (Neil S. Blaisdell Center and the Department of Agriculture building along King Street). Views are generally confined to the viewer's immediate surroundings.

For Alternative Alignment 1, Kāheka Street is a sparsely landscaped, two-lane road that runs mauka-makai, fronted by mixed residential and commercial properties. For Alternative Alignment 2, visual resources for Kalauokalani Way are similar to those for Kāheka Street.

4.10.2 Potential Impacts and Actions to Minimize Impacts

4.10.2.1 Proposed Action

Construction

No significant impacts on visual and aesthetic resources would be associated with the Proposed Action. Construction related activities would be temporary. HECO will coordinate with its arborist and the City and County of Honolulu Department of Parks and Recreation (DPR) to avoid affecting root structures of trees along the Proposed Action alignment.

Operation

No significant impacts on visual and aesthetic resources would occur. The subtransmission lines would be underground with no visual obstructions.

[34] City and County of Honolulu. Revised Ordinances of Honolulu, *Chapter 24, Development Plans*.

4.10.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to visual resources from the alternative alignments is the same as for the Proposed Action. No significant impacts to visual resources from construction or operation would occur.

4.10.2.3 No Action Alternative

Under the No Action Alternative, no potential impacts on visual resources would occur.

4.11 BIOLOGICAL RESOURCES

4.11.1 Existing Conditions

The area affected by the Proposed Action and alternative alignments consist of existing paved City and County of Honolulu streets and adjacent sidewalks or landscaping. No threatened or endangered species or their habitats are known to exist here. No exceptional trees have been identified along the considered alignments where trenching or directional drilling would occur. Exceptional trees are defined as "a tree or grove of trees with historic or cultural value, or which by reason of its age, rarity, location, size, esthetic quality or endemic status has been designated by the city council as worthy of preservation" by ROH 41-13, Protective Regulations for Exceptional Trees.[35] Exceptional trees identified along the project route are mahogany trees (*Swietenia mahogani*) along the Kalākaua Avenue median; however, these occur in areas where circuits would be installed in existing ductlines. Other large trees along the route identified by the City and County of Honolulu DPR Division of Urban Forestry as either private or City and County of Honolulu-owned, but not designated as exceptional, include monkeypod trees (*Samanea saman*) along Makaloa Street and rainbow shower trees (*Cassia x nealiae*) along King Street.[36]

Animals common to urbanized areas of Honolulu are mainly alien birds, rodents, mammals, and insects.

35 Revised Ordinances of Honolulu, Chapter 41. http://www.co.honolulu.hi.us/refs/roh/41a1_25.htm. Accessed June 25, 2004.

36 City and County of Honolulu, Department of Parks and Recreation. June 14, 2004. Personal communication with Mr. Stanley Oka and Belt Collins Hawaii.

4.11.2 Potential Impacts and Actions to Minimize Impacts

4.11.2.1 Proposed Action

Construction

Construction activities within existing streets would have no effect on biological resources in the area. HECO would coordinate with its arborist and the City and County of Honolulu DPR to avoid affecting root structures of trees along the Proposed Action alignment. If landscaped areas, e.g., grassy areas fronting McKinley High School and Washington Middle School are affected, they would be restored by HECO.

Operation

Operational activities would have no effect on biological resources.

4.11.2.2 Alternative Alignments

The analysis of potential construction and operational impacts to biological resources from the alternative alignments is the same as for the Proposed Action. No significant impacts to biological resources from construction or operation would occur.

4.11.2.3 No Action Alternative

With no construction or operation, no impacts would occur.

4.12 SOCIOECONOMIC ENVIRONMENT

This section describes the socioeconomic characteristics of the project area, including demographics, residential characteristics, employment and income, economic activities, and energy use, and assesses construction-related and operational impacts of the Proposed Action, Alternative Alignments, and No Action Alternative.

4.12.1 Existing Conditions

4.12.1.1 Demographics

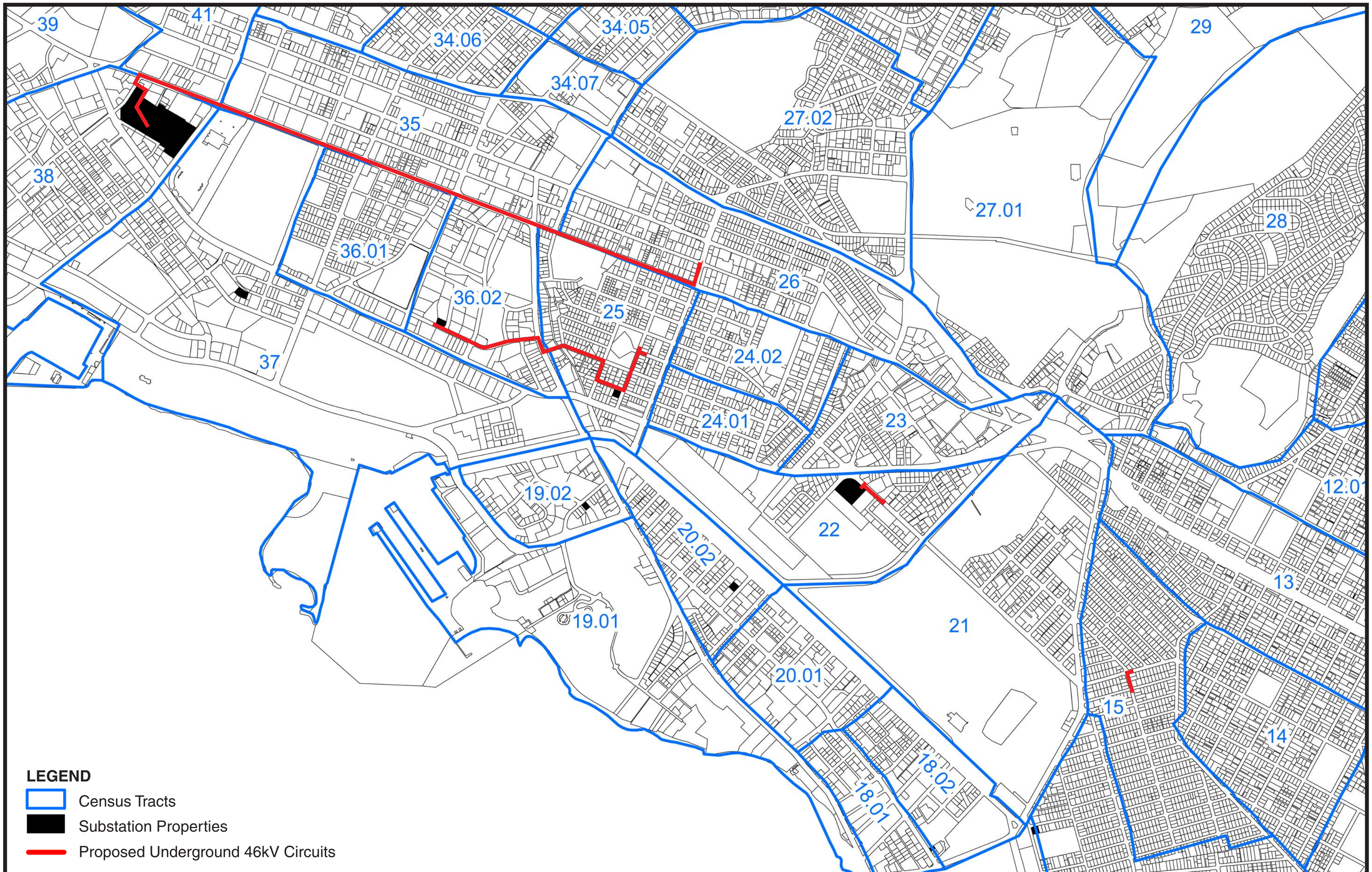
The proposed project area is located in Oʻahu Census Tracts 16, 25, 26, 35, 36.01, 36.02, 37, and 38 (Figure 4-8). In 2000, the population of these census tracts totaled 33,237 people. The population in these tracts has been stable, increasing a total of approximately one percent over the 20 years between the 1980 and 2000 census counts. In the 1990s, the rate of population growth in the proposed project area (as defined by the census tracts listed here) exceeded that of the island as a whole.

Population projections for the City and County of Honolulu show that the Primary Urban Center, which extends from Pearl City to Kāhala and in which the proposed project area is situated, is expected to experience higher rates of growth than in the past decades. The annual rate of growth between 2000 and 2025 is projected to be in the range of 0.6 percent. Since the Primary Urban Center is already extensively developed, population growth will likely be accommodated in higher density residential projects in existing residential areas, through infill or replacement.

Census data indicates that population in the proposed project area differs from the island as a whole. Households are smaller; average household size is 1.95 compared to 2.95 for the entire island. Two-thirds of the homes in the project area are occupied by renters, compared to less than half (46 percent) for the island as a whole. And the project area population is older, with a mean age of 44 years compared to 37 years island-wide.

4.12.1.2 Residential Characteristics

Residential uses account for approximately half of the buildings fronting the Phase 1 alignment and the alternative alignments, whereas only about 3 percent of the buildings fronting the Phase 2 alignment are in residential use. These are a mix of housing types ranging from single-family homes to high-rise condominiums. Many are two- and three-story apartment buildings.



2004.33.0800/019-1 d8.9.04 8

NORTH

0 1000 2000
SCALE IN FEET

Figure 4-8
CENSUS TRACTS

Environmental Assessment for the 46kV Phased Project
East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

4.12.1.3 Employment and Income

The proposed project area has a lower rate of labor force participation (55 percent employed) than O'ahu as a whole (65 percent employed). This reflects the generally older population in the project area. With fewer workers, mean household incomes are much lower: $45,889 (project area) versus $65,439 (island-wide). Per capita income in the project area is higher than for the island as a whole ($23,995 versus $21,998).

4.12.1.4 Businesses in the Project Area

An inventory was conducted of structures fronting the proposed and alternative alignments to estimate the number and types of ground-level businesses with the potential to be affected by in-road construction activities. The inventory also identified hours of business in cases where this information was clearly posted. Table 4-17 is a summary of the inventory.

Table 4-17. Business Inventory

	Proposed Action Phase 1	Phase 1 Alternative Alignment 1	Phase 1 Alternative Alignment 2	Proposed Action Phase 2
Ground Level Businesses				
Gas station	0	0	0	5
Grocery store	3	3	2	0
Office: not likely to have visitors	1	1	0	6
Office: service (bank, dentist, etc.)	20	16	18	51
Other retail	10	9	4	70
Restaurant	16	11	11	47
Vacant storefront	0	0	0	6
TOTAL	50	40	35	185
Hours Posted				
Normal business hours	14	13	13	62
Open evenings	5	4	1	16
Open after 10 PM	4	5	3	9
Open 24 hours	2	2	2	0
TOTAL	25	24	19	87

The ground-level businesses along the proposed and alternative alignments are primarily a mix of retail, offices that provide services, and restaurants.

About half of the businesses had their hours of business clearly posted. Of these, most had normal business hours (generally between 9:00 A.M. and 6:00 P.M.). About a quarter of the businesses along the Phase 1 route and along the alternative alignments were open late at night or all night. Along the Phase 2 route, only 10 percent of the businesses were open late.

The Hawai‘i Convention Center is located on both of the alternative alignments.

4.12.1.5 Construction Activity

In the 1980s, government construction spending accounted for as much as 30 percent of all construction. As of 2003, the share of government spending on construction had dropped to 15 percent. Roadway construction projects have taken place in recent years on most streets in the project area.

A 1994 study of government spending by development plan area suggested that spending per capita was appreciably higher for the older, established communities of O‘ahu than for the new growth areas in ‘Ewa and Central O‘ahu. While the project area has been relatively stable in terms of population and development, it is likely to experience new residential, commercial, and institutional developments in the vicinity that have been announced or are now underway.

4.12.1.6 Energy Use

As O‘ahu’s sole electric utility, HECO responds to demand for about 7.5 billion kilowatts of power annually. Commercial users account for most of the energy use. Residential energy use has been growing, especially when measured in terms of demand per resident. While energy use trend statistics are not specifically available for the project area, regional data from HECO suggests that the distribution of energy use has changed little over the last decade.

4.12.2 Potential Impacts and Actions to Minimize Impacts

4.12.2.1 Proposed Action

Construction

No significant adverse socioeconomic impacts would be associated with the Phase 1 and Phase 2 construction activities.

Population Impacts. Population impacts arise when a project attracts new residents to the island or region. There would be no measurable change in population due to short-term construction. With no population change and no permanent new employment, no housing impacts are expected.

Impacts on Project Area Residents. Project area residents would not experience any significant economic impacts during the Phase 1 and Phase 2 construction. Management measures would assure vehicular and pedestrian access to and from residential properties. Other potential impacts on residents—such as noise and traffic—are discussed in other sections of this document.

Impacts on Employment and Income. The Proposed Action would involve approximately 106 direct jobs in the course of construction. Using the State of Hawaiʻi Input-Output Model multipliers for engineering, electrical work, and other construction (i.e., not residential or commercial building construction), indirect and induced jobs associated with the project can be estimated. Since these jobs are found throughout the economy, indirect and induced incomes are estimated on the basis of average wages in the island economy. Table 4-18 shows that the total wages associated with project construction would be about $11.1 million (2004 dollars).

Table 4-18. Construction-related Employment and Incomes

	Phase 1 Proposed Action	Phase 1 Alternative 1	Phase 1 Alternative 2	Phase 2
Construction Employment				
Direct Jobs	38	54	54	68
Indirect Jobs	25	36	36	45
Induced Jobs	32	45	45	57
TOTAL	95	134	135	170
Wages				
Direct Jobs	$2,258,000	$3,173,000	$3,206,000	$3,197,000
Indirect Jobs	$903,000	$1,263,000	$1,277,000	$1,607,000
Induced Jobs	$1,131,000	$1,585,000	$1,602,000	$2,016,000
TOTAL	$4,292,000	$6,021,000	$6,085,000	$6,820,000

Note: A “job” is a year's full-time equivalent of work. The number of people actually engaged in the work will likely be much greater, with specialty contractors working only part of the time. Direct jobs are estimated from preliminary HECO construction cost estimates. Indirect and induced jobs are based on the Hawaiʻi State Input-Output model (DBEDT 2002), combining ratios for engineering, electrical work, and other construction. Wages for indirect and induced workforce are from the Department of Labor and Industrial Relations (DLIR) (2003).

Impacts on Businesses in the Project Area. To assess the potential economic impact of construction activity on businesses in the project area, HECO commissioned interviews of businesses elsewhere in Honolulu located near currently ongoing and recently completed projects involving in-road construction. The objective was to learn how nearby in-road construction affects small business revenues and activities. A total of 33 interviews were conducted with owners, managers, and employees of businesses on the east side of Honolulu. Comments received from these interviews are summarized below:

- Many respondents accepted that the construction was needed and that some short-term impact was inevitable.
- Several anticipated that road improvements would eventually lead to more customers and revenues.
- Some respondents reported short-term loss of income. These businesses typically depended on the sidewalk and roadway access more than most, for example, restaurants that set up tables outside and merchants that depended on walk-in traffic.
- Noise and dust were mentioned as problems.
- Concern for pedestrian safety on sidewalks was also mentioned.

Although the projects experienced by the 33 respondents may differ from the Proposed Action in terms of construction methods and duration, as well as management measures implemented, the comments received are useful in suggesting measures to avoid or minimize the impacts noted.

A total of 63 restaurants are located along the proposed alignment (16 restaurants in Phase 1 and 47 in Phase 2). Few of the restaurants along King and Makaloa are open to the street. An exception is the food court in front of Daiei near Makaloa Street. This food court is not comparable to the restaurants described by the interview respondents because it fronts a noisy, congested parking lot, and project construction would occur on the far side of the lot.

As mentioned in the interviews, loss of revenue appeared to be associated with restricted vehicular or pedestrian access. Appropriate management measures during construction would assure that access to small businesses such as small grocery and convenience stores with drive-by and pedestrian customers would not be blocked. Such measures would also minimize impacts on fast food outlets and gas stations, which depend on open vehicular access, as well as service-oriented offices such as banks and dentists. The management of traffic, noise, and dust (air quality) impacts is covered in other sections of this document.

Fiscal Impacts. The City and County of Honolulu depends on property taxes as its largest single source of revenues. The Proposed Action is not expected to affect property taxes since it would not result in any increase or reduction of values or amenities for any taxable properties.

If HECO’s construction work can be coordinated with City and County of Honolulu projects, there is a potential for repaving to be done simultaneously for both projects, resulting in a modest saving to the City and County of Honolulu in the cost of future capital improvements. The City and County of Honolulu’s curb-to-curb repaving directive transfers the cost of repaving to the utility, saving the City some part of the cost of future capital improvements. If the City and County of Honolulu’s directive were enforced, overall cost of the 46kV Phased Project is estimated to increase by approximately $5.3 million.

The State of Hawai‘i derives revenues from several tax streams, notably excise and income taxes. Table 4-19 provides an estimate of revenues for the state associated with the Phase 1 and Phase 2 construction. The total income stream for the state is estimated to be slightly below $2 million (2004 dollars).

Table 4-19. State Revenues Associated With Construction (Millions of 2004 Dollars)

	Phase 1 Proposed Action	Phase 1 Alternative 1	Phase 1 Alternative 2	Phase 2
Construction-Related Wages	$4.3	$6.0	$6.1	$6.8
Revenues for Contractors[1]	$11.3	$13.4	$13.5	$11.5
Excise Taxes on				
Construction Spending	$0.47	$0.56	$0.56	$0.48
Construction-Related Workforce Spending[2]	$0.12	$0.17	$0.17	$0.19
CORPORATE INCOME TAX[3]	$0.03	$0.03	$0.03	$0.03
PERSONAL INCOME TAX [4]				
Construction-Related Workforce Incomes	$0.24	$0.33	$0.33	$0.38
TOTAL	$0.86	$1.09	$1.10	$1.08

Notes:

1 Construction will involve both HECO personnel and outside contractors. This calculation uses current estimates of the amount of work to be performed by outside contractors, and estimates of materials costs.

2 Direct, indirect and induced construction workforce spending; disposable income estimated from historical averages (DBEDT 2003).

3 Ratio of revenues to corporate income tax estimated as 0.25%, (Department of Taxation 1991).

4 Ratio of taxes paid to incomes estimated as 5.5%, based on historical data (DBEDT 2003)

Operation

With completion of the project, economic impacts on HECO rate payers are expected in the form of rate increases. Based on current estimates of project cost, the incremental rate impact per month for the typical residential customer would be an increase of $0.73 in 2008, the year after Phase 1 is installed. After Phase 2 is installed in 2010, the rate impact for a typical residential customer's bill would be an increase of $0.93. With curb-to-curb repaving, the incremental rate impact per month would be higher: $0.74 in 2008 and $1.02 in 2010. These increases would only go into effect if the Public Utilities Commission approves a rate increase.

No other socioeconomic impacts would be associated with operation of the proposed improvements.

4.12.2.2 Alternative Alignments

Construction

No significant adverse socioeconomic impacts would be associated with construction of the alternative alignments.

Population Impacts. Similar to the Proposed Action, no population impacts are expected.

Impacts on Project Area Residents. Project area residents would not experience any significant economic impacts during construction. Management measures would assure vehicular and pedestrian access to and from residential properties.

Impacts on Employment and Income. The alternative alignments for Phase 1 would have higher construction costs and involve more jobs than under the Proposed Action. Total wages associated with project construction would be about $6.6 million (2004 dollars) for the Alternative Alignment 1 and $6.7 million for Alternative Alignment 2 (compared to $4.7 million for Phase 1 of the Proposed Action). The number of direct jobs would be 63 for each alternative alignment, compared to 44 direct jobs for Phase 1 of the Proposed Action.

Impacts on Businesses in the Project Area. The inventory of businesses along the alternative alignments shows fewer ground-level businesses in the project vicinity, compared to Phase 1 of the Proposed Action. The Hawai‘i Convention Center is located on both alternative alignments. Management measures during construction would minimize impacts along these alignments, similar to the Proposed Action.

Fiscal Impacts. The alternative alignments would have no effect on City and County revenues. The cost saving to the City and County of Honolulu if its curb-to-curb repaving directive is enforced would be approximately the same as under the Proposed Action—about $5.3 million.

As shown in Table 4-19, revenues to the state would be higher under each Phase 1 alternative ($1.14 million for Alternative Alignment 1 and $1.15 million for Alternative Alignment 2) than under the Proposed Action ($0.89 million for Phase 1).

Operation

The analysis of potential socioeconomic impacts for the alternative alignments is the same as for the Proposed Action. No significant socioeconomic impacts would occur from operations along the alternative alignment.

4.12.2.3 No Action Alternative

With No Action, there would be no construction-related impacts relative to socioeconomics. The operational impact of the No Action Alternative would be the potential for economic losses experienced by businesses, government, residents, and others due to an increase in power outages.

The Proposed Action is intended to provide added reliability to the eastern and windward portions of O‘ahu, which represent 56 percent of HECO’s total load. Under No Action, the transmission problems described in Chapter 2 would not be addressed, thereby increasing the risk of overload situations and concerns.

4.13 ELECTRIC AND MAGNETIC FIELDS (EMF)

4.13.1 Introduction

In 2003, HECO gathered public comments for new proposed line initiatives. Surveys showed that EMF was a public concern, with a majority feeling somewhat concerned (17.2 percent), quite a bit concerned (4.7 percent), or very concerned (34.4 percent). A number of people expressed questions and concerns including: (1) how EMF is measured; (2) the effect of nearness to the EMF sources; (3) the latest understanding of health hazards related to EMF; and (4) the honesty of HECO’s portrayal of EMF levels (3Point 2003). The following section provides information on EMF relating to the Proposed Action. This section includes:

- An overview of electric and magnetic fields;
- A review of current standards, guidelines and policies related to EMF;
- A review of evaluations of EMF research by national and international scientific organizations; and

- A summary of the Magnetic Field Evaluation prepared by Enertech Consultants of Santa Clara, Inc. (Enertech) describing the existing and projected magnetic field levels (Appendix D).

In the United States, there are presently no federal standards for occupational or residential exposure to 60 Hz EMF.

HECO looks to the Department of Health's position of "prudent avoidance" for guidance in this area. Briefly, prudent avoidance consists of taking reasonable, practical, simple and relatively inexpensive actions to reduce exposure to EMF. For the new power lines in the Proposed Action, HECO will optimize placement of multiple circuit cables to achieve partial cancellation of EMF, resulting in reduced EMF levels.

4.13.2 EMF Overview

4.13.2.1 Sources of EMF

There are many natural sources for electric and magnetic fields. They appear throughout nature and in all living things. The earth has a strong magnetic field created by the rotation of its inner core. Atmospheric forces cause large electric fields at the earth's surface during thunderstorm activity. Certain minerals in the earth's crust, particularly iron and its compounds, have magnetic properties and give rise to magnetic fields. At the human level, the body itself is a strong source of internal electric fields. All cells in the body maintain large natural electric fields across their outer membranes. These naturally occurring fields are at least 100 times more intense than those that can be induced by exposure to common electric power-frequency fields.

Since the development of commercial and domestic uses of electricity in the last century, many manmade sources of EMF have been added to the natural sources, including from the electric power systems that generate and deliver electricity to industry, offices, and homes. On O'ahu, 138kV transmission lines form the island's transmission system. These 138kV transmission lines terminate at substations, where step-down transformers reduce the voltage for distribution purposes. The power is then carried shorter distances over various types of subtransmission and distribution lines at voltages of 46kV and below to the ultimate users. By the time the power is delivered to the residential user, its voltage has been reduced to the household level of 120/240 volts. The Proposed Action would be operated at 46kV. In contrast, transmission lines in operation in the mainland United States range in voltage up to 765kV.

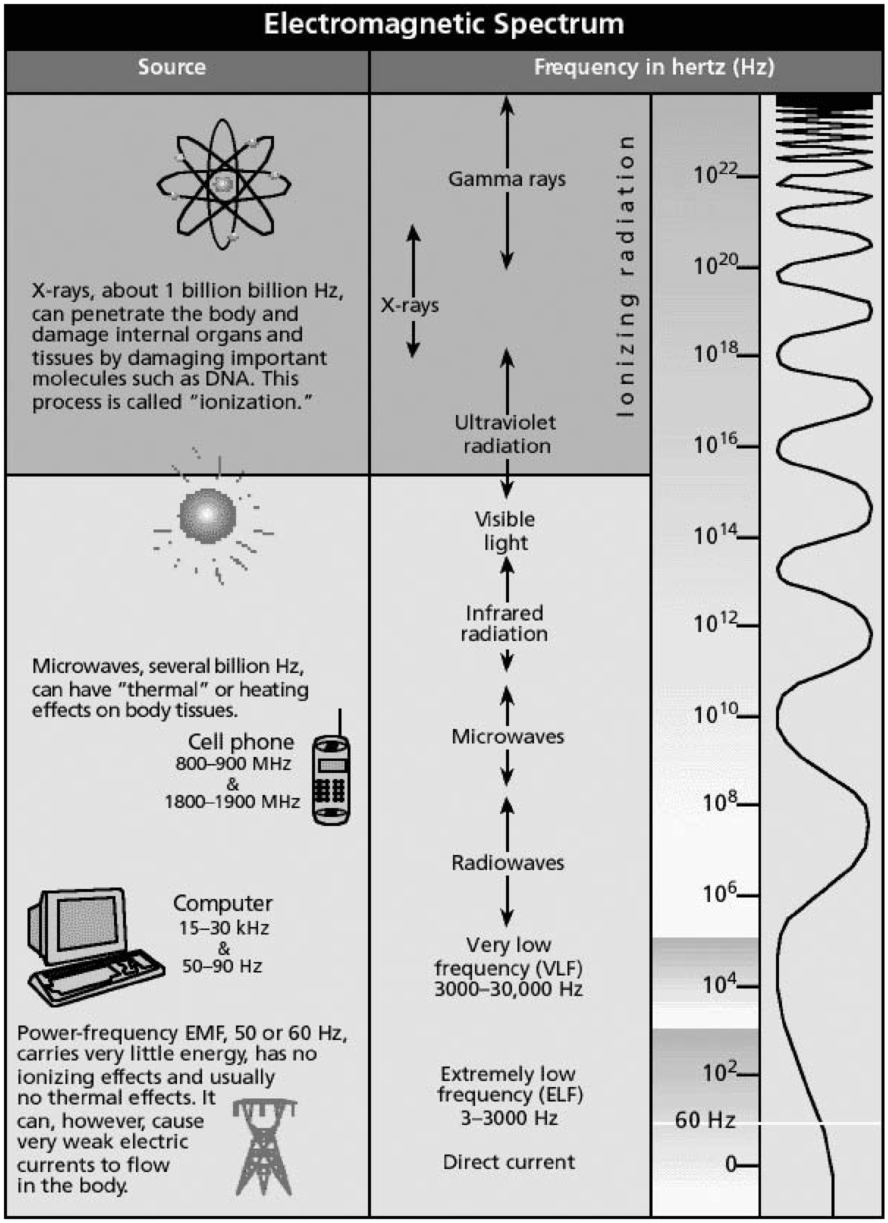
Electric and magnetic fields are not only from transmission and distribution power lines, but also from the distribution and use of that power inside buildings. One common source of such fields is the building wiring, which delivers the electricity to the individual rooms in which it is used for lighting, climate control, or operating appliances. Although the magnetic fields from wiring in modern buildings are usually low, wiring in older buildings can make significant contributions to the average magnetic field in homes and buildings. Another source, often overlooked, are the "ground currents" that flow through the water pipes, gas lines, or steel framing typically used for grounding the wiring system of a building. Magnetic fields produced by ground currents can contribute substantially to the overall magnetic field in homes.

A third common source of EMF is electric equipment and appliances. For industry, this means all machines and tools powered by electricity—virtually all industrial machinery in use today. In the office, this means fluorescent light fixtures and equipment such as computers, video display terminals, printers, copiers, typewriters, and fax machines. In the home, this means television sets, videocassette recorders, compact disc players, radios, table lamps, vacuum cleaners, power tools, air conditioners, electric shavers, hair dryers, clothes washers and dryers, irons, electric ovens and ranges, refrigerators and freezers as well as toasters, coffee makers, food processors, and all other small kitchen appliances.

Power frequency electric and magnetic fields are different from other types of energy such as x-rays, visible light, microwaves and radiowaves. For example, cellular telephones communicate by emitting high-frequency electric and magnetic fields similar to those used for radio and television broadcasts. Microwave ovens produce 60-Hz fields of several hundred milligauss (mG), but they also create microwave energy inside the oven that is at a much higher frequency (about 2.45 billion Hz) (NIEHS 2002). These radio frequency and microwave fields are quite different from the extremely low frequency EMF produced by the underground power lines in this Proposed Action as shown on Figure 4-9.

4.13.2.2 Electric Fields

Electric fields are a result of the voltage or electric potential on an object. Any object with an electric charge on it has a voltage at its surface caused by the accumulation of more electrons on that surface as compared to another object or surface. The voltage effect is not limited to the surface but exists in the space surrounding the object. The change in voltage over distance is known as the electric field. The units describing an electric field are volts per meter (V/m) or kilovolts per meter (kV/m). The electric field is stronger near a charged object and decreases rapidly with distance from an object.



The wavy line at the right illustrates the concept that the higher the frequency, the more rapidly the field varies. The fields do not vary at 0 Hz (direct current) and vary trillions of times per second near the top of the spectrum.

Note that 10^4 means 10 x 10 x 10 x 10 or 10,000 Hz.
1 kilohertz (kHz) = 1,000 Hz
1 megahertz (MHz) = 1,000,000 Hz

Figure 4-9
ELECTROMAGNETIC SPECTRUM

Source: National Institute of Environmental Health Sciences, 2002

Electric fields are a common phenomenon. Static electric fields can result from taking off a sweater or walking across a carpet. Most household appliances and other devices that operate on electricity create electric fields. Appliances need not be in operation to create an electric field. An electric field occurs whenever an appliance is connected to an electrical outlet.

Electric fields are shielded by objects in the environment, especially objects that conduct electricity. For example, buildings, tall fences, and even trees can partially shield electric fields originating from nearby power lines.

4.13.2.3 Magnetic Fields

An electric current flowing in any conductor (for example, electric equipment, household appliance) creates a magnetic field. This magnetic field is the region of space in which the moving electrical charge is capable of exerting, at a distance, a magnetic force over any other moving charge. The magnetic field is different from the electric field. For example, the magnetic field does not have a beginning or an end, but forms closed, continuous loops of force around the source of the field. However, like the electric field, the strength of the magnetic field also diminishes with distance. In contrast to electric fields, magnetic fields can pass through most objects and can be blocked only by special shielding materials. Also unlike electric fields, magnetic fields are caused by a flow of current and can be generated only when a device is in operation.

The magnetic fields under transmission lines are relatively low in comparison with fields measured near many household appliances and other common electrical equipment. In fact, the most intense magnetic fields in the home are found near appliances (particularly those with small motors or transformers such as hairdryers and fluorescent light fixtures). However, users generally spend only brief periods of time around these household appliances (with the exception of television sets, home computers, fans, and air conditioners).

Magnetic fields produced by these appliances are generally not the main source of background magnetic field levels. Although household appliances can produce higher, more concentrated magnetic fields, they originate from a single point. Line sources, such as power lines, produce lower, less concentrated magnetic fields, but are distributed along the line. Magnetic fields decrease rapidly with distance from the source. Fields that originate from a single point source drop off more rapidly than fields that originate from a line source. The magnetic fields of a large number of typical household appliances have been measured and reported in several previous studies. Table 4-20 shows typical values of magnetic fields associated with household appliances as measured by the Illinois Institute of Technology Research Institute for the U.S. Navy (Gauger 1985). The strength or intensity of a magnetic field is primarily proportional to its current.

Table 4-20. Typical Magnetic Field Values for Household Appliances

Appliance	Magnetic Field (mG)	
	12 Inches Away	Maximum
Electric Range	3-30	100-1,200
Electric Oven	2-5	10-50
Garbage Disposal	10-20	85-1,280
Refrigerator	0.3-3	4-15
Clothes Washer	2-30	10-400
Clothes Dryer	1-3	3-80
Coffee Maker	0.8-1	15-250
Toaster	0.6-8	70-150
Crock Pot	0.8-1	15-80
Iron	1-3	90-300
Can Opener	5-250	10,000-20,000
Mixer	6-100	500-7,000
Blender, Popper, Food Processor	6-20	250-1,050
Vacuum Cleaner	20-200	2,000-8,000
Portable Heater	1-40	100-1,100
Fans, Blowers	0.4-40	20-300
Hair Dryer	1-70	60-20,000
Electric Razor	1-100	150-15,000
Color Television	9-20	150-500
Fluorescent Light Fixture	2-40	140-2,000
Fluorescent Desk Lamp	6-20	400-3,500
Circular Saws	10-250	2,000-10,000
Electric Drill	25-35	4,000-8,000

Source: Gauger 1985.

The most commonly used units of measurement of the strength of a magnetic field, or more accurately, the magnetic flux density are the tesla (T) or gauss (G), where $1\ T = 10^4\ G$. Because the range of magnetic fields encountered is usually quite small, the fields are generally described in units of microtesla ($1\ \mu T = 0.000001\ T$) or milligauss ($1\ mG = 0.001\ G$).

4.13.2.4 Electric and Magnetic Field Standards, Guidelines, and Policies and Governmental Publications

In Hawai‘i, general transmission line safety standards are imposed by the State of Hawai‘i Public Utilities Commission General Order Nos. 6 (Rules for Overhead Electric Line Construction) and 10 (Rules for Construction of Underground Electric and Communications Systems). On issues not covered by General Orders 6 and 10, the National Electrical Safety Code may be used as guidance. These rules primarily address the electrical safety of the public but do not specifically address EMF. Although a few States within the United States have set non health-related standards for levels of electric and magnetic fields, neither the federal government nor any of the State governments have developed health-related standards specifically for 60-hertz EMF. However, several State and national agencies have developed guidelines and policies to assist in the siting of future transmission lines and to aid in developing research into the potential effects of electric and magnetic fields. Some of the more relevant guidelines and policies relating to EMF are outlined below.

State of Hawai‘i Department of Health. On January 19, 1994, the Hawai‘i State Department of Health (DOH) issued a statement entitled “DOH Policy Relating to Electric and Magnetic Fields from Power-Frequency Sources.” This statement replaces an earlier one issued on April 3, 1991. The statement reads as follows:

> *The Department of Health, in response to continuing but inconclusive scientific investigation concerning EMF from low-frequency power sources, recommends a “prudent avoidance” policy. “Prudent avoidance” means that reasonable, practical, simple, and relatively inexpensive actions should be considered to reduce exposure.*
>
> *A cautious approach is suggested at this time concerning exposure to EMF around low-frequency sources, such as electric appliances and power lines. The existing research data on possible adverse health effects, including cancer, are inconclusive and not adequate to establish or quantify a health risk. For example, the biological mechanisms that might underlie any apparent relationship between EMF and cancer have yet to be clearly defined. Also, some epidemiological studies suggest that, if these fields increase the risk of cancer, it is a very small increase. Other epidemiological studies suggest that there is no increased risk.*
>
> *The Department of Health will continue to collect and evaluate information on possible health hazards associated with electric and magnetic fields. If adequate data ever become available to establish what levels may be harmful, appropriate standards will be established.*

State of Hawai‘i Public Utilities Commission. On April 7, 1994, the Hawai‘i PUC issued *Decision and Order No. 13201* approving the Waiau-CIP Transmission Lines, Part 2, Project. In reaching its decision, the PUC considered the potential adverse health effects from the project's magnetic fields. Extensive testimony by national experts of different viewpoints was submitted during the evidentiary hearing and related proceedings. The PUC's decision on this issue is contained in its *Decision and Order*.

> *Based upon a thorough examination of all of the evidence presented in this docket with regard to the possible health effects of exposure to EMF, we find that a causal link between EMF and adverse health effects has yet to be established by those in the scientific community who have been researching this matter. A few studies, such as the Swedish studies mentioned above, appear to have established an association between EMF exposure and the occurrence of certain cancers. However, the results of these studies have yet to be accepted by the scientific community as proof that exposure to EMF causes cancer or other diseases.*
>
> *In the absence of more definitive evidence on the health effects of EMF exposure, we find that we cannot order HECO to place the Waiau-CIP Part 2 transmission lines underground as a result of EMF concerns. We will, however, expect HECO to exercise "prudent avoidance" with respect to EMF.*

The PUC's position in the *Decision and Order* adopted the following explanation of prudent avoidance put forth by the EPA in its *Questions and Answers About Electric and Magnetic Fields (EMF)*:

> *Prudent avoidance is an approach to making decisions about risks. This decision-making process is based on judgment and values, can be applied to groups and individuals, and can be considered for all aspects of our lives, not just EMFs. Prudent avoidance applied to EMFs suggests adopting measures to avoid EMF exposures when it is reasonable, practical, relatively inexpensive and simple to do. This position or course of action can be taken even if the risks are uncertain and even if safety issues are unresolved.*

U.S. EPA. The U.S. EPA issued a booklet *Questions and Answers About Electric and Magnetic Fields (EMF)* (402-R-92-009) in December 1992. This document stated that neither the EPA nor any other federal regulatory agency has established a standard for EMF, because the scientific evidence is inadequate to determine if magnetic fields are harmful, and if they are, at what levels.

Swedish National Electric Safety Board. The Swedish National Electrical Safety Board (NESB) in November 1995 stated, "Our knowledge regarding how weak magnetic fields affect humans is not sufficient to set any limit values." The NESB, which is responsible for establishing a Swedish public EMF policy, decided not to set EMF exposure limits. However, it did recommend that a certain amount of caution be exercised. The NESB suggested the following guidelines for community planning and development efforts:

- Strive to design and site new power lines and electrical installations in such a way that magnetic fields are reduced.
- Avoid building homes, schools, day care centers, and similar facilities in proximity to existing power lines that produce significant magnetic fields—but only if alternative sites are available.
- Work to limit high-level fields in existing homes, schools, and workplaces.

International Non-Ionizing Radiation Committee Guidelines. The International Commission on Non-Ionizing Radiation Protection of the International Radiation Protection Association published "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)" in the April 1998 issue of *Health Physics*. The organization confirmed the guidelines after considering evidence in laboratory and epidemiological studies of both occupational and general populations. Its conclusion is that the data related to cancer does not provide a basis for health risk assessment of human exposure to power frequency fields. The guidelines are summarized in Table 4-21.

Table 4-21. Guidelines on Limits of Exposure to 50/60-Hz Electric and Magnetic Fields

Exposure Characteristics	Electric Field Strength (kV/m)	Magnetic Flux Density (mG)
General Public Exposure	4.16	830
Occupational Exposure	8.3	4,160

Source: International Radiation Protection Association. 1998.

National Institute of Environmental Health Sciences (NIEHS)/National Institutes of Health (NIH). In June 2002, the NIEHS and the NIH published a brochure entitled, "*EMF Electric and Magnetic Fields Associated with the Use of Electric Power, Questions and Answers*." This brochure evaluates potential health effects from EMF, describes the results of EMF research, discusses typical magnetic exposures in homes and workplaces, describes standards and guidelines and presents the findings and recommendations of major EMF research reviews.

Transmission Line Standards in Other States. A few states have some form of electric field limits, and two states (Florida and New York) have magnetic field limits. These states established limits primarily to keep future installations from exceeding present conditions. These limits are not based on any established health-based conclusions. These limits (summarized in Table 4-22) are all based on field strengths within or at the edge of transmission line rights-of-way. The widths of these rights-of-way vary greatly, according to the voltage of the lines and the regulatory requirements of each state.

Table 4-22. State Regulations that Limit Field Strengths on Transmission Line Rights-of-Way (ROW)

Electric Field Limits	
Montana	1 kV/m at edge of ROW in residential areas 7 kV/m maximum for highway crossings
Minnesota	8 kV/m maximum in ROW
New Jersey	3 kV/m at edge of ROW
New York	1.6 kV/m at edge of ROW 7 kV/m maximum for highway crossings 11 kV/m maximum for private road crossings 11.8 kV/m maximum in ROW
Oregon	9 kV/m maximum in ROW
Florida	2 kV/m maximum for 500kV lines at edge of ROW 8 kV/m maximum for 230kV and smaller lines in ROW 10 kV/m maximum for 500kV lines in ROW
Magnetic Field Limits	
New York	200 mG (maximum load) at edge of ROW
Florida	150 mG for 230kV and smaller lines at edge of ROW 200 mG for 500kV lines (maximum load) at edge of ROW 250 mG for double-circuit 500kV lines at edge of ROW

Source: Enertech Consultants. 1985.

4.13.2.5 Health Effects of Electric and Magnetic Fields

Overview

Public concern regarding possible health risks from residential and occupational exposure to low-strength, low-frequency electric and magnetic fields produced by power lines and electrical appliances has generated considerable debate among scientists and public officials. The concern over power frequency magnetic fields began with an epidemiological study of childhood leukemia, conducted by Wertheimer and Leeper in Denver, Colorado, in 1979. Until this study, no association between magnetic fields and human health had been reported. Since then, some epidemiology studies have reported similar associations while others have not.

Epidemiology is the study of patterns of health and disease in human populations. Interpretation of epidemiological studies regarding potential causal relations between exposures and health outcomes is a complex process and relies upon a wide range of supporting data. Although there have been studies that reported positive associations between magnetic fields and human health effects, the number of well-designed studies supporting this association are not sufficient in themselves to conclude that the association is causal. Other explanations, such as systematic bias, have not been ruled out.

Mechanistic and animal toxicology studies have failed to demonstrate any consistent pattern of biological effects, including increased cancers in animals. This lack of connection between human data (epidemiology) and the experimental data (mechanistic and animal) weakens the belief that this association is actually due to EMF.

The NIEHS has stated,

> *The NIEHS believes that the probability that ELF-EMF [Extremely-Low-Frequency EMF] exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm…. The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard.* [NIEHS, 1999, p.36]

In 1999, the National Academy of Sciences National Research Center (NRC), after reviewing and evaluating the research conducted under the DOE/NIEHS National EMF Research and Public Information Dissemination (EMF-RAPID) Program, stated,

> *The results of the EMF-RAPID program do not support the contention that the use of electricity poses a major unrecognized public-health danger.... In view of the negative outcomes of the EMF-RAPID replication studies, it now appears even less likely that MFs [Magnetic Fields] in the normal domestic or occupational environment produce important health effects, including cancer.* [NRC, 1999, pp.78 and 8]

Evaluations Of EMF Research By National And International Scientific Organizations

Scientific and regulatory organizations in the United States have reached conclusions regarding EMF. Scientists have been convened by several organizations to work together to review the scientific information on EMF. These panels included representatives from diverse organizations, who had expertise in several different scientific disciplines including the biological sciences (toxicology, genetics, epidemiology, cancer biology) and the physical sciences (physics or engineering).

In 1992, Congress mandated an EMF research program, which was managed by NIEHS. In 1998, the NIEHS convened a Working Group to evaluate the results of this research program and other EMF research. They concluded that the epidemiologic data was limited, but they categorized EMF as possibly carcinogenic. Using the methods routinely applied by of the National Toxicology Program (NTP) of the NIH, the NIEHS concluded that EMF exposure would not be listed in the NTP Report on Carcinogens as a "known human carcinogen" or as "reasonably anticipated to be a human carcinogen."

The NIEHS prepared a report to the U.S. Congress and concluded that the probability that EMF is a health hazard is relatively small and evidence is insufficient to warrant aggressive regulatory actions (NIEHS 1999). They suggested that "the power industry continue its current practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards" (p. 38).

The epidemiological and laboratory data published after the NIEHS report was completed in 1998 have provided additional evidence that EMF does not contribute to childhood cancer. For example, a large (more than 1,000 cases) and well-designed epidemiologic study of childhood leukemia was conducted in England by the United Kingdom Childhood Cancer Study investigators (UKCCS 1999). These researchers reported no increased risk of leukemia in those children with average annual exposures to EMF from 2 mG up to 4 mG in the home and school. No statistically significant increase was found for children whose exposure was above 4 mG, that is, a small increase was reported but chance could not be excluded as an explanation. Investigators at the National Cancer Institute reported no association between childhood leukemia and EMF in their study (Linet et al. 1997), and a reanalysis using a different measure of exposure also found no evidence of cancer risk (Kleinerman et al, 2000). In addition, the majority of studies of breast cancer have not supported an association with residential EMF (Gammon et al, 1998; Forssén et al, 2000; Kabat et al, 2003; London et al, 2003; Schoenfeld et al. 2003).

Laboratory studies published after the NIEHS report, some of which were part of the research program and available for review by the NIEHS, provide evidence for a lack of carcinogenicity, or provide no basis to conclude that EMF affects the development or promotion of cancer (e.g., Babbitt et al, 1998; Anderson et al, 1999; Boorman et al, 1999; McCormick et al, 1999; Morris et al, 1999; Mandeville, 2000).

Several organizations outside of the United States have sponsored comprehensive reviews of EMF research by multidisciplinary groups of scientists. The International Agency for Research on Cancer (IARC), the International Commission on Nonionizing Radiation Protection (ICNIRP), the Health Council of the Netherlands (HCN), the National Radiological Protection Board of Great Britain (NRPB) have all convened large groups of independent scientists with different expertise (epidemiologists, toxicologists, biologists, neurobiologists, physicists, etc.) to review the body of literature surrounding EMF and health. Each organization has produced a report that is available to the public.

Reviews of the scientific research regarding EMF and health by the HCN were published in 2000 and updated in 2001 and 2004. ICNIRP published its review in 2003. The NRPB published reviews in 2001 and 2004, which included comprehensive discussions of the individual research studies.

IARC reviewers evaluated the animal data and concluded that they were "inadequate" to support a risk for cancer. The scientists stated that the EMF data does not merit the category "carcinogenic to humans" or the category "probably carcinogenic to humans," nor did they find that "the agent is probably not carcinogenic to humans." Many hypotheses have been suggested to explain possible carcinogenic effects of electric or magnetic fields; however, no scientific explanation for carcinogenicity of these fields has been established (IARC 2002).

The Working Group concluded that the epidemiologic studies do not provide support for an association between childhood leukemia and residential magnetic fields at intensities less than 4 mG. Overall, magnetic fields were evaluated as "possibly carcinogenic to humans" (Group 2B), based on the statistical association of higher-level residential magnetic fields with childhood leukemia. Other agents and mixtures have been classified as 2B as well, including coffee, pickled vegetables, and gasoline engine exhaust.

In the rating system used by IARC, the recognition of an association between exposure and cancer in epidemiology studies is considered "limited evidence" of carcinogenicity. A rating of "limited evidence" for epidemiology studies, even without any evidence from laboratory studies that an exposure might pose a cancer risk, requires that the exposure be categorized as a "possible carcinogen," even though chance, bias and confounding cannot be ruled out with reasonable confidence (IARC, 2002).

The IARC Working Group did not regard the association between magnetic fields and childhood leukemia as reflecting a causal association because there was insufficient evidence from epidemiology studies that magnetic fields caused cancer in humans, insufficient evidence that magnetic fields caused cancer in laboratory studies of animals, and no evidence for a mechanism to lead to cancer.

The assessments by the NIEHS, IARC, ICNIRP, NRPB, and HCN agree that there is little evidence that EMF is associated with adverse health effects, including most forms of adult and childhood cancer, heart disease, Alzheimer's disease, depression, and reproductive effects. However, all of the assessments concluded that epidemiology studies in total suggest a possible association between magnetic fields at higher exposure levels (annual average greater than 4 mG) and childhood leukemia. All agree that the experimental laboratory data do not support a causal link between EMF and any adverse health effect, including leukemia, and have not concluded that EMF is, in fact, the cause of any disease. These organizations have not recommended exposure limits or required measures to reduce exposures since they have not concluded that a causal relationship between EMF and adverse health effects exists.

Other organizations have provided perspectives on EMF and health. These include a report from the California EMF Program and a more recent summary from the NIEHS.

In response to a request from the California Public Utilities Commission, three scientists from the California EMF program (two epidemiologists and a physicist) reviewed the scientific research regarding EMF and health (Neutra et al. 2002). The scientists agree that EMF is not a universal carcinogen. They evaluated data regarding 13 health conditions and concluded that the epidemiologic data provided little support for an association of EMF with nine of the conditions. For the rest, they expressed the belief "that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig's disease, and miscarriage." Their median "confidence ratings" for these conditions, however, were not high enough to indicate any strong certainty or "high probability" that EMF was a cause of these conditions.

At the time the conclusions of the California EMF Program became available, the NIEHS published a brochure on questions and answers on EMF and health (NIEHS 2002). The status of EMF and health is summarized by NIEHS as:

> *Over the past 25 years, research has addressed the question of whether exposure to power-frequency EMF might adversely affect human health. For most health outcomes, there is no evidence that EMF exposures have adverse effects. There is some evidence from epidemiology studies that exposure to power-frequency EMF is associated with an increased risk for childhood leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields with childhood leukemia* (p. 57).

The NIEHS also noted that:

> *At the current time in the United States, there are no federal standards for occupational or residential exposure to 60-Hz EMF* (p. 57).

4.13.2.6 Other Transmission Line Electrical Factors

Overhead high-voltage transmission lines can sometimes produce impacts on the surrounding environment related to audible noise, and radio or television interference. These potential factors are explained below.

Corona. Corona is the physical manifestation of energy loss and can transform energy into very small amounts of light, sound, radio noise, chemical reaction, and heat. Because energy loss is not economical, corona has been studied since the early part of this century. Consequently, it is well understood by engineers and steps to minimize it are major factors in overhead line design. The line designer can control corona with good design practices, and it is usually not a problem for lines rated at 230kV and lower. Corona does not occur with underground lines, such as those proposed for this project.

Audible Noise. During corona activity, overhead transmission lines (mainly 345kV and above) generate a small amount of sound energy. This audible noise from the line can barely be heard in fair weather conditions on the higher-voltage lines and usually not at all on lines at 46kV. During foul weather, water drops collect on the conductor and increase corona activity so that a crackling or humming sound may be heard near the line. This noise is caused by small electrical discharges from the water drops. Audible noise decreases rapidly with distance from the line. Audible noise does not occur with underground lines, such as those proposed for this project.

Radio and Television Interference. Overhead transmission lines do not, as a general rule, interfere with normal radio or television reception. As described above, corona discharges can sometimes generate unwanted electrical signals. There are two potential sources of interference: corona and gap discharges. Corona may affect AM radios; gap discharge can affect television and radio reception. Corona activity is minimized by proper line design and, therefore, is almost never a source of interference, especially on lines with voltage lower than 230kV. Radio and television interference does not occur with underground lines, such as those proposed for this project.

Gap discharges on overhead lines are a very different problem. They are caused by electrical discharges between broken or poorly fitting hardware (e.g., insulators, clamps, and brackets). Hardware is designed and installed to be problem-free, but gunshot damage, wind motion, or corrosion damage sometimes can create a gap discharge condition. When this condition develops, intermittent gaps at connection points between hardware items allow small electrical discharges to occur between the gaps. This phenomenon is not limited to transmission lines and can often be found on distribution lines. The discharges act as small transmitters at frequencies that may be received on some radio and television receivers. Gap discharge sources can be located by HECO engineers and repaired. Underground lines, such as the lines proposed for this project, will not produce gap discharges.

Computer Monitors. Only monitors that use cathode ray tubes or CRTs to project an image are subject to interference from magnetic fields. Liquid crystal display (LCD), also called flat panel monitors are not susceptible to interference. Interferences with typical CRT computer monitors, which appear as a faint shimmering, can be detected at magnetic field levels of about 10 mG and above. If the Proposed Action is implemented, the highest magnetic field at the nearest edge of any building to the Proposed Action is much less than this threshold. The magnetic fields continue to decrease with distance. Therefore, no significant impact on CRT computer monitors is anticipated if the project is implemented.

Ozone. Ozone is another possible byproduct of higher-voltage overhead transmission lines (345kV and above). Ozone (0_3) can be formed from charged air molecules through the combination of three oxygen atoms. Ambient ozone levels in rural areas are typically around 10 to 30 parts per billion (ppb) at night and may peak during the day at around 100 ppb. In urban areas, concentrations greater than 100 ppb are common. Cities like Los Angeles may peak at 500 ppb. The National Ambient Air Quality Standard for oxidants (of which ozone is usually 90 to 95 percent) is 120 ppb, not to be exceeded as a peak concentration on more than 1 day a year. 46kV underground lines, such as the lines proposed for this project, will not produce ozone.

Cardiac Pacemakers. One concern associated with high-voltage transmission lines (usually 345kV or higher) has been the possibility of interference with cardiac pacemakers. There are two general types of pacemakers: asynchronous and synchronous. The asynchronous pacemaker pulses at a predetermined rate. It is practically immune to interference because it has no sensing circuitry and is not exceptionally complex. The synchronous pacemaker pulses only when its sensing circuitry determines pacing is necessary. Interference may result from the transmission line electric field, which may cause a spurious signal on the pacemaker's sensing circuitry. However, when these pacemakers detect a spurious signal, such as a 60-hertz signal, they are programmed to revert to an asynchronous or fixed pacing mode of operation. Cardiovascular specialists do not consider prolonged asynchronous pacing to be a problem. Some pacemakers are designed to operate that way. Periods of operation in this mode are commonly induced by cardiologists to check on pacemaker performance. Therefore, although an overhead transmission line electric field may interfere with the normal operation of some pacemakers, the result of the interference is of a short duration and not harmful. Underground lines, such as the lines proposed for this project, will not generate electric fields and will not interfere with cardiac pacemakers. The magnetic fields from this line are far below 1,000 mG threshold limit value set by the American Conference of Governmental Industrial Hygienists for cardiac pacemakers and similar medical electronic devices.

Construction

Since magnetic field levels will not change until the new power lines are energized when the Proposed Action is in operation, there will be no effect during construction.

Operation

Magnetic field levels will change when the new power lines are energized when the Proposed Action is in operation. There will, however, be no effect during operation on CRT computer monitors or cardiac pacemakers. Because the proposed lines will be underground, there will be no corona, ozone, audible noise or radio and television interference during operation.

No-Action Alternative. Because no changes to the electrical subtransmission or distribution system would occur with this alternative, electric and magnetic field levels would remain the same as those described under the year 2009 without the project, as described in the Magnetic Field Evaluation (Appendix D).

4.13.3 Magnetic Field Evaluation for the Proposed Action

Enertech performed a Magnetic Field Evaluation for the Proposed Action, a copy of which is attached as Appendix D. The following summarizes the results of Enertech's Magnetic Field Evaluation.

Existing magnetic field levels from HECO facilities are typical of levels from similar facilities throughout the State of Hawai'i.

Magnetic field measurements were conducted at eleven selected segments along portions of the proposed project to characterize field strengths due to existing electrical facilities. Existing magnetic field levels along these segments range from a few tenths of a mG to over 25 mG, depending upon location. Existing electric facilities surveyed included 12kV, 25kV, 46kV, and 138kV power line facilities.

The difference in projected magnetic field levels between the existing and proposed power line configurations under 2009 forecasted loading can decrease slightly, remain unchanged, or increase depending upon the project segment.

In addition to field measurements, magnetic field levels were also calculated for 2009 forecasted normal and Pūkele outage conditions for eleven different project segments. The difference in projected magnetic field levels between the existing and proposed power line configurations under 2009 forecasted loading can decrease slightly, remain unchanged, or increase depending upon the project segment. For the segment on King Street between Ward Avenue and Victoria Street, where no 46kV power lines presently exist (identified as Segment "I" in Appendix D), the projected magnetic field generally remains unchanged since the proposed underground 46kV power lines would only be utilized under Pūkele outage conditions. For the segment on Date Street east of Kamoku Substation where modifications to an existing overhead 46kV power line are proposed (identified as Segment "E" in Appendix D), the range of projected magnetic field levels decreases slightly since the 2009 forecasted load is somewhat lower for the proposed configuration than for the existing configuration. At all other segment locations, the projected magnetic field increases due to the proposed power line configuration under 2009 forecasted loading conditions. While the largest magnetic field increases typically occur within street locations, projected magnetic field levels can also increase at sidewalk locations. Under proposed 2009 Pūkele outage conditions, the projected magnetic field increases at all segment locations.

The levels described in Enertech's Magnetic Field Evaluation (Appendix D) are within the range of magnetic field levels found at numerous locations in the local environment. The line locations are mainly in the street, and the forecasted increases occur predominantly in the street and sidewalk, and so would be mostly a source of brief intermittent exposure to the population. Magnetic field levels decrease with distance from the source, and the projected magnetic field levels beyond the sidewalks for any of the segments evaluated by Enertech are well within the range of levels commonly encountered in the local area and in other communities.

If the project is implemented, the proposed underground circuits would have little effect on EMF levels at nearby institutions; EMF levels will be in the range of common everyday levels.

A magnetic field assessment was performed to evaluate present and future levels at various institutions along the proposed project. Several institutions are located near portions of the proposed project, including day care centers, pre-schools and schools, hospitals, churches, and retirement homes. Distance measurements were taken to determine the closest building edge to the proposed project. Using these distance measurements, the projected magnetic fields for 2009 loading conditions were evaluated for each of these institutions. Six different institutions are located within 100 feet of the proposed project. The two closest institutions are the Kaplan

Test Preparation Center and the Lunalilo Elementary School. For the Kaplan Test Preparation Center, projected 2009 magnetic field levels of 0.0 mG with the existing power line configuration would increase about 1.1 mG with the proposed configuration under normal loading. For the Lunalilo Elementary School, projected 2009 magnetic fields of about 4.0 mG with the existing power line configuration would decrease to about 3.3 mG with the proposed configuration under normal loading (due to some field cancellation). Four other institutions within 100 feet would have no projected magnetic field under normal operating conditions, since the underground power lines are only loaded during Pūkele outage conditions (and even then the projected field at the closest building edge is less than 1 mG). There are five additional institutions located within 200 feet of the proposed project. Of these, two institutions have projected magnetic fields of about 0.6 or less under Pūkele outage conditions, and three institutions would have no projected magnetic field under normal operating conditions (since the underground power lines are only loaded during Pūkele outage conditions and have negligible projected field influence of about 0.1 mG). Beyond 200 feet, the projected magnetic field influence from the proposed project is negligible.

The magnetic field levels projected by Enertech for six selected public institutions within 100 feet of the proposed route indicated either no influence of the fields or a minimal increase. For example, the projected magnetic field under normal operating conditions is less than 4 mG at a corner of the Lunalilo Elementary School, which represents no increase over the existing configuration.

The proposed substations, manholes, and risers of the East O‘ahu Transmission Project will be similar to existing facilities and have very low EMF levels at a relatively short distance away.

Another aspect of the proposed East O‘ahu Transmission Project is the installation of new transformers within certain substations, manholes in the streets, and risers on wooden poles at sidewalk locations. The magnetic field from a substation transformer or manhole is typically reduced by about 90 percent at a distance of about 20 feet away from the facility (for transformers, magnetic fields due to these sources are typically reduced to ambient levels at the substation perimeter). For this project, the closest property line is at least 30 feet away from any proposed substation transformer location. For risers, the magnetic field is typically reduced by over 90 percent at a distance of about 3 feet away from the riser.

There are a wide variety of EMF levels and sources encountered in everyday life that are comparable to EMF due to electric power facilities.

In addition to measuring and calculating magnetic fields for electrical facilities associated with the proposed project, magnetic field measurements of everyday environments were performed at ten different locations in Honolulu. These measurements were performed to provide a range of magnetic field levels encountered in everyday locations and for comparison with the magnetic field levels associated with the proposed East Oʻahu Transmission Project. Measured magnetic fields ranged from 0.1 mG to over 99 mG in everyday environments. Many of these magnetic field sources are common appliances and electrical devices, such as refrigeration units in supermarkets, electric stoves in food preparation areas, library security gates, escalators, vending machines, display counters, video games, cash registers, and ATM machines.

Construction

Since magnetic field levels will not change until the new power lines are energized when the Proposed Action is in operation, magnetic field levels will remain unchanged during construction.

Operation

Magnetic field levels will change when the Proposed Action is in operation. Although magnetic field levels in 2009 may decrease slightly, remain unchanged, or increase depending upon the segment, none of these changed magnetic field levels would have a significant impact on human health or the environment.

No-Action Alternative

Because no changes to the electrical subtransmission or distribution system would occur with this alternative, electric and magnetic field levels would remain the same as those described under the year 2009 without the project, as described in the Magnetic Field Evaluation (Appendix D).

4.13.4 Prudent Avoidance

HECO has adopted strategies consistent with the Department of Health's prudent avoidance approach in routing and designing transmission lines.

Optimizing Cable Placement and Phasing Arrangement

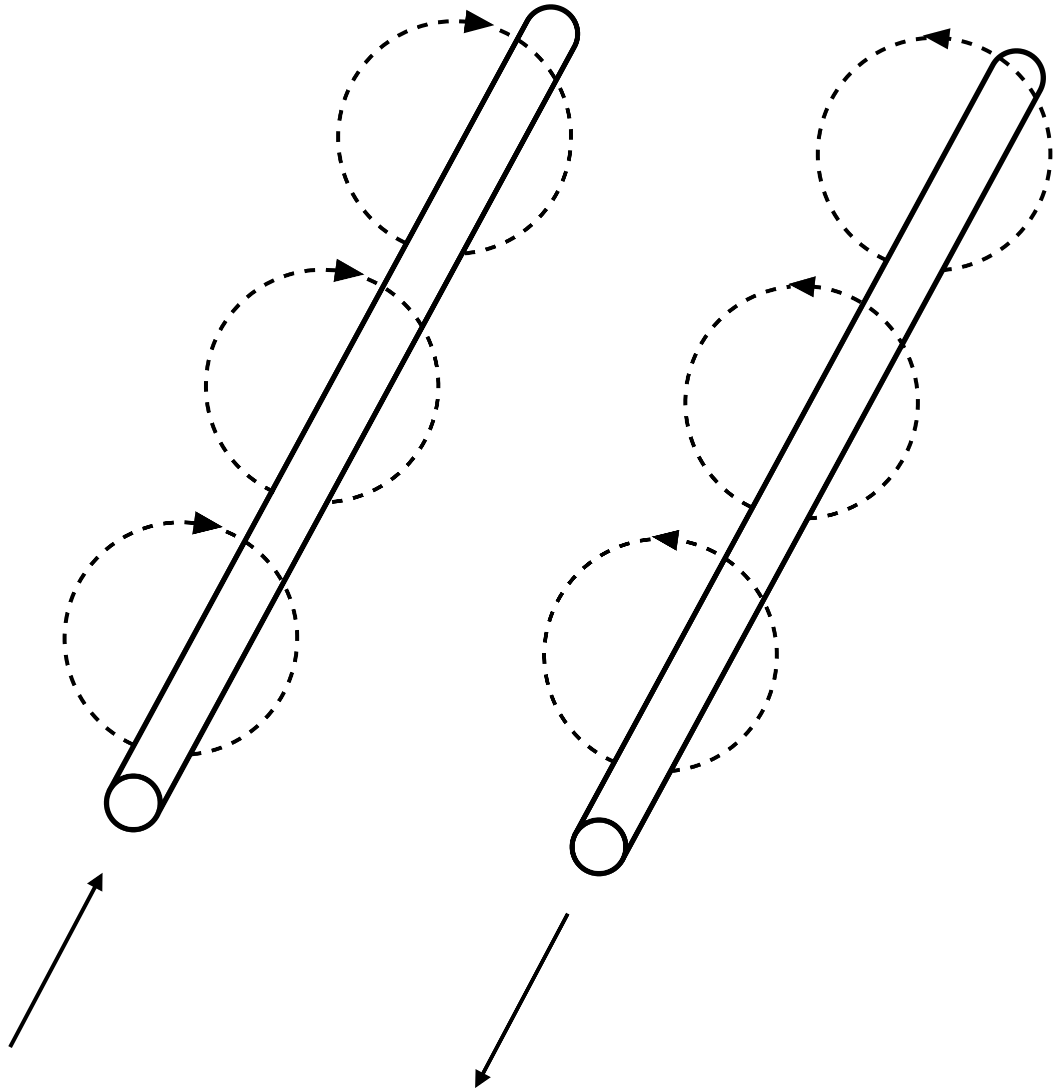
Reduction of EMF levels can be achieved for multiple circuit power lines with similar loads by optimizing the cable placement and phasing arrangement within the cable ducts. Optimized placement of multiple circuit cables can achieve a partial cancellation of EMF and result in reduced EMF levels when circuits are similarly loaded. The maximum EMF cancellation occurs when all circuits have identical loads and their individual phases are placed in an optimum manner in adjacent ducts. In general, multiple circuits will not always have simultaneous identical loads, so that EMF reduction is less when circuit loads are not the same.

Figure 4-10 shows how magnetic fields circle the electric current that gives rise to them. Two wires with equal and opposite currents create magnetic fields in opposing directions that partially cancel at locations to either side of the wires.

Enertech studied a variety of cable placements and phasing arrangements for the 46kV circuit cable sections to determine the optimum phase configuration for EMF reduction. For the 46kV double circuit configuration, the optimized configuration is to arrange each circuit horizontally within the duct, with one circuit directly above the other circuit, and with unlike or opposite phasing. For the 46kV triple circuit configuration, the optimized configuration is to arrange each circuit vertically within the duct, with one circuit directly adjacent to the other circuit, and with a specific phasing arrangement. When the circuits do not have identical loading, the cancellation effect is less; therefore, the calculations for identical circuit loading provide an upper bound for EMF reduction. The optimum phasing option is not available for the single circuit 46kV cables because there is no adjacent circuit to create the partial EMF cancellation.

Enertech's calculated results for multiple circuit 46kV cables show that use of optimum phase placement in the cable ducts can reduce EMF levels by a maximum amount of about 87 percent when all circuits have identical loads. The EMF levels can be characterized for the Normal and Emergency loading cases by the calculated maximum level above the underground cable and at a distance of 50 feet away for circuits with assumed identical loads. For the *double circuit* 46kV cable sections with optimized phasing and identical circuit loads, the maximum EMF level above the cable ranges from 16.2 mG (Normal) to 19.6 (Emergency); at 50 feet away, the EMF level is about 0.1 mG for both load cases. For the *triple circuit* 46kV cable sections with optimized phasing and identical current loads, the maximum EMF level above the cable ranges from 19.3 mG (Normal) to 23.8 mG (Emergency); at 50 feet away, the EMF level is about 0.1 mG for both load cases.

HECO has applied prudent avoidance in its engineering design for ductlines with multiple circuits by optimizing the cable placement and phasing arrangement within the cable ducts. Reduction of EMF levels has been achieved in the engineering design for these new ductlines by utilizing horizontal ductbanks with reversed phasing in the two following locations: (1) the segment of Phase 1 of the Proposed Action between Poni Street and McCully Substation; (2) the segment of Phase 2 on King Street between Cooke Street and McCully Times Supermarket.



Magnetic fields circle the electric current that gives rise to them. Two wires with equal and opposite currents create magnetic fields in opposing directions that partially cancel at locations to either side of the wires.

Figure 4-10
DIAGRAM OF CABLE AND CURRENT CONFIGURATIONS FOR MAGNETIC FIELD CANCELLATION
Environmental Assessment for the 46kV Phased Project
East O‘ahu Transmission Project
Hawaiian Electric Company, Inc.

HECO will continue to identify and implement actions to reduce EMF levels wherever possible. Utilization of phasing arrangements to optimize reduction of EMF levels will be analyzed for the following segments where new circuits will be placed near existing underground or overhead lines: (1) the segment of Phase 1 on Makaloa Street between Amana Street and Poni Street; (2) the segment of Phase 1 on Pumehana Street between Lime and Date Streets; and (3) the segment of Phase 1 on Winam Avenue between Ho‘olulu Street and Mo‘oheau Avenue; and (4) for the two 46kV lines exiting Kamoku Substation and running east and west on Date Street. In each of these areas, the existing circuits may or may not be configured in a manner which would allow implementation of phasing to achieve magnetic field cancellation with the new underground circuits. HECO will use computer modeling which examines factors such as the physical and electrical properties of existing overhead and underground circuits, including proximity to new circuits, loading of the existing and future power lines and current direction to determine whether, and to what extent, cancellation of magnetic fields can be achieved. HECO will phase the new circuits to achieve cancellation of magnetic fields in those areas where prudent avoidance measures can be implemented.

Along all other project segments, EMF exposure cannot be prudently avoided by optimizing cable placement and phasing arrangements because the configuration of lines in existing ducts and overhead circuits prevents implementation of phasing to achieve reduction in EMF.

Route Planning

HECO has also implemented prudent avoidance in the route planning for the Proposed Action. EMF levels from power lines drop off rapidly with distance, meaning that reduction of EMF levels might be achieved by locating the lines closer to the middle of the roadways to reduce EMF levels at the near edge of the roadways. This requires detailed engineering and consultation with the City and County of Honolulu permitting agencies to determine if physical space is available to locate the 46kV ductlines closer to the middle of the roadways and whether locating the lines there would cause conflicts with future facilities planned by government or private entities.

Prudent avoidance of EMF has been considered in the routing of the proposed lines. Along King Street between Cooke Street and McCully Times Supermarket, the power line will be located away from the makai curb. Along all other project segments, the power lines cannot be located near the center of the street due to constraints imposed by existing utilities.

Chapter 5

Other Considerations

CHAPTER 5
OTHER CONSIDERATIONS

5.1 SECONDARY AND CUMULATIVE IMPACTS

5.1.1 Secondary Impacts

As defined by HAR 11-200-2, the term "secondary impacts" means those impacts caused by the action that are later in time or farther removed in distance but still reasonably foreseeable. They may include effects related to induced changes in land use patterns and population density or growth rate, and related effects on air, water, or other natural systems, including ecosystems.

The Proposed Action and alternative alignments involve the installation of subtransmission lines and related substation improvements to address several transmission problems that can affect system reliability. This action and its alternatives respond to growth that is already occurring or planned within the City and County of Honolulu and, therefore, are not growth-inducing. No secondary impacts have been identified and none are anticipated.

5.1.2 Cumulative Impacts

"Cumulative impacts" are defined in HAR 11-200-2 as environmental impacts resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. As such, all the impacts on affected resources could be considered cumulative. Because it is not practical to analyze the cumulative effects of an action on the universe, the list of environmental effects must focus on those that are truly meaningful. Cumulative effects analysis should "count what counts," not produce superficial analyses of a long laundry list of issues that have little relevance to the effects of the proposed action or the eventual decisions.[1] Under the Proposed Action and alternatives, cumulative impacts could result when combined with the effects of

[1] Council on Environmental Quality. January 1997. *Considering Cumulative Effects Under the National Environmental Policy Act*.

other construction projects during the same period of time or at different times, either within the same roadway alignment or in the same project vicinity (defined by the geographic boundary for the resource it affects, as described below). In certain cases, projects cumulatively affecting a similar resource, e.g., landfill capacity, can be geographically distant.

Other actions considered in this cumulative impact analysis were identified by defining the cumulative impact study timeframe and geographic boundaries. The initial time frame used in this analysis was determined by considering the period of effect caused by the Proposed Action and alternative alignments, a period from mid 2006 to early 2009. Through pre-assessment consultations, which help to provide focus for the analysis, projects identified since 2002 were identified and the timeframe was subsequently expanded to a period of 10 years, from 2002 through 2011. Because the cumulative impacts analysis is evaluating the cumulative impacts on resources, geographic boundaries are specific for each of the potentially affected resources of the Proposed Action and alternatives. Reasonable geographic boundaries for the Proposed Action and alternatives for each resource follow:

- Land Use: Immediate geographic area of Proposed Action and alternatives
- Infrastructure: Immediate geographic area of Proposed Action and alternatives
- Solid Waste: Disposal facilities affected by Proposed Action and alternatives
- Traffic: Communities where in-road construction of the Proposed Action and alternatives would occur (Ala Moana, Waikīkī, McCully, Mōʻiliʻili, and Kapahulu)
- Noise: Within an approximate one square block from the Proposed Action and alternatives
- Emergency Response: Communities where in-road construction of the Proposed Action and alternatives would occur (Ala Moana, Waikīkī, McCully, Mōʻiliʻili, and Kapahulu), and emergency response facilities in the path of the Proposed Action and alternatives
- Schools: Immediate geographic area of Proposed Action and alternatives
- Soils and Topography: Immediate geographic area of Proposed Action and alternatives
- Groundwater Resources: Underlying aquifer
- Surface Water Resources: City and County of Honolulu MS4 system and State waters
- Air Quality: Immediate geographic area of Proposed Action and alternatives

- Cultural Resources: generally from Beretania Street to Ala Moana/Ala Wai Boulevards in a mauka-makai direction, and from Cooke Street to Kapahulu Avenue in an ‘Ewa–Koko Head direction; and in the area near the intersection of Winam Avenue and Mo‘oheau Avenue, east of Kapahulu Avenue.
- Visual and Aesthetic Resources: view planes in Ala Moana, Waikīkī, McCully, Mō‘ili‘ili, and Kapahulu
- Biological Resources: Immediate geographic area of Proposed Action and alternatives
- Socioeconomic Environment
  - Population: Communities where in-road construction of the Proposed Action and alternatives would occur (Ala Moana, Waikīkī, McCully, Mō‘ili‘ili, and Kapahulu)
  - Electrical Reliability: the areas of O‘ahu (Honolulu District, Ko‘olau Poko, Ko‘olau Loa, Hawai‘i Kai, Kailua, and Kāne‘ohe) where electrical transmission system reliability would be affected
  - Businesses and Residents: Immediate geographic area of Proposed Action and alternatives
- EMF: Immediate geographic area of Proposed Action and alternatives

In addition to pre-assessment consultations with City and County of Honolulu departments, the following resources were used to identify other actions for consideration in this cumulative impact analysis:

- the bi-monthly *Environmental Notice* of the Office of Environmental Quality Control (OEQC), and
- the records of the City and County of Honolulu’s Utility Coordination Committee, of which HECO is a member.

Past, present, and reasonably foreseeable future actions with impacts that are considered in this EA are described as follows:

- **Archer–Kewalo 138kV transmission line project.** In November 1992, HECO filed an application with the PUC (Docket No. 7526) requesting approval to commit funds for Item BT-467, Installation of Kewalo A and B 30/40/50 MVA Transformers. In this docket, the Archer-Kewalo project involved the purchase and installation of a 138kV/25kV transformer and related substation equipment at the existing Kewalo Substation, two 138kV underground transmission lines between the Archer and Kewalo Substations, 25kV underground distribution lines, and fiber optic cable. The need for the Archer-Kewalo project was to meet and accommodate load growth demands in the Kaka'ako, Ala Moana, and Waikiki areas by providing the necessary substation infrastructure to service the new demand. Construction of the Archer-Kewalo project started in October 1996 and was completed in February 2003. The Archer-Kewalo project is today a part of HECO's existing Southern 138kV Transmission Corridor.

- **Kewalo–Kamoku 138kV transmission line project.** In February 1993, HECO filed an application with the PUC (Docket No. 7602) requesting approval to commit funds for Item BT-476, Installation of Kewalo-Kamoku 138kV Transmission Line. In this docket, the Kewalo-Kamoku project involved the purchase and installation of a 138kV/25kV transformer and related substation equipment at the existing Kamoku Substation, an underground 138kV transmission line between the Kewalo and Kamoku Substations, 25kV underground distribution lines, and fiber optic cable. The need for the Archer-Kewalo project was to meet and accommodate load growth demands in the Kaka'ako, Ala Moana, and Waikiki areas by providing the necessary substation infrastructure to service the new demand. Construction of the Kewalo–Kamoku 138kV transmission line project began in July 1996 and was completed in September 2002. The Archer-Kewalo project is today a part of HECO's existing Southern 138kV Transmission Corridor.

- **City and County of Honolulu's BRT project.** A section of the BRT line, on Kapi'olani Boulevard between Kāheka Street and Atkinson Drive, is in the vicinity of the Proposed Action. A section of the BRT line, on King Street between Cooke and Pensacola Streets, coincides with the Phase 2 alignment. On King Street, plans include a semi-exclusive BRT lane along the makai curb (shared with vehicles turning right into driveways and cross streets) and an exclusive contra-flow lane for 'Ewa-bound BRT buses in the mauka curb. Implementation dates for the BRT on King Street, between Cooke and Pensacola Streets, are not known.

- **City and County of Honolulu's roadway resurfacing projects.** Resurfacing of McCully Street and a section of King Street from South Street to McCully Street took place during 2003-2004. Roadway rehabilitation projects along King Street from University to Old Wai'alae Avenue, Pi'ikoi Street from Ala Moana Boulevard to Matlock Avenue, Queen Street 'Ewa of Ward Avenue, Ke'eaumoku Street from Kapi'olani Boulevard to Kinau Street, and University Avenue above Kapi'olani Boulevard were also planned for 2004 and 2005. Rehabilitation projects on various Waikīkī roadways have been programmed through 2006.

- **Board of Water Supply's Honolulu District water system improvements (new 42-inch and 24-inch mains).** Funding is planned for fiscal years 2005 and 2007 or 2008, with installation on Beretania and King Streets.

- **Other BWS projects.** The following BWS projects occurred in 2003:
  - Diamond Head Water System Improvements on Kapahulu Avenue, and
  - Kalākaua Avenue Water System Improvements.

The following are planned for 2005:

- Mōʻiliʻili Water System Improvements on Date Street, Kapiʻolani Boulevard, and Kamoku Street,
- Pensacola Street Water System Improvements, along the length of Pensacola Street,
- Kakaʻako Water System Improvements, makai of Kapiʻolani Boulevard,
- Ward Avenue 12-inch and 8-inch mains, along Ward Avenue from Waimanu to Kinau Street,
- Ala Moana Boulevard 12-inch main, along Ala Moana Boulevard from Ward Avenue to Atkinson Drive,
- Waikīkī Water System Improvements, Part V, between Ala Wai Boulevard and Kūhiō Avenue,
- Kalākaua Avenue 16-inch main, on Kalākaua Avenue from Young Street to Kapiʻolani Boulevard, and
- Kapiʻolani Boulevard Water System Improvements, along Kapiʻolani Boulevard.

The following are planned for 2006:

- Kona Street 8-inch main, on Kona Street from Waimanu Street to Atkinson Drive, and
- Mōʻiliʻili Water System Improvements, along University Avenue.

The following is planned for 2007:

- Mōʻiliʻili Water System Improvements, Part II, which will occur in the following areas:
  - on Beretania Street from Isenberg Street to University Avenue,
  - on Dole Street from Wilder Avenue to University Avenue,
  - on Isenberg Street from Bingham Street to Beretania Street,
  - on McCully Street from King Street to Date Street,
  - on Wilder Avenue from Metcalf Street to H-1 Freeway.

- **The City and County of Honolulu's wastewater projects:**
  - Kalākaua Avenue Sewer Reconstruction Project: expected to occur in 2006; would parallel the Proposed Action underground subtransmission lines for one block on Kalākaua Avenue, between Makaloa Street and Fern Street.
  - Mōʻiliʻili Sewer Rehabilitation project: scheduled to start some time between 2007 and 2009.
- **Young Street and Wilder Street improvements.** Master Plans have been completed for these projects, but no funds have been appropriated for design and construction. Future improvement projects along Young Street and Wilder Avenue are proposed but not yet funded. Because the timing of these projects is uncertain, they are not considered reasonably foreseeable future actions for purposes of this cumulative impact analysis.
- **WalMart/Sam's Club complex.** The construction of a shopping center and parking structure on approximately 10 acres on the ʻEwa side of Keʻeaumoku Street is planned for completion in 2004.
- **McCully-Mōʻiliʻili Beautification Master Plan.** An Environmental Assessment was prepared in 2002 that identified the top priority beautification projects for the McCully-Mōʻiliʻili neighborhood. Projects identified in the master plan include planting street trees and improving sidewalks, curbs, gutters, and storm drainage. The beautification projects were planned to begin in 2002.
- **U.S. Army Corps of Engineers/DLNR Ala Wai Watershed Improvement Project.** The Army Corps of Engineers is preparing an EIS for a proposed project to protect Waikīkī and surrounding areas from flooding and to restore the ecosystems of the Ala Wai Canal and tributaries. Ecosystem restoration actions being investigated include stream channel reconstruction, stream bank revegetation and reinforcement, sedimentation basin and dam construction, debris catchment and energy dissipation, and better maintenance accessibility. Other measures being evaluated for flood control include dredging the Ala Wai Canal deeper and widening the portion makai of the McCully Street bridge, removing flow obstructions such as some bridge supports, and building floodwalls or berms along the Ala Wai Canal and lower reaches of Mānoa-Pālolo Canal and Makiki Stream. As this project is in the early planning stages, this is not considered reasonably foreseeable future action for purposes of this cumulative impact analysis. The draft EIS for the project is anticipated to be completed in 2005.
- **HECO's Ala Wai Canal circuit relocation project.** HECO is planning to relocate two existing 46kV circuits that cross the Ala Wai Canal in the area fronting Kaiʻolu Street by year-end 2007 to accommodate anticipated

construction of the above mentioned DLNR/U.S. Army Corps of Engineers Ala Wai Canal Watershed Improvement Project. HECO is presently examining relocation options, including installation of the circuits deeper in the canal at the location of the existing canal crossing. This project, which is independent of the EOTP, will not require construction within the roadway alignment of the Proposed Action. Limited construction activity for this project during the 2007 time frame is anticipated in the area surrounding the existing 46kV circuit crossing and possibly nearby roadways.

Land Use

No adverse cumulative impacts would occur from implementation of the Proposed Action or alternatives, as there would be no associated land use changes, and the activities would support and be consistent with the State and City and County of Honolulu land use plans.

Infrastructure

New underground subtransmission lines may constrain the availability of underground space for future utility lines. Because public roadways usually offer the most practical solution to the routing of utilities, capacity is limited by two factors: the width of the roadway right-of-way, and the number of existing utilities (at-grade and underground). At some point, the total number of utilities (water lines, sewer lines, electrical, and telecommunications cable) under a given roadway would preclude the addition of any other utilities.

With respect to water and wastewater system improvements, HECO would coordinate scheduling with the City and County of Honolulu to minimize construction in the same area at the same time. In reviewing the past, present, and reasonably foreseeable projects listed above, no adverse cumulative impacts would occur from the Proposed Action or alternatives.

Solid Waste

In addition to the Proposed Action and alternatives, solid waste would be generated during street resurfacing, construction of the BRT system, and construction of the BWS projects. Types of solid waste may include excavated soil, asphalt, and transite (asbestos cement) ductlines/conduits. The quantity of waste from these projects is unknown. For the Proposed Action and alternatives, the majority of the excavated soil would be sold for reuse in other construction projects and the asphalt would be recycled, minimizing the cumulative impact of solid waste generation from this project.

Roads and Traffic

The Proposed Action and its alternative alignments would represent another in-road construction project affecting motorists in the area. Generally, multiple lane closures on the same roadway could increase traffic delays. While contractors are restricted from conducting construction activities during peak A.M. and P.M. traffic periods, construction during non-peak periods, including nighttime hours, may result in multiple lane closures and frustrating traffic delays and/or rerouting. The City and County of Honolulu Department of Planning and Permitting's coordination of multiple construction projects in the same area would reduce impacts to traffic. Because the BRT project could be in operation while the Proposed Action is under construction, cumulative impacts on traffic were evaluated for the section of Kapi‘olani Boulevard between Kāheka Street and Atkinson Drive during Phase 1, and the section along King Street between Cooke and Pensacola Streets during Phase 2. Table 5-1 summarizes the potential cumulative impacts on traffic with the BRT project.

Table 5-1. Additional Traffic Impacts and Actions to Minimize Impacts with BRT

Potential Impacts	Potential Actions to Reduce Impacts
Phase 1: Makaloa	
No impact from BRT	None required
Phase 1 Alternative Alignment: Kāheka–Kapi‘olani Corridor	
Traffic at intersection of Kāheka Street and Kapi‘olani Boulevard exceeding intersection capacity by 7 percent with delays greater than 80 seconds may cause traffic to divert to parallel streets.	• Shift construction to nighttime in this section.
Work area would block pedestrian access from mauka curb to BRT platform and curb bus stop at Atkinson Drive.	• Construct this section at nighttime to lessen impact. OR • Provide temporary crosswalk and access from ‘Ewa end of platform, which may not be fully accessible. • Temporarily move curb bus stop outside of affected area.
Phase 1 Alternative Alignment: Kalauokalani–Kapi‘olani Corridor	
Little impact from BRT.	None required

Table 5-1. Additional Traffic Impacts and Actions to Minimize Impacts with BRT *(continued)*

Potential Impacts	Potential Actions to Reduce Impacts
Phase 2: King Street Area (Open Trenching Option–Preferred)	
With BRT, there would be traffic delays at Ward Avenue or Pensacola Street during ductline construction.	• Delay start of nighttime work in these areas until lower traffic activity at 9 P.M. • Allow temporary through-traffic use of Koko Head-direction BRT lane during nighttime work hours (by City and County of Honolulu).
BRT lanes and bus stops would be blocked by repaving work.	• Obtain City and County of Honolulu waiver of requirement to resurface the BRT lanes. OR • Temporarily operate Koko Head-direction BRT in general traffic lane, and re-route the ‘Ewa-direction BRT buses, with relocation of bus stops. OR • Repave only during hours BRT line not in service.
With BRT and daytime trenching (not preferred), traffic delays at Ward Avenue and Pensacola Street are anticipated.	• Construct section from Archer Lane to Pensacola Street at nighttime.
Phase 2: King Street Area (Partial Directional Drilling Option)	
With BRT, lengthy delays and severe congestion would occur at intersections near work areas during afternoon peak hour.	• Construct Phase 2 prior to BRT operation. OR • Temporarily relocate ‘Ewa direction BRT buses to Kapi‘olani Boulevard, and open mauka curb lane to Koko Head traffic for duration of work between Cooke and Pensacola Streets.
With BRT, Ward Avenue intersection would exceed intersection capacity during all three peak traffic periods, and Pensacola Street intersection would operate at 93 percent capacity during afternoon peak.	• Temporarily relocate ‘Ewa direction BRT buses to Kapi‘olani Boulevard, and open mauka curb lane to Koko Head traffic for duration of work between Cooke and Pensacola Streets.
BRT lanes and bus stops would be blocked by repaving work.	• Obtain City and County of Honolulu waiver of requirement to resurface the BRT lanes. OR • Temporarily operate Koko Head-direction BRT in general traffic lane, and re-route the ‘Ewa-direction BRT buses, with relocation of bus stops. OR • Repave only during hours BRT line not in service.

Table 5-1. Additional Traffic Impacts and Actions to Minimize Impacts with BRT *(continued)*

Potential Impacts	Potential Actions to Reduce Impacts
Phase 2: King Street Area (Partial Directional Drilling Option) *(continued)*	
With BRT, makai curb lane (BRT lane) would be blocked during trenching of ductline at the intersection with Cooke Street.	• Construct Phase 2 prior to BRT operation. OR • Merge buses into general traffic. OR • Construct this section only during hours BRT line not in-service.

Public Health and Safety

Noise. Concurrent projects could exacerbate noise. State of Hawaiʻi noise control rules would need to be followed, minimizing cumulative noise impacts from this project.

Emergency Response. Multiple projects in the same area could affect the routes that emergency responders take to reach certain locations. HECO would continue to communicate and coordinate with emergency responders to minimize disruption to their activities.

Schools. No other projects would affect schools during the construction phases of the Proposed Action.

Soils and Topography

No cumulative impacts on soils or topography would result from the various projects planned during the same period. The surface of the sites would be restored to pre-construction conditions.

Water Resources

Cumulative impacts to water resources are possible if multiple subsurface construction projects requiring dewatering occur in the same area. However, cumulative impacts would be minimized because dewatering would be confined to the area of trenching, and engineering controls would be implemented to eliminate the need for area-wide dewatering. Applicable State and City and County of Honolulu permit requirements would also minimize impacts to water from dewatering activities.

Air Quality

Cumulative impacts on air quality would be short-term and temporary. Compliance with existing DOH rules would minimize fugitive dust and emissions.

Cultural Resources

While cultural resources may be encountered for those projects with subsurface activity, the primary cultural concern is the potential for encountering human burials. All projects are subject to State requirements governing the inadvertent discovery of human remains; and no cumulative impacts from the project or its alternatives are expected.

Visual and Aesthetic Resources

The Proposed Action would have no impact on visual and aesthetic resources; therefore, no cumulative impacts on these resources would occur.

Biological Resources

The Proposed Action would have no impact on biological resources; therefore, no cumulative impacts on these resources would occur.

Socioeconomic Environment

No cumulative socioeconomic impacts are expected during construction or operation. For the Proposed Action and alternative alignments, the only direct construction-related impact identified is the potential for small businesses to lose revenues if customer access is blocked. Appropriate management measures would assure pedestrian and vehicular access to businesses along the alignments. In the case of multiple in-road projects in the same vicinity, impacts would be minimized through close coordination with other utilities and implementation of management measures.

EMF

The Magnetic Field Evaluation (Appendix D) prepared by Enertech projects changes to magnetic field levels if the project is implemented. As discussed in Chapter 4, the difference in projected magnetic field levels between the existing and proposed power line configurations under 2009 forecasted loading can decrease slightly, remain unchanged, or increase depending upon the project area. In addition, if the project is implemented, the proposed underground circuits would have little effect on EMF levels at nearby institutions and EMF levels would be in the range of common everyday levels.

5.2 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENT OF RESOURCES

A commitment of resources is considered irreversible when it precludes restoration of those resources to their pre-project condition. Use, consumption, destruction, or degradation of resources resulting from implementation of the proposed project, such that the resource cannot be retrieved or replaced in any form, is considered an irretrievable commitment of resources. Most resource commitments for the Proposed Action are temporary and would only occur during construction. Irreversible and irretrievable resource commitments include:

- construction materials, including materials that make up the ductlines, circuits, manholes, overhead poles, transformers, and other associated materials;
- soil that would be excavated and disposed;
- available space in the construction and demolition landfill;
- money;
- manpower; and
- energy in the form of direct consumption of fossil fuel for vehicles.

There is no irrevocable commitment or loss or destruction of any natural or cultural resources.

5.3 SUMMARY OF PERMITS AND APPROVALS

Government permits, approvals, and consultations that may be required for this project were identified during the pre-assessment consultation process and the development of this document are included in Table 5-2. This reference table is not a comprehensive list of all permits and approvals that may eventually be required.

Table 5-2. Summary of Government Permits and Approvals

Permit, Consultation, or Concurrence	Regulatory Agency
Federal	
None required	Not applicable
State	
PUC Review and Approval	PUC
NPDES, HAR 11-55	DOH-Clean Water Branch
Community Noise Permit, Noise Variance, HAR 11-46	DOH-Noise, Radiation, and Indoor Air Quality Branch
Rules Governing Procedures for Historic Preservation Review to Comment on Section 6E-42, HRS, and Burial Sites and Human Remains, HAR 13-300	DLNR-State Historic Preservation Division
HCDA review	HCDA
City and County of Honolulu	
Dewatering Discharge Permit (in conjunction with NPDES permit)	City Department of Environmental Services
Conditional Use Permit – Minor	City Department of Planning and Permitting (DPP)
Construction Plan Review; Excavation Permit; Grubbing, Grading, and Stockpiling Permit; Building Permit; Street Usage Permit	City DPP

5.4 SUMMARY OF POTENTIAL IMPACTS AND MANAGEMENT AND DESIGN CONSTRAINTS

Table 5-3 summarizes the potential impacts of the Proposed Action, alternative alignments, and No Action. Planned management and design constraints used to prevent significant adverse impacts are also identified.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
LAND USE				
	No adverse impacts. Proposed Action is consistent with applicable State and City and County of Honolulu land use plans and requirements. *Management Constraints:* HECO will obtain necessary permits (i.e., Conditional Use Permit – Minor).	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
INFRASTRUCTURE				
Electrical	No adverse impacts. During construction, there could be brief interruptions in some areas during electrical disconnection and connection. *Management Constraints:* HECO will notify those affected by power interruptions.	Same as the Proposed Action.	Same as the Proposed Action.	Potential for adverse impacts associated with a loss of power to areas of East O'ahu and possibly entire island.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
INFRASTRUCTURE *(continued)*				
Potable Water	No adverse impacts. *Management Constraints:* HECO will research available records, conduct field explorations, and coordinate with BWS to confirm locations of water lines to avoid conflicts.	Same as the Proposed Action.	Same as the Proposed Action.	Potential for adverse impacts associated with a loss of power and subsequent loss of water distribution.
Wastewater	No adverse impacts. *Management Constraints:* HECO will research available records, conduct field explorations, and coordinate with the responsible City and County of Honolulu agency to confirm location of sewer lines to avoid conflicts.	Same as the Proposed Action.	Same as the Proposed Action.	Potential for adverse impacts associated with a loss of power and subsequent loss of treatment capacity.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
INFRASTRUCTURE *(continued)*				
Drainage	No adverse impacts. *Management Constraints:* HECO will research available records, conduct field explorations, and coordinate with the responsible City and County of Honolulu agency to confirm location of drainage lines to avoid impacts.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
Communications	No adverse impacts. *Management Constraints:* HECO will research available records, conduct field explorations, and coordinate with communications companies to confirm location of communication lines to avoid conflicts.	Same as the Proposed Action.	Same as the Proposed Action.	Potential for adverse impacts associated with a loss of power and subsequent loss of some communications capacity.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations		No Action
		Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignment 2 (requires new ductline throughout entire alignment)	
INFRASTRUCTURE *(continued)*				
Solid Waste	No adverse impacts. Solid wastes will be generated during construction. The material to be excavated during trenching would be sold for reuse at other construction sites. The material to be excavated by directional drilling and the potentially contaminated soil that may be excavated during trenching that would not be sold for reuse can be accommodated at the PVT construction and demolition landfill. If construction activities encounter existing contaminated soil, contaminated waste may be disposed. *Management Constraints:* Solid wastes generated during construction will be reused, recycled, or disposed according to applicable government requirements. Contaminated or hazardous wastes, if encountered, would be disposed of in accordance with applicable laws.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
TRAFFIC				
	No adverse impacts. Impacts during construction would be temporary, with no area affected longer than two months and, in most cases, less than one week. With the directional drilling option in Phase 2, the presence of equipment within the roadway 24 hours a day would affect peak hour periods of traffic.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
	Management Constraints: In non-residential areas, scheduling work during nighttime hours, providing flagmen to help direct traffic, and working during hours of no bus service would minimize traffic impacts.	*Management Constraints:* Scheduling work near intersections during nighttime hours, and relocating bus stops where possible would minimize traffic impacts.	*Management Constraints:* Scheduling work near intersections during nighttime hours, and relocating bus stops where possible would minimize traffic impacts.	

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations		No Action
		Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignment 2 (requires new ductline throughout entire alignment)	
PUBLIC HEALTH AND SAFETY				
Noise	No adverse impacts. Noise levels from construction equipment could exceed maximum permissible sound levels. Such occurrences would be short-term and performed under a DOH-issued noise permit or variance. *Management Constraints:* Applying various controls to construction work such as conducting work during specific hours would minimize noise impacts.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
Emergency Response	No adverse impacts. Emergency response time during day or night construction is not anticipated to exceed travel time standards. *Management Constraints:* Coordination and communication with emergency responders would ensure ingress and egress across construction areas and minimize impacts to emergency responders.	Same as the Proposed Action.	Same as the Proposed Action.	In the event of increased electrical outages, the Honolulu Fire and Police Departments may receive increased calls to assist in areas without power.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations		No Action
		Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignment 2 (requires new ductline throughout entire alignment)	
PUBLIC HEALTH AND SAFETY (continued)				
Schools	No adverse impacts. Construction activities would occur adjacent to Lunalilo Elementary, Washington Middle School, and McKinley High School. Potential traffic, noise, and pedestrian safety impacts would be avoided or minimized through implementation of management constraints. Areas of Washington Middle School and McKinley High School campuses may be used for construction staging activities. *Management Constraints:* Scheduling work during school vacations, fencing off construction work areas, and communication with school administration would minimize impacts to schools.	Same as the Proposed Action.	Same as the Proposed Action.	To the extent schools rely on electrical service, an interruption of service associated with an overload and related outages could affect school operation.
GEOLOGY, TOPOGRAPHY, AND SOILS				
	No adverse impacts. During construction, soils and topography would be temporarily disturbed. *Management Constraints:* Incorporation of erosion control measures into construction practices would minimize impacts to geology, topography and soils.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
WATER RESOURCES				
Groundwater	No adverse impacts. Dewatering may be required during Phase 1 trenching, but would have only a localized, minimal, and temporary effect on groundwater levels. Drinking water resources would not be affected. *Management Constraints:* Dewatering, if required, would be conducted in accordance with applicable law.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
Surface Water	No adverse impacts. Pollutants associated with construction activities could run off via storm water to the City and County of Honolulu's MS4 system. *Management Constraints:* If best management practices to prevent introducing pollutants to surface waters are implemented during construction and storm drain lines and intakes in the project vicinity are protected, then impacts to surface waters would be minimized.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations		No Action
		Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignment 2 (requires new ductline throughout entire alignment)	
AIR QUALITY				
	No adverse impacts. Air emissions from fossil fuel-powered generators, heavy-duty construction equipment, and fugitive dust would be short-term. *Management Constraints:* If all applicable permit requirements and HAR 11-60, 1-33 are followed, then impacts to air quality would be minimized.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
CULTURAL RESOURCES				
Archaeological Resources	No adverse impacts. Archaeological sites may be inadvertently encountered during construction excavation. *Management Constraints:* Any subsurface archaeological features encountered during construction, and any inadvertent burials found, will be treated in accordance with the law.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations		No Action
		Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignment 2 (requires new ductline throughout entire alignment)	
CULTURAL RESOURCES *(continued)*				
Traditional Cultural Practices	No adverse impacts. There is no evidence of traditional cultural practices in the project area.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
Historic Resources	No adverse impacts. Buildings at McKinley High School, listed on the State and National Register of Historic Places, would not be affected by construction activities fronting the school. Two other historic sites in the vicinity, Thomas Square and Linekona School, would not be affected.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.
VISUAL AND AESTHETIC RESOURCES				
	No adverse impacts. Construction activities would be temporary, and underground subtransmission lines would not affect view planes.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
BIOLOGICAL RESOURCES				
	No adverse impacts. Construction would occur within existing paved and heavily disturbed urban areas, where no threatened or endangered species or their habitat are found. No exceptional trees were identified along the project alignment. Tree roots and landscaping may be affected. *Management Constraints:* Coordination with HECO's arborist and the City and County of Honolulu's Department of Parks and Recreation to avoid impacting root structures of trees would minimize impacts to biological resources.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations		No Action
		Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignment 2 (requires new ductline throughout entire alignment)	
SOCIOECONOMIC ENVIRONMENT				
	No adverse impacts. Impacts on revenues of ground-level businesses located along the alignment would be minimal with implementation of management measures. *Management Constraints:* If businesses are informed of construction activities, and provided coned access routes and signs indicating that businesses are open, and special-duty police officers and flagmen are present to direct traffic, impacts to the socioeconomic environment would be minimized. Work will be conducted at night in certain commercial areas.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

Table 5-3. Summary of Potential Impacts and Management and Design Constraints *(continued)*

Issue or Resource	Proposed Action (reuses approximately 2,450 feet of existing ductline)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 1 (requires new ductline throughout entire alignment)	Alternative Alignments Between Makaloa and McCully Substations: Alternative Alignment 2 (requires new ductline throughout entire alignment)	No Action
ELECTRIC AND MAGNETIC FIELDS (EMF)				
	No adverse impacts. EMF levels would be in the range of common everyday levels. *Management Constraints:* Routing subtransmission lines close to the middle of roadways, phasing the cables to cancel magnetic fields, and placing subtransmission lines underground would prudently avoid exposure to EMF levels.	Same as the Proposed Action.	Same as the Proposed Action.	No impacts.

5.5 FINDING OF NO SIGNIFICANT IMPACT DETERMINATION

5.5.1 Applicant

The applicant is the Hawaiian Electric Company, Inc (HECO).

5.5.2 Approving Agency

The approving agency is the State of Hawai‘i Public Utilities Commission (PUC).

5.5.3 Brief Description of the Proposed Action

HECO is proposing to install underground subtransmission lines and transformers in the eastern district of the Primary Urban Center within the City and County of Honolulu. Subtransmission lines or electrical circuits, which are used to transmit electricity, would be designed for a nominal rating of 46 kilovolts (kV). Transformers would step down electrical energy from 138kV lines to 46kV lines or from 46kV lines to 12kV lines, which allows higher voltage electricity (needed for transmission) to be distributed locally for use by the consumer. Additional equipment upgrades, such as circuit breakers, switchgear, and protective relays, are also proposed and would be installed in existing substations. Because the installation and the use of 46kV circuits would be implemented in two phases, the Proposed Action is referred to as the East O‘ahu Transmission Project (EOTP) 46kV Phased Project.

5.5.4 Determination and Reasons Supporting Determination

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.

No irrevocable commitment or loss or destruction of any natural or cultural resource would result from the Proposed Action and alternative alignments. The Proposed Action and alternative alignments would occur in existing rights-of-way or structures. There is the possibility of encountering two buried fishponds and burials associated with the Catholic Cemetery on King Street. A plan for documenting and properly treating these resources during the course of construction excavations will be developed and implemented by HECO.

(2) Curtails the range of beneficial uses of the environment.

The proposed utility installation project would not curtail the range of beneficial uses of the environment. Underground subtransmission lines would not restrict beneficial uses of the environment.

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

The Proposed Action and alternative alignments are consistent with the State's long-term environmental policies, goals, and guidelines as expressed in HRS Chapter 344, in that it serves to (1) increase the reliability of electrical power so that the social and economic requirements of the people of Hawai'i can be met and (2) enhance the quality of life. While the Proposed Action and alternative alignments are designed to avoid impacts to resources by undergrounding subtransmission lines and eliminating visual impacts, the action is proposed in response to community growth and does not initiate changes in population, types of economic activities, and community planning.

(4) Substantially affects the economic or social welfare of the community or State.

The Proposed Action and alternative alignments would not substantially affect the economic or social welfare of the community or the State. No permanent new employment or increase in new residents would occur. Costs associated with the project would be distributed among all HECO customers; therefore, specific populations would not be disproportionately impacted.

Short-term impacts to businesses from loss of revenues during construction would be minimized by providing access routes through the project area with signage; conducting open trenching and paving at night in commercial areas; and having special-duty police officers or flagmen present to assist with the flow of traffic through the project area.

Short-term impacts of construction on residents would be minimized by management measures that include informing residents and businesses of upcoming construction activities, allowing residents vehicular access to closed streets, and scheduling activities to minimize impacts to residents.

(5) Substantially affects public health.

The Proposed Action and alternative alignments would not substantially affect public health. During construction, noise levels and air emissions would comply with State rules so that public health and welfare are not jeopardized, and emergency responders would not be significantly affected. The projected EMF levels from these projects are within the range of magnetic field levels found at numerous locations in the local environment. Magnetic field levels decrease with distance from the source, and the projected magnetic field levels beyond the sidewalks are well within the range of levels commonly encountered in the local area and in other communities. That there would be no impact to human health is further supported by evaluations of EMF research by national and international scientific organizations.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities.

The Proposed Action and alternative alignments respond to growth that is already occurring or planned within the City and County of Honolulu and, therefore, are not growth-inducing. Because the project would not induce growth, no secondary impacts such as those resulting from increases in population and their subsequent effects on schools and other public facilities have been identified or are anticipated.

(7) Involves a substantial degradation of environmental quality.

No substantial degradation of environmental quality would result from the Proposed Action and alternative alignments. Construction activities would be limited to installation of new ductline and manholes in existing rights-of-way and upgrades to substations and would not involve use of materials or cause emissions to air, water, or ground that could substantially degrade environmental quality.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.

The Proposed Action and alternative alignments would not have a considerable cumulative effect on the environment or involve a commitment for larger actions. Cumulative impacts could result from the incremental effect of the Proposed Action or alternative alignments, plus other construction projects during the same period of time. These impacts are temporary and will not have a considerable effect upon the environment or involve a commitment for larger action.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat.

No rare, threatened, or endangered species or their habitats are found in the project vicinity. The project is located within existing roadway rights-of-way and existing substations.

(10) Detrimentally affects air or water quality or ambient noise levels.

The State of Hawai‘i is in an attainment area for all criteria air pollutants. The Proposed Action and alternative alignments would not have a significant effect on air quality. Air emissions for construction activities are localized and temporary and would be minimized as required by HAR 11-60.1.

The Proposed Action and alternative alignments would not have a significant effect on water quality. Construction activities are localized, temporary and will be conducted in compliance with State law. If needed, dewatering would be localized and would not have a significant impact on groundwater.

The Proposed Action and alternative alignment would not have a significant effect on ambient noise levels. In certain cases, HECO may apply for a noise permit or variance when noise levels are anticipated to exceed the noise levels in HAR 11-46. Approval of the permit or variance may require additional noise attenuation devices on construction equipment or further limits on construction hours and activities.

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

The Proposed Action and alternative alignments are not located in a tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters. The Proposed Action and alternative alignments are not likely to affect or suffer damage by being located in a flood plain. Construction in areas of the project located in flood plains will not occur during heavy rains Underground circuits and related equipment are designed to operate under water.

(12) Substantially affects scenic vistas and view planes identified in county or state plans or studies.

The Proposed Action and alternative alignments would not substantially affect scenic vistas and view planes because the activities would occur generally underground or inside substation properties.

(13) Requires substantial energy consumption.

Energy consumed to operate construction equipment would not be substantial. The Proposed Action and alternative alignments do not require an increase in generating capacity.

5.5.5 Name, Address, and Phone Number of Contact Person for Further Information

Mr. Kerstan J. Wong

Hawaiian Electric Company, Inc.

P.O. Box 2750

Honolulu, Hawai‘i 96840-0001

(808)543-7059

Chapter 6

Public Participation

CHAPTER 6
PUBLIC PARTICIPATION

The following agencies and organizations were contacted prior to drafting the EA to solicit input. Meetings and phone conversations were conducted with some of the agencies or organizations are summarized in Table 6-1.

Table 6-1. Pre-Assessment Consultations

Contact Name	Organization	Meeting Dates
STATE AGENCIES		
Ms. Mary Lou Kobayashi, Acting Director	State of Hawai‘i, Department of Business, Economic Development & Tourism, Office of Planning	No meeting conducted. Both the Office of Planning and the Strategic Industries Division reviewed the summary information for the EOTP EA and concluded that a pre-assessment consultation meeting was not needed.
Ms. P. Holly McEldowney, Administrator (acting)	State of Hawai‘i, Department of Land and Natural Resources, State Historic Preservation Division	April 15, 2004 meeting with staff.
Mr. Glenn Yasui, Highways Administrator	State of Hawai‘i, Department of Transportation, Highways Division	No meeting conducted. Planning Engineer indicated that no meeting was necessary.
Mr. Laurence Lau, Esq., Deputy Director	State of Hawai‘i, Environmental Health Administration	March 19, 2004 meeting with staff of the Noise, Radiation and Indoor Air Quality Branch.
Mr. Clyde Namu‘o, Administrator	State of Hawai‘i, Office of Hawaiian Affairs, Support Services	April 15, 2004 meeting with staff.
CITY AND COUNTY AGENCIES		
Mr. Clifford Jamile, Manager and Chief Engineer	City and County of Honolulu, Board of Water Supply	March 18, 2004 meeting with staff.
Mr. Tim Steinberger, P.E.	City and County of Honolulu, Department of Design & Construction	March 18, 2004 meeting with staff.
Mr. Frank Doyle, P.E., Director	City and County of Honolulu, Department of Environmental Services	March 16, 2004 phone conversation with staff.

Table 6-1. Pre-Assessment Consultations *(continued)*

CITY AND COUNTY AGENCIES *(continued)*		
Mr. William Balfour, Jr., Director	City and County of Honolulu, Department of Parks and Recreation	March 30, 2004 meeting.
Mr. Eric Crispin, AIA, Director	City and County of Honolulu, Department of Planning and Permitting	March 11, 2004 meeting.
Ms. Cheryl Soon, Director	City and County of Honolulu, Department of Transportation Services	March 18, 2004 meeting with staff.
Mr. Larry Leopardi, P.E., Director	City and County of Honolulu, Facility Maintenance Department	March 18, 2004 meeting.
Mr. Attilio Leonardi, Fire Chief	City and County of Honolulu, Honolulu Fire Department	No meeting conducted. HFD declined preconsultation meeting but requested a copy of Draft EA for comment during public comment period.
Mr. Glen Kajiyama, Interim Chief	City and County of Honolulu, Honolulu Police Department	April 1, 2004 meeting with staff.
FEDERAL AGENCIES		
None	None	Federal agencies with areas of jurisdiction were not identified for the proposed project.
POTENTIAL INTERVENERS		
Senator Carol Fukunaga	Hawaiʻi State Legislature District 11	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Representative Scott Saiki	Hawaiʻi State Legislature District 22	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Councilmember Ann Kobayashi	Honolulu City Council District 5	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Ms. Darlene Nakayama	Hoolaulima o Pālolo	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Ms. Daisy Murai, Secretary	Kapahulu Neighbors	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Mr. Henry Curtis, Vice President for Consumer Issues	Life of the Land	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Dr. Jeremy Lam, President	Malama o Mānoa	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.

Table 6-1. Pre-Assessment Consultations *(continued)*

POTENTIAL INTERVENERS *(continued)*		
Ms. Karen Iwamoto, President	Pālolo Community Council	Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
Ms. Michelle Matson		May 11, 2004 phone conversation.
Ms. Carolyn Walther		Declined meeting. Requested public scoping meeting, which is not part of the EA process under HAR 11-200.
INTERESTED PARTIES		
Mr. Mike Polovcin, Director of Operations, SMG Inc.	Hawai'i Convention Center	March 22, 2004 meeting.
Mr. Clyde Igarashi, Principal	Lunalilo Elementary School	May 21, 2004 meeting.
Mr. Milton Shishido, Principal	McKinley High School	April 28, 2004 meeting.
Mr. Michael Harano, Principal	Washington Middle School	May 4, 2004 meeting.

Chapter 7

References

CHAPTER 7
REFERENCES

Anderson L.E.W., G.A Boorman, J.E. Morris, L.B. Sasser, P.C. Mann, S.L. Grumbein, J.R. Hailey, A. McNally, R.C. Sills, J.K. Haseman. 1999. Effects of 13-week magnetic field exposure on DMBA-initiated mammary gland carcinomas in female Sprague-Dawley rats. *Journal of Carcinogenesis.* 20:1615-1620.

Babbitt, J.T.; A.I. Kharazi,; J.M.G. Taylor, C.N. Rafferty, R. Kovatch, D.B. Bonds; S.G. Mirell; E. Frumkin; F. Dietrich; D. Zhuang; T.J.M. Hahn. 1998. *Leukemia/Lymphoma in Mice Exposed to 60-Hz Magnetic Fields; Results of the Chronic Exposure Study.* Electric Power Research Institute Report TR-110338. Palo Alto, California.

Boorman G.A., D.L. McCormick, J.C. Findlay, J.R. Hailey, J.R. Gauger, T.R. Johnson, R.M. Kovatch, R.C. Sills, J.K. Haseman. 1999a. Chronic toxicity/oncogencity evaluation of 60 Hz (power frequency) magnetic fields in F344/n rats. *Toxicologic Pathology.* 27:267-278.

Boorman G.A., L.E. Anderson, J.E. Morris, L.B. Sasser, P.C. Mann, S.L. Grumbein, J.R. Hailey, A. McNally, R.C. Sills, J.K. Haseman. 1999b. Effects of 26-week magnetic field exposure in a DMBA initiation-promotion mammary glands model in Sprague-Dawley rats. *Journal of Carcinogenesis.* 20:899-904.

Building Industry Association. *Military Housing Privatization Initiative in Hawaii*. http://biahawaii.inets.com/docs/webdocs/RTC/BIA0306171.pdf. Accessed June 16, 2004.

CH2MHILL. June 1995. Final *Kamoku-Pukele 138-kV Transmission Line Alternatives Study.* Prepared for Hawaiian Electric Company, Inc.City and County of Honolulu. Revised Ordinances of Honolulu. Chapter 24 Development Plans, and Chapter 41. http://www.co.honolulu.hi.us/refs/roh.

City and County of Honolulu, Board of Water Supply. Half Size Plans. Numbers 31 (12/20/1989), 38 (12/5/1989), 39 (8/3/1987), 44 (12/4/1989), and 45 (9/26/1990).

City and County of Honolulu, Board of Water Supply. http://hbws.org/ea_wat_resource/ea01_ct01_mainpage.htm. Accessed May 21, 2004.

City and County of Honolulu, Department of Planning and Permitting. 2004. Honolulu Land Information System (HOLIS). http://gis.hicentral.com. Accessed May and June 2004.

City and County of Honolulu, Department of Planning and Permitting. July 1999. *Primary Urban Center Development Plan.*

Corbisier, C. July/August 2003. *Living with Noise in Public Roads*, Vol. 67, No. 1. http://www.tfhrc.gov/pubrds/03july/06.htm. Accessed June 22, 2004.

EDM International, Inc. December 2003. *Evaluation of the Applicability and Practicability of Live Working (LW) Methods for Hawaiian Electric Company, Inc.'s (HECO) 138 kV Transmission System.*

Enertech Consultants of Santa Clara, Inc. July 22, 2004. *Hawaiian Electric Company East Oahu Transmission Project Magnetic Field Evaluation.* Provided in Appendix D.

Enertech Consultants of Santa Clara, Inc. 1985. "AC Field Exposure Study: Human Exposure to 60 Hz Electric Fields." EPRI Report EA-3993.

Ernest K. Hirata & Associates, Inc. August 30, 2002. *Soils Investigation Rehabilitation of Streets Kapiolani Boulevard from Ward Avenue to Kalakaua Avenue Honolulu, Hawaii.* Prepared for Engineers Surveyors Hawaii, Inc.

Federal Emergency Management Agency (FEMA). November 20, 2000. *Flood Insurance Rate Map.* Map numbers 15003C0365 and 15003C0370.

Federal Highway Administration. No date. *Effective Noise Control During Nighttime Construction.* http://opsfhwa.gov/wz/workshops/accessible/Schexnayder_paper.htm.

Fewell Geotechnical Engineering, Ltd. May 19, 2004. *Draft Boring Logs Directional Drilling Feasibility Study King Street, Between Ward Avenue and Punahou Street East Oahu Transmission Line Honolulu, Oahu, Hawaii.*

Forssen, U.M., M. Feychting, L.E. Rutqvist, B. Floderus, A. Ahlbom. 2000. Occupational and residential magnetic field exposure and breast cancer in females. *Epidemiology*. 11:24-29.

Gammon, M.D., J.B. Schoenberg, J.A. Britton, J.L. Kelsey, J.L. Stanford, K.E. Malone, R.J. Coates, D.J. Brogan, N. Potischman, C.A. Swanson, L.A. Brinton. 1998. Electric blanket use and breast cancer risk among younger women. *American Journal of Epidemiology.* 148:556-563.

Gauger, J.R. 1985. "Household Applicance Magnetic Field Survey." IEEE Transactions on Power Apparatus and Systems. Vol. PAS-104, No. 9, pp. 2346-44.

Hawai‘i Community Development Authority (HCDA). August 1999. *Mauka Area Plan Kakaako Community Development District Honolulu, Hawaii.* Unofficial Compilation. http://www.hcdaweb.org/images/maukaareaplan_a383.pdf. Accessed June 10, 2004.

Hawaiian Electric Company, Inc. December 2003. *East Oahu Transmission Project: Options to the Koolau/Pukele Transmission Overload Problem.*

Hawaii Electric Company, Inc. September 2000. *Revised Final Environmental Impact Statement, Kamoku Pukele 138-kV Transmission Line Project.*

Hawaiian Electric Company, Inc. March 2000. Review of the Distributed Generation Alternatives to the Kamoku-Pukele Line. Honolulu, Hawaii.

Hawaiian Electric Company, Inc. September 24, 1993. Decision & Order No. 12627, docket No. 7602.

Hawaiian Electric Company, Inc. August 1992. *East Oahu 138 kV Requirements Study Updated.*

Hawaiian Electric Company, Inc. July 1991. *East Oahu 138 kV Requirements.*

Hawaiian Electric Company, Inc. No Date. *Transmission Planning Criteria.* Section IV.3

International Agency for Research on Cancer (IARC). IARC Monographs on the evaluation of carcinogenic risks to humans. Volume 80: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields. IARC Press, Lyon, France, 2002.

International Commission on Non-Ionizing Radiation Protection April 1998. "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (Up to 300 GHz)." Health Physics. Vol 74, No. 4, pp. 494-522.

Juvik, Sonia P. and James O. Juvik. 1998. *Atlas of Hawaii.* Third edition. University of Hawaii Press, Honolulu, Hawaii.

Kabat, G.C., E.S. O'Leary, E.R. Schoenfeld, J.M. Greene, R. Grimson, K. Henderson, W.T. Kaune, M.D. Gammon, J.A. Britton, S.L. Teitelbaum, A.I. Neugut, M.C. Leske. 2003. Electric blanket use and breast cancer on Long Island. *Epidemiology.* 14:514-520.

Kleinerman. R.A., W.T. Kaune, E.E. Hatch, S. Wacholder, M.S. Linet, L.L. Robison, S. Niwa, R.E. Tarone. 2000. Are children living near high-voltage power lines at increased risk of acute lymphoblastic leukemia? *American Journal of Epidemiology.* 151:512-515.

Linet, M.S., E.H. Hatch, R.A. Kleinerman, L.L. Robison, W.T. Kaune, D.R. Friedman, R.K. Severson, C.M. Haines, C.T. Hartsock, S. Niwa, S. Wacholder, R.E. Tarone. 1997. Residential exposure to magnetic fields and acute lymphoblastic leukemia in children. *New England Journal of Medicine.* 337:1-7.

London, S.J., J.M. Pogoda, K.L.Hwang, B. Langholz, K.R. Monroe, L.N. Kolonel, W.T. Kaune, J.M. Peters, B.E. Henderson. 2003. Residential magnetic field exposure and breast cancer risk: A nested case-control study from a multiethnic cohort in Los Angeles County, California. *American Journal of Epidemiology.* 158:969-980.

Macdonald, Gordon A., Agatin T. Abbott, and Frank L. Peterson. 1983. *Volcanoes in the Sea*. Second edition. University of Hawaii Press, Honolulu, Hawaii.

Mandeville, R., E. Franco, S. Sidrac-Ghali, L. Paris-Nadon, N. Rocheleau, G. Mercier, M. Desy, C. Dexaux, L. Gaboury. 2000. Evaluation of the potential promoting effects of 60-Hz magnetic fields on N-Ethyl-N-Nitrosourcea induced neurogenic tumors in female F344 rats. *Bioelectromagnetics.* 21:84-93.

McCormick, D.L., G.A. Boorman, J.C. Findlay, J.R. Hailey, T.R. Johnson, J.R. Gauger, J.M. Pletcher, R.C. Sill, J.K. Haseman. 1999. Chronic toxicity/oncogenicity evaluation of 60 Hz (power frequency) magnetic fields in B6C3F mice. *Toxicologic Pathology.* 27:279-285.

Mink, John F. and L. Stephen Lau. 1990. *Aquifer Identification and Classification of O'ahu: Groundwater Protection Strategy for Hawai'i, Technical Report No. 179.*

Morris, J.E., L.B. Sasser, D.L. Miller, G.E. Dagle, C.N. Rafferty, K.L. Ebi, L.E. Anderson. 1999. Clinical progression of transplanted large granular lymphocytic leukemia in Fischer 344 rats exposed to 60 Hz magnetic fields. *Bioelectromagnetics.* 20:48-56.

National Institute of Environmental Health Sciences (NIEHS). 2002. *EMF Electric and Magnetic Fields Associated with the use of Electric Power: Questions and Answers.* Research Triangle Park, North Carolina: National Institute of Environmental Health Sciences of the U.S. National Institutes of Health.

National Institute of Environmental Health Sciences. 1999. Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields. NIH Publication No. 99-4493. Research Triangle Park, North Carolina: National Institute of Environmental Health Sciences of the U.S. National Institutes of Health.

National Institute of Environmental Health Sciences. 1998. *Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields: Working Group Report.* NIH Publication No. 98-3981. Research Triangle Park; North Carolina: National Institute of Environmental Health Sciences of the U.S. National Institutes of Health.

National Research Council (NRC). 1999. *Research on Power Frequency Fields Completed Under the Energy Policy Act of 1992.* Washington, D.C. National Academy Press.

Neutra, R.R., V. Delpizzo, G.M. Lee. 2002. *An evaluation of the possible risks from electric and magnetic fields (EMFs) from power lines, internal wiring, electrical occupations and appliances.* Final Report. California Department of Health Services (CDHS). California EMF Program, Oakland, California.

Occupational Safety and Health Administration. Occupational Safety and Health Standards-Code of Federal Regulations Chapter 29 Part 1910.

Pacific Legacy, Inc. August 2004. *Archaeological Assessment for the Hawaiian Electric Company Inc. East O'ahu Transmission Project–46kV Phased Project.* Prepared for Belt Collins Hawaii. Provided in Appendix C1.

Pacific Legacy, Inc. August 2004. *Cultural Impact Assessment for the Hawaiian Electric Company, Inc. East O'ahu Transmission Project 46kV Phased Project.* Prepared for Belt Collins Hawaii. Provided in Appendix C2.

Power Engineers. May 28, 2004. Draft Report. HLY 019-280 (STU) HECO (5/12/04)br 105240.

Power Engineers. August 2004. *The Hawaiian Electric Company, Inc., East O'ahu Transmission Project Phase 2–46kV Lines, Horizontal Drilling Feasibility Study.* Provided in Appendix A.

Schoenfeld, E.R., E.S. O'Leary, K. Henderson, R. Grimson, G.C. Kabat, S. Ahnn, W.T. Kaune, M.D. Gammon, M.C. Leske. 2003. Electromagnetic fields and breast cancer on Long Island: a case-control study. American Journal of Epidemiology. 158:47-58.

State of Hawai'i Department of Business, Economic Development and Tourism. October 2003. *2002 The State of Hawaii Data Book A Statistical Abstract*

State of Hawai'i, Department of Business, Economic Development and Tourism. *State of Hawaii Data Book 2001.* www.hawaii.gov/dbedt/db01/sec01.html.

State of Hawai'i, Department of Business, Economic Development and Tourism, Office of Planning. 2004. Hawai'i Statewide GIS Program. http://www.state.hi.us/dbedt/gis/. Accessed June 2004.

State of Hawai'i, Department of Business, Economic Development and Tourism, Office of Planning. July 23, 1998 Comment letter regarding the *Kamoku-Pukele 138-kV Transmission Line Project Draft Environmental Impact Statement.*

State of Hawai'i, Department of Business, Economic Development and Tourism. *1997 Benchmark Report.*

State of Hawai'i, Department of Commerce and Consumer Affairs, Division of Consumer Advocacy. May 3, 1993. *Consumer Advocate's Amended Statement of Position.*

State of Hawaiʻi, Department of Education. http://doe.k12.hi.us/about/intro_calendar.htm. Accessed May 7, 2004.

State of Hawaiʻi, Department of Health. February 27, 2004. *2004 List of Impaired Waters in Hawaii, Public Comment Draft.*

State of Hawaiʻi, Department of Health. May 2003. *Minimizing Construction and Demolition Waste*. Third edition.

State of Hawaiʻi, Department of Health. January 19, 1994. "DOH Policy Relating to Electric and Magnetic Fields from Power-Frequency Sources." Memorandum.

State of Hawaiʻi, Department of Health. September 22, 1992. Hawaii Administrative Rules. Title 11, Chapter 23.

State of Hawaiʻi, Department of Health, Office of Solid Waste Management. July 2000. *Hawaiʻi 2000 Plan for Integrated Solid Waste Management.* Table 7.2.

State of Hawaiʻi, Department of Health, Environmental Management Division, Solid and Hazardous Waste Branch, Underground Storage Tank Division. March 2000. *Technical Guidance Manual for Underground Storage Tank Closure and Release Response.*

State of Hawaiʻi, Department of Health, Office of Solid Waste Management. July 2000. *Hawaiʻi 2000 Plan for Integrated Solid Waste Management.*

State of Hawaiʻi, Department of Land and Natural Resources, Commission on Water Resource Management. No date. Well locations marked on USGS. 1983. Map O-13 (Honolulu Quadrangle).

State of Hawaii, Department of Labor and Industrial Relations. *2002 Employment and Payrolls in Hawaii.*

State of Hawaiʻi, Public Utilities Commission. April 7, 1994. Decision and Order No. 13201.

3Point. September 2003. *East Oahu Transmission Project: A Report on Public Input Collected in June and July 2003.*

United Kingdom Childhood Cancer Study (UKCCS) Investigators. Exposure to power frequency electric fields and the risk of childhood cancer in the UK. 2002. *British Journal of Cancer.* 87:1257-1266, 2002.

United Kingdom Childhood Cancer Study (UKCCS) Investigators. Childhood cancer and residential proximity to power lines. 2000. *British Journal of Cancer.* 83:1573-80, 2000.

United Kingdom Childhood Cancer Study (UKCCS) Investigators. Exposure to power frequency magnetic fields and the risk of childhood cancer. 1999. *The Lancet.* 353:1925-1931.

U.S. Census. 2000.

U.S. Department of Agriculture, Soil Conservation Service. 1972. *Soil Survey of Islands of Kauai, Oahu, Molokai, and Lanai, State of Hawai'i.*

U.S. Department of Energy's Office of Emergency Management. <date>. *Hawaiian Islands Hazard Mitigation Report.*

U.S. Department of Transportation and City and County of Honolulu, Department of Transportation Services. July 2003. *Primary Corridor Transportation Project Final EIS.*

U.S. Department of Transportation, Federal Highway Administration. No date. *Effective Noise Control During Nighttime Construction,* Table 2. http://ops.fhwa.dot.gov/wz/workshops/accessible/Schexnayder_paper.htm. Accessed June 22, 2004.

U.S. Department of Transportation, Federal Highway Administration. No date. *Highway Traffic Noise.* Website: http://www.fhwa.dot.gov/environment/htnoise.htm. Accessed June 22, 2004.

United States Environmental Protection Agency (EPA). December 1993. *Questions and Answers about Electric and Magnetic Fields (EMF).* Washington, D.C. Government Printing Office (GPO); Booklet No. 402-R-92-009.

U.S. Environmental Protection Agency. No date. National ambient air quality standards.

U.S. Environmental Protection Agency. *Protective Noise Levels*. Condensed version of EPA levels document. http://www.avlelec.com/epa_noise.html.

U.S. Geological Survey. 2001. *USGS Water Resources Date, Hawaii and Other Pacific Area, Water Year 2000.* Volume 1, Hawai'i. Water Date Report HI-00-1.

U.S. Geological Survey. 1998. Honolulu Quadrangle map.

West Virginia Department of Highways. No date. http://www.wvcorridorh.com/engineer/noise.html. Accessed June 22, 2004.

Wilbur Smith Associates. August 2004. *Traffic Impact Study East O'ahu Transmission Project.*

World Health Organization. No date. *Guidelines for Community Noise.* http://www.who.int/docstore/peh/noise/Comnoise-3.pdf. Accessed June 22, 2004.

World Health Organization. No date. *Occupational and Community Noise.* http://www.who.int/mediacentre/factsheets/fs258/en/. Access June 22, 2004.