DRAFT

NA PUA MAKANI
25 MW WINDFARM
OAHU, HAWAII

ENVIRONMENTAL ASSESSMENT

OAHU WIND POWERPARTNERS, LLC
WAIALUA, HAWAII

PREPARED FOR OAHU WIND POWERPARTNERS, LLC BY:

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Dear Participant:

Attached for your review is a Draft Environmental Assessment ("DEA") which was prepared pursuant to the EIS law (Hawaii Revised Statutes, Chapter 343) and the EIS rules (Administrative Rules, Title 11, Chapter 200).

TITLE OF PROJECT: **Oahu Wind PowerPartners 25 MW Windfarm Project**

LOCATION: ISLAND **Oahu** *DISTRICT* **Kahuku-Koolauloa**

TAX MAP KEY NUMBERS: **4-8-01: par. 1**

AGENCY ACTION: ____ *APPLICANT ACTION:* __X__

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I, the undersigned, hereby certify that this DEA and all ancillary documents were prepared under my direction and that the information submitted, to the best of my knowledge fully addresses document content requirements as set forth in section 11-200-17, Hawaii Administrative Rules, Chapter 200.

Keith Avery, President
Oahu Wind PowerPartners, LLC

If you no longer need this DEA, please recycle it. Thank you for your participation in the D EA Process!

PREFACE

This document is a draft Environmental Assessment ("DEA") prepared to meet State of Hawaii ("State") and City and County of Oahu ("County") environmental requirements regarding a 25 Megawatt ("MW") windfarm project, entitled Na Pua Makani, which has been proposed by Oahu Wind PowerPartners LLC ("OWP"), Waialua, Oahu, Hawaii. The primary purpose of Na Pua Makani is to supply clean, renewable wind energy to the Hawaiian Electric Company ("HECO") in support of attainment of HECO's renewable portfolio standard. Secondary purposes include overall economic and environmental benefits to the STATE and certain economic, social and cultural benefits to the local community.

Background. An Environmental Assessment ("EA") or Environmental Impact Statement ("EIS") must be prepared in accordance with the requirements and standards established by the National Environmental Policy Act ("NEPA") of 1964 when certain circumstances occur, such as use of federal or State lands or federal or State funds for a proposed action, such as a windfarm project.

Since the Na Pua Makani project is to be sited on State agricultural lands near the community of Kahuku on the north shore of Oahu, both State and County environmental requirements must be met. Specifically, the State established requirements for EAs and EISs in compliance with NEPA in Chapter 343 of the Hawaii Revised Statutes ("HRS"), 1983. At a minimum, an EA is required in Hawaii whenever the use of State lands proposed for a project to examine potential environmental impacts and specifically to determine if there are potential significant impacts. If there are potential significant impacts, an EIS may be required.

In addition to an EA, the State, and specifically the Department of Land and Natural Resources ("DLNR") is requiring a Habitat Conservation Plan ("HCP") before granting a lease for use of the State agricultural lands for the proposed Na Pua Makani project. However, while DLNR will negotiate and award leases for projects on State land, DLNR does not issue permits for projects on agricultural lands. Instead, the County requires a Conditional Use Permit ("CUP") for the proposed windfarm on agricultural land.

Role of the DEA. This DEA is an informational document for decision-makers and citizens regarding the OWP proposed Na Pua Makani 25 MW windfarm. Information regarding the proposed action and its potential impacts on the natural, social and economic environments of Oahu is described and discussed herein. Potential alternatives to the proposed action were investigated and are discussed.

This DEA is one element of the public/governmental involvement and review process, which will lead to an overall environmental decision-making process on the proposed action. The intent of the public/governmental involvement process, which can include coordination with technical specialists, meetings and hearings, is to establish and facilitate a flow of information between the project applicant (OWP), the citizens of the community and agencies of the federal, State and local governments.

This process draws on the expertise and experience of all process participants to develop and analyze alternatives. Thereby, all participants can and are encouraged to assist in the review of this document and use it as decision-making tool.

DEA Contents. This one-volume DEA contains the following:

- A Table of Contents and a list of tables, figures, and acronyms used in this document,
- An Introduction and Summary (Section 1) to provide an overview of the document and to serve as an alternative for those who do not need to read the entire document,
- A Project Description (Section 2), including discussion of its purpose and the needs the project proposes to address, and the anticipated benefits to Oahu,
- A discussion of alternatives considered to the proposed project (Section 2.3.2), including alternate windfarm sites evaluated and a *no action* alternative. Rationale for eliminating these alternatives from further consideration is provided,
- A discussion of environmental consequences, including potential beneficial and adverse natural, social and economic impacts associated with the proposed action. (Section 3). Measures are discussed for mitigating or reducing the potential impacts,
- An evaluation of how the proposed action relates to land use plans, policies and controls (Section 4),
- A discussion of topical issues including unresolved issues (Section 5),
- A description of the public and agency organizations and individuals that were consulted during the preparation of this DEA (Section 6), and additional documents that were prepared in support of this DEA,
- A listing of references to this DEA (Section 7), and
- A Clipper Windpower Brochure and two consultant reports (one on a biological survey and one on an archaeological study) in the Appendix (Section 8). The Clipper Windpower Brochure includes information on the Clipper 2.5 Liberty wind turbine.

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Acronyms and Nomenclature

Acronym	Definition
AWEA	American Wind Energy Association
BLM	Bureau of Land Management, U S. Department of the Interior
BLNR	Board of Land and Natural Resources
dB	decibels, a logarithmic ratio between pressures caused by a given sound and a standard sound pressure
dBA	decibel measurement using an “A-weighted” scale that takes into account the way humans perceive sounds
CUP	Conditional Use Permit
DBEDT	Department of Business, Economic Development and Tourism
DOFAW	Division of Forestry and Wildlife, DLNR
DOH	Department of Health
DLNR	Department of Land and Natural Resources, Honolulu, HI
EPRI	Electric Power Research Institute, Palo Alto, CA
FHA	Federal Highway Administration, U. S. Department of Transportation
FAA	Federal Aviation Administration, U. S. Department of Transportation
FEMA	Federal Emergency Management Agency
HCEI	Hawaii Clean Energy Initiative
HRS	Hawaii Revised Statutes
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers, Washington, DC
IRPA	International Radiation Protection Association
IRS	Interconnect Requirements Study
NREL	National Renewable Energy Laboratory
OCEA	Office of Conservation and Environmental Affairs
SCS	Soils Conservation Service, Honolulu, HI
SHPD	State Historic Preservation Division
USDOE	United States Department of Energy, Washington, DC
USDOT	United States Department of Transportation, Washington, DC
OWP	Oahu Wind PowerPartners LLC

1. INTRODUCTION AND SUMMARY

1.1. Background

1.1.1. Purpose of the Document

Oahu Wind Partners LLC ("OWP"), Waialua, Hawaii proposes to construct and operate a 25 Megawatt ("MW") windfarm, entitled Na Pua Makani on State agricultural land in Kahuku, ahupua'a near Kahuku Town on the north shore of Oahu. The State of Hawaii ("State") Department of Land and Natural Resources ("DLNR") is custodian of the agricultural land. OWP has applied to DLNR for a lease for the use of the State land. DLNR has indicated that the lease will be subject to approval to approval of an Environmental Assessment ("EA") and a Habitat Conservation Plan ("HCP"). OWP must also secure a Conditional Use Permit ("CUP") for the proposed windfarm from the City and County of Honolulu ("County"). OWP therefore forwards this draft EA ("DEA") in support of its applications to DLNR and the County.

This DEA was prepared by WSB-Hawaii, an independent consultant in Kaneohe, Hawaii, for OWP in accordance with:

- National Environmental Protection Act ("NEPA");
- Chapter 343, Hawaii Revised Statutes ("HRS");
- Act 241, Session Laws of Hawaii, 1992;
- Chapter 200, Title 11, Department of Health ("DOH"); and
- Chapter 5, Title 13, DLNR Administrative Rules.

The proposed windfarm project is consistent with guidelines of Chapter 344, HRS and the permitted public purpose uses of Conservation land as specified in Chapter 220, Title 13, Sub-Title 7, DLNR Administrative Rules. DLNR is the accepting agency for this DEA. Cooperating agencies include the US Departments of Interior (Fish and Wildlife Division) and Transportation (Federal Aviation Administration), State of Hawaii Departments of Business, Economic Development and Tourism ("DBEDT") and Health ("DOH"), and the County.

1.1.2 Proposed Action

OWP proposes to construct and operate a 25 Megawatt ("MW") windfarm project, entitled Na Pua Makani, on State agricultural lands[1] near the community of Kahuku on the north shore of Oahu. The primary purpose of Na Pua Makani is to supply clean, renewable wind energy to the Hawaiian Electric Company ("HECO") in support of HECO's attainment of their Renewable Portfolio Standards ("RPS").

The proposed windfarm would consist of ten Liberty 2.5 MW wind turbines to be installed on 80 meter ("m") or 262 foot ("ft") towers in the hills mauka and makai of the Kahuku Agricultural Park ("Kahuku Ag Park"). Four of the Liberty 2.5 MW turbines would be installed on the makai hills, six in the mauka hills. The Liberty 2.5 MW is a horizontal axis wind turbine with three fiberglass blades, a rotor diameter of 96m (315ft), an electrical output of 2.5 MW, and a variable blade pitch control system to smooth power and to feather the blades to shutdown the turbine.

[1] Land location is Zone: 5 Sec. 6 Plat: 08 Lot 6, 232 acres. The turbines sites will be located on former Dept. of Agricultural lands used as a buffer zone surrounding the Kahuku Agricultural District Part.

Site construction would include a foundation and tower for each wind turbine, one operation and maintenance building, an underground electrical distribution network, a substation for interconnection to HECO's transmission system and improvements to existing and existing road to access the windfarm site and an intrasite road network.

1.1.3 Evaluation of Alternatives

During the initial development phase of this project, OWP identified and evaluated several alternative sites on Oahu.

OWP sought to identify alternative sites with good exposure to the prevailing tradewinds and close to HECO's transmission system. Potential sites included locations on the North Shore, and on the windward and leeward coasts. While there are several alternative sites with a sufficient wind resource, a number of sites were eliminated after preliminary screening of key siting issues, such as insufficient space for a 25 MW windfarm (e.g., Kaena Point, Koko Head and Barber's Point), environmental concerns (e.g., Kaena Point, Koko Head), potential visual impact (e.g., Kahe, Koolau Ridge and perhaps others), difficulty and expense of construction (e.g., along the Koolau Ridge), and time constraints associated with responding to HECO's RFP[2] for up to 100 MW of as-available renewable power (e.g., potential off-shore locations could not be secured in the available time frame).

In large part, the initial screening resulted in elimination of all of the "non-North Shore" sites. Logically, the old Westinghouse windfarm site[3] was arguably the first choice, given existing data and information on the site, and previous acceptance of the windfarm by the community. However, that site is now owned by the U. S. Army, and up to the present time the Army has not been willing to make the windfarm site available. The Army offered nearby contiguous land as an alternative. Unfortunately, the land consists of rugged terrain that would be too expensive to develop. East of the Army land are two potential sites, one which is being developed by First Wind, and hence not available, and the site proposed by OWP herein. OWP also considered other sites closer to the ocean and ruled them out due to their proximity to the Kahuku Wildlife Refuge. In short, the remaining potentially viable site is the one proposed by OWP to HECO.

A *no action* alternative was considered. A *no action* alternative would mean that OWP would *not* seek to develop a windfarm on Oahu. WSB-Hawaii evaluated the *no action* alternative as follows. First, the purpose of the proposed action is to develop a windfarm in an environmentally-sound manner to help meet energy needs as discussed below. Second, HECO has indicated their willingness to purchase the electricity from the proposed windfarm, based on the OWP proposal submitted to HECO in response to the 100 MW RFP and subject to the negotiation of a power purchase agreement. Third, none of the public and private sector representatives contacted to date by OWP have suggested that the project should not be developed, constructed and operated. Finally, a *no action* alternative would mean that Oahu would forgo a project that WSB-Hawaii believes would provide overall positive benefits as discussed in the next section. Therefore, WSB-Hawaii recommends against a *no action* alternative.

[2] HECO issued a RFP for 100 MW of as-available renewable power in June 2008. WWW submitted a proposal to HECO on September 25, 2008. HECO informed WWW in January 2009 that the proposal was selected to be on the "short-list" of potential winning proposals. WWW has subsequently entered into negotiations with HECO.

[3] The Westinghouse site was developed by Hawaiian Electric Renewable Systems ("HERS"), an unregulated subsidiary of Hawaiian Electric Industries. Fifteen, 600 kW Westinghouse wind turbines were installed in 1985 and operated into the mid-1990s, first by HERS and subsequently by New World Power. The turbines were subsequently removed and the U. S. Army land, including the windfarm site, from the Campbell EState.

1.1.4 Project Purpose, Needs and Benefits

The purpose of the proposed project is to develop a windfarm in an environmentally-sound manner on Oahu and to sell clean renewable wind electricity to HECO. The needs of the proposed project (action) are to provide 25 MW of wind-generated electricity towards the electrical energy demand of Oahu, to support the State's policy to reduce Hawaii's dependence on imported energy sources, and to help protect the State's environment. It is anticipated that HECO, DLNR, the County and its citizens, the State, and OWP would all benefit as follows:

- *HECO would benefit by purchasing electricity at a price below their* ***long-term avoided cost,*** *reducing their use of fossil fuels, showing their support for renewable energy sources and diversifying their electrical power purchase portfolio;*

- *DLNR would benefit through collection of a land use fee.* This fee could be used to off-set a portion of the funds that have been spent by the State to develop renewable energy alternatives such as wind*;*

- *The citizens of the County and the State would benefit from the energy, economic and environmental characteristics of the project:*

  - ◊ Energy. The windfarm would help diversify the energy resource base on Oahu and *reduce* the amount of imported fossil fuels (estimated at the equivalent of 147,000 barrels of oil per year). *Avoidance of fossil fuels would help reduce energy security and price risks and would make Oahu less dependent on oil;*

  - ◊ Economic. There would be *direct* economic activity during construction and operation (temporary and permanent jobs, equipment, materials and supplies), and the project-related income and excise tax revenues over the project's lifetime. The primary *indirect* economic activity is stimulated by the reduction of the dollars that are paid for imported fossil fuels, i.e., those dollars recirculate on Oahu and in Hawaii, and help improve Hawaii's balance of trade. In addition, a wind power purchase contract would specify the value (in cents/kWh) to be paid over contract lifetime. The price for the windpower is thus known and independent of the price of fossil fuels; and

  - ◊ Environmental. Similarly, environmental benefits accrue from the reduction of fossil fuel use, i.e., fossil emissions would be reduced. There could be additional benefits to the environment through implementation of a HCP to protect endangered bird and bat species as proposed by OWP;

- An endowment to the community of Kahuku for the life of the wind project to be administered by the elected Kahuku Community Association; and

- *OWP* would benefit by the opportunity to recover its investment in the wind project and make a fair profit over the projected 20 year lifetime of the windfarm.

1.2 Summary of Potential Environmental Consequences and Mitigative Measures

The evaluation of the potential impacts, discussion of the State significance criteria and the proposed mitigative measures are summarized in this section. See Section 3.0 for the detailed discussion.

1.2.1 Types of Impacts and Levels of Significance

WSB-Hawaii has identified and summarized the potential consequences (impacts) by category. The significance of the impacts was evaluated using guidelines established in Section 12, Chapter 200, Title 11, State Department of Health ("DOH"), Administrative Rules as authorized by Chapter 343, HRS.

The significance of the impacts was evaluated in terms of context, duration and severity. *Context* refers to the setting of the action and how the significance of a specific impact may vary with the setting. For example, the significance of some impacts may be localized, i.e., impacting a local area, but not the whole island of Oahu. *Duration* refers to the time period of the impact and its consequences. For example, some impacts may be short-term or temporary, such as potential impacts that would occur during the construction phase, while others may be longer-term or permanent, such as during the operational lifetime of the windfarm. *Severity* refers to the level of potential consequence (positive or negative) resulting from an impact.

An example of a positive (or beneficial) consequence would be modification of an existing road to reduce soil erosion. An example of a negative consequence would be physical injury, damage or casualty to a plant or an animal. A more severe negative consequence could occur if the plant or animal was an endangered species. Given the above criteria, WSB-Hawaii has evaluated the severity of each potential impact to be in one of the following five levels:

- **Beneficial --** the impact provides a positive effect on the environment;
- **None** -- there is no perceptible consequence (positive or negative);
- **Negligible** -- there is a negative impact, but the consequence is negligible;
- **Non-Significant** -- there is a non-negligible, negative impact, but the consequence of the impact does not meet defined standards of significance; and
- **Significant** -- there is a negative consequence that meets the standard of significance defined for the specific resource or environmental element.

1.2.2 Summary of the Potential Environmental Impacts

Given the existing conditions in the study area, the County and the State, the potential impacts on most of the factors were evaluated as *non-significant* or less. Some impacts were evaluated as *beneficial*. This is due, in part, to the following three reasons:

(1) windfarms generally have less negative environmental consequences than conventional generation facilities,

(2) one of OWP's goals is to minimize all potential negative environmental impacts, and

(3) OWP has demonstrated its desire to meet this goal through the care they have taken in the design and layout of the proposed windfarm. However, the potential impact on avifauna (birds and bats) was evaluated as potentially significant. As discussed herein, this resulted in potentially significant impacts on the broader land use and community acceptance factors. Again, in line with its overall goal to reduce environmental impacts, OWP has diligently studied and investigated possible impacts to the birds and bats in the study area in cooperation with DLNR, the Fish & Wildlife Service (U. S. Department of Interior), other agencies, organizations and individuals. With the proposed HCP that is being prepared by OWP in consultation with and DLNR and U. S. Fish & Wildlife, the potential impacts on birds and bats will be evaluated further with the hopes that the severity of the potential impacts can be reduced. Correspondingly with mitigative measures, the impacts on land use and community acceptance can also be reduced.

The environmental impacts are summarized in Table 1.2.2-1, including WSB-Hawaii's evaluation of the context, duration and severity of each potential impact before and after proposed mitigative measures.

Table 1.2.2-1[4]
Summary of Potential Environmental Consequences and Impacts

Without Mitigative Measures				Following Mitigative Measures			
Factor	**Context**	**Duration**	**Severity**	**Mitigative Measures**	**Context**	**Duration**	**Severity**
Land Use							
Agricultural – Buffer Zone	Local	Short-term	Significant	Various: Coordinate with DLNR	Local	Short-term	Non Sig.
	Local	Long-term	Non Sig.	Various: Coordinate with DLNR	Local	Long-term	Non Sig.
Transmission Lines	Local	Long-term	Non Sig.	Various: Coordinate with HECO and community	Local	Long-term	Negligible
Topography							
Proposed Site	Local	Short-term Long-term	Non Sig. None	Minimize grading/ replace grass	Local n. a.	Short-term n. a.	Negligible n. a.
Site Access	Local	Short-term Long-term	None None	None Required None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Geology							
Proposed Site	Local	Short-term Long-term	None None	None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Site Access	Local	Short-term Long-term	None None	None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Soils							
Proposed Site	Local	Short-term	Non Sig.	Minimize grading/ replace grass/water	Local	Short-term	Negligible
	Local	Long-term	Non Sig.	Repair new damage/ replace grass/water	Local	Long-term	Negligible
Site Access	Local	Short-term	Non Sig.	Minimize grading/ repair damage/water	Local	Short-term	Negligible
	Local	Long-term	Non Sig.	Grade periodically/repair	Local	Long-term	Negligible

[4] Note: this table is the same as Table 3.1-2.

(Continued)

Without Mitigative Measures				Following Mitigative Measures			
Factor	**Context**	**Duration**	**Severity**	**Mitigative Measures**	**Context**	**Duration**	**Severity**
Land Use							
Agricultural – Buffer Zone	Local	Short-term	Significant	Various: Coordinate with DLNR	Local	Short-term	Non Sig.
	Local	Long-term	Non Sig.	Various: Coordinate with DLNR	Local	Long-term	Non Sig.
Transmission Lines	Local	Long-term	Non Sig.	Various: Coordinate with HECO and community	Local	Long-term	Negligible
Topography							
Proposed Site	Local	Short-term Long-term	Non Sig. None	Minimize grading/ replace grass	Local n. a.	Short-term n. a.	Negligible n. a.
Site Access	Local	Short-term Long-term	None None	None Required None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Geology							
Proposed Site	Local	Short-term Long-term	None None	None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Site Access	Local	Short-term Long-term	None None	None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Soils							
Proposed Site	Local	Short-term	Non Sig.	Minimize grading/ replace grass/water	Local	Short-term	Negligible
	Local	Long-term	Non Sig.	Repair new damage/ replace grass/water	Local	Long-term	Negligible
Site Access	Local	Short-term	Non Sig.	Minimize grading/ repair damage/water	Local	Short-term	Negligible
	Local	Long-term	Non Sig.	Grade periodically/repair damage/water	Local	Long-term	Negligible

Summary of Potential Environmental Consequences and Impacts, Table 1.2.2-1
(Concluded)

Without Mitigative Measures				Following Mitigative Measures			
Factor	**Context**	**Duration**	**Severity**	**Mitigative Measures**	**Context**	**Duration**	**Severity**
Air Quality & Meteorology	Local	Short-term	Non Sig.	Minimize grading/ replace grass/water	Local	Short-term	Negligible
		Long-term	Non Sig.	Repair new damage/ replace grass/water	Local	Long-term	Negligible
	Regional	Short-term	Beneficial	None Required	n. a.	n. a.	n. a.
		Long-term	Beneficial	None Required	n. a.	n. a.	n. a.
Noise - Construction	Local	Short-term	Non Sig.	Ensure safe driving and operating procedures	Local	Short-term	Non Sig.
	Region	Short-term	Non Sig.	Ensure safe driving and operating procedures	Region	Short-term	Non Sig.
- Operation	Local	Long-term	Non Sig	Implement noise reduction measures	Local	Long-term	Non Sig.
EMF - existing	Local	Short-term/ Long-term	Negligible	Establish/ensure safe O&M procedures	Local	Short-term/ Long-term	Negligible
- with windfarm	Local	Short-term/ Long-term	Non Sig	Establish/ensure safe O&M procedures	Local	Short-term/ Long-term	Negligible
Visual Impact	Local	Short-term/ Long-term	Non Sig.	Solicit community input/ address & resolve issues	Local	Short-term/ Long-term	Negligible
	Regional	Short-term/ Long-term	Non Sig.	Solicit community input/ address & resolve issues	Regional	Short-term/ Long-term	Negligible
Community Acceptance	Local	Short-term/ Long-term	Significant	Solicit community input/ address & resolve issues	Local	Short-term/ Long-term	Non Sig.
	Regional	Short-term/ Long-term	Significant	Solicit community input/ address & resolve issues	Regional	Short-term/ Long-term	Non Sig.

1.2.3 Summary of Mitigative Measures Program

The mitigative measures program is being implemented in three phases as follows:

Project Design and Preliminary Review Phase (Completed). Specifically, OWP:

- conducted a botanical survey to identify native plants and wildlife in the project area;

  Results. Native plants found at the preliminary sites identified for the wind turbines and throughout the project area. However, no endangered plant or wildlife species were found. Some bat detections were made in areas nearby but below the intended turbine sites. See Sections 3.7 and 3.8 for details.

- conducted a desk survey of previous archaeological surveys to identify culturally-significant archaeological sites in the proposed project area;

  Results. No culturally-significant archaeological sites have been found in previous studies nearest to and including most of the project area. An additional survey will be conducted to confirm that no cultural sites exist in the “”unsurveyed” areas which appear to overlap onto at least one potential wind turbine site.

- designed the windfarm layout to reduce visual impact; and

  Results. The 10 Liberty 2.5 MW wind turbines would be installed on 80 meter (“m”) or 262 foot (“ft”) towers in the hills surrounding the Kahuku Ag Park. The two rows, each oriented north to south, are approximately 610 m (2,000ft) apart. The on-site electrical distribution power cable network collecting the power from each of the turbines will be buried underground from the turbines to the site substation. The substation will be located near the utility’s transmission lines to minimize the length of the overhead high voltage cables to the interconnect point. While the project site is in a rural setting near the Kahuku Town, the wind turbines will be visible from the Town and several locations along Kamehameha Highway on either side of the Town. A visual presentation and assessment of the project is included herein.

- Prepared and submitted a “Notice of Construction and Alteration” to the Federal Aviation Administration (“FAA), Department of Transportation for approval of the project as “no interference with aviation.” FAA review and action is pending.

Final Review and Approval Phase (Prior to construction). OWP plans to:

- prepare and submit the HCP (which is required for the lease from DLNR) to DNLR, Department of Forestry and Wildlife (“DOFAW”) for approval of a take license and the U. S. Fish & Wildlife Service for approval of take permit.

- apply to the City and County of Honolulu (“County”) for approval of Conditional Use Permit (“CUP”), which in part, is conditional on approval of this DEA;

- review construction plans with the County and the State Department of Transportation;

- negotiate a land lease with DLNR (Land Division) and power purchase agreement with HECO; and

- continue to solicit and review of public comments.

Construction and Operation Phase. OWP plans to:

- coordinate with the County and the State Department of Transportation;
- minimize disruption of soil during the improvements to the site access road network and construction and operation of the windfarm;
- continue coordination with DLNR/DOFAW and the U. S. Fish & Wildlife Service while implementing the HCP; and
- coordinate with the community and provide and endowment for the Community Benefits Fund to the .

1.2.4 Hawaii Administrative Rules -- Significance Criteria

The Hawaii Administrative Rules, Title 11, Department of Health, Chapter 200, Sub-Chapter 6-12 specifies thirteen criteria when considering the significance of potential environmental effects. Agencies are to consider the sum of the effects on the quality of the environment and shall evaluate the overall and cumulative effects of an action. The following is an assessment of the potential effects of the action.

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;

WSB-Hawaii Assessment. An irrevocable (irreversible) commitment to loss or destruction of any natural or cultural resource is one that cannot be changed once it occurs. Natural resources include topographic and geologic features, soils, hydrology, air, water, and flora and fauna.

No geologic features and hydrological resources will be disturbed (See Sections 3.5 and 3.6). Some soil will be disturbed during the construction of the windfarm, but this use is revocable. For example, if the windfarm were to be decommissioned, the wind turbines, towers, the electrical substation, other above-ground structures and all equipment would be removed. The soil would be restored to its original condition, including covering of the tower foundations. Note: The project will not generate any air or water emissions and will provide positive benefits through the reduction of fossil fuel use and the resulting emissions on Oahu (See Sections 3.12 and 3.13).

Regarding flora and fauna, potential negative impacts to avifauna have been identified (See Sections 3.7 and 3.8). WSB-Hawaii believes that negative impacts to endangered avifauna can be reduced through proposed mitigative measures developed and implemented in a Habitat Conservation Plan (“HCP”).

Regarding cultural resources, no culturally-significant archaeological sites have been found in previous studies in locations nearest to and including most of the project area. An additional survey will be conducted to confirm that no cultural sites exist in the “”unsurveyed” areas which appear to overlap onto at least one potential wind turbine site. (See Section 3.9 for details).

(2) Curtails the range of beneficial uses of the environment;

WSB-Hawaii Assessment. The project will not curtail the range of beneficial uses of the environment. The proposed windfarm is consistent with the primary purpose and use of the DLNR as a "buffer zone" for the Kahuku Ag Park.

(3) Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;

WSB-Hawaii Assessment. Overall, the proposed windfarm is consistent with and supports long-term State policy to conserve the State's natural resources and to improve the quality of life. The project will help reduce our dependence on imported energy use and increase our use of indigenous natural resources, including energy, e.g., our tradewinds. The project helps improve the quality of life on Oahu by offsetting a portion of the fossil fuel used to generated electricity. This reduced fuel use (estimated at 147,000 barrels of oil a year) will also avoid the air pollutants that result from the fossil fuel use. The project further helps to improve the quality of life by bringing outside investment, tax and use revenues and new jobs to Oahu. The primary concern regarding this criterion is the potential negative impacts on birds and bats as discussed above.

(4) Substantially affects the economic or social welfare of the community or State;

WSB-Hawaii Assessment. The proposed windfarm will have positive economic and social welfare impacts on the community. The project will bring outside investment that will create both short-term and long-term jobs, and tax and use revenues. Perhaps the most significant economic benefit will be the avoidance of imported energy fuel costs, as dollars that would normally go out of State to pay for fossil fuels would recirculate on Oahu and in the State. The project implementation will not negatively impact the social welfare (including cultural resources) of the community.

(5) Substantially affects public health;

WSB-Hawaii Assessment. The project will not result in any negative public health impacts. The project health impacts will be positive through the reduction of pollution from the utility power plants at Kahe, Waiau and downtown, as well as independent power producer plants at Barber's Point.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities;

WSB-Hawaii Assessment. The project is anticipated to have negligible impacts on population and public facilities. Most of the jobs created by the project will be filled by local residents. The project will be self-contained and will require no extension of public facilities, e.g., water or other utilities.

(7) Involves a substantial degradation of environmental quality;

WSB-Hawaii Assessment. The project will not result in a substantial degradation of environmental quality. Quite to the contrary, the project is anticipated to improve environmental quality in the project area and within the County.

This will be accomplished taking care taken during the construction and operation to minimize damage to the land, including flora and fauna, and the implementation of the HCP. It is anticipated that the mitigative measures to be designed and implemented in the HCP will provide a positive benefit over the project lifetime.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;

WSB-Hawaii Assessment. The proposed 25 MW windfarm is not anticipated to have any individual or cumulative affects. The proposed windfarm is optimum given the size of the Liberty 2.5 MW wind turbines and available land in the project area. Therefore, the proposed windfarm would not involve a commitment to larger actions, e.g., utilizing additional land.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat;

WSB-Hawaii Assessment. A biological survey did not identify any endangered plant or bird species in the proposed project area. However, bats were detected in areas at elevations below the wind turbine sites. A HCP, required by DLNR for the land lease for the project area, will be prepared to mitigate potential significant impacts to bats and endangered birds that may frequent the area.[5]

(10) Detrimentally affects air or water quality or ambient noise levels;

WSB-Hawaii Assessment. The project will not detrimentally affect air or water quality or ambient noise levels. In actuality, the project will provide an overall positive impact on air quality, since the project itself does not result in air emissions and because the wind-generated electricity will offset use of fossil fuels and their resulting emissions on Oahu. All water used during construction and operation will be trucked in. As noted in Section 3.6, there are no hydrologic and water resources in the areas. Regarding noise levels, the wind turbines will slightly increase the ambient noise levels within the project area. It is believed that the noise will serve to alert birds and bats which may frequent the area. As discussed in Section 3.14, the turbines may be heard at the nearest residences to the project. The project will not detrimentally affect air or water quality or ambient noise levels. As discussed above, the impacts on air quality are considered positive, the impacts on water quality are negligible and impacts on ambient noise levels are non significant.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive areas such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;

WSB-Hawaii Assessment. The proposed project site is not located in an environmentally sensitive area of the type as described above. Therefore, the project will not affect or is likely to suffer the type of damage of concern by this criterion. The site, which has been used previously as a buffer zone for the Kahuku Ag Park, is a forested area dominated by non-native flora.

(12) Substantially affects scenic vistas and viewplanes identified in County or State plans or studies; and

[5] WSB-Hawaii notes that the project is close to the Campbell Wildlife Refuge.

WSB-Hawaii Assessment. The project is not anticipated to substantially affect scenic vistas and viewplanes identified in County or State plans or studies. The County Plan encourages both preservation of scenic vistas and environmentally-sound energy systems, including wind energy conversion (i.e., wind turbines). The Ko'olauloa Community Plan emphasizes preservation of the areas rural character and scenic view, and protects against conversion of agricultural land to residential, commercial or industrial uses. Neither plan identifies specific areas on Oahu for special protection. Windfarms are generally compatible with agricultural lands and their uses, such as farming and ranching. As with all windfarms, the evaluation of visual impact generally rests with the community. As such, the community as a whole has not expressed concerns regarding visual impact (See Section 3.16).

(13) Requires substantial energy consumption.

WSB-Hawaii Assessment. The project would generate and consume electrical energy. However, the amount of electrical energy consumed is negligible to the amount that would be generated and delivered to the utility.

1.2.5 Unresolved Issues

Two specific areas have emerged for additional review and evaluation with proposed mitigative as follows. First, OWP recognizes that endangered birds and Hawaiian hoary bats may occasionally frequent the area. Mitigative measures are to be determined via the HCP, which will be prepared by OWP for approval by DLNR/DOFAW and the U.S. Fish & Wildlife Service. Given that the land lease from DLNR (Land Division) to OWP is contingent upon an approved HCP and the Conditional Use Permit from the County, WSB-Hawaii considers this issue to be resolved for the purpose of this DEA.

Second, regarding potential visual impact, OWP recognizes that some members of the community may not support the windfarm because of its potential visual impact. However, WSB-Hawaii proposes that the discussion herein be sufficient pending review and comment by the community and other interested Parties. Given that OWP must also obtain a Conditional Use Permit for the project from the County, OWP will continue to solicit inputs from the community in support of the permit application.

1.3 Summary of Compatibility with Land Use Policies and Plans

The proposed windfarm is consistent with Federal, State and local plans and policies as summarized below. The relationship of the proposed action to land use plans, policies and controls in discussed in Section 4.0.

1.3.1 Federal

There are no known Federal plans or policies that directly relate to or influence the proposed action. However, there are two Federal agencies that need OWWP needs to consult, i.e., the Department of Transportation ("USDOT"), Federal Aviation Administration ("FAA), and the Department of Interior ("USDOI"), U.S. Fish & Wildlife Service.

FAA. OWP has filed a "Notice of Proposed Construction or Alteration" with the FAA. The FAA is reviewing OWP's filing in order to determine if the proposed project would be an obstruction to air navigation under Part 77 of Federal Aviation Regulations. Since the height of

the turbines including the blades would exceed 200ft), lighting is required to alert pilots. For this project, the OWP has proposed lighting four of the ten turbine nacelles with a steady burning red obstruction light. The FAA review and decision is pending.

U.S. Fish & Wildlife Service. U.S. Fish & Wildlife Service administers the Federal Endangered Species Act ("ESA") of 1973, and normally becomes involved in projects where Federal lands and/or funds are to be used. This is not the case for this project. However, in part, with the development of three previous windfarm in Hawaii and the State's strong environmental law (Chapter 343), the U.S. Fish & Wildlife Service and DLNR, Department of Fish & Wildlife ("DOFAW") have developed a joint, collaborative process to administer the ESA. To facilitate the process, the U.S. Fish & Wildlife Service and DOFAW have formed an Endangered Species Committee Meeting to consult with developers as they prepare HCPs and to provide guidance to their respective organizations when developers, such as OWP, apply for an incidental take permit from the U.S. Fish & Wildlife Service and an incidental take license from DOFAW. Preparation of the draft HCP is proceeding in parallel with this DEA.

1.3.2 State

The applicable State plans, policies and programs include: State land use and conservation and resource law related to land use districts, the Hawaii State Constitution, Hawaii State Plan, and the Hawaii Integrated Energy Plan.

Hawaii State Constitution. The proposed windfarm is consistent with the Hawaii State Constitution, referencing Article XI, section 1:

> "For the benefit of present and future generations, the State and its political subdivisions shall conserve and protect Hawaii's natural beauty and all natural resources, including land, water, air, minerals and energy sources, and shall promote the development and utilization of these resources in a manner consistent with their conservation and in furtherance of the self-sufficiency of the State."

State Land Use and Conservation and Resource Law. The proposed windfarm site is on State-owned agricultural land, previously used as a buffer zone for the Kahuku Ag Park on Oahu. The State Department of Agriculture ("DOA"), custodian of Kahuku Ag Park, determined that the buffer zone was longer needed and transferred ownership buffer zone to DLNR. Wind energy facilities are a permissible use State agricultural land, per HRS §205-4.5. DLNR can negotiate a land lease, but not the permit[6]. In August 8, 2008, OWP obtained approval in principle for a lease and a right-of-entry from DLNR for the proposed project site [Kahuku-Malaekahana, Ko'olauloa, Oahu. Tax Map key: (1) 5-6-08:6]. The land lease is contingent upon a Conditional Use Permit and the HCP.

Hawaii State Energy Plan and Objectives. The proposed windfarm is consistent with the Hawaii State Plan, Chapter 226-18, HRS) which include the overall objective of providing economic, efficient and reliable electrical service. The specific energy objectives are:

(1) "Dependable, efficient, and economical Statewide energy systems capable of supporting the needs of the people;

[6] In the case of State agricultural land the counties have jurisdiction and issue conditional use permits.

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

(3) Greater energy security in the face of threats to Hawaii's energy supplies and systems; and

(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use."

WSB-Hawaii notes that creased use of renewables in Hawaii, and particularly the proposed 25 MW windfarm will:

- provide wind-generated electricity at a levelized cost lower than the utility's incremental cost of generation,
- increase Hawaii's use of indigenous resources,
- by decreasing Hawaii's use of fossil fuel, increase Hawaii's energy security, and
- by decreasing Hawaii's use of fossil fuel, reduce greenhouse gas emissions from the utility's generators.

1.3.3 City and County of Honolulu

The proposed windfarm is consistent with the County General Plan and the Ko'olauloa Community Plan. The proposed windfarm would:

a. provide electricity to HECO's transmission system. The electricity supplied to HECO's grid would help supply the energy needs of Oahu,

b. be a compatible use of State agricultural land, allowing the land to continue being a buffer zone for the Kahuku Ag Park in addition to supporting the proposed windfarm, and,

c. provide an economic stimulus to the County. A number of short-term and long-term jobs will be created and sustained. The windfarm will also provide revenues to the County in the form of general excise, use and property taxes.

1.4 Required Approvals and Permits

Federal, State and County permits and approvals required for the proposed windfarm are summarized in Table 1.4-1 and described in more detail in Section 4.

Federal Approvals. Because their heights, wind turbines and their towers can represent possible obstacles to commercial or private aircraft. However, the site is in rural Oahu and not the island's airports or in their primary landing flight paths. OWP has filed a "Notice of Construction or Alteration" to the U. S. Department of Transportation ("USDOT") Federal Aviation Administration ("FAA") The FAA review and action is pending. As note above, the draft HCP is being prepared for review by the U. S. Fish & Wildlife Service

Table 1.4-1[7]
Permits and Approvals

Accepting Authority: (Agency/Organization)	Approval/Permit/Action	Estimated Application Date	Estimated Process Time	Public Hearing
DLNR Land Management Division Board of Land & Natural Resources	Draft Environmental Assessment Final Environmental Assessment Approval of FONSI	Jul. 29, 2009 Sep. 29, 2009 Nov. 29, 2009	1 to 2 months 1 to 2 months 1 month	If Required If Required If Required
DLNR Historic Preservation Division	Historic Sites Review	Jul. 29, 2009	1 to 2 months	Not Required
DLNR, DOFAW USDOI, U. S. Fish & Wildlife Service	Draft HCP Final HCP Approve and issues take licenses and take permits	Aug. 28, 2009	1 to 2 months	If Required
DLNR Land Management Division Board of Land & Natural Resources	Direct Lease Application Submittal to Board for approval Approval of Land Lease	Dec. 1, 2009 Feb. 1, 2010 Apr. 1, 2010	1 to 2 months 1 to 2 months 2 to 3 months	If Required If Required If Required
County Planning Department	Conditional Use Permit, Minor	Dec. 1, 2009	2 to 3 months	If Required
County Planning Department	Site Construction and Related Permits Approval of all Permits	Jan. 1, 2010 Jan. 1, 2010	2 - 4 months May 1, 2010	If Required If Required
DOT, Highways Division	Review of Construction Plans	Jan. 1, 2010	2 months	Not Required
USDOT Federal Aviation Administration	Review and Approval of Notice of Construction or Alteration	Aug. 1, 2009	1 to 2 months	Not Required

[7] Note: this table is identical to Table 4.4-1.

State Approvals and Permits (See also Section 4 for more details). Approvals and a land lease would be required from DLNR. As discussed above, the proposed windfarm site lies entirely within State lands, designated agricultural, requiring a HCP. In the case of the proposed windfarm, OWP must apply for and be granted a Use of State Lands Approval ("USLA") from the Land Management Division and a Board Permit from the Board of Land and Natural Resources ("BLNR"). These applications require the submittal of and acceptance by DLNR of an Environmental Assessment or an Environmental Impact Statement (if required).

The DEA includes the archaeological survey conducted for OWP by the International Archaeological Research Institute, Inc. ("IARII"), and will be forwarded to the State Historic Preservation Department ("SHPD") for review along with the DEA.

City and County of Honolulu Permits. A conditional use permit, minor and a construction and related permits are required from the County Planning Department. With respect to the construction permit, the State Department of Transportation ("DOT"), Highways Division will review the construction plan prior to approval by the County.

2.0 PROJECT DESCRIPTION

This section includes a discussion of the project purpose and need, background information on existing power generation and transmission needs, background information on site selection, a description of the project and the anticipated benefits of the project.

2.1 Project Purpose and Need

Oahu Wind PowerPartners, LLC ("OWP"), Waialua, Hawaii proposes to construct and operate a 25 Megawatt ("MW") windfarm, entitled Na Pua Makani on State agricultural land, Kahuku ahupua'a near Kahuku on the north shore of Oahu. OWP's primary corporate objective is to develop windfarms in an environmentally-sound manner for the people of Hawaii. OWP has worked with various organizations and individuals in Hawaii since 1981 to identify high potential sites for wind energy development.

The primary purpose of Na Pua Makani is to supply clean, renewable wind energy to the Hawaiian Electric Company ("HECO") in support of HECO's attainment of their Renewable Portfolio Standards ("RPS"). The need of the proposed action is to provide 25 MW of wind generated electricity to meet a portion of the electrical energy demand of Oahu in support of HECO's attainment of their renewable portfolio standard. HECO has indicated their willingness to purchase the electricity from the proposed windfarm, based on the proposal OWP submitted to HECO on the 100 MW RFP and subject to the negotiation of a power purchase agreement. Contract negotiations are underway with the completion of the Interconnect Requirement Study ("IRS") due in August 2009 followed by the final PPA negotiations.

2.2 Background: Existing Power Generation and Transmission System

The following information on HECO's existing power generation and transmission system is provided as background discussion supporting the need for the proposed 25 MW windfarm.

Generation

The total electrical generating capacity on HECO's utility system is currently about 1755 MW[8]. HECO operates its oil-fired units at Honolulu (113 MW), Kahe (650 MW), Waiau (500 MW) and 30 MW of distributed generators ("DG"). HECO purchases power from three independent power producers: H-Power (46 MW) – waste to energy, Kalaeloa Energy Partners (208 MW) – oil-fired, and AES (160 MW) – coal.

Transmission

The power generated by HECO is supplied to its customers via an island-wide transmission and distribution system[9]. The primary transmission voltage is 138 thousand volts ("kV") to the key load centers on Oahu, including Honolulu and East Oahu on the South Corridor and to Wahiawa on the North Corridor. A 46 kV sub-transmission line serves the North Shore area from Wahiawa to Haleiwa and Waialua to Kahuku around the windward side of the island to Kaneohe and Kailua. Thus, the proposed 25 MW windfarm would be interconnected on the 46 kV North Shore sub-transmission line.

[8] From HECO's web-site (http://www.heco.com/vcmcontent/StaticFiles/pdf/01_01_PowerFacts.pdf), of the 1755 MW, 1727 is firm and 28 is as-available.

[9] Section 5 of HECO's September 2008 Draft IRP-4, and for the complete IRP-4 draft see the following:. http://www.heco.com/vcmcontent/IntegratedResource/IRP/PDF/HECO_IRP4_Plan2009_2028_Final_Report.pdf

Existing and Future Loads

Oahu had a 10-year period of sustained load growth of about 3% a year from 1995 to 2005[10]. Since then load growth peaked at 1,327 MW in 2004, then fluctuated as follows: 1,273 MW in 2005, 1,315 MW in 2006, 1,261 MW in 2007, and 1,227 MW in 2008[11]. Future load predictions will need to be revised given the economic turndown that deepened during 2008. Regardless, HECO needs the project's expected output to help meet its RPS.

2.3 Background: Site Viability and Selection

This section includes discussion of OWP's site selection criteria, the sites considered and evaluated and summary of the site selection.

2.3.1 Site Selection Criteria

The following is a discussion of the key criteria that OWP evaluates in order to select a site suitable for wind energy development:

Wind Resource Characteristics. The key wind resource characteristics are the strength, direction, duration and turbulence of the wind and its temporal and spatial variations on the proposed site. Sites with wind speed averages of 15 miles per hour ("mph") or greater are generally viable in many locations in Hawaii. Averages of 18 mph or greater are considered excellent. Ideally, the wind measurements should be conducted at one or more on-site locations for at least two years. A highly energetic site provides incentive for the windfarm developer to consider the feasibility and costs associated other factors in determining the overall site viability.

Landowner Interests and Terms for Land Use Agreement. While a site may be windy enough for consideration, the windfarm developer must gain access to site, either by purchasing the land/or through a land use agreement. Generally, it is not desirable or cost effective to purchase the land for wind use, especially in Hawaii. Instead, the windfarm developer typically obtains the "wind rights" on the site from the landowner via a lease or easement. Since the windfarm generally does not tie up all the land, an easement may be the preferred contractual vehicle. The u fee is generally a fixed amount per year or a percentage of the gross project revenues (usually 2% during capitalization and 3% thereafter) or a combination of the two. The Maui Wind Project (Kaheawa Pastures) was assessed a 3.5% of the Projects gross revenue per year. After year ten the DLNR can re-open the Lease to review the national market value consistency with the Wind Industry average at that time.

Permitting Requirements. Since permitting requirements vary dramatically with the land designation and zoning, this can be a key consideration. In Hawaii, wind energy is a pre-approved use on privately-owned agricultural land and requires a minimum of permitting and approvals. On the other hand, a wind energy project on State agricultural land (as discussed herein) triggers the need for special permits and approvals, and potentially a number of special studies to address environmental issues. Thus, the developer must carefully weigh the permitting costs along with other project costs in determining the overall site viability.

[10] HECO Adequacy of Supply letter to the Public Utility Commission, dated January 30, 2008.
[11] HEI's 2008 Annual Report to Shareholders (http://www.hei.com/hei2008annualreport.pdf).

Utility Interconnection and Integration Issues. Key issues are the design and rating of the utility's transmission system and the distance from the proposed wind site to the nearest point suitable for interconnection. Generally, the developer pays for the interconnection facility (substation) and the electrical network to collect and deliver the windfarm output to the substation. There may be special interconnection hardware requirements. Integration issues include delivered power quality requirements (e.g., voltage and frequency regulation, harmonic distortion) delivered to the utility and the possible curtailment in certain circumstances. These factors can result in additional hardware costs or potential loss revenues.

Site Construction. Key cost components are the hardware and construction costs (wind turbines, towers, foundations, site electrical collection network, transformers, substation and roads and other facilities). Additional factors are the distance required to interconnect to the utility's transmission system and other interconnection costs, the remoteness of the site, and the site terrain. Increased costs for remote and rugged sites must be traded-off against the other cost and performance factors in determining the overall site viability.

Environmental Issues. Environmental issues can play a key role in determining the overall viability of the site. Windfarms generally are recognized as providing positive environmental benefits, e.g., windfarms can reduce fossil fuel use and their associated air emissions, including greenhouse gases. As with all power plants, there can be damage to the environment due to potential impacts during construction and operation on topography, geology, soils, hydrological resources, flora and fauna and their habitats, archaeological or other cultural sites, visual resources and noise. The costs to study these issues and to design and implement mitigative measures must be evaluated in determining the overall site.

Community Acceptance Issues. Community acceptance issues can play a key role in determining the overall viability of the site. Generally, the community will accept and support a project based a positive evaluation of project overall costs and benefits. Earlier in the site evaluation phase, it is important for the developer to get a sense of how the community views the project proposal. A conscientious developer wants to be a "good neighbor" and will actively seek out comments on the full range of issues associated with his project. Typically, if the community recognizes the benefits of a windfarm to the community or State as a whole, it will support the project. On the other, the community may wish to benefit more directly from the project. In some cases, members of the community or the community itself may become investors in the project, or seek other direct benefits, such as assistance in community benefits projects or programs.

Overall Project Viability. All of above factors must be evaluated and weighed. Given a preliminary assessment of the wind resource, the developer can estimate: (i) potential revenues (based the anticipated power purchase agreement), and (ii) expenses, such as the project's development, construction, operating and maintenance, financing and other costs. With this preliminary assessment, the developer can determine the project's potential economic viability. Finally, the developer can make the decision on taking the next step – examining overall project viability, including a more detailed examination of the above plus additional factors, such as community support and permitting issues.

2.3.2 Sites Considered and Evaluated

During the initial development phase of this project, OWP identified and evaluated several alternative sites on Oahu. OWP sought to identify alternative sites with good exposure to the prevailing tradewinds and close to HECO's transmission system.

Potential sites included locations on the north shore, and on the windward and leeward coasts. While there are several alternative sites with a sufficient wind resource, a number of sites were eliminated after preliminary screening of key siting issues, such as insufficient space for a 25 MW windfarm (e.g., Kaena Point, Koko Head and Barber's Point), environmental concerns (e.g., Kaena Point, Koko Head), potential visual impact (e.g., Kahe, Koolau Ridge and perhaps others), difficulty and expense of construction (e.g., along the Koolau Ridge), and time constraints associated with responding to HECO's RFP[12] for up to 100 MW of as-available renewable power (e.g., potential off-shore locations could not be secured in the available time frame).

In large part, the initial screening resulted in elimination of all of the "non-north shore" sites. The old Westinghouse windfarm site[13] was arguably the first choice, given existing data and information on the site, and acceptance of the windfarm by the community. However, that site is now owned by the U. S. Army, and up to the present time, the Army has not been willing to make the windfarm site available. The Army offered nearby contiguous land as an alternative. Unfortunately, the land consists of rugged terrain that would be too expensive to develop. East of the Army land are two potential sites, one which is being developed by First Wind, and hence not available, and the site proposed by OWP herein. OWP also considered other sites closer to the ocean and ruled them out due to their proximity to the Kahuku Wildlife Refuge. In short, the remaining potentially viable site is the one proposed by OWP to HECO, the Na Pua Makani.

2.3.3 Summary of Site Selection

OWP selected the Na Pua Makani site for the proposed 25 MW windfarm. Preliminary wind resource measurements have confirmed an overall site average wind speed in excess of 8.1 meters/second ("m/s") or 18 mph at 80m (262ft). The high winds are due to the excellent exposure of the site to tradewinds, which are accelerated as they ascend from ocean. Given the strong wind resource and certain key project elements, OWP is able to offer HECO the project's clean renewable wind electricity at an attractive price. The key project elements include its close proximity to HECO's transmission line, and good access to the project site from existing roads. The North Shore near Kahuku is the only wind resource available on Oahu lands. Another site adjacent and near the Na Pua Makani project is in development.

[12] HECO issued a RFP for 100 MW of as-available renewable power in June 2008. WWW submitted a proposal to HECO on September 25, 2008. HECO informed WWW in January 2009 that the proposal was selected to be on the "short-list" of potential winning proposals. WWW has subsequently entered into negotiations with HECO.

[13] The Westinghouse site was developed by Hawaiian Electric Renewable Systems ("HERS"), an unregulated subsidiary of Hawaiian Electric Industries. Fifteen, 600 kW Westinghouse wind turbines were installed in 1985 and operated into the mid-1990s, first by HERS and subsequently by New World Power. The turbines were subsequently removed and the U. S. Army land, including the windfarm site, from the Campbell EState.

2.4. Project Design

This section includes a presentation of the required facilities and activities, relevant windfarm experience and implementation issues in Hawaii, and the detailed engineering design.

2.4.1 Required Facilities and Activities

The proposed 25 MW windfarm would consist of the following facilities and activities:

(1) Improvements to the existing asphalt road from the main highway to the entrance to the windfarm site. The improvements include widening sections of the road, and repaving as necessary before and after construction;

(2) Installation of 10 Clipper Liberty 2.5 MW ("Liberty 2.5 MW") wind turbines including excavation and construction of foundations, erection of the towers and turbines, and installation of base-mounted transformers (to increase the turbine generator's 690 VAC output to intrasite collection network voltage of 34 kV);

(3) Construction of a site facility building and an intrasite road network;

(4) Construction of an intrasite electrical distribution network, including excavation and burying of all wires, and re-vegetation of the disturbed areas; and

(5) Transformation of the on-site electrical distribution network voltage to the interconnection voltage of 46 kV;

(6) Delivery of 46 kV power to HECO by building a new, short 46 kV HECO line to connect with the existing 46 kV line for another approximately 4 kilometers ("K") or 2.6 miles ("mi") to the interconnection point at HECO's 46 kV substation located near Turtle Bay and approximately 2k or 1.2mi southeast of Waikalae.

Improvements to the access road and construction of the intrasite road network are expected to take one month. The construction of the windfarm facilities, including the wind turbines and site operation and maintenance buildings, are expected to take four to six months. An additional two months would be required for check-out and commissioning of the windfarm. Thus, the windfarm should be fully operational 7 to 9 months from project go-ahead.

The Liberty 2.5 MW wind turbine is manufactured by Clipper Windpower in Cedar Rapids, Iowa. The 333,000 square foot manufacturing and assembly facility is ISO 9001:2000 QMS Certified[14]. In addition to manufacturing, Clipper is engaged in advancing wind energy technology and wind project development. With offices in California, Colorado, Maryland, Mexico and the U.K., Clipper's activities extend to the Americas and Europe. To date, Clipper installations total over 200 MW in the U. S. (Iowa, Maryland and Wyoming).

Clipper designed the 2.5 MW in partnership with the U. S. Department of Energy and its National Renewable Energy Laboratory ("NREL"). This followed years of experience operating a variety of wind turbines, starting with windfarms in the Tehachapi and San Gorgonio Pass areas of California since the early 1980's[15]. Each Liberty 2.5 MW (see Figure 2.4.1.1 on the next page) is a horizontal axis wind turbine with three fiberglass blades, a rotor diameter of 96m (315 ft), an electrical output of 2.5 MW, and a variable blade pitch control system to smooth power and to feather the blades to shutdown and secure the turbine in extreme wind conditions, including hurricanes.

[14] ISO9001:2000 QMS Certified = International Organization for Standardization, series 9001, adopted in 2000 for the Quality Management System, in this case for the manufacture of wind turbines.

[15] The key principals in Clipper were also involved in the design and/or operation of precursor wind turbines in the U. S., including the Zond Z-40 and Z-48, the Enron Wind 750 and the GE 1.5 MW.

See the Clipper Windpower Brochure in Appendix 8.1 for more details on Clipper and the Liberty 2.5 MW wind turbine.

Figure 2.4.1-1. Liberty 2.5 MW Wind Turbine

2.4.2 Proposed Windfarm Design and Layout

The general location of proposed windfarm site on Oahu's north shore near Kahuku is indicted in Figure 2.4.2.1 below.

Figure 2.4.2-1. Na Pua Makani Site Location

The overall project design and layout is illustrated in Figure 2.4.2.2, on next page. Note that two rows of five Liberty 2.5 MW wind turbines would be installed in the hills surrounding the Kahuku Ag Park near Kahuku. Each of the ten Liberty 2.5 MW wind turbines will be installed on a 80m (262 ft) tapered, tubular steel tower. Each turbine with its tower and foundation would require an area of approximately 30.5m (100ft) diameter. There is also a lay down area for the cranes and the blades. The "side-to-side" distance between the turbines in each row will be approximately 305m (1,000ft), and the distance between the two rows will average about 750m (2,460ft).

The figure also includes the location of HECO's 46 kV substation located near Turtle Bay. The substation is about 1K (0.6mi) south of the entrance to the Turtle Bay Resort. This substation is identified with a "green push pin" in the aerial map below. From the substation, OWP proposes to overbuild an existing 12 kV HECO line with a 46 kV line for approximately 4K (2.5 miles. This overbuild line routing is also shown in "turquoise" on the aerial map. On the project leasehold, a new, 1K (0.6mi), 46 kV line (shown in "pink") will be built from HECO's existing 12 kV line to the proposed project's on site substation (identified by the "red push pin").

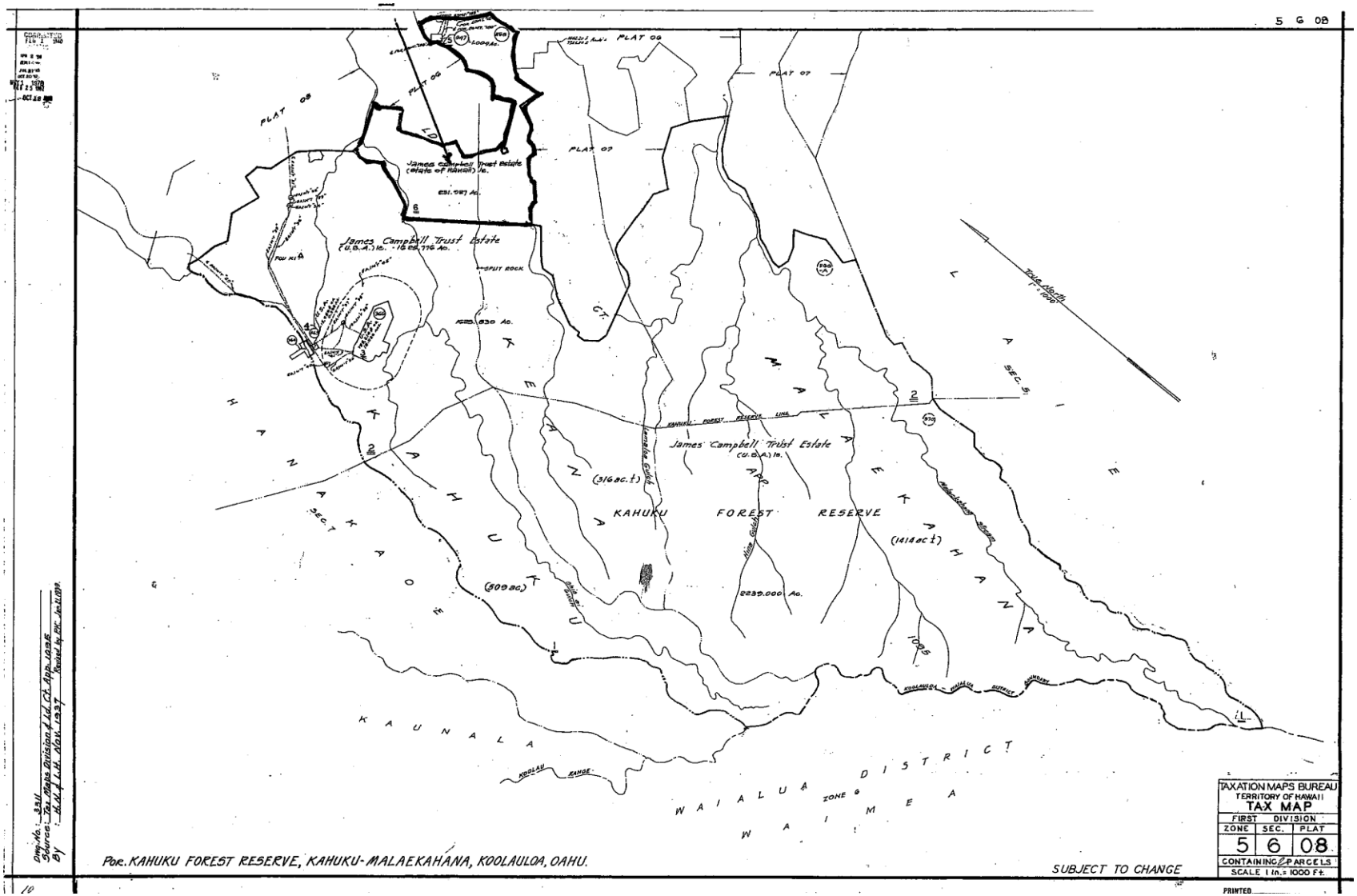
Figure 2.4.2.3 on the following page provides a more detailed view of the windfarm site, including the locations of each of the wind turbine sites, the operation and maintenance ("O&M") facility, intrasite road network and site access road, electrical distribution network, the site substation, and wind monitoring equipment. The 15.2m x 30.5m (50ft x 100ft) site substation is located approximately in the center of the windward row of turbines.

Operation and Maintenance Facility. A 6.1m x 12 m (20ft x 40ft) operation and maintenance facility would be constructed on a location approximately in the middle of the site. This facility would serve as the office for the site manager and maintenance workers. The windfarm system controller would be housed in the facility. The controller will provide for monitoring of the overall system, individual turbine and wind monitoring equipment operational status and performance. The system controller will have the capability of being operated remotely either by OWP or HECO. The facility will also provide for a small indoor work area and limited amount of spare parts storage.

Intrasite Road Network and Site Access Road Network. The site road network would include a single, U-shaped 6m (20ft) wide road approximately 2,000m (6,560ft). Individual spurs branch off from the main intrasite road to each turbine site. All on-site roads will be graded and maintained with gravel only where necessary. The operation and maintenance facility would be located close enough to the main road, such that a separate spur is not required. The intrasite road network will be accessed from a 100m (33ft) extension from the existing site access road. OWP anticipates that sections of the existing unnamed access road from Kamehameha Highway will need to be surfaced during and after the construction of the windfarm. Details will be provided in the construction plans to be submitted to the County.

Site Electrical Distribution Network. The output of each wind turbine would be transformed at the base of the tower to 34 kV, collected and delivered to the site substation via the intrasite electrical distribution network. All electrical cabling and wiring would be buried in trenches approximately 1m (3ft) deep. All disturbed vegetation will be replaced in position. The site electrical distribution network, with the exception of a short section of power cables from the site substation to the interconnection point on the new 1K (0.6m) mile connector lines to the utility's transmission lines, would be buried underground. Note: Once the turbines are erected the areas around the towers will be re-seeded with endemic vegetation.

Figure 2.4.2-2. Na Pua Makani Windfarm Design and Layout with interconnection Details


5 6 08
PLAT 08
PLAT 07
James Campbell Trust Estate
(State of Hawaii) Ie.
James Campbell Trust Estate
(U.B.A.) Ie.
SPLIT ROCK
KAHUKU FOREST RESERVE
(316 ac.±)
(1414 ac.±)
(508 ac.)
2239.000 Ac.
KAUNALA
WAIALUA DISTRICT
WAIMEA
Por. KAHUKU FOREST RESERVE, KAHUKU-MALAEKAHANA, KOOLAULOA, OAHU.
SUBJECT TO CHANGE
TAXATION MAPS BUREAU
TERRITORY OF HAWAII
TAX MAP
FIRST DIVISION
ZONE 5 SEC. 6 PLAT 08
CONTAINING 2 PARCELS
SCALE 1 in. = 1000 Ft.
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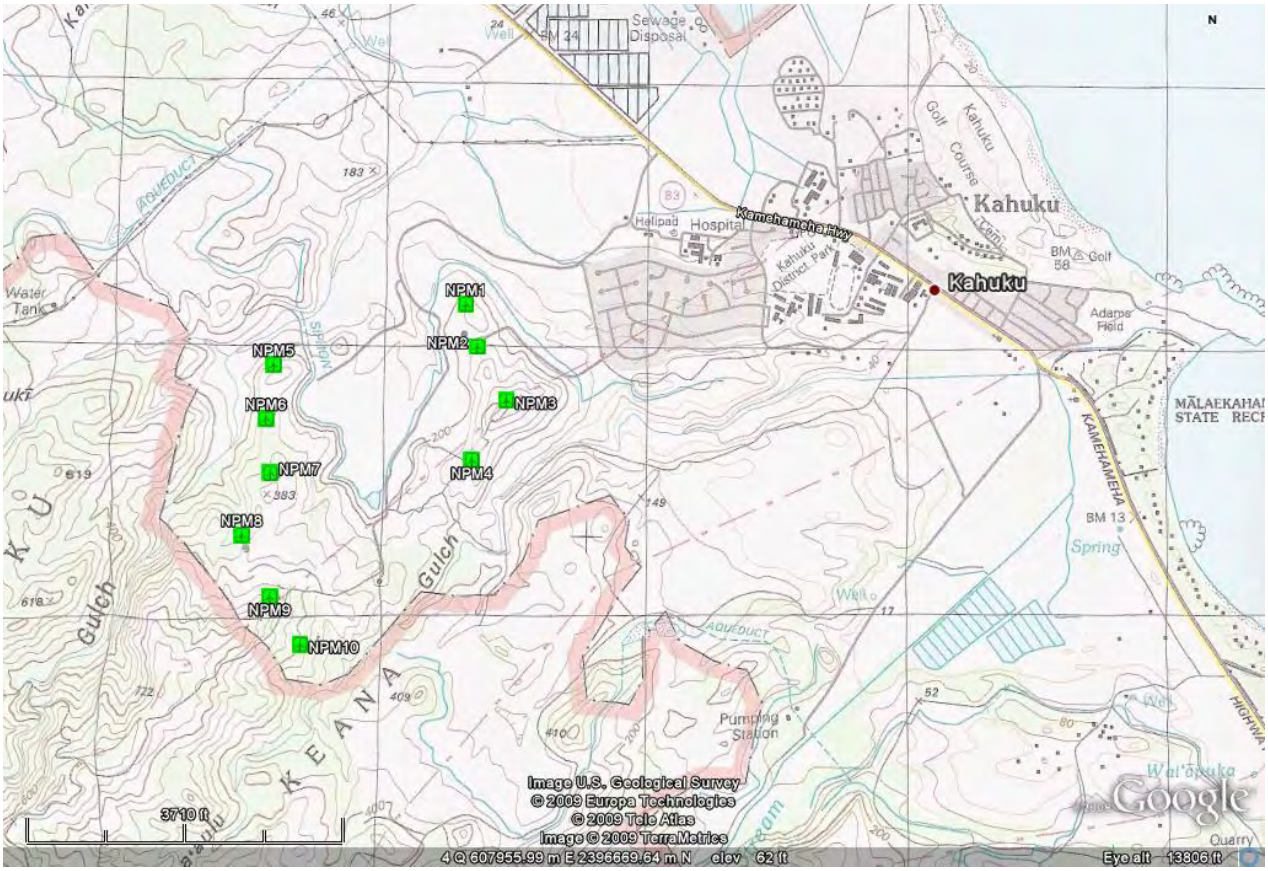


Figure 2.4.2-4. Na Pua Makani Project Site Layout

Site Substation. The purpose of the substation and interconnection hardware is to transform and interconnect the electrical output from the intrasite electrical distribution network to HECO's transmission line. The 12 kV output is first transformed to 46 kV at the substation and then delivered via overhead cables to the interconnection point at the HECO substation.

Wind Monitoring Equipment. OWP plans to maintain one meteorological tower (60m in height) for monitoring the overall wind conditions at the site. These systems would provide data for analysis of the overall windfarm performance, as well as the long-term wind conditions at the site. The monitoring systems also provide wind direction input signals to the turbine yaw controller for maintaining the turbine's orientation into the wind. Each wind turbine is also equipped with meteorological equipment above each nacelle.

2.4.3 Proposed Land Use Agreement

The proposed windfarm site is on State-owned agricultural land, previously used as a buffer zone for the Kahuku Ag Park on Oahu. The State Department of Agriculture, original custodian of the buffer zone, determined that the land was no longer needed as a buffer zone and transferred ownership to DLNR. In the case of State agricultural land, DLNR will negotiate a land lease, but not the permit.[16]

[16] In the case of State conservation land, windfarms are a permitted use. In the case of State agricultural land the counties have jurisdiction and issue conditional use permits.

In August 8, 2008, OWP obtained approval in principle for a direct lease and a right-of-entry from DLNR for the proposed project site [Kahuku-Malaekahana, Ko'olauloa, Oahu. Tax Map key: (1) 5-6-08:6]. Per Exhibit A, the land lease is contingent upon a conditional use permit and the HCP. OWP has applied to DLNR for a lease for the use of the State land. DLNR has indicated that the lease will be subject to approval to approval of an Environmental Assessment ("EA") and a Habitat Conservation Plan ("HCP"). OWP must also secure a Conditional Use Permit ("CUP"), Minor, for the proposed windfarm from the City and County of Honolulu (County"). This DEA is prepared in support of OWP applications to DLNR and the County.

Contractual negotiations with the Land Management Division are underway. This negotiation includes a land use fee which would be paid by OWP for the wind rights, conditions for granting access to the site for visitors, and restoration of the site at the end of the lease or easement period.

2.4.4 Proposed Power Purchase Agreement

HECO issued a RFP for 100 MW of as-available renewable power in June 2008. OWP submitted a proposal to HECO on September 25, 2008. HECO informed OWP in January 2009 that OWP's proposal was selected to be on the "short-list" of potential winning proposals. OWP has subsequently entered into negotiations with HECO for a power purchase agreement ("PPA").

At the present time, negotiations are pending the result of an Interconnection Requirements Study ("IRS") being conducted by HECO for the proposed Na Pua Makani windfarm project. Once completed, it is anticipated that subsequent discussions between OWP and HECO will resolve the details of the infrastructure and equipment required to interconnect the windfarm, and an agreement as to what costs are to be covered by OWP and HECO. Given that, OWP anticipates that agreement can be reached on the purchase price for the project's wind electricity. In the case of the latter, HECO has requested that the purchase price be de-linked from the price of oil. Note: previous windfarm PPAs had been tied to the price of oil via the "avoided cost" methodologies that have been in place since 1978.

In de-linking a baseline (or starting) is established and then "levelized" the over time with annual adjustments to account for inflation. Such adjustments can be accomplished via a consumer price index or a fixed escalator. Either way, OWP would assume all risks associated with the escalation of its costs to operate the windfarm and or potential lost revenues. For example, if annual escalator is used, it could be less than actual inflation. With respect to potential lost revenues, actual wind availability or turbine availability may fall short of expectation or there may be operational circumstances on HECO's system that require the windfarm to be shutdown or curtailed. The PPA will identify the times and or conditions under which the windfarm output would be shutdown or curtailed and the circumstances for resumption of output to HECO. Finally, levelized purchase prices are a win-win, as OWP will have an opportunity to earn a fair return on its investment, and the utility and its ratepayer will know the cost of windpower, as opposed to predicting the cost based on the price of oil.

2.4.5 Construction Plan and Operations

Construction will proceed in two consecutive phases. Construction plans will be reviewed by and coordinated with the City & County of Honolulu Planning Department and the STATE Department of Transportation. During the initial part of the construction phase, the existing access road network would be improved from the main highway to the windfarm site to:

(1) minimize the amount of soil that must be disturbed,

(2) avoid disturbing native plants, and

(3) avoid areas where the slope of the terrain exceeds 30 degrees.

Construction would then proceed in the following steps:

(1) construction of the main intrasite road and spurs to the individual turbine sites.

(2) construction of the operation and maintenance facility,

(3) excavation and installation of the individual turbine and transformer foundations,

(4) excavation and installation of foundations for the site substation and interconnection hardware,

(5) erection of towers, wind turbines and transformers,

(6) installation of the site substation and interconnection hardware, and

(7) excavation and installation of the intrasite electrical distribution network.

Note: see sections 3.5, 3.6 and 3.8 for additional discussion of the measures proposed to mitigate potential impacts on the topography, geology and soils, hydrologic resources and flora.

OWP will operate the facility in accordance with Clipper's established "Warranties and Operation and Maintenance" procedures. A site-specific operations and maintenance manual will be prepared. The manual will include routine and emergency procedures for maintenance of the wind turbines and other site equipment. Like other operating machinery, there are hazards from rotating and electrical components. The manual includes provisions for safe operation to prevent equipment damage and injury to OWP personnel, consultants and visitors. These provisions include:

- tower designs to deter climbing without special equipment. This equipment would only used by site personnel during maintenance activities;

- Shielding and grounding of all electrical equipment to prevent electrical shock hazards and locking of key components to prevent entry; and

- no-trespass signs will be posted to warn *uninvited* visitors that they should not be in the area unless authorized by DLNR or OWP. OWP's experience, as well as other windfarm operators, is that trespass and/or vandalism have not been a problem.

Regarding liability for possible vandalism and potential injuries, OWP will secure liability insurance to cover possible injuries and death due to equipment failure or negligence on the part of OWP personnel.

The land use agreement with DLNR (i.e., the Conservation District Use Permit) will include a clause to indemnify the State from any windfarm-related incidents.

Finally, all of OWP windfarm land-use contracts or permits contain a clause requiring removal of wind turbines and all site equipment at completion of the project, and full restoration of the site. The wind turbines and their towers are designed for ease of installation and removal. Since the tower foundations are buried below the surface, returning the turbine sites to the original condition is a straightforward process. OWP's anticipate that such a clause would be included in the Conservation District Use Permit with DLNR for this project.

2.4.6 Proposed Project Timeline

From project go-ahead, OWP estimates the following timeline:

- Mobilization (3 months) – to ship and mobilize all equipment and supplies to the site,
- Phase 1 construction (1 month) – to improve the access road to the project site,
- Phase 2 construction (4 to 6 months) - to construct the intra-site road network, excavate and construct the tower foundations and the intrasite electrical network, erect towers and turbines, construct the O&M facility and site substation, permanent meteorological towers, and construct and interconnect the project transmission line to HECO's sub-station, and
- Project Check-Out and Commissioning (2 months): Following the construction period, there would be a two month operational check-out and commissioning period.

Thus, the windfarm should be fully operational 10 to 12 months from project go-ahead.

2.5 Project Benefits

It is anticipated that HECO, DLNR, the citizens of Oahu and the State, and OWP would all benefit as follows:

- *HECO would benefit by purchasing electricity at a levelized price below their avoided cost, reducing their use of fossil fuels, showing their support for renewable energy sources and diversifying their electrical power purchase portfolio in attaining their RPS;*
- *DLNR would benefit through collection of a land use fee.* This fee could be used to off-set a portion of the funds that have been spent by the State to develop renewable energy alternatives such as wind*;*
- *The citizens of Oahu and the State would benefit from the energy, economic and environmental characteristics of the project:*
  - ◊ Energy - The windfarm would help diversify the energy resource base on Oahu and *reduce* the amount of imported fossil fuels (estimated at the equivalent of 147,000 barrels of oil per year). *Avoidance of fossil fuels would help reduce energy security and price risks and would make Oahu less dependent on oil and coal;*
  - ◊ Economic – There would be *direct* economic activity during construction and operation (temporary and permanent jobs, equipment, materials and supplies), and the project-related income and excise tax revenues over the project's lifetime. The primary *indirect* economic activity is stimulated by the reduction of the dollars that are paid for imported fossil fuels, i.e., those dollars recirculate on Oahu and in Hawaii. In addition, a wind power purchase contract would specify the value (in cents/kWh) to be paid over contract lifetime. The price for the windpower is thus known and independent of the price of fossil fuels. Therefore, the ratepayers would benefit by saving the incremental cost of fossil fuels with respect to the cost of windpower; and
  - ◊ Environmental - Similarly, environmental benefits accrue from the reduction of fossil fuel use, i.e., fossil emissions would be reduced. There could be additional benefits to the environment through implementation of native plant propogation and the HCP as proposed by OWP.
- OWP would benefit by the opportunity to recover its investment in the wind project and make a fair profit over the projected 30 year lifetime of the windfarm;
- The State will benefit from environmental funds (TBD) to support the project's Habitat Conservation Plan; and
- An Endowment to the Community of Kahuku and administered by the Kahuku Community Association of $50,000/yr and after the tenth year of successful operation $100,000/yr for the next ten years, or the life of the project.

3. Existing Conditions, Environmental Consequences and Mitigative Measures

3.1 Introduction

The proposed action is the construction and operation of a 25 MW windfarm by OWP on State-owned agricultural land, previously used as a buffer zone for the Kahuku Ag Park on Oahu. The project details are discussed in Section 2. The existing conditions and potential environmental consequences of the proposed action the study area[17] are described in this section. A program has been developed to mitigate potential consequences (impacts) of the proposed action. The engineering, environmental, and land jurisdiction and use characteristics for the proposed windfarm site are summarized in Table 3.1-1.

WSB-Hawaii identified and evaluated the potential consequences for the proposed action using the guidelines established in Hawaii Administrative Rules, Title 11, Department of Health, Chapter 200, Sub-Chapter 6-12. The significance of the impacts was then defined in terms of context, duration and severity (see also the discussion in Section 1.2.1).

WSB-Hawaii evaluated the potential impacts before and after proposed mitigative measures. These impacts are summarized in Table 3.1-2,[18] including evaluation of the environmental consequences before and after the mitigative measures program. The details of this process are discussed below.

OWP's philosophy is to minimize the impact of its projects on the environment. While DLNR may approve a project that has an overall impact of *non significant*, OWP's goal is mitigate all impacts such that the potential impacts are evaluated as *beneficial* or in the worse case as *negligible.*

OWP designs its windfarms to be *compatible* with existing and planned land uses to the *mutual* benefit of the landowner and OWP. To OWP, *compatible* means the proposed use does *not* preclude or interfere with an existing or planned use and the proposed use is *consistent* with the existing or planned use. *Mutual* benefit means both the landowner and OWP have access to the land and both can benefit from the land.

For example, windfarms can be compatible on agricultural lands that are used primarily for grazing livestock, growing certain types of crops or buffer zones between agricultural and urban areas. There are many windfarms that have been constructed and operated successfully on ranch lands in Hawaii, California and other States. The landowner derives *multiple* income streams from his own agricultural ventures, such as livestock, and from fees charged to the windfarm operator for the *wind rights* to his land. The windfarm operator benefits through the access to the windy land and the sale of the wind-generated electricity to the utility.

In Hawaii, OWP's goal is to design windfarms to be compatible with conservation land agricultural ands, including their primary uses, e.g., conservation of the native flora and fauna, grazing of livestock and recreation in some locations. In this case, the State, as custodian of proposed windfarm site, could derive revenue for the wind rights while not impacting the original use and continuing value of the land as a buffer zone.

[17] Note: the study area includes the windfarm site and the site access.
[18] Identical to Table 1.2.2-1

Table 3.1-1
Windfarm Site Characterization

Factor	Engineering/Environmental/Land Ownership/Land Use
Design Site	U-Shaped band of land surrounding the Kahuku Agricultural Park near the community of Kahuku
Site Layout	Consists of two rows of turbines with towers and foundations, electrical distribution network, interconnection substation, meteorological towers, operation and maintenance facility, and intrasite road network. Access to individual turbine sites would be provided by spurs from the main intrasite road.
Turbine Rating - MW	2.5
Number of turbines	10
Rotor Diameter	96m (315ft)
Height of towers	80m (64ft)
Turbine Layout	Two rows, approximately 2,000ft apart, oriented southeast to northwest, mauka and makai of the Kahuku Ag Park
Site access	Via an asphalt road that connects the Kahuku Ag Park with Kamehameha Highway. The total distance from Kamehameha Highway to the site entrance is approximately 3K (1.8mi)
Distance from substation to HECO transmission line	1K (0.6mi) - estimate
Environmental EA review and approval	State Department of Land and Natural Resources, Land Management Division
Stream/Gulch Crossings Site Access Road	 None None
Archaeological Sites Site Access Road	 None None
Topography, Geology and Soils	Hills surrounding the Kahuku Ag Park, eroded volcanic dome, Kaena Stony Clay, Paumalu Badlands Complex, Coral outcrops
Vegetation Types	Mixed grass, low-lying shrubs, trees, some native plants
Birds and Wildlife Types	Mixed native, alien species, and potentially some endangered
Land Ownership/Land Use Site Access Road Network	 State DLNR/Agricultural State DOH/Agricultural

Table 3.1-2*
Summary of Potential Environmental Consequences and Impacts

Without Mitigative Measures				Following Mitigative Measures			
Factor	**Context**	**Duration**	**Severity**	**Mitigative Measures**	**Context**	**Duration**	**Severity**
Land Use							
Agricultural – Buffer Zone	Local	Short-term	Significant	Various: Coordinate with DLNR	Local	Short-term	Non Sig.
	Local	Long-term	Non Sig.	Various: Coordinate with DLNR	Local	Long-term	Non Sig.
Transmission Lines	Local	Long-term	Non Sig.	Various: Coordinate with HECO and community	Local	Long-term	Negligible
Topography							
Proposed Site	Local	Short-term Long-term	Non Sig. None	Minimize grading/ replace grass	Local n. a.	Short-term n. a.	Negligible n. a.
Site Access	Local	Short-term Long-term	None None	None Required None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Geology							
Proposed Site	Local	Short-term Long-term	None None	None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Site Access	Local	Short-term Long-term	None None	None Required None Required	n. a. n. a.	n. a. n. a.	n. a. n. a.
Soils							
Proposed Site	Local	Short-term	Non Sig.	Minimize grading/ replace grass/water	Local	Short-term	Negligible
	Local	Long-term	Non Sig.	Repair new damage/ replace grass/water	Local	Long-term	Negligible
Site Access	Local	Short-term	Non Sig.	Minimize grading/ repair damage/water	Local	Short-term	Negligible
	Local	Long-term	Non Sig.	Grade periodically/repair damage/water	Local	Long-term	Negligible

*Note: Table 3.1-2 and Table 1.2.2-1 are identical

Table 3.1-2
Summary of Potential Environmental Consequences and Impacts
(Continued)

Without Mitigative Measures				Following Mitigative Measures			
Factor	**Context**	**Duration**	**Severity**	**Mitigative Measures**	**Context**	**Duration**	**Severity**
Hydrology and Water Resources	Local Local	Short-term Long-term	Non Sig. Non Sig.	Minimize grading/ replace grass/water Repair new damage/ replace grass/water	Local Local	Short-term Long-term	Negligible Negligible
Terrestrial Flora	Local Local	Short-term Long-term	Non Sig. Non Sig.	Coordinate route and site design/installation Define/coordinate detail site O&M procedures	Local Local	Short-term Long-term	Negligible Negligible
Fauna Birds Mammals	Local Local	Short-term Long-term Short-term Long-term	Significant Significant Significant Significant	Prepare and implement HCP Prepare and implement HCP	Local/ Regional Local	Short-term Long-term Short-term Long-term	Non. Sig. Non. Sig. Non. Sig. Non. Sig.
Cultural Resources	Local/ Regional	Short-term Long-term	Non Sig. Non Sig.	Implement mitigative measures	Local/ Regional	Short-term Long-term	Negligible Negligible
Socioeconomics	Local Regional	Short-term Long-term Short-term Long-term	Beneficial Beneficial Beneficial Beneficial	None Required None Required None Required None Required	n. a. n. a. n. a. n. a.	n. a. n. a. n. a. n. a.	n. a. n. a. n. a. n. a.
Infrastructure	Local	Short-term Long-term	Significant Non Sig.	Implement mitigative measures	Local/ Regional	Short-term Long-term	Non Sig. Non Sig.
Public Services & Facilities	Local/ Regional	Short-term Long-term	Non Sig. Non Sig.	Implement emergency response procedures	Local/ Regional	Short-term Long-term	Negligible Negligible

*Note: Table 3.1-2 and Table 1.2.2-1 are identical

Table 3.1-2
Summary of Potential Environmental Consequences and Impacts
(Continued)

Without Mitigative Measures				Following Mitigative Measures			
Factor	**Context**	**Duration**	**Severity**	**Mitigative Measures**	**Context**	**Duration**	**Severity**
Air Quality & Meteorology	Local	Short-term	Non Sig.	Minimize grading/ replace grass/water	Local	Short-term	Negligible
		Long-term	Non Sig.	Repair new damage/ replace grass/water	Local	Long-term	Negligible
	Regional	Short-term	Beneficial	None Required	n. a.	n. a.	n. a.
		Long-term	Beneficial	None Required	n. a.	n. a.	n. a.
Noise							
- Construction	Local	Short-term	Non Sig.	Ensure safe driving and operating procedures	Local	Short-term	Non Sig.
	Region	Short-term	Non Sig.	Ensure safe driving and operating procedures	Region	Short-term	Non Sig.
- Operation	Local	Long-term	Non Sig	Implement noise reduction measures	Local	Long-term	Non Sig.
EMF							
- existing	Local	Short-term/ Long-term	Negligible	Establish/ensure safe O&M procedures	Local	Short-term/ Long-term	Negligible
- with windfarm	Local	Short-term/ Long-term	Non Sig	Establish/ensure safe O&M procedures	Local	Short-term/ Long-term	Negligible
Visual Impact	Local	Short-term/ Long-term	Non Sig.	Solicit community input/ address & resolve issues	Local	Short-term/ Long-term	Negligible
	Regional	Short-term/ Long-term	Non Sig.	Solicit community input/ address & resolve issues	Regional	Short-term/ Long-term	Negligible
Community Acceptance	Local	Short-term/ Long-term	Significant	Solicit community input/ address & resolve issues	Local	Short-term/ Long-term	Non Sig.
	Regional	Short-term/ Long-term	Significant	Solicit community input/ address & resolve issues	Regional	Short-term/ Long-term	Non Sig.

*Note: Table 3.1-2 and Table 1.2.2-1 are identical

3.2 Overview of the Environmental Setting

The proposed 25 MW windfarm would be located on State agricultural lands[19] near the community of Kahuku on the north shore of Oahu. Two rows of five for a total of ten Liberty 2.5 MW wind turbines are to be installed on 80m (262ft) towers in the hills mauka and makai of the Kahuku Agricultural Park ("Kahuku Ag Park"). The distance between the two turbine rows will be approximately 610m (2,000ft).

Site access would be via existing asphalt road for about 3K (1.8mi) from the main highway to the entrance to the windfarm site. An intrasite road network will provide access to individual turbines, the site operations and maintenance building, anemometer towers, and the site electrical substation. To supply windpower to HECO's grid, a new 1K (0.6mi) 46 kV transmission line will be constructed to interconnect with HECO's existing 46 kV transmission line near the northwest boundary of the project site. From there, the existing transmission line interconnects with HECO's substation which is located about 1K (0.6mi) south of the entrance to the Turtle Bay resort on Kamehameha Highway.

The hills (up to about 350ft in elevation) on the mauka-side of proposed windfarm site slope moderately downward towards the Kahuku Ag Park, but precipitously on the mauka side towards a large gully. The hills (about 250ft in elevation) on the makai-side of the project also slope moderately downward both towards Kahuku Ag Park and in the opposite direction towards Kahuku and the ocean. From several wind turbine sites, and possibly from all turbine nacelles, there are broad-sweeping panoramas Kahuku Point to the northwest and the ocean to the northwest, Kahuku to the east, and towards Laie and the Ko'olau mountains to the southeast. There are no known archaeological sites in the study area.

A botanical and wildlife survey was conducted on the project site. The site vegetation includes mixed grasses, shrubs and trees including a number of native species. A number of avian species were identified, and bats were detected within the Ag Park and near the transition from the Ag Park to the lower margin of the mauka hills. The climate is moderately wet with 0.51m (45 to 50 inches) of rainfall a year. The site is excellent exposure to the trade winds, which accelerate from sea level to the hills on the project site.

[19] Land location is Zone: 5 Sec. 6 Plat: 08 Lot 6, 232 acres. The turbines sites will be located on former Dept. of Agricultural lands used as a buffer zone surrounding the Kahuku Agricultural District Part.

3.3 Land Description: Ownership, Designation, Zoning and Regulation

The proposed windfarm site land ownership, land designation, zoning and regulation are described in this section. Details on approvals and permits are discussed in Section 4.

3.3.1 Ownership

The proposed windfarm site is on State-owned agricultural land, previously used as a buffer zone for the Kahuku Ag Park on Oahu. The State Department of Agriculture ("DOA") is the custodian of the Kahuku Ag Park, and formerly the custodian of the buffer zone. DOA determined that the land was no longer needed as a buffer zone and transferred ownership to DLNR. See Sections 2.4.3 and 3.4 for more details on land ownership and use issues.

3.3.2 Designation, Zoning and Regulation

The State Land Use Commission, pursuant to HRS, Chapter 205, has established land use districts throughout the State. All lands in Hawaii are designated into one of the following four districts: Urban, Rural, Agricultural and Conservation. The proposed site is located in State agricultural lands of the Kahuku-Malaekahana district, previously used as a buffer zone for the Kahuku Ag Park.

Wind energy facilities are a permissible use within the agricultural district per item (14) of Hawaii Revised Statutes ("HRS") §205-4.5 as noted below:

> "Wind energy facilities, including the appurtenances associated with the production and transmission of wind generated energy; provided that the wind energy facilities and appurtenances are compatible with agriculture uses and cause minimal adverse impact on agricultural land."

A wind developer must obtain both a permit and a lease for the use of the State agricultural land. The permit is needed to approve the use of the windfarm as a "permissible use" per HRS §205-4.5 as noted above. A lease is needed to secure use of land for specified period of time. The lease specifies the terms and conditions for the land use, including any lease rents. In the case of State agricultural land, the counties have jurisdiction for the issuance of conditional use permits for windfarms. DLNR has jurisdiction to negotiate a land lease. The details of all required approvals and permits are discussed in Section 4.4.

3.4 Land Use: Existing and Proposed Land Uses

This section includes a description and discussion of existing conditions, including current and planned land use, the potential impact of the proposed action on existing and planned land uses, and proposed mitigative measures, including an evaluation of the impact consequences before and after mitigative measures. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.4.1 Existing Conditions

Current Land Use

The current land uses in the general area include the Kahuku Ag Park, the previous buffer zone (proposed project site) and a corridor for HECO's 46 kV transmission line.

Kahuku Ag Park. The existing uses (purposes) of the Kahuku Ag Park, as well as the State's other Ag Parks are explained and defined in HRS §166-1 and §166-2 as follows:

> "Legislative findings. The legislature finds that important *agricultural lands* should be *preserved* for *productive purposes*; the contribution of *diversified agriculture* and aquaculture to export and local markets should be expanded, thereby increasing its importance in the State's economy; and *continued use* of the *State's agricultural land resources* should be ensured by providing lands to new farmers, displaced farmers, and other qualified farmers. In order to meet these goals, the objectives of the State shall include the *provision* of: lands of appropriate size and productive potential, with an adequate supply of water, to ensure economically viable farm operations; lands at reasonable cost with long term tenure and security from urbanization pressure; and lands with common facilities and activities to encourage farm production and distribution economies." (§166-1)
>
> "Agricultural activities" means the care and production of livestock, livestock products, poultry, or poultry products, or apiary, horticultural, or floricultural products, or the planting, cultivating, and harvesting of crops or trees, including tree farms.
>
> "Agricultural Park" means any agricultural or aquacultural complex so designated by the board, for which State land or State funds are used, in order to meet the goals and objectives Stated in section 166-1. Agricultural buildings, farm residences, and employee dwellings necessary to the production and distribution of agricultural and aquacultural commodities may be considered part of the agricultural park."(§166-2)

Proposed Project Site. In the case of the proposed site, WSB-Hawaii notes that its previous use of the "buffer zone" for the Kahuku Ag Farm served to separate the agricultural activities from nearby conservation and urban districts.

HECO Transmission Corridor. The HECO 46 kV transmission line crosses the main site access road approximately 1.5km (0.9m) mauka of Kamehameha Highway (See Figure 2.4.2-1). Note: the figure also indicates the location of a new transmission line to interconnect the windfarm to the HECO transmission line.

Planned Land Use

WSB-Hawaii has not identified any new planned land uses for the project area in either the City and County of Honolulu's ("County") General Plan or the Ko'olau Loa Sustainable Communities Plan. See Section 4 for a discussion of the relationship of the proposed action to the goals and objectives of the County and Ko'olau Loa plans.

3.4.2 Potential Impacts on Current and Planned Land Uses

This section includes a description and discussion of the impact of the proposed changes in land use, and identification and evaluation of the potential environmental consequences. See Section 4 for a discussion of the consistency of the project goals and objectives with local, State and Federal, environmental and land use plans and policies.

Current Land Use

WSB-Hawaii believes there are potential impacts of proposed windfarm on the Kahuku Ag Park, including residences, the former buffer zone (proposed project site) and the HECO transmission line.

Kahuku Ag Park

When transferring the project site area to DLNR, DOA indicated that land is no longer needed as a buffer zone for the Kahuku Ag Park. Given that the project has been designed to minimize the amount of disruption to the existing terrain, the windfarm could have a positive impact by continuing to provide a buffer between the existing conservation and urban districts contiguous to the project. There are potential negative impacts to the Kahuku Ag Park, including residences and other building, in terms of fugitive dust, noise during construction and operation, and visual impact. See sections 3.5, 3.14 and 3.16 for detailed discussions.

Former Buffer Zone - Proposed Project Site

Similar to the Kahuku Ag Park itself, there are potential negative impacts due to soil erosion, fugitive dust, and noise during construction and operation. There are also potential impacts to flora and fauna within the project area. There are potential impacts to the Kahuku community, including noise during construction and operation, and visual impact. See sections 3.5, 3.7, 3.8, 3.14 and 3.16 for detailed discussions.

HECO's Transmission Line

The close proximity of HECO's 46 kV transmission line facilitates the interconnection of the windfarm, and is compatible use and provides a positive impact. However, during construction of the windfarm transmission line and intertie, there are potential impacts due to soil erosion, fugitive dust and noise.

Planned Land Use

Since no other planned uses of the project area have been identified, the potential impacts on planned land uses are moot.

Evaluation

The evaluation of the severity of total impact on land use necessarily includes these other elements of the land and its inhabitants or users. WSB-Hawaii believes there are potential land use impacts that must be addressed through design and implementation of appropriate mitigative programs. These impacts have been identified above, and are summarized briefly below.

Kahuku Ag Park:

- Fugitive dust,
- Noise during construction and operation, and
- Potential visual impact.

Former Buffer Zone:

- Soil erosion,
- Fugitive dust,
- Noise during construction and operation,
- Potential harm to flora fauna, and
- Potential visual impact.

HECO Transmission Line Corridor:

- Soil erosion,
- Fugitive dust, and
- Noise during construction and operation.

WSB-Hawaii's believes the total impact to the Kahuku Ag District, the project site area and HECO's Transmission Line *can not be less* than the impact to any of these other elements. As discussed herein, some of these impacts are negative, e.g., per Section 3.8, the potential impact on avifauna is evaluated as significant. The other impacts are evaluated as non-significant or less.

WSB-Hawaii's evaluation of the overall potential impacts of the proposed action on land use includes the following four components:

(1) Primary Kahuku Ag Park uses – "significant,"

(2) Buffer Zone – Project Area uses – "significant," and

(3) HECO's transmission lines -- "non-significant."

Therefore, WSB-Hawaii evaluates the overall potential *land use impact* as *"significant."*

WSB-Hawaii believes the potential land use impacts can be avoided through careful siting of the windfarm and continued consultation with landowners, agency representatives and other parties. With mitigative, WSB-Hawaii believes the impacts can be reduced to non significant as discussed in section 3.4.3

3.4.3 Mitigative Measures

WSB-Hawaii proposes a mitigative program to ensure that the proposed action is fully compatible with the primary uses of agricultural lands, including the Kahuku Ag Park.

Kahuku Ag Park

The mitigative program includes measures to:

(1) minimize hazards and prevent damage due to fugitive dust during the construction and operational phases of the proposed action. See Section 3.5 for details;

(2) minimize noise impacts during construction and operation. See Sections 3.14 for details;

(3) reduce visual impact of the project. See Section 3.16, and

(4) coordinate the on-going planning and operational activities with DLNR, County and other agencies as appropriate.

Project Site Area

The mitigative program includes measures to:

(1) minimize hazards and prevent damage to the topography, geology and soils during the construction and operational phases of the proposed action. See Section 3.5 for details;

(2) minimize hazards and prevent damage to flora during the construction and operational phases of the proposed action. See Sections 3.7 for details;

(3) minimize hazards and prevent damage to fauna and their habitats during the construction and operational phases of the proposed action. See Section 3.8 or details;

(5) minimize noise impacts during construction and operation. See Sections 3.14 for details;

(6) reduce visual impact of the project. See Section 3.16; and

(7) coordinate the on-going planning and operational activities with DLNR, County and other agencies as appropriate.

HECO Transmission Line

The mitigative program includes measures to:

(1) minimize hazards and prevent damage due to soil erosion, fugitive dust during the construction and operational phases of the proposed action. See Section 3.5 for details;

(2) minimize noise impacts during construction and operation. See Sections 3.14 for details; and

(3) Coordinate on-going planning, construction and operational activities with HECO.

Evaluation

Based on the implementation of the mitigative program as discussed above and in the subsequent sections, WSB-Hawaii evaluates the severity of the potential impacts of the proposed action as follows:

1) *Kahuku Ag Park Land uses -- "non-significant*,*"*

   Note. This evaluation assumes that all other potential impacts on the key elements of the conservation land use are mitigated to negligible or less. This includes mitigative efforts to reduce impacts See Section 3.8 for details.

2) *Project Area – "non-significant,"*

   Note. This evaluation assumes that impacts due to fugitive dust, noise and visual impact are mitigated to non-significant.

3) *HECO's transmission lines -- "negligible," and*

4) *Total Land Use Impact – "non significant*."

3.5 Topography, Geology and Soils

This section includes a description and discussion of the topography, geology and soils in the study area, identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures, including an evaluation of the impact con-sequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.5.1 Existing Conditions

Topography

The study area is located on State agricultural lands near the community of Kahuku on the north shore of Oahu. The project site is located in the U-shaped former "buffer zone" which features two dissected ridges (oriented in a southeast-to-northwest direction) surrounding a gently sloping valley. The Kahuku Ag Park is located in the valley (see Figure 2.4.2-1). The ridge makai of the Kahuku Ag Park and mauka of Kahuku Town rises to about 76m (250ft), while the ridge mauka of the Kahuku Ag Park rises up to about 107m (350ft) in elevation. The makai ridge slopes moderately downward both towards Kahuku Ag Park and in the opposite direction towards Kahuku Town and the ocean. The mauka ridge slopes moderately downward towards the Kahuku Ag Park, but precipitously on the opposite side towards a large gully. From several wind turbine sites, and possibly from all turbine nacelles, there are broad-sweeping panoramas Kahuku Point to the northwest and the ocean to the northwest, Kahuku to the east, and towards Laie and the Ko'olau mountain range to the southeast. There are no significant topographic features in the study area.

Geology

The study area, including the nearby community of Kahuku, is in at the extreme northern part of the Ko'olau Range and just above the coastal plane.[20] Geologically, the general shape is that of a volcanic dome in its greatest stage of growth The project site's hills are less eroded than the gullies to west of the makai hills.. There are no unique or unusual geologic resources or conditions known to exist on or along the existing access roads.

Soils

"Soils within the Kahuku Agricultural Park have been classified by the Soil Conservation Service Soil Survey and include the Paumalu, Lahaina, Kaena, Haleiwa and Waialua services. These soil types represent a wide range of characteristics. The soils within the developed areas of the agricultural park are generally in the Lahaina, Haleiwa and Paumalu series. Erosion hazard and runoff are slight to moderate and slopes range from 2 to 25 percent."[21]

Soils in the project area include Kaena Stony Clay, 12-20% slopes (KaeD), Paumalu Badlands Complex (PZ) which is highly dissected and steep, and with coral outcrops (CR) at elevations below 100 ft. (Foote et al, 1972)." [22]

[20] Revised EIS, Kahuku Ag Park, State, DOA, prepared by Wilson Okamoto and Associates, Inc., May, 30,1984, p. III-3.
[21] *Ibid, p. III-14.*
[22] Biological Resources Survey, Na Pua Makani, Kahuku, Oahu, R. Hobdy, February 2009.

3.5.2 Potential Impacts

This section includes the identification and evaluation of potential environmental consequences to local topography, geology and soils during construction and operational activities.

There are no significant topographic or geological features on the proposed windfarm site or along the existing access road. The primary hazards are to the soils and primarily during the construction phase. As discussed in section 2.4.2. an intrasite road network would be constructed to form a single, U-shaped 5m (16.4ft) wide road approximately 2,000m (6,560ft). Individual spurs branch off from the main intrasite road to each turbine site. The tower foundations will require excavations of 30ft by 30ft by 30ft (deep). The intrasite road network will be accessed from a 100m extension from the existing site access road. These roads will be graded and maintained with gravel only where necessary. In addition, sections of the existing unnamed access road from Kamehameha Highway will need to be surfaced during and after the construction of the windfarm.

The potential impacts include:

1. disturbing excess amounts of soil during grading during construction of the intrasite road network and turbine pads,
2. disturbing or damaging native plants,
3. removing of trees,
4. grading in areas of extreme slope, and
5. damaging the existing site access road.

<u>Evaluation</u>

Based on the discussion above, WSB-Hawaii evaluates the severity of the potential impacts of the proposed action to the following:

(1) *Topography -- "non-significant,"*

(2) *Geology -- "none," and*

(3) *Soils -- "non significant."*

With mitigative, the severity of the environmental consequences to the soils on the windfarm site and along the site access can be reduced.

3.5.3 Mitigative Measures

In this section, mitigative measures are proposed and discussed. Refer to Table 3.1-2 for a summary of the environmental consequences and mitigative measures program.

<u>Geology</u>

No mitigative measures are required for geological resources.

Topography and Soils

Mitigative measures are required both during and immediately following the construction period and during the operation of the windfarm. WSB-Hawaii recommends the following mitigative program:

Construction Period.

- prior to construction, all access road and site construction plans should be reviewed with the County and the State Department of Transportation;
- the number of the spurs branching off the main intrasite road should be minimized. The main road widths should be held to 5m (16.4ft);
- construction activities should not be carried out in periods of high winds (excess of 40 mph) or in wet conditions (during or after heavy rain periods) to reduce the potential for wind and water erosion;
- the size of the turbine sites should be minimized;
- equipment should be used to compact the road and site surfaces to further reduce the potential for wind erosion;
- all disturbed native plants should be replanted nearby;
- the roads should be sprayed periodically with water to reduce the potential for dust, and
- where appropriate, channels or troughs will be added along sections the on-site road network or around on-site structures network to divert water flows and prevent soil erosion. Note: the turbine sites should not create new water flow hazards. If possible, the foundations should be below the local surface.

Operational Period

- maintenance crews and vehicles should use the prepared roads and site bases exclusively, i.e., there should be no "shortcutting" across the grassland,
- crews should maintain the roads on a regular schedule and when necessary to repair ruts or eroded areas, and
- all equipment should be stored inside the O&M facility or on designated graded parking areas only.

Based on the implementation of the mitigative program as discussed above, WSB-Hawaii evaluates the severity of the potential impacts of the proposed action to the following:

(1) Topography -- "none,"

(2) Geology -- "none," and

(3) Soils -- "negligible."

3.6 Hydrology and Water Resources

This section includes a description and discussion of the hydrology and water resources in the study area, identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures, including an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.6.1 Existing Conditions

Rainfall averages 45 in. to 50 in. per year with a winter maximum (Armstrong, 1983). There are no perennial or intermittent streams in the study area. There are no tsunami inundation zones in the study area. Other conditions affecting the hydrology in the study area are the soils and vegetation. As discussed previously, the soils on the proposed site are primarily from the Kaena and Paumalu associations. The existing vegetation consists of low, windblown shrubs and trees on the ridge tops and larger trees and brush in the surrounding gullies.

3.6.2 Potential Impacts

The proposed windfarm site is in an area where there are no hydrologic or water resources to impact. Thus, the potential impacts would occur during periods of heavy rain, and thus concerns regarding soil erosion would be the same as noted in Section 3.5. As in Section 3.5, WSB-Hawaii evaluates the severity of the proposed action on the hydrologic and water resources in the study area to be *"non-significant."*

3.6.3 Mitigative Measures

The potential impacts could be reduced be the implementation of the following mitigative measures during construction and operation of the windfarm. The key recommended actions to be taken to avoid impacts are to:

- review, prior to construction, all access road and site construction plans will the County and the State Department of Transportation:
- minimize disturbance to the land in order to reduce the potential for soil erosion;
- add, where appropriate, channels or troughs along sections of the intrasite road network and site access road to promote proper drainage and prevent soil erosion by diverting divert surface water flows; and
- use gravel or other road materials as necessary to maintain the integrity of the intrasite road network and site access road.

Given the implementation of these measures in conjunction with OWP's standard operating procedures, WSB-Hawaii evaluates the severity of the proposed action on the hydrologic and water resources in the study area to be *"negligible."*

3.7 Terrestrial Flora

This section includes a description and discussion of the terrestrial flora in the study area, identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures and an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.7.1 Existing Conditions

OWP commissioned a biological resources survey of the project area. The following is a summary from the report (See Section 8.2) prepared by OWP's consultant, Robert Hobdy.

"The vegetation on this property is a mixture of aggressive weedy species that have taken over since the abandonment of sugar cane agriculture, but there is also a complement of native shrubby species remnant on windy ridge tops. Most abundant throughout the project area is the common ironwood (*Casuarina equisetifolia*). Other common species are Chinese violet (*Asystasia gangetica*), octopus tree (*Schefflera actinophylla*), (*Bidens alba*) no common name, Guinea grass (*Panicum maximum*), Dallis grass (*Paspalum dilatatum*), pitted beardgrass (*Bothriochloa pertusa*), parasol leaf tree (*Macaranga tanarius*), niruri (*Phyllanthus debilis*), Formosa koa (*Acacia confusa*), kaimi clover (*Desmodium incanum*), 'uhaloa, Koster's curse (*Clidemia hirta*), Java plum (*Syzygium cumini*), strawberry guava (*Psidium cattleianum*), huehue haole (*Passiflora suberosa*), 'ulei, 'akia and Jamaica vervain (*Stachytarpheta jamaicensis*).

A total of 100 plant species were recorded during the course of the survey. Of this total, 17 were common native species: ni'ani'au (*Nephrolepis exaltata* subsp. *hawaiiensis*), kilau (*Pteridium aquilinum* var. *decompositum*), 'uki'uki (*Dianella sandwicensis*), (*Carex wahuensis*) no common name, 'akia, pala'a (*Sphenomeris chinensis*), uluhe (*Dicranopteris linearis*), moa (*Psilotum nudum*), pi'ipi'i (*Chrysopogon aciculatus*), pili grass (*Heteropogon contortus*), pukiawe (*Leptecophylla tameiameiae*), kauna'oa pehu (*Cassytha filiformis*), 'uhaloa, huehue (*Cocculus orbiculatus*), 'ulei, alahe'e (*Psydrax odorata*) and 'iliahi alo'e (*Santalum ellipticum*). None of these are rare species and all are known from multiple islands. The native species are mixed in with non-native species for the most part with the exception of a few spots on the lower ridged where 'ulei forms large monotypic patches."[23]

3.7.2 Potential Impacts

This section includes identification and evaluation of potential environmental consequences to the terrestrial flora in the study area due to the proposed action.

<u>Discussion</u>

The primary hazard is damage to vegetation during the construction and operation of the windfarm. The construction phase will include construction of site access road and intrasite road network, transport of equipment and materials to the site, construction of the tower foundations, erection of the towers and the wind turbines, and construction of the O&M building and the site substation. The following are some additional comments from Mr. Hobdy:

[23] *Ibid, p.4.*

"The vegetation on this property is dominated by non-native agricultural weeds and tree species, although a fair number of common native species occupy some of the ridge tops. No officially listed Endangered or Threatened plant species (USFWS, 1999) were found on the property, nor were any found that are proposed for such status. No special habitats were found either.

Due to the lack of unique or sensitive species or habitats there is little of botanical concern with regard to this property and the proposed project is not expected to have a significant negative impact on the botanical resources in this part of O'ahu.

If, however, there is any re-vegetation planned along road cuts or on the margins of tower pads, it is suggested that some of the native species listed above be selected for propagation and outplanting."[24]

Evaluation

WSB-Hawaii evaluates the severity of the potential impact on the terrestrial flora to be *"non significant."*

3.7.3 Mitigative Measures

WSB-Hawaii believes the potential impacts can be reduced through the implementation of mitigative measures during construction and operation of the windfarm. WSB-Hawaii recommends the following measures be implemented by OWP:

Construction. In addition to overall site construction procedures, WSB-Hawaii recommends that OWP:

- Hire a plant expert to supervise the actual construction work in areas in or near where there are native plants. The expert would identify plants to be removed for re-vegetation; and

- Re-vegetate above removed native plants" along road cuts and on the margins of tower pads, or elsewhere on the project site.

Operation. In addition to overall site operation and maintenance procedures, WSB-Hawaii recommends that OWP incorporate guidelines in standard operating procedures to identify, remove and replant native plants.

Evaluation. With these mitigative measures, WSB-Hawaii evaluates the severity of the potential impact on the terrestrial flora to be *"negligible,"* and potentially *"beneficial"* assuming a re-vegetation program.

[24] *Ibid*

3.8 Fauna: Birds and Mammals

This section includes a description and discussion of the fauna (birds and mammals) in the study area, identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures, including an evaluation of the impact consequences before and after mitigative measures. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action.

3.8.1 Existing Conditions

OWP commissioned a biological resources survey of the project area. The following is a summary from the report (see Section 8.3) prepared by OWP's consultant, Robert Hobdy.[25]

"Most of the wildlife observed on the property is non-native and generally unremarkable from an environmental protection standpoint. One native species, however, the Hawaiian hoary bat which was detected near the lower margins of the project is a federally Endangered species with all of the protections that are associated with this status.

The Hawaiian hoary bat is currently known from the six largest islands, but is considered rare on the island of O'ahu where few recent confirmed sightings have been made. That it was detected here in the Kahuku area is thus notable. One Kahuku resident when queried about these bats mentioned that her son had seen them during the evening on more than one occasion at the Pupukea Boy Scout Camp about 3 ½ miles west of the project area. It makes sense that they would occur in such a rural part of this highly urbanized island.

The Hawaiian hoary bat is a highly mobile creature that is known to move about in response to temperature changes and insect population spikes. They are solitary (rather than colonial) bats whose roosting sites appear to be opportunistic and ever changing. They have been recorded from almost every conceivable habitat including high and low elevations, forests, pastures, lava flows, bogs and even rural communities. They can occupy one area when flying insects are abundant and be absent when feeding opportunities have moved elsewhere. Thus no critical habitats have been established for them. The more we focus on these cryptic, nocturnal bats, the more of them we find and the more widespread we find them to be.

None-the-less, the presence of these endangered flying mammals in the vicinity of proposed wind turbines is of concern and merits consideration as to how to minimize threats to their well being.

In the same vein there is also a small possibility that Endangered waterbirds from the not too distant James Campbell National Wildlife Refuge might overfly the project area and place themselves in harms way. The situations with both the waterbirds and the bats may need to be addressed in consultation with the U.S. Fish and Wildlife Service.

No other concerns regarding the wildlife in this project area are anticipated."

[25] *Ibid, p.14-15.*

3.8.2 Potential Impacts

This section includes identification and evaluation of potential environmental consequences to the fauna (birds and mammals) in the study area due to the proposed action.

Background. The wind industry, government agencies, environmentalists and others in the United States, Europe and elsewhere have recognized since the early 1980's that wind turbines and windfarms can impact birds and bats and their habitats. Much has been learned over the years, in large part, through the efforts of the National Wind Coordinating Committee ("NWCC"),[26] which has been supported financially by the U. S. Department of Energy, the wind industry, and other entities. The following excerpt from the NWCC's Brief on Wind Energy Environmental Issues[27] provides an overall historical perspective on wind turbines and birds.

> "The potential effects of wind energy projects on wildlife and the environment first gained attention in the late 1980s. Birds -- especially federally protected golden eagles -- and red-tailed hawks -were being killed by wind turbines and high-voltage transmission lines near California's Altamont Pass. This sparked opposition to the project from environmental activists and aroused concern from the U.S. Fish and Wildlife Service.
>
> It is likely that serious conflicts with birds will be confined mainly to areas where large numbers of birds congregate or migrate, or where protected species are affected. Unfortunately, many of the traits that characterize good wind sites also are attractive to birds. Birds and wind turbines, however, are not completely incompatible. Research on bird populations and migratory patterns can indicate the potential effects of turbine placement. It is important to determine if the presence of a wind plant will result in a significant decrease in the total population of a bird species. In some cases, research will have to be augmented with continued monitoring during construction and operation to ensure wildlife safety.
>
> For wind plants currently experiencing bird conflicts, the immediate task is to find practical measures to reduce bird deaths and injuries. Mitigative proposals include changing the color of wind turbine blades, using tubular towers with diagonal stringers, eliminating places for birds to perch on the towers (especially perches near uninsulated electricity transmission lines) and using radar to alert wind project operators to the passage of large flocks of birds. Federal and State agencies and environmental organizations are collaborating on a research program to address the bird issue."

In a more recent update from AWEA in its Wind and Wildlife Brief,[28] AWEA provides the following comments about birds and bat interactions with wind turbines:

[26] U.S. consensus-based collaborative, formed in 1994, the National Wind Coordinating Collaborative ("NWCC") identifies issues that affect the use of wind power, establishes dialogue among key stakeholders, and catalyzes appropriate activities to support the development of environmentally, economically, and politically sustainable commercial markets for wind power. NWCC members include representatives from electric utilities and support organizations, State legislatures, State utility commissions, consumer advocacy offices, wind equipment suppliers and developers, green power marketers, environmental organizations, agriculture and economic development organizations, and State and federal agencies. See: http://www.nationalwind.org.

[27] Wind Energy Brief, Wind Energy Environmental Issues, NWCC, January 2007, No.2

[28] Wind Energy and Wildlife.http://www.awea.org/pubs/factsheets/Wind_Energy_and_Wildlife_Mar09.pdf

> "Following the realization that a problem existed with raptor kills in Altamont Pass, the wind industry has gone on to establish a record of building projects across the U.S. that are safe for birds. The industry has now responded rapidly to the discovery of a similar problem with bats in Appalachia."
>
> The Wind and Wildlife includes more details on bat interactions as follows:
>
> "Bats can also collide with wind turbines. Before 2003, bat fatalities at windfarms were also generally low. However, in 2003, avian studies at a new wind power plant in West Virginia discovered bat kills in numbers much larger than previously known. Since then, fatalities have been documented at higher than expected rates in Pennsylvania, Alberta, New York State and some other locations. After the initial 2003 discoveries, supporters of wind energy and bats reacted quickly, forming a new organization, the Bats & Wind Energy Cooperative (BWEC), in late 2003. BWEC includes AWEA, Bat Conservation International, the U.S. Fish and Wildlife Service and the U.S. Department of Energy's National Renewable Energy Laboratory. This initiative raises millions of dollars to fund studies designed to reduce bat mortality. BWEC is focused on finding good site screening tools and testing mitigative measures, including ultrasonic deterrent devices to warn bats away from turbines. More information on the research efforts of the Bats and Wind Energy Cooperative can be found on its website: http://www.batsandwind.org/."

WSB-Hawaii notes that the NWCC is coordinating ongoing research on bird and bat issues via its Wildlife Working Group.[29]

Relevant Experience in Hawaii. Given that wind turbines and windfarms have been installed and operating in Hawaii since the early 1980's, WSB-Hawaii believes it is important to discuss both the evolution in: (i) wind technology and (ii) the wind industry's understanding of the potential impacts of wind turbines on fauna in general, and avifauna specifically.

Therefore, starting with first wave of windfarms in Hawaii that included the following projects:

(1) Hawaii Electric Renewable System's ("HERS") two projects at Kahuku on Oahu:
   a. Makani Moa'e (1985 - 1996): 15 Westinghouse 600 kW wind turbines (9 MW total capacity), and
   b. Makani Ho'olapa (1987 – 1993): one 3.2 MW MOD-5B (3.2 MW)

(2) Renewable Energy Ventures' two projects on the island of Hawaii:
   a. Kahua Ranch (1983 - 1991): 198 Jacobs wind turbines (3.5 MW), and
   b. Lalamilo Wells (1983 – 1993): 120 Jacobs wind turbines (2.3 MW).[30]

(3) Apollo Energy Corporation's Kama'oa project at South Point, Hawaii (1987 – 2005): 37, 250 kW Mitsubishi wind turbines (9.25 MW).

[29] See: http://www.nationalwind.org/pdf/NWCC_ResearchPriorities.pdf.
[30] Owned by Hawaiian Electric Light Company, Inc. from 1995 to present with approximately 1.8 MW of 20 kW Jacobs turbines.

Discussion. These windfarms, like others of this genre, were planned and installed without study of potential impacts to birds and bats. Anecdotally, there is a paucity of data regarding birds and bats interactions during their operational periods in Hawaii. Specifically, WSB-Hawaii is not aware of any reported collisions of birds or bats with the wind turbines at these early windfarms. WSB-Hawaii notes that the windfarms in Hawaii included some of the smallest wind turbines available during that period, such as the 17.5 kW and 20 kW Jacobs wind turbines to the largest commercial turbine available, the Westinghouse 600 kW, and the Boeing 3.2 MW prototype turbine. In addition, WSB-Hawaii is also not aware of any reports of collisions of birds or bats with other wind turbines installed other windfarms or individually, including the Carter 25 kW, the ESI 40 kW. Of this period, only a few Jacobs turbines still operate at Lalamilo Wells.

The second wave of windfarms were planned and installed with the recognition that there had been problems with birds in other jurisdictions, especially in the Altamont Pass area as noted above. The second wave wind turbines represent the best available turbines of late 1990 to early 2000 period in wind technology. Specifically, the Vestas 660 kW was the company's workhorse turbine prior to the accent of a new wave of MW class machines. One of the best examples of the early MW class wind turbines is the GE 1.5 MW with its advanced electronic power control systems. The second wave projects includes:

(1) Hawaii Renewable Development ("HRD") at Hawi, Hawaii on private, agricultural land (2006 to present): 16 Vestas 660 kW wind turbines (10.56 MW);

(2) First Wind at Kaheawa Pastures on Maui on State conservation land (2006 to present): 20 General Electric 1.5 MW wind turbines (30 MW); and

(3) Tawhiri Wind Power at Pakini Nui, South Point, Hawaii on private, agricultural land (2007 to present): 14 General Electric 1.5 MW wind turbines (21 MW).

Discussion. During this period of wind development in Hawaii, permitting requirements of projects differed depending on the land designation and ownership. In general, wind energy facilities are considered "permissible" uses on both conservation and agricultural district lands. DLNR has administrative jurisdiction for State conservation land. All projects which are on State lands or use State funds are required per HRS §343 to prepare, at a minimum, an Environmental Assessment ("EA"), and if there are potential "significant" impacts, an Environment Impact Statement ("EIS"). Either an EA or an EIS, which are both informational documents, are submitted by developers in support of a Conservation District Use Application ("CDUA"). When approved by DNLR, a project developer is awarded a Conservation District Use Permit ("CDUP").

The project permitting process for projects on agricultural land is more complex. In general, the counties have administrative responsibility for permits, including conditional use ("CUP") and construction permits for windfarms. The CUP is required for approval of the proposed windfarm use. Whether an EA or EIS is required depends on the land ownership. If the project is on private agricultural land, an EA is not required. If the project is on County or State agricultural land, a conditional use permit is required. Finally, all projects required construction permits.

Since the HRD and Tawhiri projects are on private agricultural lands, EAs were not required. WSB-Hawaii notes that HRD conducted night-time radar surveys[31], during which no birds of concern or bats were detected.

The First Wind project is on State conservation district land. An EIS[32] was submitted by the original project developer Zond-Pacific Systems, Ashland, Oregon in support of its for CDUA for the Kaheawa Pastures 20 MW windfarm. WSB-Hawaii notes that a mitigative program was developed to reduce the risk to the endangered Newell's Shearwater (*Puffinus* auricularis newelli), Hawaiian Dark-Rumped Petrel *(Pterodraoma phaeopygia sandwichensis),* and Hawaiian Goose or Nene (*Branta sandwichensis).* WSB-Hawaii notes there no federal nexus for a Section 7 consultation, i.e., the project was not on federal lands and did not use federal funds. Thus, a take permit from the U. S. Fish and Wildlife was not required.[33]

Subsequently, Urban Power Corporation, Newton, Massachusetts acquired the project and secured a CDUP for a larger project of 30 MW on the same parcel. Urban Power was required by DLNR to prepare a Habitat Conservation Plan ("HCP") as one of the CDUP conditions. The project became operational in 2007, and was subsequently acquired by First Wind, Newton, Massachusetts. WSB-Hawaii notes that the approved HCP did result in the issues of a take permit from the U. S. Fish & Wildlife Service and a take license from DLNR for the following endangered species: the Newell's Shearwater, the Dark-rumped Petrel, the Nene and the Hawaiian Hoary Bat.

The third wave of windfarms includes projects under active development, such as the Na Pua Makani 25 MW project at Kahuku on Oahu, First Wind's 30 MW project nearby Na Pua Makani, and First Wind's expansion of Kaheawa Pastures on Maui. Each of these projects is in the planning and permitting phases, and WSB-Hawaii believes there is one common theme. Wildlife issues are being addressed in a proactive, collaborative manner with the counties, DLNR and U. S. Fish & Wildlife via creation and implementation of project Habitat Conservation Plans.

Evaluation

The study area is habitat to a number of avian and mammalian species. The identified avian and mammalian species include a number of common, non-native species. The presence of the Hawaiian Hoary Bat was also identified by OWP's consultant, Robert Hobdy, as noted above. WSB-Hawaii agrees with Mr. Hobdy that "the presence of these Endangered flying mammals in the vicinity of proposed wind turbines is of concern and merits consideration as to how to minimize threats to their well being." Also of concern are other bird species that are known inhabitants on Oahu, such as endangered waterbirds of the nearby James Campbell National Wildlife Refuge. While these birds not identified to be in the project area during the wildlife survey, there is concern that the may frequent the area, as well as the endangered Newell's Shearwater and Pueo. Therefore, the potential impacts are "*significant."*

[31]HRD voluntarily conducted these tests upon recommendation of the U. S. Fish & Wildlife Service.

[32]Kaheawa Pastures 20 MW Windfarm, Maui, Hawaii, Final Environmental Impact Statement prepared for Zond-Pacific, Wailuku, Hawaii by WSB-Hawaii, Kaneohe, Hawaii, August 1999.

[33]WSB-Hawaii also observes at that time DLNR did not issue take licenses. DLNR subsequently issued a take license, as a companion to the U. S. Fish & Wildlife Services take permit, for the Kaheawa project.

In preliminary discussions with the Division of Forestry and Wildlife ("DOFAW"), OWP and WSB-Hawaii have identified a number of endangered birds that might be impacted by the proposed windfarm. Specifically, WSB-Hawaii recommends that the HCP cover the following endangered birds: the Hawaiian Stilt (ae'o), the Hawaiian duck (koloa), the Hawaiian Coot ('alae ke'oke'o), the Hawaiian common moorhen (`alae`ula), the Newell's Shearwater ('a'o), the Hawaiian dark-rumped Petrel (`ua`u), and Hawaiian Short-Eared Owl (Pueo). And the HCP would also cover the Hawaiian Hoary Bat (Ōpe ape ape).

As noted previously, DLNR's approval and issue of a lease to OWP for use of the proposed project site on State agricultural land is contingent upon an approved Habitat Conservation Plan ("HCP"). OWP and WSB-Hawaii have initiated discussions on the HCP, and are preparing the draft HCP in parallel with this DEA.

3.8.3 Mitigative Measures

OWP has discussed the potential impacts of the proposed windfarm on birds and bats DOFAW and U. S. Fish & Wildlife. Discussion of specific mitigative measures follows, including a discussion of siting development and turbine design and operation guidelines from the U. S. Fish & Wildlife Service, and specific recommendations for issues and mitigative measures to be addressed by OWP in the HCP.

U. S. Fish & Wildlife Service Guidelines

The following is excerpted from U. S. Fish & Wildlife Service guidance on avoiding and minimizing wildlife impacts from wind turbines:[34] WSB-Hawaii comments are inserted as appropriate using *italicized text.*

"**Site Development Recommendations**

The following recommendations apply to locating turbines and associated structures within WRAs[35] selected for development of wind energy facilities:

1. Avoid placing turbines in documented locations of any species of wildlife, fish, or plant protected under the Federal Endangered Species Act.

   WSB-Hawaii Comments. While this is a worthy objective, unfortunately, some of Hawaii's best wind sites are near nesting and habitat areas for certain of Hawaii's endangered birds, e.g., Nene and Pueo at Kaheawa Pastures, and Na Pua Makani. WSB-Hawaii believes the Kaheawa Pastures is a example of how wind and birds can co-exist via an approved HCP together with the issuance of a take permit and take license to the windfarm owner/operator (First Wind) and ongoing monitoring and reporting. WSB-Hawaii notes that the risks to endangered birds from the proposed Na Pua Makani project site are to be evaluated and addressed in the proposed project HCP.

2. Avoid locating turbines in known local bird migration pathways or in areas where birds are highly concentrated, unless mortality risk is low (e.g., birds present

[34] Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines, U. S. Fish & Wildlife Service, Washington, DC, May 13, 2003.
[35] WRA = Wind Resource Areas.

rarely enter the rotor-swept area). Examples of high concentration areas for birds are wetlands, State or Federal refuges, private duck clubs, staging areas, rookeries, leks, roosts, riparian areas along streams, and landfills. Avoid known daily movement flyways (e.g., between roosting and feeding areas) and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.

WSB-Hawaii Comments. Whereas Hawaii does serve as the winter habitat to the migratory species Pacific Golden Plover, the Plover is not an endangered species. Moreover, WSB-Hawaii is not aware of any issues with the Plover at Kaheawa Pastures. This issue should be reviewed in the Na Pua Makani HCP.

3. Avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.

   WSB-Hawaii Comments. WSB-Hawaii observes that the Hawaiian Hoary Bat is not colonial, and it is not clear if the issues are the same as implied above. However, the issues with the Hawaiian Hoary Bat should be addressed in the Na Pua Makani HCP.

4. Configure turbine locations to avoid areas or features of the landscape known to attract raptors (hawks, falcons, eagles, owls). For example, Golden Eagles, hawks, and falcons use cliff/rim edges extensively; setbacks from these edges may reduce mortality. Other examples include not locating turbines in a dip or pass in a ridge, or in or near prairie dog colonies.

   WSB-Hawaii Comments. Hawaii has two raptors: (i) the endangered Hawaiian Hawk (I'o) known only to reside in high volcano areas of the island of Hawaii, and (ii) the Hawaiian Short-Eared Owl (Pue'o) which is listed as endangered on Oahu. The Pue'o should be covered on the proposed HCP.

5. Configure turbine arrays to avoid potential avian mortality where feasible. For example, group turbines rather than spreading them widely, and orient rows of turbines parallel to known bird movements, thereby decreasing the potential for bird strikes. Implement appropriate storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species (e.g., Sage Grouse).

   WSB-Hawaii Comments. The proposed Na Pua Makani project will consist of only 10 wind turbines and in two widely-spaced rows. While Hawaii has not Sage Grouse, the issue of the overall project design and layout raise in this recommendation should be addressed in the HCP.

6. Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated, and away from areas of intact and healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.

   WSB-Hawaii Comments. WSB-Hawaii notes this recommendation is hard to meet in Hawaii, as our islands generally contain large, contiguous tracts of

wildlife habitat. Oahu, perhaps, is an exception to that, given its larger ratio of human habitat than the other islands. However, the proposed Kahuku project area would appear to be more on the side of the "fragmented or degraded habitat." This issue should be addressed in the HCP.

7. Avoid placing turbines in habitat known to be occupied by prairie grouse or other species that exhibit extreme avoidance of vertical features and/or structural habitat fragmentation. In known prairie grouse habitat, avoid placing turbines within 5 miles of known leks (communal pair formation grounds).

   WSB-Hawaii Comments. This recommendation does not apply, in part, as there are no prairie grouse in Hawaii. There are birds in the same family as grouse, notably the Gray Francolin, native to India and southern Pakistan; the Black Francolin and the Erkel's Francolin, natives of the Near East. However, these local birds are not endangered, and given that their habitats differ from the prairie grouse, WSB-Hawaii does not believe this recommendation applies to Hawaii.[36]

8. Minimize roads, fences, and other infrastructure. All infrastructure should be capable of withstanding periodic burning of vegetation, as natural fires or controlled burns are necessary for maintaining most prairie habitats.

   WSB-Hawaii Comments. WSB-Hawaii believes the proposed design and layout of the Na Pua Makani project meets this recommendation. The intrasite road network will minimize the road dimensions, including the number of spurs to specific turbine sites. Also there will be no fences.

9. Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. For example, avoid attracting high densities of prey animals (rodents, rabbits, etc.) used by raptors.

   WSB-Hawaii Comments. This recommendation will be addressed in the HCP.

10. Reduce availability of carrion by practicing responsible animal husbandry (removing carcasses, fencing out cattle, etc.) to avoid attracting Golden Eagles and other raptors."

    WSB-Hawaii Comments. *WSB-Hawaii notes there while there are no Golden Eagles in Hawaii, there could be an issue here with respect to the Pue'o and this should be addressed in the HCP.*

[36] Personal Communication, Robert Hobdy, July 11, 2009.

"**Turbine Design and Operation Recommendations**

1. Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching and nesting. Avoid use of guy wires for turbine or meteorological tower supports. All existing guy wires should be marked with recommended bird deterrent devices (Avian Power Line Interaction Committee 1994).

   WSB-Hawaii Comments. The Na Pua Makani project will meet this recommendation as the Clipper turbines will be installed on tapered, tubular steel towers. Access to the turbine will be via an internal ladder system and/or elevator. If guyed meteorological towers are to continue to be used during the operation of the windfarm, they should be marked with recommended bird deterrent devices.

2. If taller turbines (top of the rotor-swept area is >199 feet above ground level) require lights for aviation safety, the minimum amount of pilot warning and obstruction avoidance lighting specified by the Federal Aviation Administration (FAA) should be used (FAA 2000). Unless otherwise requested by the FAA, only white strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. Solid red or pulsating red incandescent lights should not be used, as they appear to attract night-migrating birds at a much higher rate than white strobe lights.

   WSB-Hawaii Comments. Status on FAA application: OWP has obtained approval for avoidance lighting (red lights) on four of the 10 turbine nacelles.

3. Where the height of the rotor-swept area produces a high risk for wildlife, adjust tower height where feasible to reduce the risk of strikes.

   WSB-Hawaii *Comments. WSB-Hawaii does not believe this recommendation applies to the Na Pua Makani project.*

4. Where feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of the Avian Power Line Interaction Committee (1994, 1996) for any required above-ground lines, transformers, or conductors.

   WSB-Hawaii Comments. All intrasite electrical power lines will be place underground on the Na Pua Makani project. The referenced Avian Power Line Interaction Committee recommendations should be used with respect to other electrical equipment, such as the site substation.

5. High seasonal concentrations of birds may cause problems in some areas. If, however, power generation is critical in these areas, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates for specific sites. Where feasible, turbines should be shut down during periods when birds are highly concentrated at those sites.

   WSB-Hawaii Comments. WSB-Hawaii does not believe this recommendation applies to the Na Pua Makani project.

6. When upgrading or retrofitting turbines, follow the above guidelines as closely as possible. If studies indicate high mortality at specific older turbines, retrofitting or relocating is highly recommended."

   WSB-Hawaii Comments. Since *WSB-Hawaii the Na Pua Makani project is a new project to be constructed. .WSB-Hawaii does not believe this recommendation applies.*

Overall WSB-Hawaii Comments on U. S. Fish & Wildlife Service Recommendations. WSB-Hawaii believes that all of the recommendations are being addressed in the development and design of the Na Pua Makani project, or should be in the HCP. To be clear, WSB-Hawaii believes while the site development and wind design and operation guidelines have already been met, these issues will be revisited in the HCP. Also importantly, the remaining issues regarding the mitigative of potential impacts to wildlife during the construction and operation of the Na Pua Makani project should be addressed and resolved in the HCP.

Evaluation

The potential impacts to avian and mammalian species in the study area have been discussed in Section 3.8.2. Potential significant impacts have been identified to a number of endangered species, including the:

1. Hawaiian Stilt (ae'o),
2. Hawaiian duck (koloa),
3. Hawaiian Coot ('alae ke'oke'o),
4. Hawaiian common moorhen (`alae`ula),
5. Newell's Shearwater ('a'o),
6. Hawaiian dark-rumped Petrel (`ua`u),
7. Hawaiian Short-Eared Owl (Pueo), and
8. Hawaiian Hoary Bat (Ōpe ape ʻa

Given that DLNR is requiring the Na Pua Makani project to prepare and submit a HCP as one of the conditions for a land lease, WSB-Hawaii recommends that the following be addressed in the HCP:

1. the U. S. Fish & Wildlife Services recommendations for Site Development and Turbine Design and Operation as discussed above,

2. whether or not additional avifauna surveys could be conducted,

3. recommendations for mitigative measures for each of the covered species,

4. recommended resources for implementation of the HCP.

WSB-Hawaii Comments. WSB-Hawaii believes that appropriate mitigative measures can be developed and implemented to reduce the potential impacts to the covered species in the HCP. Given that, WSB-Hawaii believes the severity of the potential impact on the birds and mammals could be classified as *"non significant."* WSB-Hawaii notes that the objective of the Na Pua Makani project should be to apply for a take license from DLNR and a take permit from U. S. Fish & Wildlife Service, and to work with both agencies on an ongoing basis during the construction and operation of Na Pua Makani.

3.9 Cultural Resources

This section includes a description and discussion of the cultural resources in the study area, identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures, including an evaluation of the impact consequences before and after the proposed mitigative measures. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.9.1 Existing Conditions

OWP commissioned a desk study of the cultural resources in the study area. The scope of work included a review of relevant archaeological investigations that had been conducted in the project area, and recommendations regarding the adequacy and relevance of the previous studies to the proposed Na Pua Makani windfarm.

The following is a summary from the report (see Section 8.3) prepared by OWP's consultant, International Archaeological Research Institute, Inc. ("IARII"), Honolulu, Hawaii.[37]

> "**Recommendations**
>
> The review of previous land use patterns in the survey area as well as the visual inspection of maps of the cultivated areas and previous archaeological survey suggests that cultural remains are not likely to be encountered within the project area. Consequently, it is recommended that archaeological survey and testing need not be conducted in the areas already surveyed by Cultural Surveys Hawaii. Additionally, the areas indicated as disturbed and/or under previous pineapple cultivation are not likely to contain cultural resources. However, if activities associated with the construction of the Windfarm are to be conducted in other unsurveyed portions of the project area, it is recommended that pedestrian survey be conducted. The total unsurveyed portion of the project area is 53.5 acres."

WSB-HawaiiComment. After a review and comparison of the proposed windfarm project layout in Figure 2.4.2-2) with Figure 6 in the IARII report,[38] WSB-Hawaii concludes that the proposed project may extend into the unsurveyed areas as indicated by IIARI in Figure 6, for example at the proposed sites for turbines 5 and 10. Therefore, prior to construction, WSB-Hawaii recommends that IIARI be commissioned to survey the area around the turbine 5 and 10 sites and other locations as appropriate. For example, OWP may choose to move one or more of the other turbine sites, and/or the location of the intrasite road network. In addition, IARII has forwarded their report to the State Historic Preservation Division ("SHPD") for review. The SHPD review is pending.

[37] Archaeological Background Report for the Proposed Na Pua Makani Windfarm Project, Kahuku, O'ahu (TMK 5-6-008:006), IARII, Honolulu, Hawaii, May 2009, p.3.
[38] *Ibid, p.6.*

3.9.2 Potential Impacts

Based on the results of the IARII study, there are no known culturally-significant resources in the project area, and therefore, no potential impacts to be evaluated. As noted in Section 3.9.1, WSB-Hawaii has recommended a preconstruction archaeological survey in the areas around the sites for turbines 5 and 10.

There are still some concerns, however, that construction of the windfarm may "uncover" some significant resources, such as burials. This possibility, however remote, might occur, for example, during the excavations for the ten tower foundations.

Given the above, WSB-Hawaii evaluates the severity of the potential impacts to the cultural resources in the study area to be *"non significant."*

3.9.3 Mitigative Measures

WSB-Hawaii recommends the following measures to mitigate potential damage to cultural resources that may be discovered during the construction and operation phases of the Na Pua Makani windfarm:

1. Conduct a pre-construction archaeological survey of the turbine sites (number 5 to 10) and intrasite roads planned on the mauka ridge to ensure that there are no cultural sites;
2. Incorporate a protocol for halting of construction or other operations that uncover potential archaeological sites. Specifically, if historic remains are inadvertently uncovered during construction, all work should cease in the vicinity and OWP should contact both its consultant (IARII) and the State Historic Preservation Division office; and
3. Continue to Work with the State Historic Preservation Division of DLNR and others to record and preserve all sites that are identified as culturally-significant.

WSB-Hawaii believes implementing these procedures will mitigate the impacts to the cultural resources on the site. Given the mitigative measures, WSB-Hawaii evaluates the severity of the potential impact on the cultural resources in the study area to be *"negligible."*

3.10 Socioeconomic Environment

This section includes a description and discussion of the socioeconomic environment in the study area, identification and evaluation of the potential environmental consequences of the proposed action, and proposed mitigative measures, including an evaluation of the impact consequences before and after the mitigative measures. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.10.1 Existing Conditions

Introduction

The study area is located on State agricultural lands in the Kahuku-Malaekahana district near the community of Kahuku on the north shore of Oahu. The project would be located on a U-shaped parcel surrounding the Kahuku Ag Park. The parcel was a former buffer zone to the Ag Park. There are a number of farmers and permanent residents within the Ag Park.

The City and County of Honolulu ("County") has a current resident population of about 905,000.[39] The population of Kahuku Town is approximately 2,100. Oahu's economy has grown steadily resulting in a corresponding increase in demand for electricity. This growth has traditionally been spawned by new resort developments and overall growth in the visitor industry. As discussed in Section 2.2, Oahu had a 10-year period of sustained load growth of about 3% a year from 1995 to 2005[40]. Since then load growth peaked at 1,327 MW in 2004, then fluctuated as follows: 1,273 MW in 2005, 1,315 MW in 2006, 1,261 MW in 2007, and 1,227 MW in 2008. Future load predictions will need to be revised given the economic turndown that deepened during 2008. Regardless, HECO needs the project's expected output to help meet its RPS.

From the Hawaii Science and Technology Council Report entitled "Innovation and Technology in Hawaii: An Economic and Workforce Profile:[41]

> 'In 2007, the U.S. Bureau of Economic Analysis reported that economic output related to tourism-reliant services, the federal defense sector, and agriculture represented more than 17 percent of the State's $61.5 billion economy. The accommodations industry represented the single largest segment of the State's tourism industry, alone accounting for about 5.6 percent of State gross domestic product (GDP). Federal civilian and military expenditures accounted for another 11.5 percent of the State's GDP. Nationally, these two economic sectors combined to comprise only 5.4 percent of the U.S. gross domestic product (GDP), so they were over three times more concentrated in terms of relative economic output in Hawaii as they were in the U.S. as a whole.
>
> Between 2002 and 2007, the State benefited from growth in both tourism and defense. Hawaii's accommodations industry increased at a rate of about 4.2 percent annually (as compared with 3.9 percent for the nation) and its military expenditures grew 2.7 percent annually while spending nationally grew at 1.4 percent annually. These trends represented a turnaround for Hawaii, as prior to 2002 growth in both sectors lagged behind the rest of the nation. However, increased fuel prices, rising airline ticket prices, and reduced airline carrying capacity suggest that the State's tourism economy will face significant challenges in the months and years ahead.

[39] County web-site: http://www.visit-oahu.com/sec/about/facts.aspx
[40] HECO Adequacy of Supply letter to the Public Utility Commission dated January 30, 2008.
[41] http://www.hiscitech.org/_data/n_0001/resources/live/Innovation+Tech+Hawaii+Report+Sept30.pdf

> Likewise, changes in defense policy priorities and continued strains on the U.S. budget point to a future in which military spending in Hawaii could either stagnate or even decline.
>
> Not surprisingly, the tourism-related and federal civilian/military sectors were also among the State's largest employing sectors in 2007. The State's accommodations and food services industry provided more than 100,000 jobs, representing 11.7 percent of the State's nearly 870,000 jobs. About 84,000, or 10 percent of the State's workers, were employed in federal military or civilian agency jobs. Average income for the two sectors was significantly different, however. Average income earned for federal workers was $85,081 while the average income for accommodations industry workers was $43,978.
>
> Last year, the private-sector component of Hawaii's technology sector was nearly the size of Hawaii's financial sector. While the State's economy remains relatively healthy, the significant difference between the earnings of federal personnel as compared with food and accommodations workers illustrates the tremendous divide among Hawaii residents in their ability to afford a high quality of life in their home State. As Hawaii seeks to diversify its economic base, the State's technology sector could represent an important "third leg" in supporting the Hawaii economy and providing quality jobs for middle-class Hawaii residents."

From the above fairly positive view, the following overall assessment of the State's economy was provided to the 2008 Legislature by DBEDT Director, Ted Liu is more measured:[42]

> "For Hawaii, the economic conditions of 2008 mirrored the world's economic condition.
>
> Our economy slowed significantly in 2008, and that situation is expected to prevail through most of 2009. However, while the visitor industry has been seriously impacted by economic conditions, the overall State economy is doing better than the nation as a whole.
>
> Assuming that the national economy begins a recovery by mid 2009 as currently forecast, Hawaii should see improved economic conditions beginning late this year, with continued improvement into 2010.
>
> Wage and salary jobs for October 2008, were down a slight 0.3 percent from the same month in 2007. Most job losses in 2008 were heavily tied to visitor arrivals, which were down 9.5 percent for 2009 through October. Final figures for 2008 are expected to show total visitor arrivals down 10.1 percent for the year as a whole.
>
> We expect the contraction to continue into 2009. Tourism will decline again in 2009, but likely much less than this past year, just short of -2 percent. We also expect wage and salary jobs to show a slight decline for 2009 of -0.2 Percent.
>
> While it is of limited consolation, Hawaii's economy has so far shown less impact on jobs than the nation as a whole. National unemployment climbed to 6.7 percent in November 2008."

[42] 2008 Annual Report, State, DBEDT, http://hawaii.gov/dbedt/main/about/annual/2008/2008-dbedt.pdf.

WSB-Hawaii Comments. WSB-Hawaii observes that the economic conditions in Hawaii and on Oahu specifically have deteriorated since the reports noted above. For example, the State is still struggling to balance its budget and in doing so a number of State jobs are in jeopardy either from lay-offs, furloughs, pay decreases or other cost-cutting measures. However, amidst the "gloom and doom" associated with the recession, the technology sector and particularly the renewable energy sub-sector are the rising stars, and quite likely can help provide an economic stimulus now when it is most needed and on an on-going basis. The Na Pua Makani project is a good example of the specific types of projects that are needed.

3.10.2 Potential Impacts

This section includes identification and evaluation of potential impacts of the proposed action on the socioeconomic environment in the study area, the region and the cxounty.

Economic Assessment of the County

A number of elements of the County's economy could be impacted by the proposed project including the following.

Population and Housing

The construction of the windfarm would require approximately 100 jobs, form shipping turbines equipment to the site, site construction. Most of these workers would be expected to be existing Oahu or other Hawaii residents. These workers would most likely commute daily to the job site rather than relocating closer to the project area. The remaining workers would be existing supervisory OWP employees from the mainland that would obtain temporary housing accommodations on Oahu for the duration of the construction phase of the project.

Operational and maintenance ("O&M") activities would require three full-time and two part-time employees. Most of these positions are expected to be filled by existing Oahu residents. Thus, the project would have a net positive impact on the County population and housing.

Displacement and Relocation

Since the proposed windfarm is on currently undeveloped land, there would be no displacement of residences or businesses.

Public Services

Gas and electric services would not be required during construction. Communication from the site to other locations would be via cellular phones. Permanent electrical service would be established once the windfarm is interconnected with the utility's transmission system. Excavation would be required for installation of the wind turbine towers, site O&M facility and other foundations. Water would be trucked in as needed for control of dust. Sanitary wastes generated during and after construction would be collected in portable toilets.

Solid wastes generated during construction, not suitable for re-use on-site or recycling, would be transported to the County Waimanalo landfill on the Waianae coast. Note: excavated soils could be re-used on site and in repair of the intra-site and access roads. However, there may be miscellaneous construction debris that cannot be reused on site. Adverse impacts on public services and utilities are not expected during construction or operation of the windfarm.

While the windfarm would not continuously generate power, it would increase the reliability of HECO's system. The windfarm is expected to operate at an average capacity factor of 35% or greater. The windfarm would generate valuable electricity when the tradewinds blow or the wind is sufficiently strong from other directions. Thus, the windfarm would reduce the amount of fossil fuels needed at the HECO's powerplants.

Growth Inducement

The windfarm will provide "as available" power to HECO's system. As an "as available power" source, HECO does not consider wind-generated energy or other intermittent sources to have a capacity value. Therefore, this project is not considered growth inducing.

Economic Impacts

The proposed action would generate significant economic activity for the County and the State. The impacts of the $93M windfarm would about $280M in economic impacts during the expected 20-year lifetime of the project including:

Direct short-term economic activity of about $37M including:

- $35.5M in site construction contracts, services and other costs;
- $1.4M in State excise tax revenues; and
- $0.2K in County excise tax revenue.

Direct long-term economic activity about $247M including:

- $7M in fees paid by OWP to the state for the land lease;
- $6M in job-related income,` plus the resulting income tax revenues;
- $0.8M in revenues from excise taxes paid on operational materials and services;
- $3.7M in personal property taxes on improvements to the project;
- $220M in imported fuel costs savings (based on oil at $75/barrel).[43] A significant portion of this $220M would recirculate in Hawaii;
- Ratepayer savings over the 20 year lifetime. However, prior to the negotiation of the power purchase agreement, these savings cannot be estimated;
- Community Benefits Fund of $1.5M ($50/year for the first 10 years; $100K/year for the next 10 years) to be paid in the form of an endowment from the proceeds of the windfarm operation to the Kahuku Community Association; and
- $TBD for bird and bat mitigative measures, contingent upon approval of Habitat Conservation Plan.

Discussion of Imported Fuel Cost Savings. Imported fuel cost savings result in a number of positive and negative impacts. On the positive side, the direct short-term and long-term economic activity noted above is substantial, over $300M including the imported fuel costs savings, but the associated indirect (economic multiplier) effects. On the negative side, project finance payments would most likely go out of Hawaii (unless Hawaii investors are found) and profits would go out of Hawaii to OWP and its investors. Also, there would be an offset of imported fuel-based revenues, e.g., tax revenues associated with imported fuel purchases, and a reduction in revenues in the local refining and shipping industry.

[43] Based on an average capacity factor of 35 percent, the estimated annual electrical output would be 76,650 MWH. From HECO's IRP report, the average heat rate of its generators is 10 mmbtu/MWH. Thus, the windfarm would save 766,500 mmbtu a year. Since the average Btu content of a barrel of oil used by HECO is 6 mmbtu, the windfarm would save HECO 127,750 barrels of oil a year or almost 3.2 million for 25 years. At $75/barrell, the annual savings would be almost $9.6 million, the 25 year savings would be over $239 million.

Discussion of Potential Ratepayer Savings. The estimated ratepayer savings are based on the compelling history of increasing avoided costs over time. When OWP signs a power purchase agreement ("PPA") with HECO, the future payment rate (in cents/kWh) for windpower will be fixed and known. Given the known payment rate and an estimated annual windfarm output, the total costs per year for the windpower would also be known.

However, HECO's costs that are avoided by the use of windpower are not fixed and are not known, i.e., the avoided costs go up and down, primarily due to the rise and fall of fuel costs. Assuming (at the start of the windfarm project) HECO's avoided cost is similar to the floor price for wind, there would be no ratepayer savings if wind payments turn out to be the same as the avoided costs. However, if the avoided costs escalate at a higher rate than the wind payments, the ratepayers will save. The opposite, of course, would be true, i.e., should the utility's avoided cost go down and the ratepayers would pay more for windpower. Consequently, once the PPA has been signed, the ratepayer savings can then be estimated based on the avoided costs at the signing of the PPA and assumptions about how the avoided costs will escalate with time. Historically, since the avoided costs will escalate more rapidly that typical consumer price indices, WSB-Hawaii believes there indeed will be savings to the ratepayer derived from the operation of the Na Pua Makani windfarm.

Evaluation

There is a compelling economic argument that the multiplier effects associated with using windpower on Oahu are higher than those associated with HECO's use of imported fuels. WSB-Hawaii believes that the proposed action would have a net positive impact on the economy of the County and the State as a whole. This benefit would come from the combination of the direct and indirect economic benefits of the economic activity that the project would generate. WSB-Hawaii believes the benefits will increase further, if local investment is made in the project. Thus Therefore, WSB-Hawaii evaluates the severity of the impacts on economy of County to be *"beneficial."*

3.10.3 Mitigative Measures

WSB-Hawaii believes no mitigative measures are required.

3.11 Infrastructure

This section includes a description and discussion of the infrastructure in the study area identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures, including an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.11.1 Existing Conditions

The study area is located on State agricultural lands in the Kahuku-Malaekahana district near the community of Kahuku on the north shore of Oahu. The project would be located on a U-shaped parcel surrounding the Kahuku Ag Park. The parcel was a former buffer zone to the Ag Park. There are a number of farmers and permanent residents within the Ag Park.

Roads and Traffic

There is an existing asphalt road (unnamed) which provides access to the Kahuku Ag Park primarily for farmers and residents. Site access would be via existing asphalt road for about 3K (1.8m) from the main highway to the entrance to the windfarm site. An intrasite road network will constructed to provide access to individual turbines, the site operations and maintenance building, anemometer towers, and the site electrical substation. Access to the proposed windfarm site is discussed in more detail in Sections 2.4.2, 3.4 and 3.5.

Utilities

There are utility distribution lines within Kahuku Ag Park, and HECO's 46kV line crosses the northern, flat part of the Ag Park and reaching the Kamehameha Highway near the site access road. See Figure 2.4.2-1.

3.11.2 Potential Impacts

This section includes identification and evaluation of potential environmental consequences to the infrastructure in the study area due to the proposed action.

Roads and Traffic

As discussed in Section 3.5, the primary potential impacts to roads will be during the construction phase of the project, in this case, damage to the existing, unnamed asphalt access to the Kahuku Ag Park. Without mitigative, WSB-Hawaii evaluates the severity of the impacts as "*non significant*."

There are other potential impacts to the traffic on the main highway. These would occur during the construction phase, e.g., heavy trucks transporting the wind turbines and towers, and concrete trucks for the foundation.

Utilities

The electric utility service would be established on-site once the windfarm has been intertied to HECO's transmission system. Water and waste removal systems would be installed with the operations and maintenance facility. During construction, all necessary utilities would be brought on site, i.e., portable toilets, bottled water and portable generators as necessary. There would be the normal hazards with transportation and operation of these systems.

In addition, during transportation of the wind turbines, their towers and blades to the site, there are potential impacts to the existing utility distribution lines. Specifically, given that the asphalt road is "narrow" in spots, care must be taken to avoid contract the utility poles and lines, especially in areas where the road bends. WSB-Hawaii cannot also rule out at this point whether there could be some clearance issues on Kamehameha Highway.

Given these potential hazards, WSB-Hawaii evaluates severity of the impacts as "*significant*."

Evaluation

With the implementation of OWP's standard safety practices, the hazards associated with transporting the wind turbines, towers, equipment and construction materials to the site can be minimized in the study area. Therefore, WSB-Hawaii evaluates the severity of the impacts on roads and traffic and the utilities to be *"significant."*

3.11.3 Mitigative Measures

WSB-Hawaii recommends that the following mitigative measures be taken by OWP:

1. As part of the construction and transportation planning process, a detailed review of the clearances (heights and widths) required during the transportation of the wind turbines, towers, equipment and construction materials to the site, and comparison of those clearances with respect to obstacles that could be encountered both on site access road and Kamehameha Highway;
2. A thorough review of the construction and transportation plans with the County and the State Department of Transportation;
3. Apply for and secure any necessary transportation permits; and
4. Repair of all damage to roads as a consequence of OWP's construction and operation activities.

WSB-Comment. As part of its lease with the State, OWP will be required to provide a "letter of credit" or a "performance bond" to ensure: (i) satisfactory completion of construction and necessary repairs to the project area, and (ii) decommissioning of the project if applicable.

WSB-Hawaii believes implementing these mitigative measures will mitigate the impacts to the existing infrastructure that could be affected during the construction and operation of the Na Pua Makani project. Given on-going and successful implementation, WSB-Hawaii evaluates the severity of the potential impact on the existing infrastructure to be *"non-significant."*

3.12 Public Services and Facilities

This section includes a description and discussion of the public services and facilities in the study area, identification and evaluation of the potential environmental consequences of the proposed action on these resources, and proposed mitigative measures, including an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.12.1 Existing Conditions

Because of its location surrounding the Kahuhu Ag Park and near Kahuku Town, the Na Pua Makani windfarm will be close to health care, police, fire protection and other public services. The Kahuku Hospital is located at 56-117 Pualalea Street and the telephone number is 293-9221. In case of emergencies, paramedic and ambulance services are available in Kahuku Town. These units are dispatched in response to a standard 911 call.

The Kahuku Police Headquarters is located at 56-470 Kamehameha Highway in Kahuku Town. In case of emergencies, units are dispatched in response to a standard 911 call. Non-emergency calls are taken at 293-8565.

The Kahuku Fire Station (#13) is located at 56-460 Kamehameha Highway in Kahuku. The fire station's phone number is 293-5005. The next closest fire station is the Waialua Fire Station (#14) is at 66-420 Haleiwa Road in Haleiwa. The phone number is 637-4222.

3.12.2 Potential Impacts

Discussion

This section includes identification and evaluation of potential environmental consequences to the public services and facilities in the study area due to the proposed action.

The proposed project is not anticipated to impact to the existing public services and facilities. However, given the rural location of the proposed windfarm site, there are potential impacts to the site and personnel. These include:

- time required for emergency medical, police and fire units to respond to the project are and specific turbine sites for serious events, such as a "heart attack," and
- situations where it may not be feasible for emergency units to respond using standard procedures, such as use of fire trucks to fight an on-site grass fire.

WSB-Hawaii believes that planned, on-site emergency capabilities would mitigate some of these hazards. For example, the site would be equipped with emergency first aid and fire-fighting equipment. This would be adequate for typical, minor incidents, accidents and fires.

Evaluation

In this case, there should be no impact on the public services and facilities. WSB-Hawaii evaluates the severity of the potential impacts on the project due to lack of nearby public services and facilities to be *"non significant."* WSB-Hawaii believes these impacts can be reduced with mitigative measures.

3.12.3 Mitigative Measures

Discussion

WSB-Hawaii recommends the following step to mitigate the potential hazards of the emergency events. These include:

- ensuring that there are adequate medical supplies on-site for minor medical and fire emergencies;
- implementing appropriate medical and fire emergency procedures, including training, into the overall site O&M procedures;
- contracting with a local helicopter company for emergency medical evacuation, such that be necessary to one of Oahu's primary hospitals, such as Queens in Honolulu; and
- coordinating with the Kahuku Fire Departments on emergency response firefighting procedures.

WSB-Hawaii also recommends coordination with the key emergency planners at the hospital, fire and police departments during the design phase of the project, including incorporation of recommendations for enhancing on-site capabilities.

Evaluation

WSB-Hawaii believes the potential impacts to the site and site personnel can be reduced per the above recommendations. Therefore, WSB-Hawaii evaluates the severity of the potential impacts on the project to be *"negligible"* following implementation of the mitigative measures.

3.13 Air Quality and Meteorology

This section includes a description and discussion of the air quality and meteorology in the study area, identification and evaluation of the potential environmental consequences of the proposed action on air quality, and proposed mitigative measures including an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the impacts of the proposed action and mitigative measures program.

3.13.1 Existing Conditions

Air quality is influenced primarily by meteorological conditions, the size and topography of the air basin, and the type and amount of pollutants emitted into the atmosphere. In this case, the air basin consists of the island of Oahu, of which, the study area is a relatively small portion.

Meteorology

The climate of Oahu, like all the major islands in the Hawaiian Island chain, is relatively uniform throughout the year, characterized by moderate temperatures with more rain during the winter months and moderate humidity throughout the year. Prevailing winds in the study area are from the northeast and east. The northeasterly and sometimes easterly tradewinds occur over 70 percent of the time. However, during "Kona" conditions, the prevailing direction changes to a southeasterly to southwesterly direction, and more rarely westerly. The winds at the proposed windfarm site are strong due to the acceleration of the air in normal tradewind conditions as the winds move from the ocean across the Kahuku plain and up the hills in the project area. These accelerated wind conditions increase the viability of the windfarm. There are diurnal variations in the wind such that the winds generally are stronger in the afternoon and lessen during the night time hours, when they can reverse during conditions when the ocean is warmer than the land ("land breeze").

With the moderating effect of the Pacific Ocean and the sub-tropical latitude of Oahu, the diurnal and seasonal ambient temperature variations in the Kahuku area are relatively small. During January, the temperature average ranges from a low of 70 degrees Fahrenheit (°F) to a high of 82°F. In August, the warmest month, the average temperature ranges from 72°F to 85°F.[44] The winter months are rainier, with monthly rainfall averages of four to five inches from November through March to two to three inches a month during the summer months. Annual rainfall is estimated to be 40 inches a year in the Kahuku area.[45]

Air Quality Standards

Air quality standards, defined as the ambient air pollutant concentration levels not to be exceeded more than once a year during a specified sampling period, have been adopted by the Federal and State governments for major pollutants. Currently the State monitors: carbon monoxide ("CO"), hydrogen sulfide ("H_2S"), nitrogen dioxide ("NO_2"), ozone ("O_3"), fine particulate matter ("$PM_{2.5}$"), particulate matter ("PM_{10}"), and sulfur dioxide ("SO_2").

[44] Temperature and Rainfall Data of Oahu, Hawaii, H. Ikawa, G. Y. Tsuji, and Neal Fuji, Revised May 2007. See: http://hikawa.htohananet.com/climate-oahu/
[45] *Ibid*

Both State and Federal air quality standards apply to the study area, although State standards contained in Chapter 59, Title 11, Department of Health, Administrative Rules are generally more stringent.

Existing Air Quality

The nearest air quality monitoring stations to the study area are all on the leeward side of Oahu at West Beach, Kapolei, Sand Island and Honolulu.[46] WSB-Hawaii is not aware of any air quality stations near the study area. In addition, there are no known significant point sources of air emissions of major pollutants in the study area. There are, of course, components of engine exhaust from roadway traffic and agricultural operations; dust and other particulates from periodic cultivating or harvesting crops; and traces of chemicals used in pesticides, ripeners and other materials that may be used in Kahuku Ag Park. Thus, ambient air quality conditions in the study area include intermittent, temporary increases in pollutant emissions that vary with the time of day, wind conditions and seasonal activities. However, WSB-Hawaii is reasonably certain that there have been no recent exceedances of State or Federal standards in the Kahuku area.

3.13.2 Potential Impacts

This section includes identification and evaluation of potential impact on the air quality the study area, the region and the County due to the proposed action.

Discussion

The proposed action would result in positive impacts in the long-term to the air quality on Oahu, and could potentially result in some negative impacts during the construction phase of the proposed action.

Positive Impacts

Background. With operation of the windfarm, the electricity generated by the wind turbines would offset a portion of fossil fuels needed to generate electricity at Oahu's power plants. Because of the reduction in the fossil fuel use, portions of the air emissions from HECO's power plants, as well as portions of the fossil independent power producers, would be avoided. The emissions are in the form of releases of gases such as carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen dioxide, particulates, and volatile organic compounds

A detailed estimate of avoided emissions has not been made for the Na Pua Makani project at this time. However, WSB-Hawaii did estimate avoided emissions for the proposed Kaheawa Pastures[47] 20 MW project on Maui. Based on those results, WSB-Hawaii believes the *annual* avoided emissions for the Na Pua Makani 25 MW would be on the order of:

1. **115 thousand pounds** of carbon monoxide
2. **106 million pounds** of carbon dioxide

[46] See: http://hawaii.gov/health/environmental/air/cab/cab_onlinedata/cab_onlinedata_intro.html.

[47] Kaheawa Pastures 20 MW Windfarm, Maui, Hawaii, Final Environmental Impact Statement prepared for Zond-Pacific, Wailuku, Hawaii by WSB-Hawaii, Kaneohe, Hawaii, August 1999.

3. **187 thousand pounds** of sulfur oxides (including sulfur dioxide)

4. **359 thousand pounds** of nitrogen oxides (including sulfur dioxide)

5. **69 thousand pounds** of particulates

6. **39 thousand pounds** of volatile organic compounds

WSB-Hawaii Comments**.** WSB-Hawaii did adjust the estimate from Kaheawa upward to account for the differences in the windfarm sizes. However, there are at two caveats for this preliminary estimate of avoided emissions. Specifically, the estimate did:

1. not account for the higher fraction of coal-fired generation on Oahu than on Maui. This would cause the estimates to be low; and

2. not account for differences in the efficiencies and dispatch of the oil-fired generation on Oahu. This could cause the estimates to be high.

On balance, it should be clear that significant amounts of fossil fuel emissions can be avoided by the operation of the Na Pua Makani windfarm.

Negative Impacts

As discussed previously in Section 3.5, there are potential soil erosion hazards during construction and operation. These could result in dust and potential negative impact to the local ambient air quality. However, these emissions are not expected to be significant.

Evaluation

There are both positive and negative potential impacts on the ambient air quality in the study area and in the region. The positive impacts are due to the avoidance of fossil fuel emissions, the negative impacts are due to the potential for dust to be released to the atmosphere during construction and operation. WSB-Hawaii evaluates overall severity of the long-term impacts as *"beneficial*," and the short-term impacts as "*non-significant.*"

3.13.3 Mitigative Measures

Mitigative measures are required to reduce the potential occurrence of dust releases to the atmosphere during construction and operation. The measures are the same as for mitigating the potential for soil erosions. They are discussed in Section 3.5.3.

Based on the implementation of the proposed mitigative measures, WSB-Hawaii evaluates the severity of the short-term impacts as *"negligible."* The long-term impacts remain *"beneficial."*

3.14 Acoustic Noise

This section includes an acoustic emissions assessment of the Na Pua Makani Wind Farm Project and project area. Specifically, sub-sections include discussion of existing conditions in the project area, potential impacts of the proposed windfarm, and mitigative procedures for the project. The project's potential impacts are reviewed in the context of applicable Hawaii State noise ordinances and the experience of other installed windfarm projects. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.14.1 Existing Conditions

This sub-section includes discussion of background information on acoustic noise, wind turbines and acoustic noise, acoustic noise standards, and existing sources of acoustic noise

Background Information on Acoustic Noise

Definitions. The following definitions will be used for the purpose of the discussion of acoustic noise in this DEA:

- **Acoustic Noise:**[48] Acoustic noise, is any sound in the acoustic domain, both wanted (music, bird song, amplified speech, etc) and unwanted. Unwanted noise includes noise pollution in an otherwise quiet environment.

- **Noise:**[49] In common use, the word **noise** means unwanted sound…

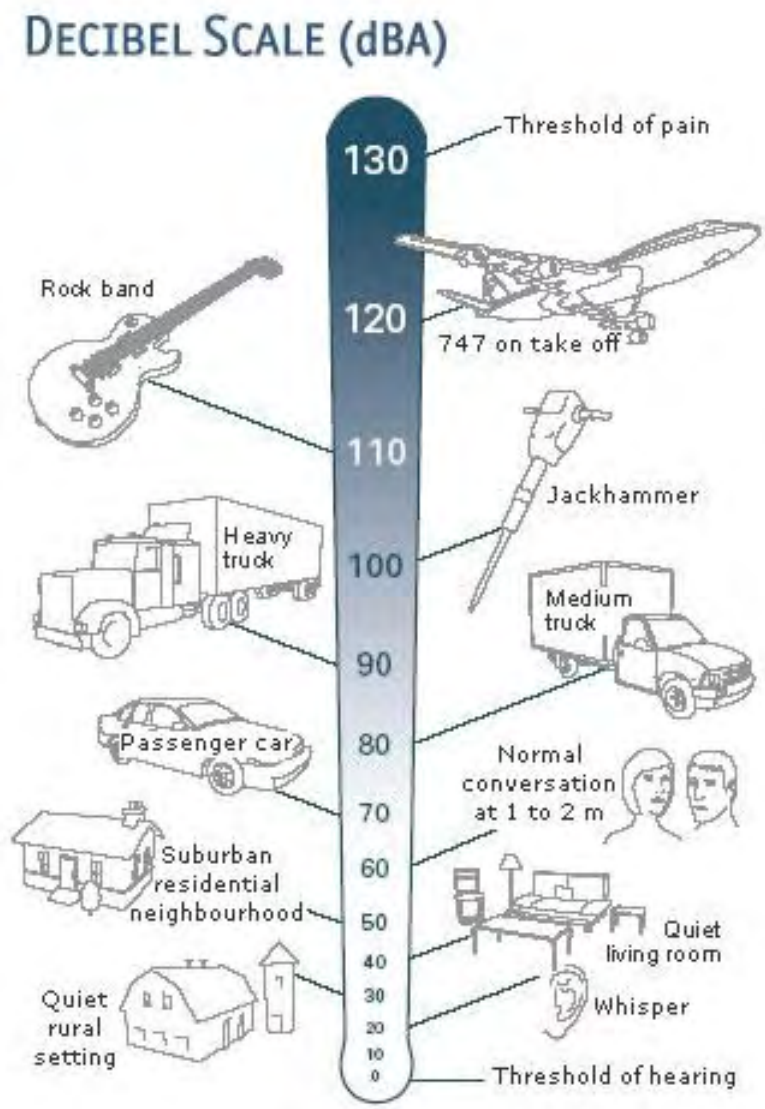
- **Sound**[50] **and Sound Waves:**[51] "*Sound* is a defined as rapid fluctuations of air pressure which create a repeating cycle of compressed and expanding air." This repeating cycle is known as *sound waves*.

- **Sound Power:**[52] "*Sound power* is the energy converted into sound by the source. Sound power is not measured directly, it is calculated from measurements, and is used to estimate how far sound will travel and to predict the sound levels at various distances from the source. Several wind turbine manufacturers provide sound power with their turbine brochures. For example, Vestas' V80, 1.8 MW turbine emits between 98 and 109 dB(A) of sound power depending on configuration."

- **Sound Pressure:**[53] **"***Sound pressure* is the local pressure deviation from the ambient (average, or equilibrium) pressure caused by a sound wave. Sound pressure can be measured using a microphone in air and a hydrophone in water. The SI unit for sound pressure is the Pascal (symbol: Pa)."

[48] Definition from Wikipedia (http://en.wikipedia.org/wiki/Noise_(acoustic))
[49] Definition from Wikepedia (http://en.wikipedia.org/ w/index.php? title=Special:Search&search =noise&fulltext=Search
[50] Primer For Addressing Wind Turbine Noise, Daniel J. Albert, Lawrence Technological University, 2006, p. 4. See: http://www.ltu.edu/cm/attach/165D79C3-DD14-41EC-8A7F-CFA2D0C272DE/ Addressing WindTurbineNoise.pdf
[51] Definition from Wikipedia
[52] Primer For Addressing Wind Turbine Noise, Daniel J. Albert, Lawrence Technological University, 2006, p. 4
[53] Definition from Wikipedia.

Measurement of Sound Pressure. The pressure created by a sound wave traveling through the air can indeed be measured. Measurements of sound pressure are typically converted into sound pressure levels called “decibels” (dB), and are reported at a specific distance from the source. Figure 3.14.1-1 shows some common sounds and their associated sound pressure level in decibels. Note: to compare sound levels at other points relative to an initial measurement, a doubling in the distance from a source of sound would result in a decrease in the sound level of 6 dB. For example, in the chart below, if the sound of a 747 on take-off is measured at a distance of 200 ft to be 120 dB, the level at 400 ft would be 114 db, and still quite loud.



City of Vancouver, Engineering Services

Figure 3.14.1-1 Typical Sound Levels

Measurement of Sound Frequency. The frequency of a sound is the number of times per second that the sound wave cycle of compressed and expanding air repeats itself. This rate is expressed in hertz (Hz) units; Table 3.14.1-1 shows the important ranges of sound frequencies in hertz. Sounds are classified based on how many frequency components they contain. A tone has only one frequency, narrowband contains two or more frequencies that are similar in value, and broadband sounds contain multiple frequencies that span more than a 1/3 of an octave.

	Range in Hertz
Normal Hearing	20 Hz - 20,000 Hz
Normal Speech	100 Hz - 3000 Hz
Low Frequency	20 Hz - 200 Hz
Infra Sound	< 16 Hz

Table 3.14.1-1. Sound Frequency Ranges

Decibel Weighting. Since low frequency sounds (20-200 Hz) seem quieter than higher frequency sounds of the same decibel level, a weighting scale is usually applied to decibel values. These weighting scales translate decibel values of various frequencies in order to more closely reflect how humans perceive sound. The A scale divides the possible frequencies of sound waves into octaves, and then adjusts the decibel levels of the octaves so that common decibel levels from different octaves will have the same loudness. The A scale is commonly used by many organizations such as the US Department of Labor, ANSI, and the EPA to assess health impacts and set noise exposure limits. The decibel scale is a logarithmic scale relative to the human threshold of hearing. There are two common guidelines relating to the human perception of sound: (i) an increase of three dB is perceived by humans as an increase in sound, and (ii) an increase of 10 decibels is perceived as a doubling of the sound level.

Attenuation. Sound attenuation refers to the lessening of sound levels by various factors including terrain, vegetation coverage, climate, reflections, and groundcover. The most influential attenuation factors are distance, wind direction, and building material absorption.

1. Distance. Low frequency sounds will attenuate less over distances than higher frequency sounds. This means that low frequency sounds can travel farther and be heard at greater distances. (As noted above, doubling of the distance from the sound source will result in a sound level drop of 6 dB).

2. Vegetation. Vegetation, either in the form of grass, shrubs or trees, decreases the propagation of sound. Vegetation decreases sound by both scattering and ground attenuation. The more permeable soil is to air the better it is at reducing sound propagation. A study by the Acoustical Society of America shows that hemlock, pine and brush can attenuate 5dB/100 feet at a frequency of 400 Hz.

3. Wind direction. Referring to Figure 3.14.1.3, reduction in noise from a wind turbine is most noticeable in the upwind and sidewind directions, while slight increases in the downwind direction may be detectable by humans. WSB-Hawaii notes these estimates are subject to the influence of other atmospheric conditions which may enhance or attenuate the effects illustrated in the figure.

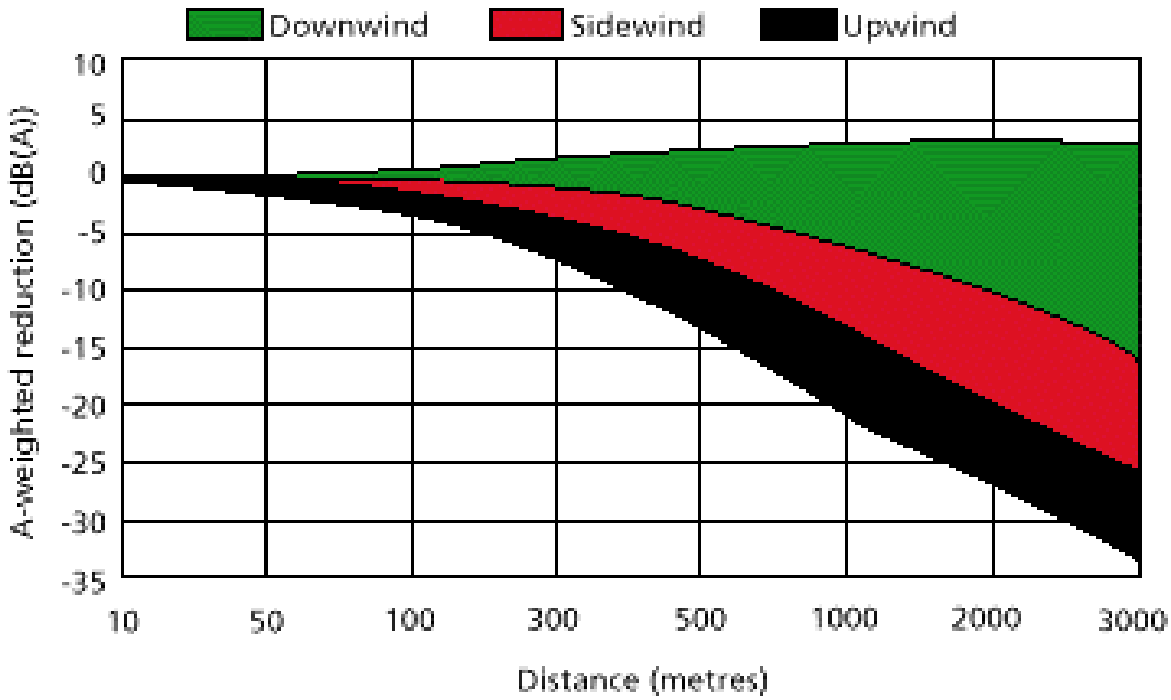


Figure 3.14.1-2 Effects of Wind Direction on Sound Attenuation

4. Absorption of Building Materials. Lower frequency sounds are attenuated less by buildings with stud walls and windows than higher frequency sounds. Temperature and climate will affect building absorption, but studies have found that a building with stud walls and windows can attenuate a 250 Hz sound by about 20 dB. A lower frequency sound, such as 63 Hz, will only be attenuated by about 5-10 dB by the same building.

Health Impacts to Humans. Excessive exposure to noise has been shown to cause health problems to humans such as; hearing loss (temporary and permanent), sleep loss, headaches, and fatigue. There is no data, or studies, to indicate that wind turbines create levels of noise sufficient to cause these health problems. Table 3.14.1-2 shows values of maximum noise exposure based on the American National Standards Institute ("ANSI").

Sound Level dB(A)	Maximum Exposure Time
90	8 Hours
95	4 Hours
100	2 Hours
110	30 Minutes

Table 3.14.1-2. ANSI Maximum Noise Exposure Levels

Wind Turbines and Acoustic Noise

Introduction. Large scale wind turbines are industrial machines and do emit noise. Wind turbines create both aerodynamic and mechanical sound as a result of wind speed, turbulence, and energy generation. Aerodynamic sound from a wind turbine comes from the wind's effect on the spinning blades, and can be affected by turbulence and the wind turbine's tower. Mechanical sound from a wind turbine is primary a result of the spinning gears within the wind turbine's gearbox in nacelle, and the "humming" of the turbines electrical generator.

A wind turbine emits noise spherically, although most of the noise radiates perpendicular to the blade's rotation. The sound power generated by a wind turbine propagates outward from the height of the hub, at the center on the blades. Most wind turbine's are on high enough towers that there is a significant attenuation even at the base. A wind turbine with a maximum noise output of 109 dB could attenuate down to 60 dB in the 80 meter journey to the base of the tower in large part due to the damping effects of the turbine's nacelle (especially with sound damping materials applied to the nacelle) and the height of the tower.

The noise emitted from wind turbines is generally broadband, containing components from frequencies spanning 20 – 3,600 Hz. A higher percentage of low-frequency noise is produced at lower wind speeds, but blade pitch and speed also factor in the frequency composition. Large wind turbines tend to make less noise than their smaller counterparts, in part due to their slower rotational speeds and sound-proofing materials installed inside the nacelle to reduce mechanical noise.

Specific Factors Affecting the Level of Acoustic Noise. Several specific factors affect the level of acoustic noise from wind turbines.

Blade Design and Rotor Tip Speed. *As* the wind blows past a wind turbine and the blades spin, low-frequency, random noise is produced from atmospheric turbulence. This noise can sound like whooshing, pulsing, or buzzing. However, according to Neil Kelley of the National Renewable Energy Laboratory:[54]

> "[These] low-frequency sounds with a random characteristic are much less likely to induce human annoyance than those which are impulsive. Typically the random low-frequency noise induces annoyance only at much higher acoustic energy levels than impulsive sounds."

The amount of aerodynamic noise created by a wind turbine is directly related to the speed of the blade tip as it rotates, i.e., the higher the blade tip speed, the more aerodynamic noise produced by a wind turbine, and indirectly to the wind turbine's design tip speed ratio.[55] In general, a turbine manufacturer must make a trade off between a higher design tip speed ration for performance and a lower tip speed ration to reduce noise. Generally, there is some sacrifice in turbine performance in order to limit the aerodynamic noise produced by the turbine.

[54]AWEA WindPower '87 conference proceedings ("A Proposed Metric for Assessing the Potential of Community Annoyance from Wind Turbine Low-Frequency Noise Emissions," SERI/TP-217-3261, Nov 1997 or Proceedings of WindPower '87, San Francisco).

[55]Ratio of the blade tip speed to the wind speed. Wind turbine rotors are more efficient at higher tip speed ratios, but with higher tip speed ratios, the blade tip speeds are higher and hence noiser. Thus, there is a design trade-off between performance and noise. Today's turbines generally sacrifice some performance for lower noise.

Tower Wake Another source of aerodynamic noise from wind turbines involves the wake of the tower. In downwind machines where the wind passes the tower before the blades, impulsive, thumping noise can be created. Since this noise is at a low-frequency it attenuates at a lesser rate and thus will travel farther. Fortunately, most current wind turbines are designed to face into the wind, which eliminates this impulsive thumping.

Wind Turbine Gearbox and Generator. A wind turbine's gearbox and generator are sources of noise. Gearboxes generally produce a "grinding" sound, while generators "hum." Fortunately, these components are contained within the nacelle of the tower high above the ground. Regarding gearboxes, those with planetary gears tend to produce more noise than helical gears. As noted above, modern wind turbine manufacturers add noise insulation to mitigate the loudness within the nacelle. As with all elements of wind turbine design, gear technology is still advancing and gears and couplings are being designed to reduce both friction and noise.

Acoustic Noise Standards

There are two types of acoustic noise standards that apply to the proposed windfarm. The first relates to the industry standard for measuring and reporting the acoustic noise of wind turbines. The second relates to governmental standards and noise ordinances on Oahu.

Wind Industry Standards. The U. S. wind industry and various other countries, primarily in Europe, have established an international standard for measuring and reporting the acoustic noise of wind turbines. This activity was sponsored and coordinated by the International Electrotechnical Commission ("IEC"), which was established in London, U.K., in 1906. The relevant standard, IEC-61400-11, was revised in 2002 and is currently undergoing further revision. WSB-Hawaii notes that this standard along with several others in the 61400 series are used as the basis for certifying wind turbines.

Government Standards and Noise Ordinances. The State of Hawaii's Department of Health's "Community Noise Control" ordinance is contained the Hawaiian Administrative Rules Title 11, Chapter 46 (§11-46-2). This ordinance defines noise as:

> "Any sound that may produce adverse physiological or psychological effects or interferes with individual or group activities, including but not limited to communication, work, rest, recreation, or sleep."

The State has set limits for maximum permissible sound levels in dB for each of its three zoning districts as shown in Table 3.14.1-3. Notice that there are different maximums for daytime and nighttime limits.

Zoning District	Daytime (7am to 10pm)	Nighttime (10pm to 7am)
Class A	55	45
Class B	60	50
Class C	70	70

Table 3.14.1-3. DOH Maximum Noise Limits by Zoning District[56]

[56]Hawaiian Administrative Rules Title 11, Chapter 46 (§11-46-2).

The zoning district classes are defined as follows:

Class A – All areas equivalent to lands zoned residential, conservation, preservation, public space, open space, or similar type. Note: The residential area in Kahuku will generally be in the upwind direction from the first row of turbines, but when the wind comes from the west or southwest, which it does part of the time, the turbines may be heard in the residential area.

Class B – All areas equivalent to lands zoned multi-family dwellings, apartments, business, commercial, hotel, resort, or similar type.

Class C – All areas equivalent to lands zoned agricultural, country, industrial, or similar type. Note: This applies generally to the area between the two rows, i.e., so the 70 dB requirement should be met at the base of the towers.

The maximum permissible sound levels specified in HAR §11-46-4 do not apply to any particular distance from a source, they apply to sound levels at the parcel boundary. The Hawaii State ordinance also sets the maximum permissible impulsive noise to be 10 decibels higher than the maximum permissible sound levels.

Existing Sources of Acoustic Noise within the Project Area

The project site's ambient noise is characteristic of a Hawaiian agricultural park or rural area. There are several ambient sources of noise in the study area. These include the wind, rain, birds and mammals. Humans also contribute to the ambient noise level in several ways, e.g., driving vehicles on existing roads (including Kamehameha Highway the access roads to the Ag Park and intra-Ag Park Roads), lawn and garden maintenance equipment, construction equipment, and residential and agricultural building.

Most of man's activities in the study area result in intermittent sources of noise. As noted before, construction provides intermittent sources that can result in exceedance of existing noise ordinances. Ambient noise conditions in the study area have not been documented, but it is believed that the ambient noise levels are low and do not exceed the State and County noise standards and ordinances, i.e., 70 dB as indicated in Figure 3.14.1.5.

3.14.2 Potential Impacts

This section includes identification and evaluation of potential noise impacts in the study area and the region due to the proposed action. These impacts could occur during construction and operation of the windfarm. The latter includes an analysis of turbine noise during when the windfarm is operating

Construction

Discussion. WSB-Hawaii believes potential noise during windfarm construction is similar to many other sources of noised during the construction of small to medium sized construction projects, including building a highway, a house or small apartment building. Refer to Table 3.14.2.1 for list of common sound levels.

Machine	Sound Level dB(A)
Vacuum Cleaner	70
Truck (Flatbed)	78
Bulldozer	82
Crane (15 to 20 ton)	83
Pneumatic Drill	85
Crane (50 ton)	88
Helicopter (100 ft)	98
Jackhammer	100
Liberty 2.5 MW wind turbine at hub height (80 meters above ground inside the nacelle)	109
Jet Takeoff (200 ft)	120

Table 3.14.2-1 Typical Noise Outputs from Machines

The primary sources of noise would include:

- trucks transporting to the site --
  - cement and other construction materials,
  - wind turbines and towers, and
  - hydraulic cranes, bulldozers, backhoes and other heavy equipment.
- Operation of heavy equipment –
  - bulldozers (access road construction),
  - backhoe (trenches and foundation excavation), and
  - hydraulic crane (tower, turbine and building construction)

Evaluation. WSB-Hawaii believes traffic noise associated with the transport of the equipment and materials to and from the project site on Kamehameha Highway and the site access road would be comparable to other heavy equipment that use the same roads. During construction the operation of heavy equipment, such as described above, will likely be heard at the nearest residences and other buildings within the Ag Park, and possibly at some of the nearest residents in Kahuku. Given that the primary transport activity would be during the day and intermittent, WSB-Hawaii believes the noise during the transport and construction activities would not be a significant impact.

If the noise production from the construction phase of the project is ever expected to exceed the maximum permissible limit, then a noise permit should be obtained by OWP from DOH. This permit could noise levels up to 78 dB, but would limit the hours during which the construction would take place. For example, any noise in excess of the applicable standard would be limited to the hours between 7am and 6pm Monday through Friday.

In consideration of the above, WSB-Hawaii evaluates the severity of these potential impacts on the study area to be *"non-significant."*

Operation

Discussion. Wind turbines are machines and they do make noise. As note previously, the primary sources of the noise are the aerodynamic *whoosh* the blades make as they rush through the air, the *whir or grinding* of gears inside the gearbox and the *hum* of the electrical generator. Just as the strength and characteristics of the wind resource differs from site-to-site, so can the potential noise and how it may impact and surrounding buildings or a community in general. Thus, the remainder of this section includes a discussion of the anticipated acoustic noise impacts inside the project area

After the construction phase of Na Pua Makani the wind turbines will generally be the only machines generating noise from the project site on a daily basis. Occasionally a crane will be used on the site for wind turbine maintenance, but this maintenance will of course be limited to the daytime.

The Liberty 2.5 MW wind turbine is currently undergoing noise testing at the National Renewable Energy Laboratory's Wind Technology Center in Golden, Colorado. Clipper rates the 2.5 MW's maximum sound output at 107 dB(A) +/- 2 dB(A).[57] For this discussion analysis, 109 dB was used as the 2.5 MW's sound power level to assume a worst case scenario. This maximum output is measured at wind speeds of 8 meters/second.

To predict potential noise impacts from the Na Pua Makani project the National Physical Laboratory's "Wind Turbine Noise Model" was used. This model allows for calculations of sound propagation and attenuation based on inputs such as the source's power level and the receiver's location. The model uses a method documented by the International Energy Agency, and compensates for both geometric and atmospheric spreading. The model accounts for spherical spreading of sound, and uses a conservative atmospheric attenuation value of 0.005 dB/meter. The model does not take uneven topography, large obstructions in the propagation path, refraction of noise, or wind speed and direction effects. Since this model does not take wind direction into account the predicted levels should be higher than actually expected, since majority of the potential receivers are actually upwind from the wind turbines. Inputs into the NPL's noise model included; 109 dB(A) as the source's power level, 80 meters as the source's height, and the coordinate position of each wind turbine. Sound levels were estimated for various dwellings and other locations both within and outside of the project area. Figure 3.14.2-1 shows the predicted maximum sound levels in dB(A) at various dwellings without vegetation or wind direction factored in. Studies suggest that vegetation and wind direction could lower these potential sound levels by at least 5 dB. The turbines and the sound receiver sites are identified and described in Table 3.14.2-1 with the preliminary results of the noise analysis.

Evaluation. Based on the quantitative analysis above, WSB-Hawaii believes certain of the operating wind turbines will be heard at residences and other buildings within the Ag Park and in the closest portion of the Kahuku community to the north and east of the first row of turbines (Numbers 1 to 4). WSB-Hawaii considers this quantitative analysis to be conservative, as it does not include the "sound-damping" qualifies of uneven topography, large obstructions in

[57] As noted previously, the maximum sound pressure level is measured inside the wind turbines nacelle during operating conditions. And the resulting sound levels are generally attenuated to 60 to 70 dB (A) by the time the sounds reach the base of the 80m tower.

the propagation path, refraction of noise, or wind speed or direction effects. Given the noise ordinances, WSB-Hawaii evaluates the potential noise impacts, first for the project area including the Ag Park, and, second, for the nearby Kahuku Community, as follows:

1. Ag Park. The noise estimates for the map points 1 to 6 from 50 to 62, with the noise estimates at the key locations of 3 (closest residence in Park), 4 (residence in the middle of the Park), and 6 (another residence in the Park), at 60, 53 and 54. Each of these sound levels is less that the 70 dB requirement on agricultural land (Class C in Figure 3.14.1.5).

2. Kahuku Town. There are two estimate points (numbers 7 and 8) for residences outside the Ag Park and close to the wind turbines. In these two cases, the estimates of 55 and 48 dB, respectively. These estimated noises levels are at or below the day-time requirement (55dB), but above the night-time requirement (45dB) for urban areas (Class A) as described in Table 3.14.2.1. However, given the likely damping effects of local terrain and vegetation, WSB-Hawaii does not believe receivers will view any noise from the wind turbines as significant

Given the above with the expressed caveats, WSB-Hawaii evaluates the severity of the potential windfarm noise impacts to be "*non significant.*" WSB-Hawaii also believes there are potential mitigative measures to reduce the noise of the windfarm.

Figure 3.14.2-1 Predicted Sound Model Levels (without Wind Direction, Soil, or Vegetation Attenuation)

Turbine	Elevation at base (meters)		
1	76		
2	74		
3	111		
4	86		
5	86		
6	88		
7	107		
8	109		
9	144		
10	109		
Map Reference	**Location**	**Elevation**	**Sound Level in**
1	Below Turbine 1	76	62
2	Below Turbine 2	74	62
3	Closest Residence in Park	68	60
4	Residence in middle of Park	72	53
5	End of southern tree line in Park	81	50
6	Residence in Park	67	54
7	Closest Residence outside of Park	38	55
8	Kahuku Neighborhood Boundary	30	48

Table 3.14.2-2. Preliminary Results of the Noise Analysis

3.14.3 Mitigative Measures

This section includes a discussion of the mitigative measures that would be implemented during the transport to the site and construction and operational phases of the proposed project.

Transport to the Site and Construction

WSB-Hawaii recommends that industry standard procedures be implemented during the transport to the site to eliminate potential noise impacts. These procedures include:

- driving all vehicles within posted speed limits on the roads and highways, and in a safe and prudent manner on the access roads to the site,
- operating all construction equipment to reduce noise impacts, and install and utilize sound-damping measures as needed to keep noise levels under 70 dB at nearby residences, and
- limiting transport of equipment and materials and all construction activity to daylight hours, and apply for noise permits from DOH is necessary.

Operation

Regarding use of vehicles and equipment for O&M purposes, WSB-Hawaii recommends the same procedures as for "Transport to the Site and Construction" above. Regarding the noise from the operating wind turbines themselves, WSB-Hawaii recommends the following:

1. Prior to the filing of the DEA, review the noise analysis results with Clipper, and make necessary revisions to the DEA,

2. Request that Clipper 2.5 MW wind turbines be fitted with additional noise-damping materials,

3. Monitor noise levels during the initial operational period to confirm that noise levels are within noise ordinance requirement.

Evaluation

Based on the overall design and operational characteristics of the wind turbines, the layout of the windfarm, and the proposed mitigative measures to be implemented during the construction and operation and maintenance periods, WSB-Hawaii evaluates the severity of all potential noise impacts on the study area to be *"non-significant."*

3.15 Electrical and Magnetic Fields

This section includes a description and discussion of the potential electrical and magnetic fields ("EMF") in the study area, identification and evaluation of the potential environmental consequences of additional EMF generated by the proposed action, proposed mitigative measures, including an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.15.1 Existing Conditions

In recent years there has been growing interest and concern about the potential effects associated with EMF in our society. Most recently, concern has been directed at possible impacts on human health due to the EMF generated by utility transmission and distribution lines. There are also concerns about EMF generated by common home appliances, such as vacuum cleaners, electric ranges and ovens, TVs and electric tools. One utility transmission line crosses through the study area and is a source of EMF. In a previous WSB-Hawaii Final EIS ("FEIS") on the Kaheawa Pastures 20 MW windfarm, WSB-Hawaii provided substantial background information on EMF, including potential health impacts potential impacts and mitigative measures for the 20 MW windfarm. Unless otherwise noted, substantial portions of the following sections on EMF are excerpted from the WSB-Hawaii FEIS.[58] Also note that references within the WSB-Hawaii FEIS (and incorporated herein) to the MECO EIS refer to the EIS submitted by MECO to support MECO's application for two new 69 kV transmission lines from the Maalaea Power Plant to Lahaina on Maui. This section includes a brief overview of EMF fundamentals, an introduction to health effects of EM, electrical and magnetic field standards, and an assessment of existing EMF levels in the study area.

<u>Electric and Magnetic Field Fundamentals</u>

Electric fields and magnetic fields are common phenomena in today's society.

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 compared with 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.

Electric fields are generated from a number of sources. Static electric fields can result from friction generated when taking off a sweater or walking across a carpet. Most household appliances and other devices that operate on electricity create electric fields. The electric field is a result of the voltage on the appliance. The field decreases rapidly with distance. Fields from point-source household appliances generally decrease more rapidly with distance than fields from line sources such as power lines. Appliances need not be in operation to create an electric field; an electric field occurs whenever an appliance is connected to an electrical outlet. Typical values, measured at 12 inches, for some common appliances are shown in Table 3-15.1-1.

[58]Final Environmental Impact Statement, Kaheawa Pastures 20 MW Windfarm, Maui, Hawaii, prepared for Zond-Pacific, Wailuku, Maui, Hawaii by WSB-Hawaii, Kaneohe, HI, August, 1999.

Appliance	Electric Field (kV/m)[1]
Electric blanket	0.25[2]
Broiler	0.13
Refrigerator	0.09
Iron	0.06
Hand Mixer	0.05
Phonograph	0.04
Coffee Pot	0.03

[1]Measured at 12 inches. [2]1 to 10 kV/m next to blanket wires (Enertech Consultants, 1985). [3]Compiled from Gauger, 1985.

Table 3.15.1-1. Typical Electric Field Values for Household Appliances[3]

	Magnetic Field (mG)	
Appliance	12 inches away	Maximum
Electric Range	3 to 30	100 to 1,200
Electric Oven	2 to 5	10 to 50
Garbage Disposal	10 to 20	850 to 1,250
Refrigerator	0.3 to 3	4 to 15
Clothes Washer	2 to 30	10 to 400
Clothes Dryer	1 to 3	3 to 80
Coffee Maker	0.8 to 1	15 to 250
Toaster	0.6 to 8	70 to 150
Crock Pot	0.8 to 1	15 to 80
Iron	1 to 3	90 to 300
Can Opener	350 to 250	10,000 to 20,000
Mixer	6 to 100	500 to 7,000
Blender, Popper, Processor	6 to 20	250 to 1,250
Vacuum Cleaner	20 to 2,000	2,000 to 8,000
Portable Heater	1 to 40	100 to 1,100
Fans/blowers	0.4 to 40	20 to 300
Hair Dryer	1 to 70	60 to 20,000
Electric Shaver	1 to 100	150 to 15,000
Color TV	9 to 20	150 to 500
Fluorescent Fixture	2 to 40	140 to 2,000
Fluorescent Desk Lamp	6 to 20	400 to 3,500
Circular Saws	10 to 250	2,000 to 10,000
Electric Drill	25 to 35	4,000 to 8,000

[1]Compiled from Gauger, 1985; Silva et. al., January, 1989.

Table 3.15.1-2. Typical Magnetic Field Values for Household Appliances[1]

Magnetic Fields

Magnetic fields are generated by substances that are naturally magnetic or from devices that electric current flowing in a conductor, such as any appliance or equipment that has an electric motor. The most commonly used unit for measuring magnetic fields is the Gauss, which is a measure of the magnetic flux density (intensity of magnetic field attraction per unit area). The unit mG (or milliGauss) is equal to one-thousandth of a Gauss. As a reference, the earth has a natural static direct current ("DC") magnetic field of about 0.36 Gauss, or 360 mG, in the Hawaiian Islands (Merrill and McElhinny, 1983).

Transmission lines, distribution lines, switching stations and substations also have magnetic fields, but the characteristics are different from earth's direct current fields because the power line field is due to alternating currents ("AC"). The magnetic fields under transmission and distribution lines, and near substations, are relatively low when compared to measurements near many household appliances and other equipment. The magnetic field near an appliance decreases rapidly with distance from the device. The magnetic field decreases with distance from electrical substation equipment (such as transformers and capacitor banks) as it does with appliances. Magnetic fields also decrease with distance from line sources, such as transmission lines, but not as rapidly as with substation equipment or appliances. A transmission line field is spatially more persistent. Since the magnetic field is caused by the flow of an electric current, a device must be operated to create a magnetic field. See Table 3.15.1-2 for magnetic field values of typical household appliances and electrical equipment. A study of typical household appliances conducted for the Electric Power Research Institute (Silva et.al., 1989) found that the mean magnetic field levels in residential homes were about 0.9 mG (at one meter above ground level).

The MECO EIS includes a summary of everyday magnetic field levels at selected Oahu and Big Island locations. These measurements were taken at a number of commercial and government locations. The measurements varied from 0.2 to 300 mG. Measurements were generally below 100 mG. The measurements on the Big Island were generally lower for similar locations.

Health Effects of Electric and Magnetic Fields

Health effects from EMF have been studied since the 1960's. The MECO EIS provides a very good discussion of the important studies and findings current to the date of the EIS. These and two more recent studies are summarized below.

Overview

The studies from the 1960's and early 1970's found no obvious harmful effects from typical transmission line electric and magnetic fields. Some studies during this period did report the potential for harmful effects. More recent studies (since about 1979) have suggested a possible association between occupational and residential exposure to magnetic fields and adverse health effects, including cancer. The evidence for such an association is still inconclusive, and studies are underway to obtain more definitive information on this subject. Although most of the research has been prompted by concern about the effects of the large, extra-high-voltage, 765 kV transmission lines, some recent research results are of interest in assessing potential health concerns related to smaller, 69 kV lines and other electrical facilities.

New York State Power Lines Project

This $5 million project, funded by the New York State, included 16 studies and follow-up projects in 1985 and 1987. The activity focused on the EMF from 765 kV lines and included epidemiology, laboratory animal and cellular research studies. There was no direct evidence or damage linking EMF to inherited effects or cancer.

Denver Study

Funded as part of the New York Project, this study focused the incidence of cancer among children living in homes near different power lines, including those with lower capacity. The study included methodologies to screen out the impacts of inherent (household) EMF from the impacts due to the transmission lines, and a wiring configuration protocol to categorize the likely magnetic field exposure over time in the home due to external power lines. The wiring code is an index loosely based on the type, number, and diameter of conductors; the distance from house to power line; and the number of nearby service drops.

The results appeared to indicate a higher incidence of cancer. However, there was no apparent correlation with either low-power (household appliances off) or high-power (many household appliances on) conditions. There was concern that other possible causative factors were involved, such as traffic density.

Seattle Study

Also part of the New York Project, this study was similar to the Denver study, e.g., had similar protocols. However, no links were established from EMF exposure to incidence of cancer. It was also noted that research has not found any biological mechanisms that could explain the role of magnetic fields in the development of cancer, and that methodological uncertainties exist in quantifying magnetic field exposure levels.

Los Angeles Study

This study was conducted in 1990 with EPRI funding and attempted to replicate the Denver study. The results generally confirmed those from the Denver study. Specifically, there was an increased risk of cancer with certain wiring codes, but not with direct field measurements. While the field measurements were the most sophisticated to date, researchers were perplexed by the results. For some, yet unknown reasons the wiring codes are a better predictor of long-term average magnetic field exposure than the 24-hour measurements that were conducted on this study.

Swedish Studies

Two epidemiological studies were conducted in Sweden in 1992. The first involved exposure of residences within 300 meters of 220 kV and 400 kV transmission lines. The second involved an occupational study of adult males. The first found a statistical association between childhood leukemia and calculated historical fields and the distance from the power lines. No correlation, however, were found between EMF and brain tumors. Similar to the other studies, there no correlation was found with actual field measurements. Consequently, these results are consistent with the Denver study.

The second study included a breakdown of personal exposure by job category. The results indicated a statistical association between a certain subtype of leukemia and estimated magnetic field exposure. It was noted that the field measurements were used to develop the estimated exposure.

Office of Technology Assessment Background Paper

In 1989 a background paper on the biological effects of EMF was prepared for the Congressional Office of Technology Assessment, Washington, DC, by Carnegie Mellon University. The paper summarizes the sources and nature of EMF exposure and the basic areas for research, which includes cellular experiments, whole animal experiments, exposure assessment and epidemiological studies.

The paper states the emerging evidence no longer allows one to categorically assert that there are no risks. But it (the evidence) does not provide a basis for asserting that there are significant risks. OTA suggests that if exposure turns out to be a health risk, it is unlikely that high voltage transmission lines will be the only sources of concern. Power-frequency fields are also produced by distribution lines, wall wiring, appliances and lighting fixtures.

Regarding the public policy issues and what should be done, the OTA backed off from the extreme ends of do nothing and aggressively regulate, and recommended a middle-ground, prudent avoidance strategy. This strategy suggests we limit field exposures with small investments of time and money, but that we shy away from drastic or expensive measures until it is proven that there are significant risks to EMF exposure.

Continuing Research

The MECO EIS highlights several areas where research is continuing: basic laboratory research to determine whether physiological changes result from exposure to electric or magnetic fields and how much changes might affect health; and risks to exposure from home sources of EMF. These sources include televisions, electric blankets, hair dryers and other appliances, and electric wiring in house walls.

More Recent Studies

WSB-Hawaii identified two additional studies applicable to this EIS. The first is a study of 560 adults living near 50-Hz 110 kV and 220 kV transmission lines in Auckland, New Zealand (Beale, I. L, et. al.). In this study, significantly elevated adjusted risk ratios were found for asthma, arthritis, type-II diabetes and combined chronic health problems. The results are consistent with the hypothesis that 50-Hz environmental magnetic fields may affect human immune function.

The second is a major study reported in the July 3, 1997 issue *New England Journal of Medicine*. The study found no evidence that electromagnetic fields from power lines can increase a child's risk of acute lymphoblastic leukemia. This study, headed by researchers at the National Cancer Institute in conjunction with hospitals and investigators of the Children's Cancer Group, has been described as one of the most comprehensive studies yet performed on the subject of EMFs and childhood leukemia.

Electric and Magnetic Field Standards

General

From the MECO EIS, currently, there are no electric and magnetic field standards for switching stations or substation facilities. However, there are no guidelines and standards regarding field levels from overhead power lines (which could originate or terminate at a substation facility). General transmission line safety standards are imposed by PUC General Order No. 6 (Rules for Overhead Electric Line Construction) and the National Electric Code. MECO notes that their third 69 kV line will comply with these codes and standards. MECO also notes that there are no national or federal government standards in the United States for electric or magnetic field exposure.[59]

[59] WSB-Hawaii notes that this is still the case. However, in light of the anticipated new significant growth in renewable energy projects, EPRI is conducting research on potential impacts of new transmission lines that are to be built for renewables. See: http://portfolio.epri.com/ProgramTab.aspx?sId=ENV&rId=134&pId=5123

DOH Policy

MECO referred to a 1991 policy from the State DOH relating to EMF from electric power facilities:

A prudent approach is needed at this time to regulate electric and magnetic fields around low-frequency electric power facilities, including high voltage transmission lines. The existing research data are inconclusive and not sufficient enough for adequate, accurate risk assessment. However, the data suggest that a 'prudent avoidance' approach to siting new facilities is appropriate. Where technically feasible and practical, public exposures should be minimized. Too little is presently known to be able to determine where or what rules would provide useful public-health protection.

Implementing actions:

(a) *All newly-installed power lines should be constructed with engineering controls to reduce exposure (for example, the delta configuration),*

(b) *The Department of Health will continue to collect and evaluate research data on electromagnetic fields in order to be aware of significant findings with public-health implications.*

Existing EMF Levels in the Study Area

In the case of the Maui EIS, there were no known measurements of electric or magnetic fields in the study area. Note: the MECO EIS includes a detailed discussion of HECO's existing transmission lines and switching stations. Some comparisons were made with transmission lines on the mainland, which can have voltages as high as 765 kV. In Hawaii, the transmission lines are generally lower in voltage due to the shorter transmission distances.

Transmission Lines

Moving now to the issues in this DEA, there are 138 kV lines on Oahu, and the aforementioned 46 kV lines in the Kahuku area of Oahu. And WSB-Hawaii is not aware of any measurements of electric or magnetic-fields in the study area for Na Pua Makani. WSB-Hawaii notes that estimates were made in the MECO EIS for the planned 69 kV lines on Maui with the results as noted belowl

Electric Fields. The following is an excerpt from the MECO EIS regarding the proposed new 69 kV lines:

> "The results of the study conducted by Enertech Consultants include predictions for the three lines: (1) from the Maalaea power plant to the Lahainaluna switching station (single-circuit) and (2) Lahaina and Puukolii (double circuit). Of these three lines, only a small portion of the Maalaea-Lahainaluna line (essentially segments 6 and 7) passes through the study area. The electric field values estimated for this line range from approximately 0.001 kV/m at a distance of about 525 feet from centerline to a maximum value of 0.506 kV/m underneath the conductors near midspan. The predictions are somewhat higher for the other two lines. MECO notes in their EIS that these electric field values are less than the other State and IRPA guidelines and standards discussed above."
>
> WSB-Comment. WSB-Hawaii believes the electric field levels would be lower in the study area, given that the existing transmission line in the study area for the Na Pua Makani is a lower voltage (46 kV vs. 69 kV).

Magnetic Fields. Similarly, the Enertech consultants provided predictions for the generation of magnetic fields from the third transmission line. In this case, the magnetic fields varied with amount of current flowing through the lines. Several cases were examined, including normal and two emergency load conditions.

> "For the Maalaea-Lahainaluna line, the maximum magnetic field at the centerline varied from 14.09 mG (normal load) to 20.89 mG (emergency load). The magnetic field decayed to 0.12 mG (normal load) and 0.18 mG (emergency load) at 800 feet from the centerline. Again, the predictions for the other segment were somewhat higher. Similarly, MECO notes in their EIS that these magnetic field values are less than the other State and IRPA guidelines and standards discussed above."
>
> WSB-Comment. Similarly, WSB-Hawaii believes the magnet field levels would also be lower in the study area for the Na Pua Makani project.

Substations and Switching Stations

The following is background information for the discussion of the windfarm interconnection substation that will need to be constructed for the Na Pua Makani project.

Overview. From the MECO EIS:

> "High-voltage substation and switching stations are an important element in the electric energy distribution system. Substations receive higher-voltage electrical power electrical power from incoming transmission lines and convert it to lower-voltage electrical power for distribution to commercial and residential customers. Substations are classified by the voltage of the incoming transmission lines and outgoing distribution lines. Switching stations are a type of substation which distribute electrical power between similar voltage transmission lines."
>
> Substations are also locations where safety devices can be installed to quickly disconnect electric circuits or equipment in the event of a fault (short circuit or other problem). The voltage of the outgoing distribution lines can be regulated at a substation and system operation is monitored at substations. Substations can have a number of components, including power transformers (for changing voltage), switches, circuit breakers, lightning arrestors, and relay and metering equipment. The energized portions of a substation are generally connected by rigid metal tubing called buswork. A typical substation has two or more incoming supply transmission lines for reliability. The layout of a substation is planned so that power lines or components can be taken out of service for maintenance without affecting the continuity of service to the utility or customers.
>
> Electric Fields. Electric fields around switching stations are usually between 0.001 kV/m and 0.05 kV/m due to electric field shielding. The grounded metallic equipment housings and switching station walls constitute effective electric field shields, thereby reducing electric fields from internal equipment and buswork. Typically, the major sources of electric fields outside of switching stations are the overhead transmission lines associated with the facility.
>
> Magnetic Fields. Magnetic field predictions were made for Lahainaluna Switching Station under normal load and two emergency load conditions. The maximum magnetic field occurs within the switchyard in the area of the 69 kV buswork, and

the dominant source of magnetic fields outside the switching station are the incoming 69 kV lines. Within the switchyard, the values range from 0.0 to 47.2 mG (normal load) to 0.0 to 77.5 mG (emergency load). At the station perimeter, the values range from 0.0 to 10.7 mG (normal load) to 0.0 to 15.9 mG (emergency load). Fields from the internal 69 kV buswork are primarily contained within the switching station boundaries. The highest calculated magnetic field levels occur underneath the Maalaea-Lahaina third 69 kV line where it enters the switchyard. "

Evalutation

The existing EMF in the study area is generated by the HECO 46 kV transmission line that crosses the northern part of the study area, and also from existing 12 kV distribution lines to the Kahuku Ag Park. Although there no known field measurements in the study area, based on the results of studies conducted fro MECO in their EIS, the EMF was estimated to decay to levels well below that of the average home within 500 to 800 feet of the transmission lines. It is assumed that this should be also the case in the study area for the Na Pua Makani project, including the planned 46 kV transmission line to be constructed to interconnect the windfarm with the HECO 46 kV transmission line. However, without an appropriate analysis, such as was conducted for the referenced MECO EIS, WSB-Hawaii evaluates the impact of the existing EMF in the study area to be *"non-significant."*

3.15.2 Potential Impacts

This section includes a general discussion of health effects of electric and magnetic fields, electric and magnetic field standards, and evaluation of potential EMF impact in the study area due to the proposed action.

EMF Impacts from the Proposed Windfarm in the Study Area

There are several sources of EMF from the proposed windfarm. They include the electrical generators in the wind turbines, the intrasite electrical collection/distribution network, the windfarm interconnection station, and the proposed 46 kV line transmission line.

Electrical Generators

The electrical generator for the Clipper 2.5 MW wind turbine provides 690 AC, 3-phase output. The generator is rated at 2.5 MW, which results in a nominal 3-phase current of 906 amps. These generators would be installed on top of 80m (262ft) tall towers. No measurements have been made of the EMF emitted by its electrical generator. However, the EMF from these generators can be compared with EMF emitted by other point sources and also line sources. From the previous discussion, it was noted that the EMF generated from point and line sources can be relatively high at short distances, but the electric and magnetic fields decay rapidly with distance. As a point source, the wind turbine's electrical generator operates at higher voltages and currents than typical household appliances and tools, but at much lower voltages than transmission lines. The operating currents are similar. Thus, WSB-Hawaii expects the resulting EMF at the base of the towers would be negligible.

Intrasite Electrical Collection Network

The network consists of the 10 individual wind turbines, step-up transformers at each turbine site and the intrasite collection lines. The electrical output from each turbine would be transformed to 12V the base of the tower and transmitted to the site interconnection substation via a network of shielded, underground lines (see detailed description in Section 2.4.2).

There is some EMF potential from the transformers and the intrasite collection line, but this is expected to be negligible. The reasons for this are: (1) the grounded metallic enclosures of the transformers provide effective electric and magnetic field shields, and (2) the shielded collection lines would be buried a minimum of 1m (3ft) underground.

Windfarm Interconnection Sub-Station

The electrical interconnection to the MECO utility system would be made at the interconnection substation (See Section 2 for details of the installation). The substation would provide for transformation of the wind-generated power from the 12 kV collection network voltage to the utility's 69 kV transmission line voltage. The design of this station is similar to typical MECO utility substations, with the exception that the normal operational mode is the opposite, i.e., power is stepped-up rather than down.

Consequently, WSB-Hawaii believes the EMF characteristics of the windfarm interconnection substation would be similar in nature to that of HECO's Lahainaluna Switching Station. Given that, the EMF characteristics would be dominated by the 69 kV transmission lines which would be connected to the windfarm interconnection substation as discussed previously. Assuming that industry-accepted design practices are employed, the EMF generated by the substation would be contained primarily within its boundaries. Therefore, the windfarm substation is not expected to add any net EMF to the study area.

O&M Facility

The O&M facility would contain a number of electric motors and other devices that are common to this type of facility. Given the insulating qualities of the building, WWW believes the EMF generated by these devices would be shielded and have a negligible impact on the study area.

Evaluation

WSB-Hawaii evaluates the potential impact on the study due to the EMF generated by the proposed action would be *"non-significant"* for the following reasons*:*

(1) EMF emitted from the electrical generators of the wind turbines would decay from the top of the towers to negligible levels at the base of the towers,

(2) EMF emitted from the individual turbine-sites, step-up transformers would be effectively shielded,

(3) EMF emitted from the intrasite collection-distribution network would be significantly reduced by the shielding of the cables and by burying the lines underground, and

(4) EMF emitted from the windfarm interconnection substation would be significantly reduced with shielding and would not add any net EMF to the existing MECO transmission lines in the study area,

(5) EMF emitted from the proposed transmission line from the project site to the interconnection point with HECO's 46 kV line is unknown, but believed to be non-significant.

3.15.3 Mitigative Measures

Discussion

WSB-Hawaii believes the proposed windfarm design and layout does not present a significant EMF health hazard to windfarm personnel and the general public. However, there is still some controversy as to which factors may or may not impact human health, and, specifically, what actions should be taken, if any, to regulate EMF emissions. WSB-Hawaii concurs with those that would take the "prudent avoidance" approach. This appears to be the best course of action, until further evidence warrants a more stringent course. WSB-Hawaii believes that the proposed windfarm design and layout is consistent with the prudent avoidance approach.

Mitigative Measures

WSB-Hawaii recommends the following mitigative measures consistent with the prudent avoidance approach:

(1) Placement of the wind turbines and their pad-mounted transformers will be located sufficiently far from buildings and residences in the study which removes all EMF exposure to the general public (WSB-Hawaii notes the planned placement of the wind turbines already meets this criterion),

(2) Ensure that all remaining "balance of plant," on-site components (intrasite electrical collection network, O&M building and site sub-station) are shielded or placed at sufficient distances to reduce the net EMF emissions (again WSB-Hawaii notes the planned placement of these components meets this criterion),

(3) Conduct an analysis of the potential EMF from the proposed transmission line from the project site to the HECO 46 kV transmission line to confirm it is non-significant,

(4) WSB-Hawaii recommends that OWP develop O&M procedures to educate its personnel and visitors to the site regarding EMF issue.

Evaluation

Given the above, WSB-Hawaii does not believe additional mitigative is necessary. Thus, WSB-Hawaii evaluates the potential impact on the study due to the EMF generated by the proposed action would be *"negligible."*

3.16 Visual Impact

This section includes an introduction to the visual impact assessment of the Na Pua Makani windfarm, a visual description and discussion of the proposed windfarm project, identification and evaluation of the potential impact of the windfarm on the visual resources in the study area, and proposed mitigative measures, including an evaluation of the impact consequences before and after the mitigative measures program. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.16.1 Introduction

Like many manmade objects, wind turbines are visible to the observer. They can stand out in a field or on a hill in contrast to the existing landscape. In an industrial landscape, the wind turbines may blend in and not be intrusive to the observer. In a rural landscape, the wind turbines may or may not be intrusive to the observer. For the most part, windfarm development has been accepted by local communities in the U. S., Europe and other areas. Visual impact has been an important issue, but generally has not precluded development. In short, when projects are proposed, visual amenity can be an important issue determining whether the community accepts the project and whether the project is approved by regulatory authorities. Some windfarm projects have been redesigned to improve their visual amenity.

Visual Assessment Methodology

In order to assess potential visual impacts from the proposed project, methods were based on and adapted from:

1. “Windfarms and Landscape Values” (Australian Wind Energy Association and the National Trust, 2004),

2. A “Method of Visual Resource Analysis” (U. S. Department of Transportation, Federal Highway Administration, 2007), and

3. “Visual Resource Management” (U. S. Department of the Interior, Bureau of Land Management, 2009). The Bureau of Land Management’s (“BLM”)’ Visual Resource Management (“VRM”) system provides guidelines to identify and evaluate scenic values in order to determine appropriate levels of management.

The first part of the visual assessment for the Na Pua Makani windfarm is an “inventory” of the potentially impacted landscape using BLM and Federal Highway Administration (“FHA”) guidelines. The second part of the visual assessment is to identify key areas of potential visual impact from the perspective of residents and visitors, and then assess the potential impact utilizing simulated photomontages of the proposed windfarm Photomontages were prepared using Google Earth and Adobe Photoshop software, and images of the wind turbines were provided by Clipper Windpower.

Background: Windfarm and Landscape Visual Characteristics

The following section is a background on the visual characteristics of windfarms, and some commonly held views on the visual impact of these farms. The section includes references to and excerpts from:

1. *The Aesthetics of Wind Energy* (Justin Good), and

2. "*Wind Farms and Landscape Values*" (Australian Wind Energy Association and National Trust, 2004)

Windfarm Components. A windfarm typically includes a number[60] of wind turbines, a transmission infrastructure, roads for construction and maintenance, a substation, and maintenance buildings or sheds. These major components are required for a windfarm to efficiently produce energy. Generally, the wind turbines are of the greatest concern when it comes to the visual impact of a windfarm. Roads can be concealed by landscape, topography, or distance; transmission lines can be buried until collection at the substation; and maintenance buildings can be painted to blend with surroundings. As the technology of wind turbines has evolved over the past 30^{+} years, manufacturers have migrated to basically one overall design, i.e., large, three-bladed, horizontal-axis wind turbines, such as those in Figure 3.16.1-1, for the express purpose of selling windpower to the utility. In order to assess the visual impact of wind turbines, we need to examine the following aspects of wind turbine design and implementation:

Figure 3.16.1-1 Examples of Three-Bladed, Utility-Scale Wind Turbines

[60]A windfarm typically refers to a facility of multiple MWs of capacity consisting of 10 or more wind turbines. Smaller facilities with several wind turbines are generally referred to as clusters.

1. Siting. Wind turbines are generally sited to maximize energy production, which naturally corresponds to the windiest areas. These areas are typically open fields, high ridges, or coastal regions. Unfortunately, these areas are usually appreciated for more than just their wind, having high cultural, aesthetic, and environmental values. In addition, windfarms are ideally sited in close proximity to transmission lines in order to reduce construction costs and maximize the amount of windpower that can be delivered to the utility grid. By siting windfarms in more rural, minimally inhabited areas, potential visual impact can be reduced. Finally, it must be recognized that turbines need to be visible to pilots and avifauna. Thus, siting to reduce visual impact is indeed a challenge for developers in Hawaii;

2. Height. As wind energy has grown as an energy source so has the size of the wind turbines and their towers for two key reasons. First, there is an economy of scale in the design and manufacturer of wind turbines. Second, placing turbines on taller towers allows wind turbines to capture the higher wind speeds that are generally available at greater distances above the local ground level. Consequently, the larger towers are more visible over greater distances;

3. Movement By design, wind turbines are machines which have rotors[61] to move (rotate) in order to capture the kinetic energy in the wind and convert it to useable mechanical and/or electrical energy. The spinning of the rotors of wind turbines can be very eye catching, especially when several can be seen at once.

4. Color. The wind industry has migrated to an off-white color as the best to accomplish the dual objectives of "blending" in with the surrounding landscape during the seasonal color changes, and to be "visible" to pilots and avifauna. The FAA supports the use of "bright white or light off-white paint…and if use, no light are required during the daytime. However, if darker paint is used, wind turbine marking should be supplemented with daytime lighting, as required.[62]

5. Lighting. The FAA[63] requires that all manmade structures above 200 feet be identifiable to pilots at night with either a white or red flashing light. In the case of wind turbines, individual turbines need to have a light on top of their nacelle, and windfarms may or may not be required to have lights on all the turbines.

Public Views on Windfarms. Justin Good identifies two commonly held beliefs on the visual impact of wind turbines. These beliefs both come from an observer who believes in renewable energy and environmental health, and has an overall appreciation for wind energy as part of a solution to the global energy crisis.

> "One of them finds the sight of the windfarm beautiful in a very deep, heartfelt sense, and if you ask her, she'll say that the perception is intimately connected, even shaped by, her understanding of the larger ecological context of energy. The other

[61]The wind turbine rotor is a subsystem generally consisting of two or three blades which are attached to a hub, which in turn is attached to the rotating shaft of the wind turbine. In the case of the Clipper 2.5 MW wind turbine, the rotor is three-bladed and rotates on a shaft that is substantially horizontal (there is a slight upward tilt of a few degrees to allow extra room for blades to clear the tower).

[62]Advisory Circular, AC 70/7460-1K, Obstruction Marking and Lighting, U.S. Dept. of Transportation, Federal Aviation Administration, 2007, p.33.

[63]*Ibid*

> literally recoils from the sight of the windfarm, as an ugly, even offensive blemish on the wondrous, untouched naturalness of the vista."

Good characterizes these receivers the aesthetics appreciator and the NIMBY ("Not In My Back Yard") appreciator respectively. The aesthetics appreciator sees windfarms as mesmerizing and appreciates them as one appreciates the Manhattan skyline or the Hoover Dam. Whether it is due to the aesthetics of line, form, and movement, or the appreciation of engineering and environmentalism, this receiver does not just tolerate wind turbines; they enjoy their presence.

Conversely, the NIMBY appreciator dislikes the sight of wind turbines and would rather choose an environmentally harmful source of energy than see a wind turbine, even from a great distance. This receiver does not disagree with wind power elsewhere; they simply do not want to experience the visual impacts themselves. NIMBY appreciators are very persuasive in wind energy policy and development.

Whether enjoyed or hated, wind turbines are displays of human accomplishment in engineering and scale. The generators display aesthetic characteristics such as:

- sleek aerodynamic/sculptural design lines and shapes,
- starkness and modernity of design,
- consistency and repetition of features,
- a sense of order and legibility, and
- a strong presence.

Wind turbines are also symbolic of a new era in energy production and environmental symbiosis. Their presence evokes a connotation of "green" living, renewability, and environmental consciousness. Wind turbines display function in their presence too. The need for electricity is a very real one, and as one tolerates the presence of a dam, coal plant, or nuclear power plant for the end result, one can see the functionality of wind turbines. Lastly, wind turbines display a substitution in their presence tied to function. Whether enjoyed or hated, one sees a substitution to a coal plant or nuclear power plant in every windfarm. The presence of a windfarm means that another energy source and its visual impacts were not created.

Perceptions of Landscape. Landscape can hold natural, aesthetic, historic, social and indigenous values. While landscape itself is a place, its values are held by people and community. These values can be based on personal experiences or stories, but tend to be very strong and important. Unfortunately, these landscape values are highly subjective, and thus hard to rate or quantify. It is hard to assign a number to a receiver's memories or culture. However, one can say objectively that landscape does have inherent quality, this quality is an environmental resource, it is a public resource, it cannot be diminished by use, and it can be changed but never destroyed. In order to assess the visual impact of the proposed Na Pua Makani windfarm, OWP will inventory the landscape and attempt to quantify its scenic quality. OWP will use BLM and NHWA standards to assess current landscape conditions. This assessment is for the purpose of mitigating potential impacts and does not intend to underrate the subjective landscape quality of the proposed project site.

3.16.2 Visual Description of the Proposed 25 MW Windfarm

This section includes a visual description of the Clipper 2.5 MW wind turbine and the proposed 25 Megawatt Na Pua Makani windfarm.

Clipper 2.5 MW

The Clipper 2.5 MW wind turbine is manufactured by Clipper Windpower, Carpinteria, California. The Clipper 2.5 MW is a three-bladed, upwind wind turbine with a 96 meter diameter rotor, and is typically installed on an 80 meter tubular steel tower. The design features are summarized in Table 3.16.2-1.

The Clipper 2.5 MW was selected by OWP not only for its power rating and advanced engineering, but also for its pleasing aesthetic presence. The wind turbine features a shorter, more compact nacelle than other wind turbines of a similar rating. WSB-Comment: The nacelle also utilizes line and form to produce an advanced design which is more visually appealing than typical box-like nacelles.

Feature	Comments
Tubular Steel Tower	Surveys typically show that tubular steel towers are favored visually over lattice towers.
Three-Bladed, 96m Diameter Rotor	Visually, three-bladed systems are generally preferred over two-bladed systems. Three-bladed can also operate over a larger range of wind speeds, and the rotor spins more of the time. Surveys show spinning blades are more aesthetically pleasing (See Figure 3.16.2-1).
Nacelle	The Clipper's nacelle has a shorter, more compact look than other modern wind turbines (See Figure 3.16.2-2.
Overall Design	The look of the Liberty wind turbine is very sleek and modern. The air vents on the side of the nacelle, and the compact nacelle design put the wind turbine in an aesthetic class of its own

Table 3.16.2-1. Design Features of the Clipper 2.5 MW Wind Turbine

Figure 3.16.2-1 Clipper 2.5 MW Wind Turbine

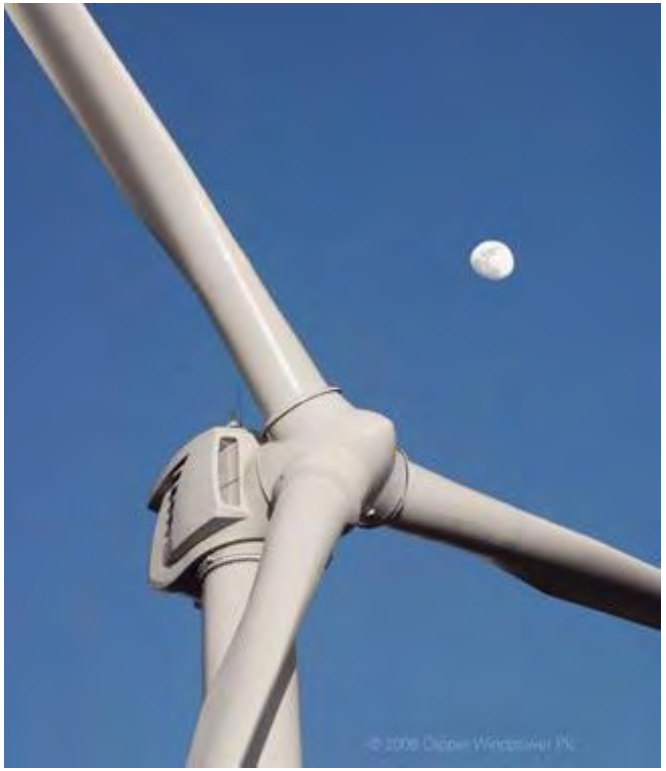


Figure 3.16.2-2. Clipper 2.5 MW Series Nacelle

Na Pua Makani 25 Megawatt Wind Farm

The proposed 25MW wind farm in Kahuku consists of ten Clipper 2.5 MW wind turbines. The ten wind turbines are arranged into two articulated rows which run predominantly in the north to south direction.

The first row is composed of four wind turbines which run atop, and follow the contour of, the eastern ridgeline of the project site. The second row comprises the six remaining wind turbines, which sit atop the curved, western ridgeline of the project site. The two rows curve toward each other creating the oval-like shape seen in Figure 3.16.2-3 (Google Earth View) and Figure 3.16.2-4 (Topographic View).

Feature	Comments
Turbine Use	Promotes visual uniformity by utilizing the same turbine model, rotor diameter, tower height, and color for all wind turbines.
Infrastructure (Roads)	The number of roads and their size has been minimized to reduce visual clutter and erosion. (See Figure 3.16.2-1).
Infrastructure (O&M Building)	The O&M building will be a prefabricated structure painted with typical earth tones, consistent with Hawaiian agricultural structures.
Infrastructure (Transmission)	The power lines of the intrasite collection network will be buried. The substation will be designed to be consistent with the existing utility transmission system.
Overall	The rural location will reduce potential visual impact.

Table 3.16.2-2 Design Features of the 25 MW Na Pua Makani Windfarm

Figure 3.16.2-3. Na Pua Makani Site Layout

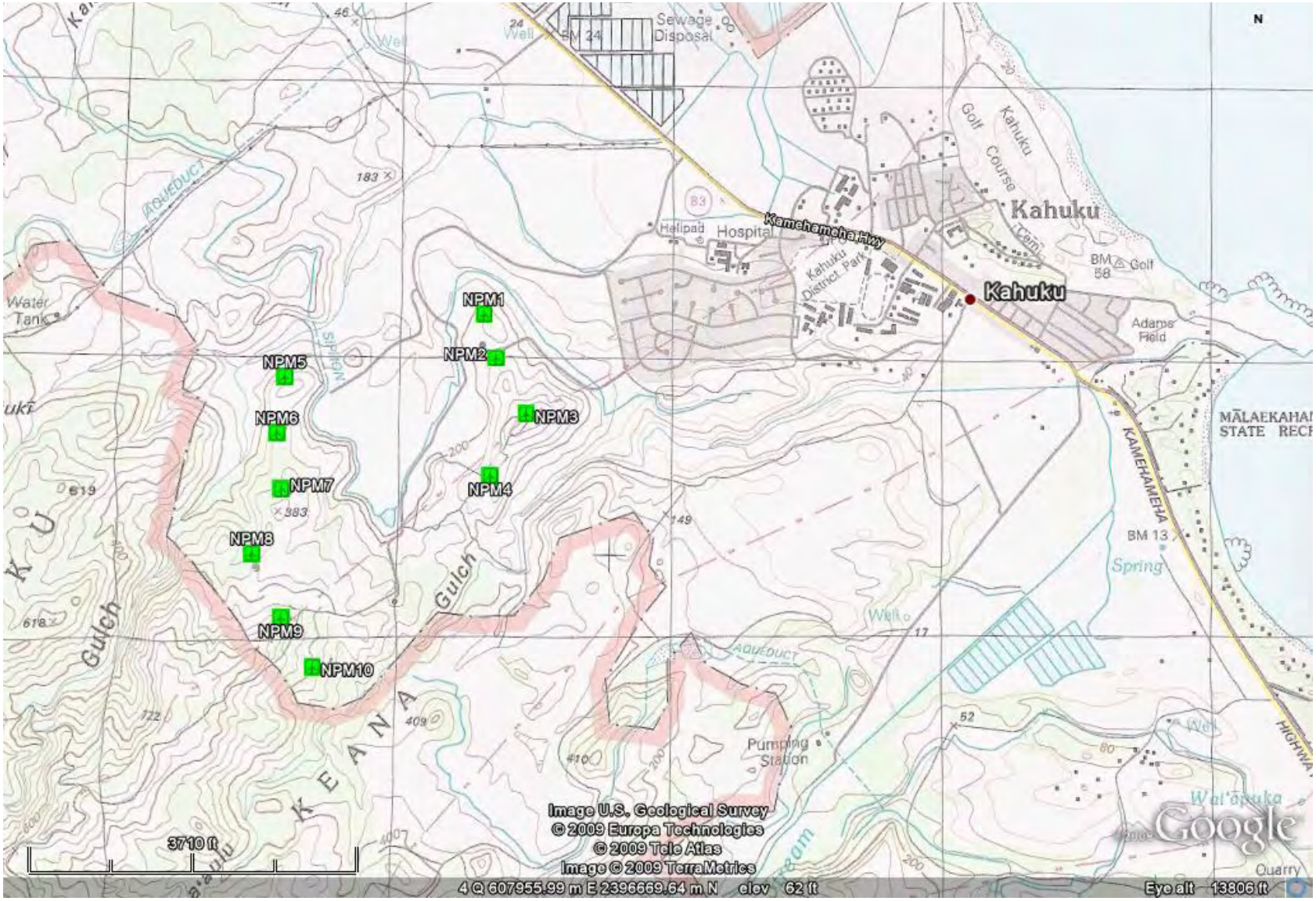


Figure 3.2.4. Topographic View of Na Pua Makani Site Layout

3.16.3 Potential Impacts

Existing Conditions

The following section is an inventory of the existing scenic quality of the regional and local landscapes of the project site. The purpose of this inventory is to quantify the existing visual characteristics of the project site in order to assess potential visual impacts. The visual resource analysis is conducted by first identifying the visual character of a landscape in a non-evaluative manner. The visual quality is then evaluated using factors such as vividness, unity, intactness, scarcity, and cultural modification. These evaluating techniques have been adapted from the BLM's "Visual Resource Management System" and the FHA's "Method of Visual Resource Analysis".

Regional Landscape Character

The island of Oahu exhibits the typical landscape character of the Hawaiian Islands. Oahu is a mixture of sandy beaches, dense forests, urban centers, and agricultural lands. Figure 3.16.3-1 shows a land use map of Oahu and the division of the island into agricultural, conservation, rural, and urban lands. The majority of the high-relief, mountainous land has been zoned conservation, leaving the low-relief, flat lands for urban and agricultural needs.

The topography of Oahu was created by two erupting volcanoes, leaving two mountain ranges (the Koolau and the Waianae Mountains) separated by a broad valley, or central plain. The volcanic products that make up the island's soil have created a region of lush vegetation and agriculture; distinguishing the island's visual character.

Regional Landscape Quality

Oahu's regional landscape is one of vividness with areas of high unity and intactness. There are views which remain very natural and whole in the face of the man-built landscape. The region also shows diversity and high cultural modification, reducing the scarcity of the region as a whole. In other words, the island has many natural landscapes, but they are separated by agricultural and urban landscapes which are the opposite of scarce. This gives the island an overall landscape quality which is common to the physiographic region and the other Hawaiian Islands. The island of Oahu does not have a scarce regional landscape which would require high levels of landscape preservation.

Local Landscape Character

The Na Pua Makani Project site sits on the last steep slopes of the Koolau Mountain Range's north end. The site and most of the landscape around it is zoned agricultural, with a small urban area (Kahuku Neighborhood) within the viewshed. The agricultural lands within the wind park and to the east of the project consist of low relief areas having high levels of human modification. Majority of vegetation has been removed from the low lands for agricultural dwellings and fields, and dirt roads have been scoured into the land between.

The urban area within viewshed consists of residential dwellings and paved streets. This area is about 1300 feet to the east of the project site, and is typical of other residential landscapes in the region. This urban area is intersected by the Kamehameha Highway, adding to the landscapes modification

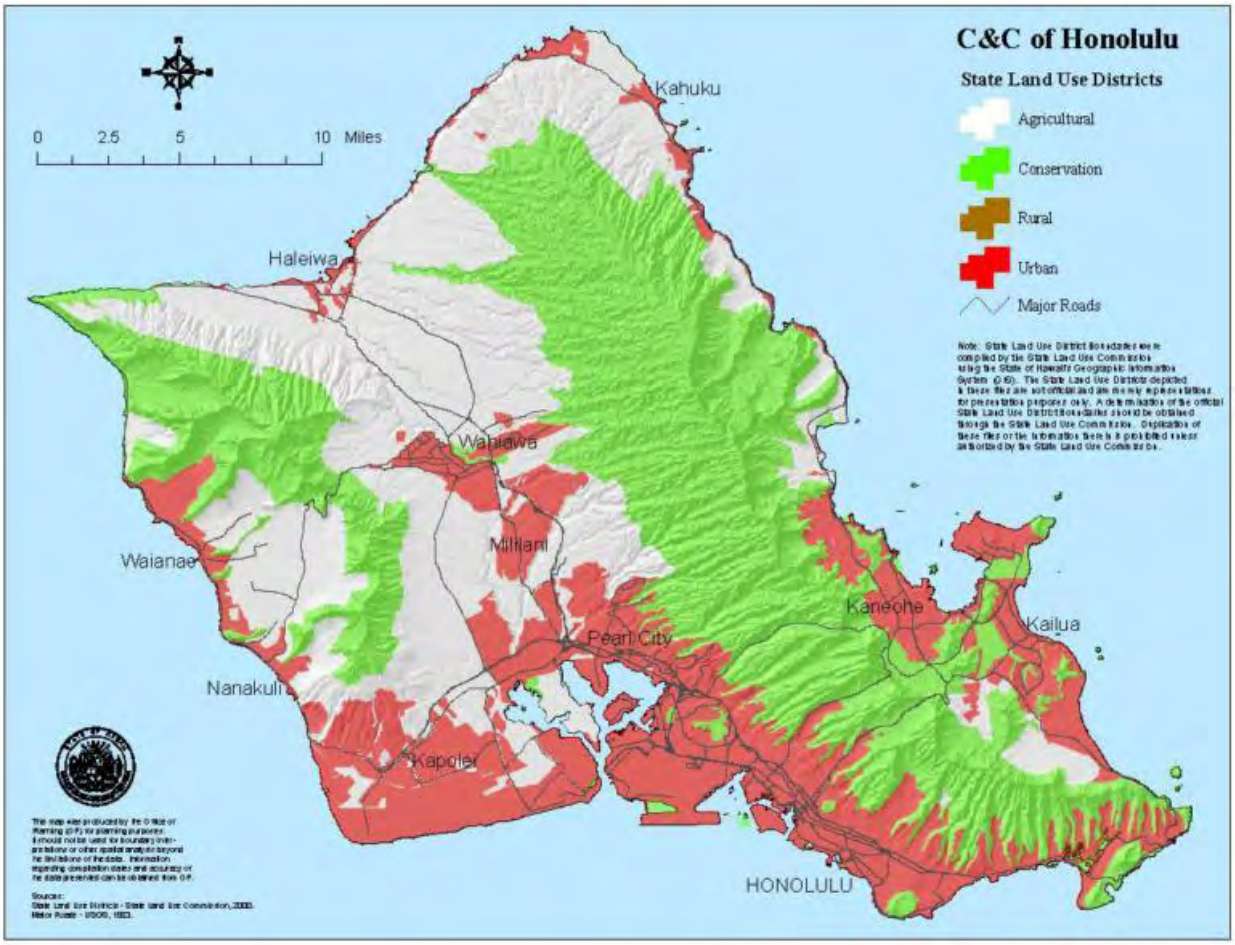


Figure 3.16.3-1. Land Use Map of Oahu

To the west of the project site is the Army's Kahuku Training Area. This is an area of high relief, steep topography, and also dense vegetation and woodlands. The restricted area contains natural, unmodified scenery and character, and requires a high level of visual protection.

Local Landscape Quality

The project site's local landscape exhibits the land use classes associated with the region's commonality and modification by man. The conservation land use class of the Oahu region contains the island's outstanding scenic quality, which should be preserved. This conservation class will not be affected by the installed wind turbines. The majority of landscape within the project's viewshed is agricultural land which has been historically deforested and modified by humans. The other landscape is urban, which displays an even higher level of human modification.

Analysis shows that the project site's area is not one exhibiting low modification or high scarcity. The landscape displays qualities and visual character that is similar to other landscapes within the region. The human modification makes the landscape's quality common, and reduces the need for a high level of landscape preservation like that in the conservation areas.

Discussion

Observer Response

The following section discusses initial view response based on project plans and construction so far. It also discusses the types of potential observers of the wind farm, and their "sensitivities". The section will then go on to define several major viewpoints from which the project will be visual. The viewpoints will be the basis for the photomontages which will help determine potential visual impacts.

Initial Observer Response. A 60m meteorological tower has been erected on site in what will become the location for turbine number 3. WSB-Hawaii notes that there have been no significant visual impacts from the meteorological tower. Initial observer response appears to find the project's visual impacts neutral. However, the meteorological tower cannot be viewed as a "surrogate" for a wind turbine, as its total height is 20m (66ft) less than the hub height of the Clipper 2.5 MW wind turbine, and it doesn't have 48m (157ft) long blades rotating in the air.

Types of Observers. The perception of visual impact is highly dependent on the perspective and characteristics of the observer. A landowner may perceive a change in the landscape differently than someone who is simply driving by. A farmer may have a different response to a landscape modification than an urban resident who does not modify the land as a livelihood. Types of observers vary based on duration of view and connection to landscape. The types of observers that will be potentially affected by the proposed wind farm are:

1. Agricultural Residents. Agricultural residents will live with the wind turbines on a day-to-day basis and will most likely experience the most visual impact. Although their number is relatively few, their sensitivity may be the greatest of all potential observers. Those who chose to live in rural areas may do so either to work the land or experience the remote views associated with the landscape. Both types of residents may have a high sensitivity for their visual surroundings, although the resident that works the land may be more likely to be open to modification of the landscape. Given the already present agricultural fields, buildings and roads, it is not clear that agricultural residents will experience any major, adverse visual impacts from the proposed wind farm.

2. Urban Residents. Urban residents of the Kahuku Neighborhood will experience the presence of the wind turbines from a further distance than the agricultural observers. The residents will likely see the windfarm on a day-to-day basis, but may only be exposed to a few of wind turbines at distance. Generally, urban residents may exhibit a more moderate sensitivity to visual surroundings than agricultural residents. Given that urban residents choose to live within a highly modified urban area, they may equate a lower value to the visual portion of landscape. Although modifications to the landscape will likely attract the attention of the urban resident, the resulting visual impact will likely be moderate to low. In part, since the Kahuku Neighborhood already borders the Kamehameha Highway it is not expected that the proposed wind farm will add to existing visual impacts that urban residents experience.

3. Recreational User. Although recreational users to the area will have a shorter duration of exposure to the wind turbines, it is believed that their visual sensitivity may be moderate to high (greater than that of the urban resident). Thus would be especially true for the recreational users that come to the area due to its scenic quality and heritage, and therefore are more sensitive to visual modifications of the landscape. Recreational activities may include hiking, horseback riding, bike riding, and other outdoor activities. On the other hand, it is possible that the wind turbines and the windfarm will create an area of visual interest to recreational users and visitors. Given that, WSB-Hawaii recommends that OWP be prepared to handle said attention. On balance, given the short duration of exposure to the windfarm that typical recreational users will experience, it is not clear to WSB-Hawaii whether any negative impacts would be significant.

4. Drivers and Commuters. The last type of observer is expected to have the varying sensitivity to visual modifications of the landscape, e.g., the commuter may have a low sensitivity, while a tourist may actually have a high sensitivity. This observer will experience the windfarm from the Kamehameha Highway while driving at moderate speeds, e.g., 30 to 45 mph, depending on the posted speed limits. Drivers may be more focused on the road and their pending destination than their surrounding landscape, i.e., the commuter, while the tourist may be paying more attention to the surrounding landscape, e.g., he may pull over to take a picture. On balance, given the potential variety and interests of this observer group, it is not clear to WSB-Hawaii whether there would be any negative impacts. It is also possible that the impacts are more likely to be positive, such that the windfarm becomes a real tourist attraction.

Major Viewpoints

This section describes the major viewpoints from which the proposed windfarm would be visible The viewpoints have been chosen based on local concern and input, wind turbine visibility, types and likely amount of observers, and distance from the project site. Table

Photo	Location Description	Distance From Closest Turbine
001	Corner of Marconi Road	7,800 feet
002	Kamehameha Highway	3,500 feet
003	Kamehameha Highway in front of Kahuku Hospital	3,800 feet
004	Credit Union Parking Lot by Kahuku Sports Fields	4,300 feet
005	Outside Kahuku Golf Course	6,000 feet

Table 3.16.3-1. Major Viewpoint Distances and Photo Numbers

Photo 001 Marconi Road

This viewpoint is the intersection of Marconi Road and the Kamehameha Highway. Marconi Road provides access to Turtle Bay Resort and is used by many receivers of various sensitivities.

The viewpoint already contains the built structures of the asphalt highway, and various transmission poles and lines. These structures are of similar scale to the wind farm and will help to blend the turbines into the landscape and minimize their visual impact

The photo faces southeast toward the project site and was taken without zoom from ground level.

3.16.3-2. Photo 001 – Marconi Road

Photo 002 Romy's

This viewpoint is across the Kamehameha Highway from Romy's Prawns and Shrimp. Romy's is a popular eatery among locals and tourist alike, and draws many receivers of various sensitivities. The view point is also in front of the James Campbell National Wildlife Refuge.

This view is a sporadic one that is mostly blocked by thick vegetation when traveling down, or even standing across, the highway.

The photo faces south southwest, and was taken with no zoom at ground level.

3.16.3-3. Photo 002 – Romy's

Photo 003 Kahuku Hospital

This viewpoint is across the Kamehameha Highway from the Kahuku Hospital. The area is widely used by both locals and tourists passing through the area. Despite the high usage, visual sensitivity is expected to be moderate to low from this viewpoint.

The landscape of the area already contains many built structures, such as transmission poles and lines. In this view particularly, the transmission lines are very obvious and become characteristic of the landscape. These poles and lines should help the turbines to better fit into the landscape as built structures.

The photo faces southwest toward the project site, and was taken with no zoom at ground level.

3.16.3-4. Photo 003 – Kahuku Hospital

Photo 004 Kahuku Sports Field

This viewpoint is the Kahuku Sports Field by the Credit Union parking lot. The sports fields are used primarily by locals who are expected to have a moderate visual sensitivity.

This view already contains large lighting poles which mimic the verticality of the wind turbines and will help to blend them into the viewscape. During night events, when the lights are on, the turbines will not be visible from this viewpoint.

The photo faces west by southwest toward the project site, and was taken with no zoom at ground level.

3.16.3-5. Photo 004 – Kahuku Sports Field

Photo 005 Kahuku Golf Course

This viewpoint is the entrance to the Kahuku golf course up North Golf Course Road. This view will be experienced by residents of the community, and visitors of the golf course. Visual sensitivity is expected to range from moderate to low.

Existing built structures include the overhead transmission lines present in all viewscapes, residences, and the Kahuku sports field lights. The sport field lights are of similar scale to the wind turbines and will help to lower their visual impacts.

The photo faces west toward the project site, and was taken with no zoom at ground level.

3.16.3-6. Photo 005 – Kahuku Golf Course

Visual Assessment

WSB-Hawaii believes that observers tend to evaluate the visual impact of wind farms on three factors in an iterative manner. These factors are visual intrusion (i.e., is a specific project visually intrusive), visual amenity (i.e., if the project is viewed as visually intrusive, is there a loss of visual amenity), and project utility (i.e., does the project provide positive benefits to the community). Positive views of project utility tend to reinforce positive visual impressions. For some observers, a positive view of project utility may mitigate a negative visual impression of the project. The evaluation of these factors is difficult to quantify and is completely subjective. The following is an assessment of visual impact from key viewing areas and aspects of the proposed Na Pua Makani windfarm.

Simulated Photomontages of the Windfarm from Key Viewpoints

Photomontages were created as simulations of what the windfarm would look like from the five key viewpoints described in the previous section. The locations and size of the turbines are based on Google Earth modeling and using the existing meteorological tower as a reference point (the tower is visible from each of the viewpoints). Although the photos utilize images of actual, installed Clipper 2.5 MW wind turbines, the photos themselves are not real and are to be viewed as simulations only.

Table 3.16.3-2 includes a description the five photomontages which have been created from the same five viewpoints as describe din Table 3.16.3-1. The location of the viewpoints is indicated in the aerial view contained in Figure The five photomontages follow on the next five pages.

Photomontage	Location Description	Distance From Closest Turbine
001	Corner of Marconi Road	7,800 feet
002	Kamehameha Highway	3,500 feet
003	Kamehameha Highway in front of Kahuku Hospital	3,800 feet
004	Credit Union Parking Lot by Kahuku Sports Fields	4,300 feet
005	Outside Kahuku Golf Course	6,000 feet

Table 3.16.3-2. Description of Photomontages

Figure 3.16.3-7. Aerial View of the Photo/Photomontage Viewpoints

Figure 3.16.3-8. Photomontage 001 – Marconi Road

Figure 3.16.3-9. Photomontage 002 – Romy's

Figure 3.16.3-10. Photomontage 003 – Kahuku Hospital

Figure 3.16.3-11. Photomontage 004 – Kahuku Sports Field

Figure 3.16.3-12, Photomontage 005 – Kahuku Golf Course

Evaluation of Visual Impact to Key Elements of the Study Area

The potential visual impact is evaluated for the following key elements of the study area.

Kahuku Town. The landscape of Kahuku Town does not appear to be particularly sensitive to change. The area shows many signs of human influence and construction, including the Kamehameha Highway, the Kahuku golf course, and many overhead transmission lines. All views of the windfarm from Kahuku include other manmade structures causing the turbines to blend into the viewscapes.

From Kahuku the eastern array of turbines can be seen in their entirety, when the view is not blocked by buildings or vegetation. The western array, consisting of the remaining six turbines, can only partially be seen due to the topography of the area. In comparison to other built structures of the area, and within the context of the surrounding landscape, the wind turbines of Na Pua Makani appear to have no significant visual impacts to the Kahuku area.

Turtle Bay Resort. Due to the topography of the area the wind turbines of Na Pua Makani will not be visible from Turtle Bay, and there should not be any visual impacts to the Turtle Bay area.

Kamehameha Highway. Observers from the highway that experience views of the wind farm will do so primarily from a moving vehicle. This will limit their view of the farm to small increments when vegetation, topography, and existing structures allow. This limited visual exposure suggests that there will likely be no significant visual impacts to receivers on the Kamehameha Highway from Na Pua Makani.

FAA Lighting Requirements. During dusk, dawn, and nighttime red lights will make the wind farm visible to pilots, as required by the FAA. These lights will possibly be reflected during downward during cloudy conditions, but should not be highly visible otherwise. The lights will be atop four of the wind turbines' nacelles that are over 80 meters in the air, and sited on ridge tops high above receivers. The lights will also be shielded from below to reduce the light emitted downward. Given that, there should be no significant impact from lighting.

Transmission Lines and Access Roads. OWP plans to overbuild an existing 46 kV transmission line, increasing its voltage capacity, in order to transport the electricity produced by Na Pua Makani to the substation located near Turtle Bay. Since the line's poles are already in place, and are already carrying a transmission line, no significant visual impacts are expected.

Also, there will be a new 46 kV transmission line built from the existing 12 kV line to the Na Pua Makani site in order to connect the wind farm to Turtle Bay. This short line will extend the already existing transmission line a mere fraction of its length. The new line is not expected to cause any additional significant visual impacts.

Access Roads. The Na Pua Makani project site is accessed by the existing Kii Road. Additional roads will need to be constructed between the individual turbine foundations in order to allow truck, crane, and component access. These access roads will be similar to existing access roads within the Ag Park, and are not expected to cause any significant visual impacts.

Overall Evaluation of Potential Visual Impact

A number of potential visual impacts have been identified from a visual assessment and evaluation of the proposed Na Pua Makani windfarm. None of these elements individually has been evaluated as significant. It is also recognized that the windfarm could be visually intrusive to some observers who may also feel a loss of visual amenity. It is possible that the windfarm could add incrementally to the visual impact of the existing landscape that already includes a significant amount of manmade elements. However, WSB-Hawaii does not believe that most observers would find the windfarm to be visually intrusive or that its presence would result in a loss of visual amenity to the community.

Therefore, based on the above, WSB-Hawaii believes that the overall visual resource impacts would be "*non significant*." With mitigative, the impacts could be reduced further as discussed below. Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action and mitigative measures program.

3.16.4 Mitigative Measures

Discussion

WSB-Hawaii believes that potential visual impacts can be reduced with a well designed and sited project, and taking into account feedback from viewers concerned about visual impacts. WSB-Hawaii believes further that OWP has already considered visual impact mitigation in the development of the Na Pua Makani wind farm, including the selection of the Clipper 2.5 MW turbine and design of turbine layout. The site design was chosen by OWP to limit visual impacts from access roads, transmission lines, and maintenance buildings as discussed in the visual description section. This design effort focused on the guidelines as indicated in Table 3.16.4-1.

Visual Impact Mitigation Guidelines
• Ensure visual uniformity • Avoid Fencing • Minimize Roads • Bury intrasite transmission lines • Limit ancillary structure • Control erosion • Remove litter and scrap • Clean dirty turbines and towers • Utilize non-reflective material • Limit vegetation removal

Table 3.16.4-1.Design Guidelines to Mitigate Visual Impact

To reduce the potential visual impacts further, WSB-Hawaii recommends the follow additional mitigation measures some of which are already being implemented:

Reduced FAA Lighting. The FAA requires that wind turbines are highly visible to pilots both day and night. OWP has worked with revised FAA guidelines to limit the required lighting for Na Pua Makani. The required flashing red lights will be limited to four wind turbines during twilight and nighttime only. The lights will be mounted on top of the wind turbines' nacelles and will be shielded to limit the amount of light projected downward toward the neighboring residences. The lighting will not be required during the day due to the white color of the wind turbines. This white color is not only more visible to pilots, but it is also regarded by most as more cheerful and less industrial than other colors. Studies also show that white blends better into the horizon, and since all views of the wind farm will be from below it, the wind turbines should blend into the skyline quite nicely.

Screening. Screening refers to the blocking of an object from view, usually by vegetation or a wall. While wind turbines are far too tall to screen at the site, ancillary structures such as the O&M building and project roads can be screened. The present vegetation at the project site will help to screen both project roads and the O&M building. Additional screening can be added to the site if it is determined to be needed.

Maintenance. Studies show that wind turbines are more aesthetically pleasing when the blades are rotating than when they are still (Australian Wind Energy Association). A proactive maintenance strategy can limit the downtime of wind turbines, keeping the blades spinning more of the time. OWP plans to instigate efficient, proactive O&M during the life of the Na Pua Makani wind farm; maximizing safety and minimizing visual impacts from inactive wind turbines.

Evaluation

Based on these mitigative measures, WSB-Hawaii anticipates that concerns can be addressed and there will be less concern regarding visual impact. Therefore, WSB-Hawaii evaluates the overall impact of the project on the community to be "*non significant"* to possibly "*negligible*" following the implementation of the mitigative measures.

3.17 Community Acceptance

This section includes an introduction to the issues relevant to community acceptance of windfarms, identification and evaluation of the community acceptance issues relevant to the proposed 20 MW windfarm, and a discussion of the need for mitigative measures, including an evaluation of the impact consequences of the proposed project (Refer to Table 3.1-2 for a summary of the environmental consequences of the proposed action).

3.17.1 Introduction

Development of a windfarm is much like any other power plant. The developer must gain access to a suitable site, plan and engineer the project, acquire permits and approvals for construction and operation, secure financing, and, if a non-utility entity, negotiate a power purchase agreement to secure a market for the electricity that the windfarm would harvest.

Experience with previous windfarm development suggests windfarm developers seek public interest and comment as early in the planning process as possible. In any case, the public most certainly will be involved during the permitting phase. While the opinion surveys have shown strong public support for wind energy, there may be concerns about specific projects.

Overall, the approving officials will seek to answer the basic question -- is the proposed windfarm an appropriate use of the land on which it is to be sited? The answer depends, in large part, on the designation and zoning of the land. For example, if the land is private and zoned agricultural, wind energy is a pre-permitted use in Hawaii. If the proposed site is on State conservation lands, wind energy use is permitted, subject to an application for and approval of a Conservation District Use Permit ("CDUP"). The application for the CDUP requires a thorough review of all potential environmental impacts via the EA/EIS process. If the proposed site, such as Na Pua Makani, is on State agricultural lands, the permitting responsibility rests with the County, and the developer must secure a lease for the land from the State.

The issues required to be addressed in the EA/EIS will impact whether the community accepts or opposes a specific project. All members of the community should ask if the proposed project is an appropriate use of the land. The community as a whole may also ask: (1) are the project's proposed benefits worth their costs, and (2) would the windfarm be a good neighbor?

Note: WSB-Hawaii defines the community as a whole to include the approving agency, other government agencies, community groups, the utility company, the site landowner, other landowners and neighbors, environmental groups and the general public. WSB-Hawaii believes each applicant has the obligation to discuss the project with all interested Parties in the community. Consequently, each interested Party would evaluate and determine whether they would support or oppose the project.

Typically, the EA preparer identifies, discusses, and evaluates key issues relevant to a proposed action. This process is oriented towards identifying and resolving potential *negative* impacts (or costs) to the proposed action. WSB-Hawaii believes the process can also reveal potential *positive* impacts (or benefits) of the proposed action.

The *generic* benefits and costs of proposed windfarm development are summarized below. This summary incorporates discussion of these issues as presented in Sections 3.4 through 3.16 and also benefits and costs identified by the National Wind Coordination Committee (National Wind Coordination Committee, 1997).

Experience has shown that windfarms can provide a number of benefits to a community when the windfarms have been *properly* sited, designed, constructed and implemented. These potential *benefits* include:

- generation of electricity at competitive prices for resale by local utilities;
- protection of utilities and ratepayers from risks associated with changing fuel prices, new environmental regulations, uncertain load growth and other unpredictable costs;
- the proposed land use is compatible with other uses, e.g., livestock grazing and agriculture, hunting and communication facilities;
- creation of new business and jobs, keeping energy dollars circulating in local economies and reducing reliance on imported energy. This improves local, State or regional trade balances; and
- reduction of utility-generated air pollutant emissions through avoidance of fossil fuel use, helping utility's meet environmental regulations and satisfy their customers' desire for clean power sources.

Experience has also shown that windfarms can result in *costs* to the community if the windfarms have *not been properly* sited, designed, constructed or operated. These potential costs include:

- preclusion of other important uses of the land;
- damage to local soils, e.g., erosion due to improper design, construction and maintenance of roads;
- impacts on local flora and their habitats, e.g., sensitive plants that are not identified and avoided, and disturbed flora that are not relocated or replaced;
- impacts on birds and other wildlife and their habitats, e.g., wind turbines may pose a threat to birds and/or their habitat;
- impacts on cultural resources, e.g., archaeological sites, possible restriction on entry and right of way to other users of the site;
- acoustic noise which may disturb neighbors, or workers and other users of the site; and
- visual intrusion to some observers or a perception of a loss of visual amenity.

Experience of windfarm developers to date suggests that it takes a concerted and conscientious effort during the planning, implementation and operational phases of windfarm projects to maximize the potential benefits while minimizing the costs. While it is desirable to eliminate all the costs (negative impacts), this may not be possible. WSB-Hawaii believes the overall process can be optimized by soliciting public comment early in the process and by addressing and resolving all public concerns. This process starts in the initial planning phase and continues throughout the construction and operation of the windfarm.

3.17.2 Potential Impacts

This section includes a discussion of the issues that impact community acceptance, identification and discussion of potential benefits and costs, and a preliminary evaluation of community acceptance of the proposed Na Pua Makani windfarm project.

Discussion

This discussion includes introductory comments on community awareness on Oahu and preliminary community attitudes and concerns about the proposed project.

Community Awareness

Community awareness regarding renewable energy projects has steadily increased over the last decade. More people are becoming knowledgeable and concerned regarding the impact of fossil fuel sources on the environment. They are also becoming more aware of alternatives to fossil fuels. In part, this is due to County and State public outreach programs in the past to inform the public of energy-efficiency and renewable alternatives. More recently, the Hawaii Clean Energy Initiative ("HCEI"), launched in January 2008 between the State and the U. S. Department of Energy, has created additional community awareness given the aggressive goals of reducing the amount of fossil fuel dramatically by the 2030. Consequently, there is increasing scrutiny as new energy projects are proposed. When a new source of power is needed, people are becoming more concerned about the type of power plant, where it would be constructed, and how it would impact the local community and environment.

Community Attitudes and Concerns

OWP has discussed the proposed 25 MW windfarm with a number of government agencies, environmental and community groups and citizens. The government agencies contacted include the U. S. Department of the Interior (U.S Fish & Wildlife Service), U S. Department of Transportation (Federal Aviation Administration), the State of Hawaii DLNR, DBEDT, DOH, DOT, County, Ko'olauloa Neighborhood and North Shore Neighborhood Boards, and the Kahuku Community Association. The environmental and community groups include the the Sierra Club and Life of the Land. Refer to Section 6 for a list of the Parties contacted.

Overall, informal reaction to the proposed project has been positive and supportive. WSB-Hawaii anticipates that formal comments will be submitted regarding the project. In anticipation of the formal comments, the anticipated benefits and costs of the project are presented below.

Benefits and Costs

WSB-Hawaii believes the thorough discussion, evaluation and assessment of the issues presented in Section 3 have identified the potential positive (benefits) and the negative impacts (costs) of the proposed action. The potential benefits and costs are summarized below.

Benefits

Wind projects can provide a number of benefits, which have been discussed in Sections 2.5 ("project benefits") from the developer perspective, and from the environmental perspective in Section 3. WSB-Hawaii believes the potential benefits of the proposed project include:

- Land Use. The proposed project is an appropriate use of the Agricultural District land in the Kahuku ahupua'a for the proposed windfarm without precluding the parcel's previous use as a buffer zone between the Kahuku Ag Park and the surrounding conservation and urban lands;

- Revenues to the State. WSN-Hawaii estimates the project will provide $13.7M in land use revenues to the State over the projected 25 year lifetime of the windfarm (see Sections 3.4 and 3.10);

- State RPS Mandate. The project will sell wind-generated electricity to HECO for resale to their Oahu customers. The project will help HECO meets its RPS, and the State's energy goal of reducing its dependence on imported energy sources;

- Reduced Imported Energy. WSB-Hawaii estimates the project will save 147,000 barrels/year of oil. At $75/barrel that would be $275M over 25 years. And significant portion of the $275M would recirculate on Oahu and in Hawaii (see Section 3.10);

- Increased Energy Security. The project would help diversity Oahu's fuel generation mix and reduce our vulnerability to fuel supply disruptions and price "spikes," such as what occurred during the Persian Gulf War and more dramatically during 2008;

- Stimulation of the Local Economy. The project will generate significant economic activity, e.g., $35M in short-term construction costs and taxes; and $7.5M in job-related income over the project's lifetime (see Section 3.10);

- Environmental Protection. The project will avoid fossil-fuel use and its resulting air emissions. WSB-Hawaii estimates that the project would avoid on the order of **107 million** pounds of pollutants/year, including over **115 thousand** pounds of carbon monoxide, over **106 million** pounds of carbon dioxide, over **187 thousand** pounds of sulfur oxides, almost **359 thousand** pounds of nitrogen oxides, almost **69 thousand** pounds of particulates, and over **39 thousand** pounds of volatile organic compounds (see Section 3.13). These fuel emissions also contribute to our State goal of reducing greenhouse gas emissions;

- Reduced Environmental Regulation Risk. The reduced emissions mitigates again potential compliance costs associated with potential carbon tax or "Cap and Trade" regulation (see Section 3.13);

- Community Benefits Fund. OWP has discussed the possibility of Community Benefits Fund to be paid in the form of an endowment from the proceeds of the windfarm operation to the Kahuku Community Association (See Section 3.10); and

- Habitat Conservation Plan. Implementation of the HCP will provide funding ($TBD) to mitigate impacts to endangered wildlife (see Section 3.9).

Costs

There are some potential costs (or negative impacts). These have been discussed in detail in Sections 3.4 through 3.16. The more important of these are impacts on:

- Avifauna and their Habitat. WSB-Hawaii recommends and OWP plans to prepare a HCP for approval by DLNR and U. S. Fish & Wildlife. The goal is to provide sufficient mitigative measures to reduce the potential severity of the impacts to avifauna to an acceptable level (see section 3.8);

- Cultural Resources. HECO's survey and archaeological survey conducted by IARII for OWP have not uncovered any archaeological sites in the study area. OWP plans an additional survey if any portions of the upper spur are to be relocated. OWP's O&M manual would include a protocol should any historic remains be inadvertently uncovered during construction. See section 3.9 for more details; and

- Visual resources. See section 3.16 for more details.

Note: WSB-Hawaii recognizes that not all potential costs have been highlighted in this section, but believes they have been adequately addressed throughout this document. It is possible that some readers may identify issues or concerns that have not been addressed. WSB-Hawaii recommends that OWP continue to solicit inputs regarding any unidentified issue from any interested Party and to discuss any concerns.

Evaluation

WSB-Hawaii believes that community acceptance of the proposed project starts with the overall question of land use. As developers pursue project opportunities, the question is first broached with landowners and approving agencies. Ultimately, to gain approval by the appropriate agency, the developer must gain support for the project by the community.

As discussed previously in Section 3.4, the question of land use involves a number of elements that may be impacted directly by the proposed action, e.g., "topography, geology and soils" (Section 3.5), "hydrology and water resources" (Section 3.6), "terrestrial flora" (Section 3.7) and "fauna" (Section 3.8).

Similarly, the question of community acceptance involves all of elements that may be impacted, e.g., those noted in the previous paragraph, plus the remainder of those discussed herein, e.g., "Air Quality and Meteorology" (Section 3.13), "Noise" (Section 3.14), "Cultural Resources" (Section 3.9), "Socioeconomics" (Section 3.10), "infrastructure" (Section 3.11), "Public Services and Facilities" (Section 3.12), "Electrical Magnetic Fields" (Section 3.15), and "Visual Impact" (Section 3.16).

As a means of evaluating the community acceptance, WSB-Hawaii believes the responses to the three key questions noted at the beginning of this section are relevant:

- Question #1 -- is the proposed project an appropriate use of the land? **Yes**. WSB-Hawaii believes the proposed action is supported by the community as an appropriate and acceptable use of Agricultural Land. The County Plan indicates use of Agricultural

Land for wind energy and other renewable energy projects as a goal (See Section 4.3.1). This evaluation assumes that the proposed mitigative measures are accepted as sufficient to ameliorate the potential impacts;

- Question #2 -- are the project's proposed benefits worth their costs? **Yes**. As discussed above and in Sections 3.10 (Socioeconomics) and 3.13 (Air Quality), there are a number of quantifiable energy, economic and environmental benefits accruable to the proposed project. WSB-Hawaii believes these benefits far exceed the potential costs that have been identifies. In part, this evaluation assumes that the mitigative measures are accepted as sufficient to ameliorate the potential costs; and

- Question #3 -- would the windfarm be a good neighbor? **Yes.** WSB-Hawaii believes the community would see and value OWP as a good neighbor, based on the initial inputs received from government and private parties, and OWP's project design and implementation approach, including their proposed mitigative measures program.

Finally, an evaluation of the severity of total impact on community acceptance must include all elements discussed herein. Specifically, the severity can *not* be less than the severity for any of these elements. Therefore, WSB-Hawaii evaluates the severity of the potential impacts of the proposed action on community acceptance to be *"significant*." With mitigative, WSB-Hawaii believes the impacts could be reduced further as discussed below.

3.17.3 Mitigative Measures

Discussion

All of the potential impacts have been discussed in the previous sections. Specifically, WSB-Hawaii has not identified any new potential negative impacts that have not been discussed previously. In all cases, WSB-Hawaii has concluded that the mitigative measures program would reduce the severity of the impacts such that the specific impacts would be *non significant, negligible, none, or beneficial.*

OWP plans to continue to discuss the proposed project with the community and to solicit comments. WSB-Hawaii anticipates that there could be additional questions and concerns from the community on the project proposal. WSB-Hawaii recommends that OWP work closely with all Parties to address and resolve all concerns.

Evaluation

Based on implementation of these mitigative measures as summarized in the previous subsection and discussed in detail throughout this document, WSB-Hawaii evaluates the overall impact of the project on the community to be "*non-significant."*

4.0 Relationship to Land Use Plans, Policies and Controls

This section describes the relationship of the proposed 25 MW windfarm project to the goals and objectives of Federal, State and County plans, policies and land controls that pertain to development of wind energy.

4.1 Federal

There are no known Federal *plans* that directly relate to or influence the proposed action. The two known Federal *policies* which do relate to and influence the proposed action are:

- FAA Rules. The Federal Aviation Administration (FAA) requires Sponsors of a Construction Project to file a "Notice of Construction or Alteration" when the Project has certain characteristics. For example, one such characteristic is when the construction includes a structure of more than 61m (200ft) in height above the ground level at its site. OWP has filed a "Notice of Proposed Construction or Alteration" with the FAA. The FAA is reviewing OWP's filing in order to determine if the proposed project would be an obstruction to air navigation under Part 77 of Federal Aviation Regulations. Since the height of the turbines including the blades would exceed 200ft), lighting is required to alert pilots. For this project, the OWP has proposed lighting four of the ten turbine nacelles with a steady burning red obstruction light. The FAA review and decision is pending; and

- DOI U. S. Fish and Wildlife Service. U.S. Fish & Wildlife Service administers the Federal Endangered Species Act ("ESA") of 1973, and normally becomes involved in projects where Federal lands and/or funds are to be used. This is not the case for this project. However, in part, with the development of three previous windfarm in Hawaii and the State's strong environmental law (Chapter 343), the U.S. Fish & Wildlife Service and DLNR, Department of Fish & Wildlife ("DOFAW") have developed a joint, collaborative process to administer the ESA. To facilitate the process, the U.S. Fish & Wildlife Service and DOFAW have formed an Endangered Species Committee Meeting to consult with developers as they prepare HCPs and to provide guidance to their respective organizations when developers, such as OWP, apply for an incidental take permit from the U.S. Fish & Wildlife Service and an incidental take license from DOFAW. Preparation of the draft HCP is proceeding in parallel with this DEA.

4.2 State

The Hawaii statutes, plans, policies and programs that apply to the proposed 25 MW windfarm project include: the State Constitution; State Land Use and Conservation and Resources Laws; the Hawaii State Plan, and the Hawaii Integrated Energy Plan.

4.2.1 State Constitution

The proposed windfarm is consistent with Article XI, Section 1, of the State Constitution:

> "For the benefit of present and future generations, the State and its political subdivisions shall conserve and protect Hawaii's natural beauty and all natural resources, including land, water, air, minerals and energy sources, and shall promote the development and utilization of these resources in a manner consistent with their conservation and in furtherance of the self-sufficiency of the State."

Specifically, the windfarm would help protect the environment through the avoidance of fossil fuel use. This means that less pollutants would be emitted on Oahu. WSB-Hawaii believes the windfarm can be designed, constructed and operated that would not significantly impact the natural beauty of the proposed site. See Sections 3.10 and 3.16 for more details.

4.2.2 State Land Use Law (HRS Chapter 205) and Conservation and Resources Law (HRS Chapter 183)

The proposed windfarm site is on State-owned agricultural land, previously used as a buffer zone for the Kahuku Ag Park on Oahu. The State Department of Agriculture ("DOA"), custodian of Kahuku Ag Park, determined that the buffer zone was longer needed and transferred ownership buffer zone to DLNR. Wind energy facilities are a permissible use State agricultural land, per HRS §205-4.5. DLNR can negotiate a land lease, but not the permit[64]. In August 8, 2008, OWP obtained approval in principle for a lease and a right-of-entry from DLNR for the proposed project site [Kahuku-Malaekahana, Ko'olauloa, Oahu. Tax Map key: (1) 5-6-08:6]. The land lease is contingent upon a Conditional Use Permit and the HCP.

4.2.3 Hawaii State Plan (HRS Chapter 226, Revised 1989)

The Hawaii State Plan provides a long-range guide for Hawaii's future. It includes State goals, objectives and policies, and specifies a State-wide planning system to implement them. The construction and operation of the proposed 25 MW windfarm is consistent with and supports many of the State's long-term goals and policies. The most relevant portion of the State plan is Section 226-18, <u>Objectives and Policies for Facility Systems - Energy/Telecommunications</u>, which in relevant part, reads:

> *(a) Planning for the State's facility systems with regard to energy/ telecommunications shall be directed towards the achievement of the following objectives:*
>
> (1) *Dependable, efficient and economical State-wide energy and tele-communication systems capable of support the needs of the people,*
>
> (2) *Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased,*

[64] In the case of State agricultural land the counties have jurisdiction and issue conditional use permits.

(3) *Greater energy security in the face of threats to Hawaii's energy supplies and systems, and*

(4) *Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use."*

The proposed 25 MW windfarm supports all four elements of this policy presented above: (1) the purpose of the windfarm is to provide reliable power of acceptable quality to CO, (2) the windfarm would increase the ratio of indigenous resources used on Oahu to generate electricity, and (3) the windfarm would reduce amount of fossil fuels needed by MECO to generate electricity, and (4) the windfarm's operation would result in the reduction of greenhouse gas emissions by avoiding a portion of Oahu's fossil fuel use

4.2.4 Hawaii Energy Plans and Policies

State Energy Functional Plan

The State Energy Functional Plan describes objectives, policies and implementing actions in the following areas:

- Energy Conservation and Efficiency,
- Alternate and Renewable Energy,
- Energy Education,
- Legislation,
- Integrated Energy Management, and
- Energy Emergency Preparedness.

The goals and objectives of the State Energy Functional Plan and the Integrated Energy Policy that flows from the plan address generation, alternate energy sources, reduction of dependency on imported energy use and conservation

Hawaii Integrated Energy Policy

DBEDT has developed an integrated energy strategy for the State, entitled the Hawaii Energy Strategy (DBEDT, 1995). The primary goals of the HES are:

- *Increased diversification of fuels and sources of supply of these fuels;*
- *Increased energy efficiency and conservation;*
- *Development and implementation of regulated and non-regulated energy development strategies with the least possible overall costs to Hawaii's society;*
- *Establishment of a comprehensive energy policy analysis, planning, and evaluation system;*

- *Increased use of indigenous, renewable energy sources; and*
- *Enhanced contingency planning capability to effectively contend with energy supply disruptions.*

Similar to Hawaii State Energy Function Plan, the proposed windfarm is consistent with these goals of the Hawaii Energy Strategy.

4.2.5 Hawaii Administrative Rules – Significance Criteria

The Hawaii Administrative Rules, Title 11, Department of Health, Chapter 200, Section 12 specifies thirteen criteria when considering the significance of potential environmental effects.

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;

WSB-Hawaii Assessment. An irrevocable (irreversible) commitment to loss or destruction of any natural or cultural resource is one that cannot be changed once it occurs. Natural resources include topographic and geologic features, soils, hydrology, air, water, and flora and fauna.

No geologic features and hydrological resources will be disturbed (See Sections 3.5 and 3.6). Some soil will be disturbed during the construction of the windfarm, but this use is revocable. For example, if the windfarm were to be decommissioned, the wind turbines, towers, the electrical substation, other above-ground structures and all equipment would be removed. The soil would be restored to its original condition, including covering of the tower foundations. Note: The project will not generate any air or water emissions and will provide positive benefits through the reduction of fossil fuel use and the resulting emissions on Oahu (See Sections 3.12 and 3.13).

Regarding flora and fauna, potential negative impacts to avifauna have been identified (See Sections 3.7 and 3.8). WSB-Hawaii believes that negative impacts to endangered avifauna can be reduced through proposed mitigative measures developed and implemented in a Habitat Conservation Plan ("HCP").

Regarding cultural resources, no culturally-significant archaeological sites have been found in previous studies in locations nearest to and including most of the project area. An additional survey will be conducted to confirm that no cultural sites exist in the ""unsurveyed" areas which appear to overlap onto at least one potential wind turbine site. (See Section 3.9 for details).

(2) Curtails the range of beneficial uses of the environment;

WSB-Hawaii Assessment. The project will not curtail the range of beneficial uses of the environment. The proposed windfarm is consistent with the primary purpose and use of the DLNR as a "buffer zone" for the Kahuku Ag Park.

(3) Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;

WSB-Hawaii Assessment. Overall, the proposed windfarm is consistent with and supports long-term State policy to conserve the State's natural resources and to improve the quality of life. The project will help reduce our dependence on imported energy use and increase our use of indigenous natural resources, including energy, e.g., our tradewinds. The project helps improve the quality of life on Oahu by offsetting a portion of the fossil fuel used to generated electricity. This reduced fuel use (estimated at 147,000 barrels of oil a year) will also avoid the air pollutants that result from the fossil fuel use. The project further helps to improve the quality of life by bringing outside investment, tax and use revenues and new jobs to Oahu. The

primary concern regarding this criterion is the potential negative impacts on birds and bats as discussed above.

(4) Substantially affects the economic or social welfare of the community or State;

WSB-Hawaii Assessment. The proposed windfarm will have positive economic and social welfare impacts on the community. The project will bring outside investment that will create both short-term and long-term jobs, and tax and use revenues. Perhaps the most significant economic benefit will be the avoidance of imported energy fuel costs, as dollars that would normally go out of State to pay for fossil fuels would recirculate on Oahu and in the State. The project implementation will not negatively impact the social welfare (including cultural resources) of the community.

(5) Substantially affects public health;

WSB-Hawaii Assessment. The project will not result in any negative public health impacts. The project health impacts will be positive through the reduction of pollution from the utility power plants at Kahe, Waiau and downtown, as well as independent power producer plants at Barber's Point.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities;

WSB-Hawaii Assessment. The project is anticipated to have negligible impacts on population and public facilities. Most of the jobs created by the project will be filled by local residents. The project will be self-contained and will require no extension of public facilities, e.g., water or other utilities.

(7) Involves a substantial degradation of environmental quality;

WSB-Hawaii Assessment. The project will not result in a substantial degradation of environmental quality. Quite to the contrary, the project is anticipated to improve environmental quality in the project area and within the County.

This will be accomplished taking care taken during the construction and operation to minimize damage to the land, including flora and fauna, and the implementation of the HCP. It is anticipated that the mitigative measures to be designed and implemented in the HCP will provide a positive benefit over the project lifetime.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;

WSB-Hawaii Assessment. The proposed 25 MW windfarm is not anticipated to have any individual or cumulative affects. The proposed windfarm is optimum given the size of the Liberty 2.5 MW wind turbines and available land in the project area. Therefore, the proposed windfarm would not involve a commitment to larger actions, e.g., utilizing additional land.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat;

WSB-Hawaii Assessment. A biological survey did not identify any endangered plant or bird species in the proposed project area. However, bats were detected in areas at elevations below the wind turbine sites. A HCP, required by DLNR for the

land lease for the project area, will be prepared to mitigate potential significant impacts to bats and endangered birds that may occasionally frequent the area.

(10) Detrimentally affects air or water quality or ambient noise levels;

WSB-Hawaii Assessment. The project will not detrimentally affect air or water quality or ambient noise levels. In actuality, the project will provide an overall positive impact on air quality, since the project itself does not result in air emissions and because the wind-generated electricity will offset use of fossil fuels and their resulting emissions on Oahu. All water used during construction and operation will be trucked in. As noted in Section 3.6, there are no hydrologic and water resources in the areas. Regarding noise levels, the wind turbines will slightly increase the ambient noise levels within the project area. It is believed that the noise will serve to alert birds and bats which may frequent the area. As discussed in Section 3.14, the turbines may be heard at the nearest residences to the project. The project will not detrimentally affect air or water quality or ambient noise levels. As discussed above, the impacts on air quality are considered positive, the impacts on water quality are negligible and impacts on ambient noise levels are non significant.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive areas such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;

WSB-Hawaii Assessment. The proposed project site is not located in an environmentally sensitive area of the type as described above. Therefore, the project will not affect or is likely to suffer the type of damage of concern by this criterion. The site, which has been used previously as a buffer zone for the Kahuku Ag Park, is a forested area dominated by non-native flora.

(12) Substantially affects scenic vistas and viewplanes identified in County or State plans or studies; and

WSB-Hawaii Assessment. The project is not anticipated to substantially affect scenic vistas and viewplanes identified in County or State plans or studies. The County Plan encourages both preservation of scenic vistas and environmentally-sound energy systems, including wind energy conversion (i.e., wind turbines). The Ko'olauloa Community Plan emphasizes preservation of the areas rural character and scenic view, and protects against conversion of agricultural land to residential, commercial or industrial uses. Neither plan identifies specific areas on Oahu for special protection. Windfarms are generally compatible with agricultural lands and their uses, such as farming and ranching. As with all windfarms, the evaluation of visual impact generally rests with the community. As such, the community as a whole has not expressed concerns regarding visual impact (See Section 3.16).

(13) Requires substantial energy consumption.

WSB-Hawaii Assessment. The project would generate and consume electrical energy. However, the amount of electrical energy consumed is negligible to the amount that would be generated and delivered to the utility.

4.3 County

The plans and policies guiding development in County that relate to the proposed windfarm project are the County General Plan and the Ko'olauloa *Sustainable* Community Plan.

4.3.1 County General Plan

The following are excerpts from the County General Plan regarding the Natural Environment (Section II) and Energy (Section VI).

> **"II. Natural Environment**
>
> **Objective A**
>
> To protect and preserve the natural environment.
>
> **Objective B**
>
> To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.
>
> **Policy 1**
>
> Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.
>
> **Policy 2**
>
> Protect Oahu's scenic views, especially those seen from highly developed and heavily traveled areas.
>
> **Policy 3**
>
> Locate roads, highways, and other public facilities and utilities in areas where they will least obstruct important views of the mountains and the sea.
>
> **Policy 4**
>
> Provide opportunities for recreational and educational use and physical contact with Oahu's natural environmental."
>
> <u>WSB-Hawaii Comments</u>. WSB-Hawaii is not aware of any "natural monuments" or "scenic views" in the Kahuku area would fall under Objective B, and be a concern for OWP on the Na Pua Makani project.

"V. Energy

Objective A

To maintain an adequate, dependable, and economical supply of energy for Oahu residents.

Policy 1

Develop and maintain a comprehensive plan to guide and coordinate energy conservation and alternative energy development and utilization programs on Oahu.

Policy 2

Establish economic incentives and regulatory measures which will reduce Oahu's dependence on petroleum as its primary source of energy.

Policy 3

Support programs and projects which contribute to the attainment of energy self-sufficiency on Oahu.

Policy 4

Promote and assist efforts to establish adequate petroleum reserves within Hawaii's boundaries.

Policy 5

Give adequate consideration to environmental, public health, and safety concerns, to resource limitations, and to relative costs when making decisions concerning alternatives for conserving energy and developing natural energy resources."

WSB-Hawaii Comments WSB-Hawaii believes that the proposed Na Pua Makani project helps meet both Objective A and the Policies, and especially Policies 1, 2 and 3

Overall, WSB-Hawaii believes the proposed Na Pua Makani 25 MW windfarm project not only comports with the objectives and policies of the County General Plan, but is a very good example of the type of project that should be replicated wherever possible on Oahu.

4.3.2 Ko'olauloa *Sustainable* Communities Plan

The following are excerpts from the Ko'olauloa *Sustainable* Communities Plan from the Preface to the Plan and regarding General Policies (Section 4.4.1):

> **"CONCLUSION**
> As a result of comments from the C&C/public meetings and community-at-large, the *Sustainable* Communities Plan for Ko'olau Loa has been formulated around the core value of retaining and enhancing the rural quality of the region. The fundamental concept for facilitating this is the use of an *ahupua'a* concept for organizing and distinguishing individual communities. With implementation of rural community boundaries, current and future needs of the region are accommodated without compromising rural quality. Other implementation tools, such as enhancement of village centers, and creation of rural subdivision standards, are used to further reinforce the rural character."
>
> <u>WSB-Hawaii Comments</u> WSB-Hawaii believes, subject to further review and comment, that the Na Pua Makani 25 MW windfarm project is proposed use of the land that is consistent with the *ahupua'a* concept. Primarily, the wind turbines will be utilizing an indigenous renewable resource, i.e., the wind, which was also used by the *ancients*, and still is.
>
> "**4.4.1 GENERAL POLICIES**
>
> The following general policy pertains to electrical power development in Ko'olau Loa.
>
> - Locate and design system elements such as renewable electrical power facilities, substations, communication sites, and transmission lines, including consideration of underground transmission lines, to mitigate any potential adverse impacts on scenic and natural resources, as well as public safety considerations."
>
> <u>WSB-Hawaii Comments</u> WSB-Hawaii believes that the Na Pua Makani 25 MW windfarm project comports with this policy statement. Specifically, OWP has taken steps in the project design and layout to mitigate impacts on "scenic (or visual) and natural resources." See the discussion in Sections 2.4.2 and 3.16.

Overall, WSB-Hawaii believes the proposed Na Pua Makani 25 MW windfarm project not only comports with the objectives and policies of the Ko'olauloa *Sustainable* Communities Plan, but is a very good example of the type of project that should be replicated wherever possible in the Kahuku-Ko'olauloa kuleana.

4.4 Permits and Approvals

Federal, State and County permits and approvals required for the proposed windfarm are summarized in Table 1.4-1 and described in more detail in Section 4.

Federal Approvals. Because their heights, wind turbines and their towers can represent possible obstacles to commercial or private aircraft. However, the site is in rural Oahu and not the island's airports or in their primary landing flight paths. OWP has filed a "Notice of Construction or Alteration" to the U. S. Department of Transportation ("USDOT") Federal Aviation Administration ("FAA") The FAA review and action is pending. As note above, the draft HCP is being prepared for review by the U. S. Fish & Wildlife Service

State Approvals and Permits (See also Section 4 for more details). Approvals and a land lease would be required from DLNR. As discussed above, the proposed windfarm site lies entirely within State lands, designated agricultural, requiring a HCP. In the case of the proposed windfarm, OWP must apply for and be granted a Use of State Lands Approval ("USLA") from the Land Management Division and a Board Permit from the Board of Land and Natural Resources ("BLNR"). These applications require the submittal of and acceptance by DLNR of an Environmental Assessment or an Environmental Impact Statement (if required).

The DEA includes the archaeological survey conducted for OWP by the International Archaeological Research Institute, Inc. ("IARII"), and was forwarded to the State Historic Preservation Department ("SHPD") for review. The review is pending.

City and County of Honolulu Permits. A conditional use permit, minor and a construction and related permits are required from the County Planning Department. With respect to the construction permit, the State Department of Transportation ("DOT"), Highways Division will review the construction plan prior to approval by the County.

Accepting Authority: (Agency/Organization)	Approval/Permit/Action	Estimated Application Date	Estimated Process Time	Public Hearing
DLNR Land Management Division Board of Land & Natural Resources	Draft Environmental Assessment Final Environmental Assessment Approval of FONSI	Jul. 29, 2009 Sep. 29, 2009 Nov. 29, 2009	1 to 2 months 1 to 2 months 1 month	If Required If Required If Required
DLNR Historic Preservation Division	Historic Sites Review	Jul. 29, 2009	1 to 2 months	Not Required
DLNR, DOFAW USDOI, U. S. Fish & Wildlife Service	Draft HCP Final HCP Approve and issues take licenses and take permits	Aug. 28, 2009	1 to 2 months	If Required
DLNR Land Management Division Board of Land & Natural Resources	Direct Lease Application Submittal to Board for approval Approval of Land Lease	Dec. 1, 2009 Feb. 1, 2010 Apr. 1, 2010	1 to 2 months 1 to 2 months 2 to 3 months	If Required If Required If Required
County Planning Department	Conditional Use Permit, Minor	Dec. 1, 2009	2 to 3 months	If Required
County Planning Department	Site Construction and Related Permits Approval of all Permits	Jan. 1, 2010 Jan. 1, 2010	2 - 4 months May 1, 2010	If Required If Required
DOT, Highways Division	Review of Construction Plans	Jan. 1, 2010	2 months	Not Required
USDOT Federal Aviation Administration	Review and Approval of Notice of Construction or Alteration	Aug. 1, 2009	1 to 2 months	Not Required

Table 4.4-1*
Permits and Approvals

*This Table is identical to Table 1.4-1

5. Topical Issues

5.1 Relationship between the Proposed Windfarm Use and Maintenance of Long Term Productivity of the Study Area

WSB-Hawaii has identified potential short-term and long-term impacts associated with the proposed 25 MW windfarm project. This section includes a discussion of how these potential impacts, both negative and positive, affect the long term productivity of the study area.

Potential Negative Impacts

Most of the potential negative impacts would be short-term, construction-related and localized. Some are long-term, operation-related, and are both localized and regional. WSB-Hawaii does not believe there would be significant impact to the long-term productivity of the site's resources and the Kahuku Ag Park. WSB-Hawaii believes all negative impacts can be mitigated to a non-significant level or lower. Note: the primary remaining issue to resolve is the potential impacts on birds and bats which will addressed in the HCP. OWP's goal is to reduce all negative impacts to negligible.

Short-Term. Impacts to the site's soil and vegetation would be short-term and associated with soil disturbances and potential erosion. For example, vegetation removed during excavation for the intrasite electrical distribution network would be replaced. Impacts to air quality would be short-term and associated with localized fugitive dust emissions from construction vehicles.

There could be short-term impacts on flora and fauna in the study area. A biological resources survey did identify native plants and wildlife in the area, but none that are endangered. Steps would be taken to avoid the native plants when the windfarm is constructed. As noted in Section 3.8, bats were detected in the area, and a HCP will be prepared to design and implement a mitigation program to protect any endangered birds or bats that frequent the project area.

No culturally-significant archaeological sites have been found in previous studies in locations nearest to and including most of the project area. An additional survey will be conducted to confirm that no cultural sites exist in the “”unsurveyed” areas which appear to overlap onto at least one potential wind turbine site.

Long-Term. There could be some minor permanent loss of vegetation due to the construction of the new access road, the intrasite road network, the foundations for the wind turbines, the site substation, and the site operation and maintenance facility.

There could be long-term impacts on the birds and other wildlife that inhabit or visit the area. WSB-Hawaii believes these impacts can be mitigated to an acceptable level through the design and implementation of the HCP (See Section 3.8). There is the potential for some impact on the visual resources in the study area, but WSB-Hawaii believes this impact will not be significant (See Section 3.16)

Potential Positive Impacts

WSB-Hawaii believes there are several potential positive impacts of the proposed 25MW windfarm. These positive impacts can be attributed to specific energy, environmental and economic benefits that the windfarm would provide to the people of Oahu and Hawaii. Specific energy benefits include providing wind as an alternative to the conventional oil-fired resources. The windfarm would help diversify the utility's resource base and support the State's goals of reducing dependence on imported energy use and increasing the use of indigenous sources (see Sections 1.3.2 and 4.2). Environmental benefits derive from the avoidance of fossil-fuel emissions. Avoiding these emissions would help protect the environment (see Sections 2.5 and 3.10). The project would create direct economic benefits through creation jobs for the County, tax revenues for the State and jobs for the County and provide multiplier effects that would help diversify the County's economy (See Section 3.10). Overall, the windfarm is a positive use of the Conservation District Use Lands provides all of these benefits and *does not interfere with the primarily conservation use of the land* and *does not preclude other uses*, such as livestock grazing, hunting, and communication facility and transmission line access.

5.2 Irreversible and Irretrievable Commitment of Resources

An irrevocable (irreversible) commitment to loss or destruction of any natural or cultural resource is one that cannot be changed once it occurs. Referring to WSB-Hawaii's response to the "Significance Criteria" has provided in Sections 1.24 and 4.2.5, there is only one potential irreversible and irretrievable commitment of resources that could be taken on the Na Pua Makani windfarm project. Specifically, if potential harm to avifauna could not be mitigated, that would result irreversible and irretrievable commitment of resources. As noted in the referenced sections and in Section 3.8, the avifauna issues will be addressed in the HCP, and WSB-Hawaii believes that a satisfactory mitigation program can be designed and implemented.

5.3 Probable Adverse Effects That Cannot Be Avoided

See the response to Section 5.2.

5.4 Unresolved Issues

Two specific areas have emerged for additional review and evaluation with proposed mitigative as follows. First, OWP recognizes that endangered birds and Hawaiian hoary bats may occasionally frequent the area. Mitigative measures are to be determined via the HCP, which will be prepared by OWP for approval by DLNR/DOFAW and the U.S. Fish & Wildlife Service. Given that the land lease from DLNR (Land Division) to OWP is contingent upon an approved HCP and the Conditional Use Permit from the County, WSB-Hawaii considers this issue to be resolved for the purpose of this DEA.

Second, regarding potential visual impact, OWP recognizes that some members of the community may not support the windfarm because of its potential visual impact. However, WSB-Hawaii proposes that the discussion herein be sufficient pending review and comment by the community and other interested Parties. Given that OWP must also obtain a Conditional Use Permit for the project from the County, OWP will continue to solicit inputs from the community in support of the permit application.

6. Consulted Organizations, Individuals and Comments

Over the past three years while acquiring the land rights OWP provided presentations and continues to communicate progress with all the North Shore Community Associations and Neighborhood Boards regarding wind energy in the Kahuku area mauka of the Kamehameha Highway. OWP has also consulted with various environmental groups, federal and state agencies, government officials, cultural leaders, and many other Project stakeholders.

The specific organizations and individuals contacted include the following:

Ko'olauloa Neighborhood Board
North Shore Neighborhood Board
Kahuku Community Association
Kahuku Village Association
Sunset Beach Community Association
Life of the Land
The Outdoor Circle
Sierra Club
Keep Country Country
Trust for Public Lands
North Shore Community Land Trust
Office of Hawaiian Affairs
Earth Justice
City and County Honolulu, Department of Planning and Permitting
State of Hawaii Department of Land and Natural Resources
State of Hawaii Department of Agriculture
U. S. Department of the Interior, U. S. Fish & Wildlife Service
U S. Department of Transportation, Federal Aviation Administration
Turtle Bay Resort
State Representatives: Hermina Morita, Donovan Del la Cruz, Michael Magaoay

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U. S. Department of Transportation, Federal Highway Administration, Office of Environmental Policy, Washington DC, “Visual Impact Assessment for Highway Projects,” March 1981.

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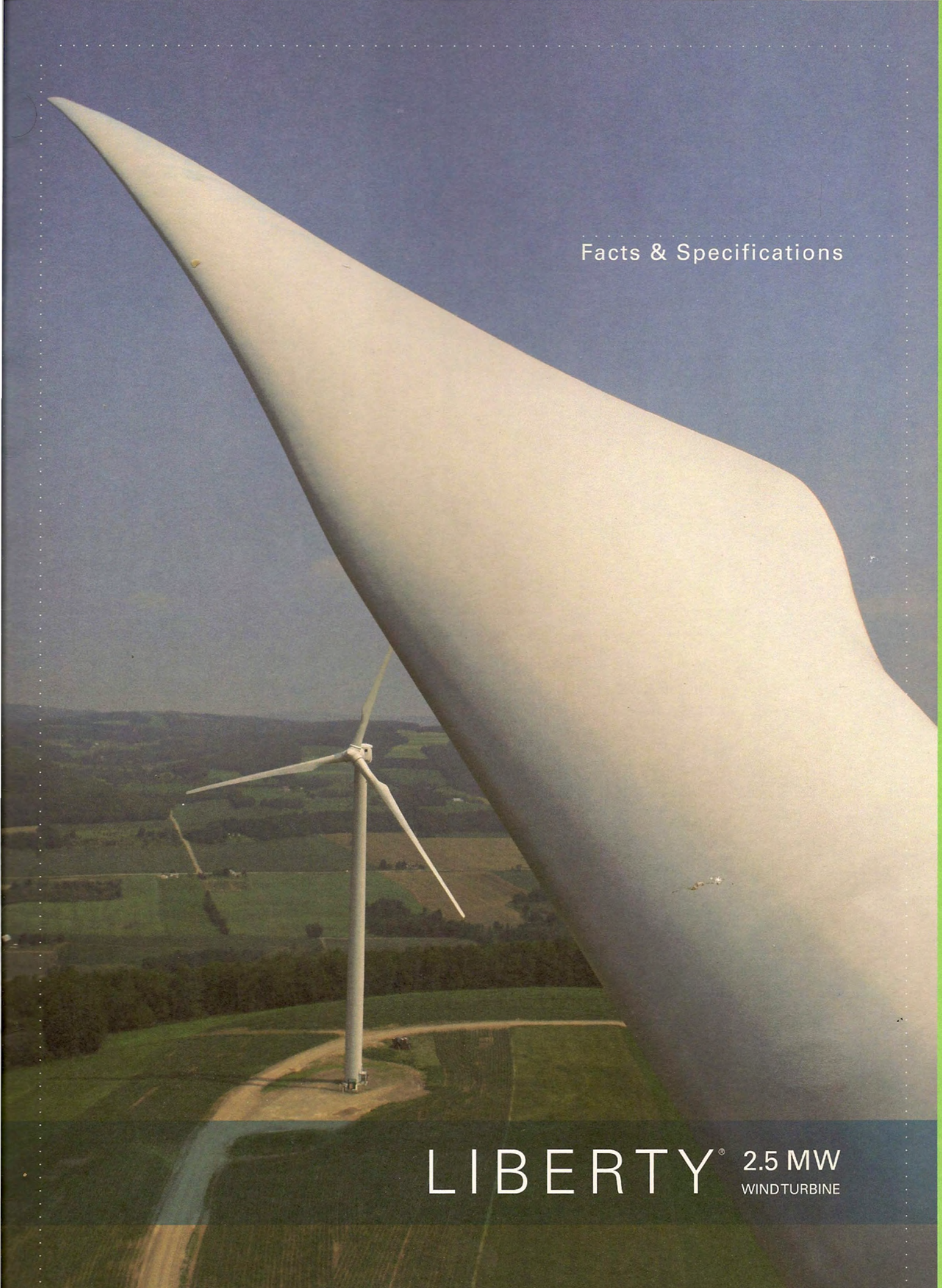
8. Appendices

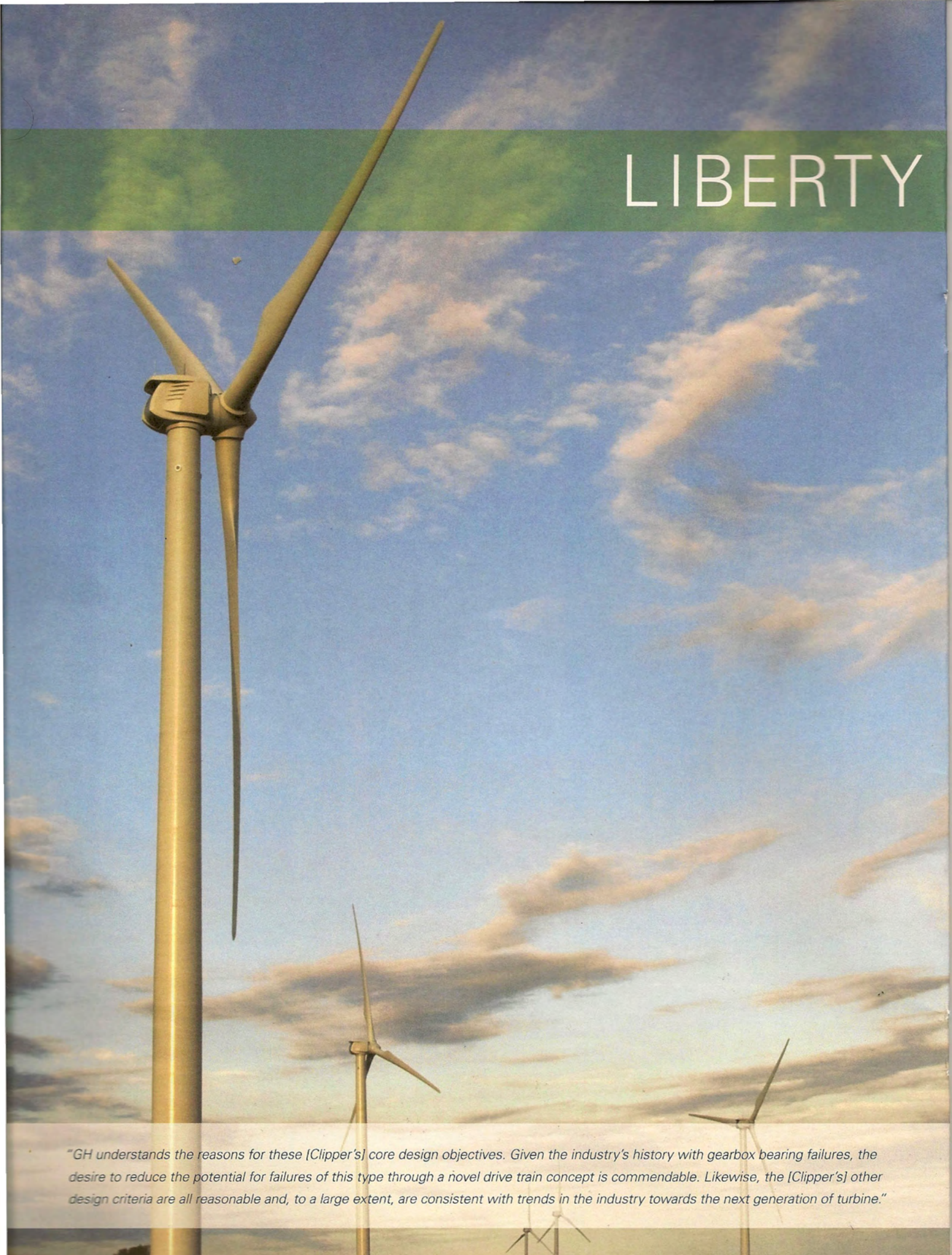
8.1

Clipper Windpower Brochure



Facts & Specifications

LIBERTY® 2.5 MW WIND TURBINE



LIBERTY

"GH understands the reasons for these [Clipper's] core design objectives. Given the industry's history with gearbox bearing failures, the desire to reduce the potential for failures of this type through a novel drive train concept is commendable. Likewise, the [Clipper's] other design criteria are all reasonable and, to a large extent, are consistent with trends in the industry towards the next generation of turbine."

WIND TURBINE DESIGN

The Liberty 2.5 MW wind turbine brings the wind industry's most valued design standards together with Clipper's purpose-engineered technologies to tackle the industry's most critical technology limitations – namely, the recognized drivers of unscheduled maintenance expense – downtime associated with gearbox stresses, large component change-outs and unscheduled crane call-outs.

Beginning with a horizontal-axis, 3-blade, upwind, pitch-regulated, variable-speed architecture, Clipper integrated its Quantum Drive® distributed drive train, a two-stage, helical load-splitting gearbox, four separate MegaFlux® permanent magnet synchronous generators, and controls optimized for variable-speed operation with full power conversion.

A number of innovative features were also added to increase worker safety, and provide ease of machine serviceability

The Liberty turbine was designed by Clipper in partnership with the U.S. Department of Energy ("DOE") and its National Renewable Energy Laboratory ("NREL"), which provided funding for development as well as facilities and support for extensive drivetrain and blade testing. As a result, an 'Outstanding Research and Development Partnership Award' was issued to Clipper by DOE in 2007, highlighting Clipper's "outstanding contribution toward industry advancements", and recognizing "the Liberty wind turbine, which attained unparalleled levels of efficiency and reliability and reduced cost of energy."

In March 2009, an independent due diligence review of the Liberty wind turbine technology was conducted by Garrad Hassan America, Inc. ("GH") on behalf of Clipper. The GH Report concluded: "Overall, GH considers the Clipper turbine design to be reasonable though novel, and the technology to be sound."

LIBERTY

LIBERTY 2.5 MW WIND TURBINE – KEY FEATURES	Reduced Cost of Unscheduled Maintenance	Greater Efficiency, Increased Production	Improved Ownership Return	Ease of Maintenance	Grid Friendliness	Lifetime Cost	Versatility
Quantum Drive® distributed powertrain	•	•	•	•	•	•	•
Four MegaFlux® permanent magnet generators	•	•	•	•	•	•	•
Variable speed technology	•	•	•	•		•	•
IEEE 519 power quality, exceeds standards	•	•	•	•			•
Extended low voltage ride-through capability	•	•	•		•		•
Design architecture accommodates 50 or 60 Hz					•		•
SCADA monitoring & control system	•	•	•	•	•	•	•
CBMS predictive maintenance system	•	•	•	•	•	•	•
Multiple gear inspection ports in powertrain	•	•	•	•	•	•	
Two-person service lift	•	•	•	•	•	•	•
Service platform with safe and ample work area	•	•	•	•	•	•	•
Internal 2-ton hoist	•	•	•	•	•	•	•
Hub accessibility from inside the nacelle	•	•	•	•	•	•	•
Comprehensive lightning protection	•	•	•	•	•	•	•
Crane size requirement for installation similar to 1.5 MW unit	•				•	•	
GL certified cold weather capability	•	•	•	•	•		•
Rotor diameter choices for optimized power generation		•	•			•	•
Full Power Conversion	•	•	•	•	•	•	•
Generator cooling: Water-to-air or air-to-air configurations	•		•	•		•	•

KEY FEATURES

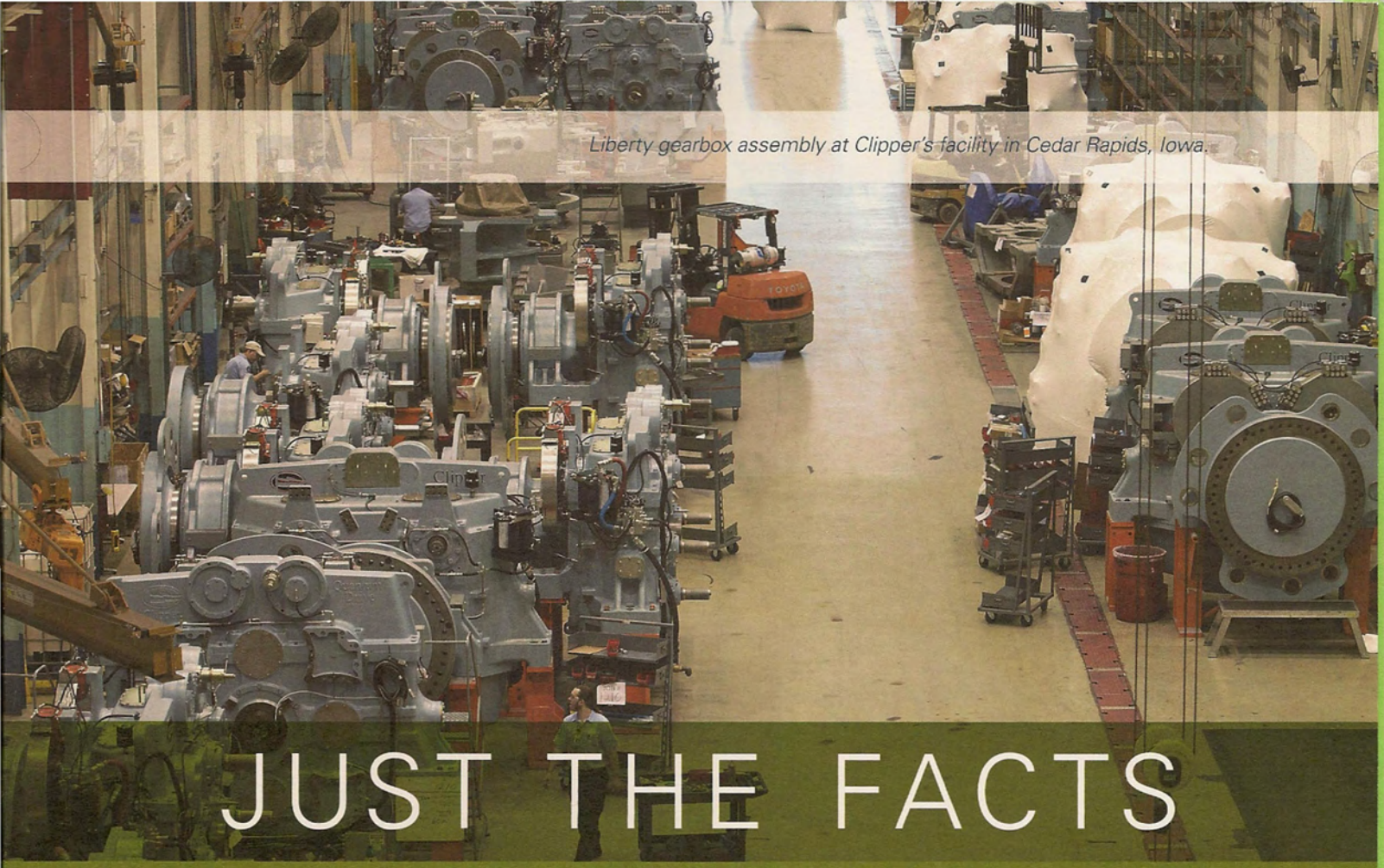
"GH notes that even some established gearbox manufacturers have struggled to meet the stringent design and manufacturing quality standards required for wind turbine applications. GH takes comfort in the fact Clipper is subjecting 100% of its production gearboxes to full load testing."

JUST THE FACTS

FEATURE	DETAIL	BENEFIT
Quantum Drive® Distributed Powertrain	Liberty utilizes a compact, two-stage helical, distributed load path powertrain.	Increased reliability and durability. Higher efficiency in comparison to three-stage powertrain designs
	Four smaller high speed shafts distribute the output to four generators, reducing the potential for premature bearing failure and decreasing time and cost associated with generator service and repair.	Increased reliability and productivity.
	Two pre-loaded, low-speed taper-roller main bearings absorb thrust loads and mitigate problematic axial motion and mainshaft misalignment associated with low speed bearing failures.	Increased reliability, reduced downtime and extended turbine life.
	High-speed gear sets are in "cartridge" form. Replacement is conducted by way of an onboard hoist without removal of the gearbox, eliminating the need for expensive crane mobilization.	Reduced downtime, increased energy production, and substantially reduced long-term operating costs.
	Multiple inspection ports facilitate simple access for visual observation of the gears, enabling a more rigorous operations and maintenance protocol and earlier detection of abnormal wear.	Reduced unscheduled maintenance cost and increased energy production.
MegaFlux® Permanent Magnet Generators	Permanent magnet generators offer advantages over induction generators in terms of increased power density, increased efficiencies at lower wind speeds, improved low-voltage ride-through capability when combined with full power conversion, and simplicity of design.	Nearly maintenance-free operation with higher efficiency, increased energy production, and a lower VAR requirement.
	Does not utilize slip rings or brushes. Historically, slip rings have been a maintenance issue requiring replacement more frequently than anticipated.	Higher efficiency.
	Stray current-induced pitting and bearing failures inherent in doubly-fed generators is eliminated, substantially extending bearing life.	Reduced unscheduled maintenance cost.
	There are no moving parts on the rotor in the rotating frame, thus the need for complex replacements of brushes, rotating rectifiers and exciters typical of doubly-fed generators is eliminated.	Reduced maintenance cost, increased reliability.
	Low short-circuit current reduces torque overload on the drivetrain due to electrical short circuit.	Extended gearbox life.
	Effective generator cooling design maintains temperature at less than Class F rise under all conditions. Form-wound Class H stator winding insulation.	Lower operating temperature provides for increased reliability, and longer life due to greater thermal margin.

FEATURE	DETAIL	BENEFIT
	The four-generator configuration and control capability can enable continued wind turbine operation with one or more generators removed until replacement is performed.	Reduced downtime, and greater productivity.
	Small, compact generators enable removal and replacement utilizing the onboard hoist, eliminating the need for expensive large crane mobilization.	Reduced downtime and long-term operating costs.
	Two IP54 configurations: "water-to-air" and "air-to-air" cooling configurations offer solutions for both mild and harsh operating environments.	Increased reliability and productivity and decreased downtime.
Variable Speed System	System is based on larger capacity IGBT's and proprietary permanent magnet generator technology which provides simpler, more reliable, more cost effective variable speed operation.	Higher energy capture. Increased productivity.
Full Power Conversion	Grid Isolation. Clipper's variable speed generator and inverter system completely decouples the generator from the grid, eliminating grid induced drivetrain torque excursions.	Improved gearbox reliability.
	Power Factor Control. Enables the operation with selectable power factor to near unity and as low as five percent load which minimizes or eliminates the need for VAR correction.	Reduced overall system cost.
	Passive Rectifier. Conversion of the generator alternating current output to direct current for the input to the variable speed inverter offers a simpler variable speed system compared to other wind turbine designs.	Higher reliability and less downtime
	Unidirectional Power Flow. Clipper's variable speed inverter system is simpler, utilizes fewer parts, and delivers power exclusively from the generator's stator. In contrast, doubly-fed generator systems require power flow to and from the generator's rotor requiring high-power slip rings and brushes.	Lower operating and maintenance costs.
	Meets or exceeds IEEE 519 high quality power requirements worldwide now common in all major electricity power markets.	Siting versatility. Increased productivity.
Low Voltage Ride-Through	The Clipper system stays online, helping to stabilize weak grid systems. The system provides low voltage ride-through capability of up to 3 seconds down to 10% of nominal voltage and for 150 msec down to zero percent, exceeding all low voltage ride-through requirements. Clipper's system exceeds the most stringent of grid requirements now in planning, enabling integration into the strictest regulatory environments.	Provides siting versatility and enables greater wind penetration on a given grid system.

FEATURE	DETAIL	BENEFIT
Blades	Rotor sizes available for all wind regimes, including 89m, 93m, 96m and 99m.	Provides siting optimization benefits.
Blade Pitch System	Each blade has an independent electromechanical pitch system with battery back-up for power control and primary braking.	Increased reliability, higher availability.
Lightning Protection	Blade tip lightening receptors connect through brushes on the blade pitch bearings and main shaft, transmitting lightning strike current down the tower to ground. A steel mesh Faraday Cage is embedded within the structure of the nacelle providing an added lightning protection for service crews and machine safety, and immunity to radio frequency interference.	Reduced downtime, reduced cost, and greater productivity.
Advanced Cold Weather Package	Operates at temperatures down to -30 degrees Centigrade, survives to -40 degrees.	Greater energy capture and reduced downtime.
Installation Requirements	Crane size and duration requirements for the installation of the Liberty turbine are similar to that of a typical 1.5 MW machine.	Improved installation value on a cost-per-megawatt basis.
Service Lift	A two-person service lift facilitates timely and efficient service calls enabling crews to service more turbines per day. In addition, experienced service personnel can extend their careers without the limitation of stringent climbing requirements.	Higher turbine operating availability. Increased worker safety.
Interior Work Platform	Provides full stand-up workspace for several technicians as well as near obstacle-free walkways, facilitating ergonomic comfort, safety and ease of service for organized, efficient work performance.	Ease of maintenance. Increased worker safety.
EHS Equipment	Personnel evacuation equipment, including a self-rescue system.	Provides greater safety levels for service technicians. Increased worker safety.
Containment Deck	The nacelle includes a 125-gallon containment deck below the powertrain, preventing tower contamination and providing increased service crew safety.	Reduced downtime associated with spills. Increased worker safety.
Hub Access	The hub can be accessed through three entry ports from inside the nacelle, eliminating the need to exit to the nacelle topside to enter the hub, facilitating quick, simple and safe hub access, particularly in extreme weather conditions.	Decreased downtime associated with performing hub maintenance in severe weather. Increased worker safety.
	Hub components, including pitch drives, can be lowered to the ground with a small, portable 2-ton hoist that attaches to lifting eyes inside the hub.	Reduced downtime for component change out. Ease of replacement and maintenance of components in the hub.



Liberty gearbox assembly at Clipper's facility in Cedar Rapids, Iowa.

JUST THE FACTS

MANUFACTURING	BENEFIT
Quality	Clipper operates with 6 Sigma quality assurance practices, including tools and training for manufacturing practices, personnel training and quality assurance of suppliers. Clipper's ISO 9001:2000 compliant Quality Management System "QMS" manages the full life cycle of the product from design through ongoing operation and maintenance. Our fleet of professional QC staff is on-site at Clipper's Iowa facility as well as at the plants of our key component suppliers to ensure production to the highest standards. This proactive hands-on approach includes mandatory hold and inspection points within all of our production processes.
In-House Manufacturing Cedar Rapids, Iowa	Located in the middle of North America near major road, rail and river barge services. Clipper has invested significantly to ensure state-of-the-art operations. Affording over 330,000 square feet of manufacturing and assembly space, Clipper's facility includes full-scale wind turbine machine base, hub and gearbox assembly lines for the highest level of quality control and supply surety.
In-House Testing	Clipper built and operates two fully rated gearbox test stands as well as a generator test stand. Gearboxes and generators undergo a rigorous fatigue testing protocol prior to final sign-off and shipment.
Purpose-Engineered Component Manufacturing	Outsourced to select, reliable, well-established companies with specialized industrial expertise, and precision-made to Clipper's strict specifications for quality assurance, Clipper's component manufacturing is purpose engineered to the highest standards.
Safety	At Clipper, we're dedicated to the safe operation of our facilities and to the protection of our employees, the public and the environment. Our experienced staff includes a ratio of full-time EHS officers to employees that is among the highest in the wind energy industry. Our practices meet or exceed local, state and federal agency standards.
Operation, Maintenance & Remote Monitoring	Clipper provides service support, covering both scheduled and unscheduled maintenance, and maintains a 24/7 Remote Monitoring and Diagnostics Center (RMDC) at its Cedar Rapids plant. The RMDC interfaces with project sites to shut down and bring on-line turbines that are going into or coming out of a maintenance cycle. The RMDC is also active throughout the turbine commissioning process. Clipper's Fleet Service team Is among the wind industry's most skilled, with decades of experience providing a highly qualified professional base.
Warranty	Warranties are available to suit our customer's needs similar to other industry standard packages.
Our People	Clipper's team represents one of the broadest and deepest levels of experienced wind industry professionals. The global staff includes a strong ratio of professionals with 10 to 20 years of proven wind energy expertise throughout the full range of key staffing roles – experience gained through prior employment within the Industry's top wind energy companies

TECHNICAL SPECIFICATIONS - LIBERTY 2.5 MW WIND TURBINE

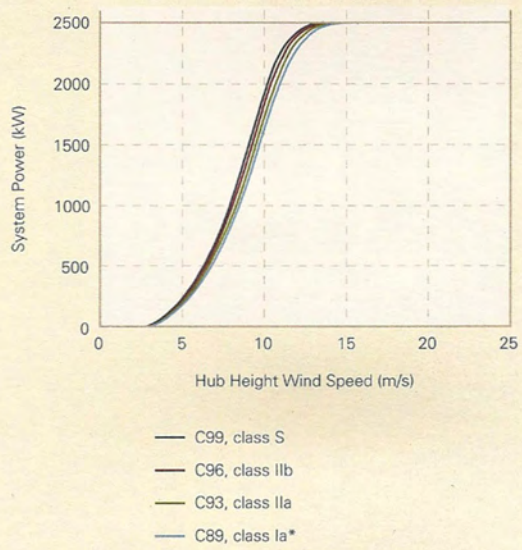
Power Output	2500 kW
Operation	Variable Speed: 9.6 - 15.5 rpm

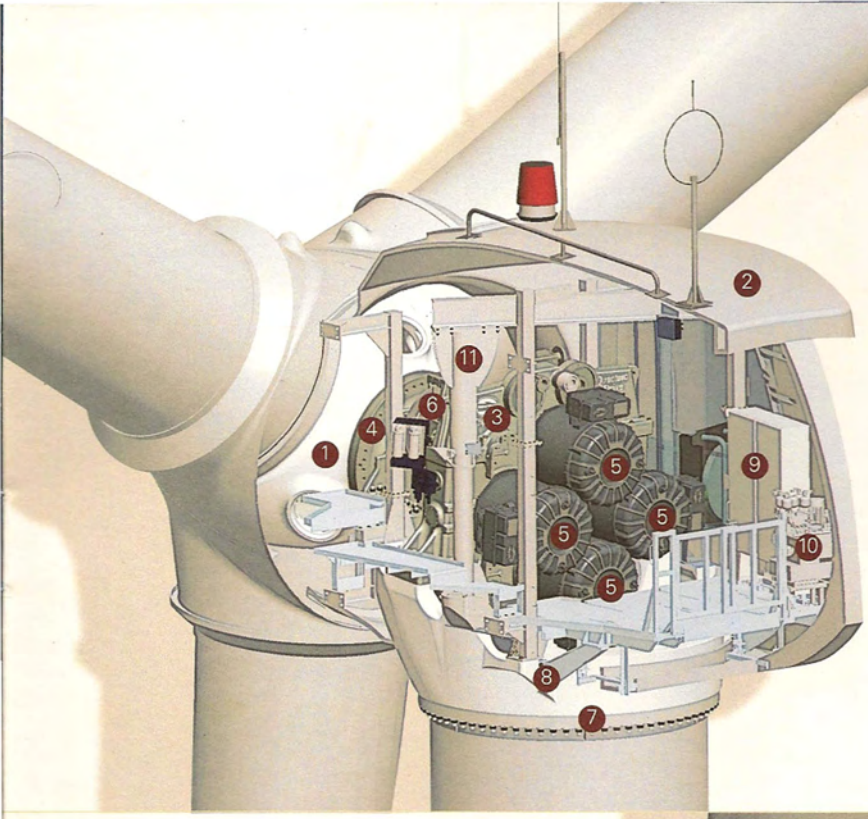
Model	**C89**	**C93**	**C96**	**C99**
Wind Class	Ia*	IIa	IIb	S
Rotor Diameter	89m	93m	96m	99m
Swept Area	6221m2	6793m2	7238m2	7698m2
Blades	43.2m	45.2m	46.7m	48.2m

*Class Ia - All parameters same as IEC Class Ia except 50-year return gust value is 64.5 m/s instead of 70 m/s

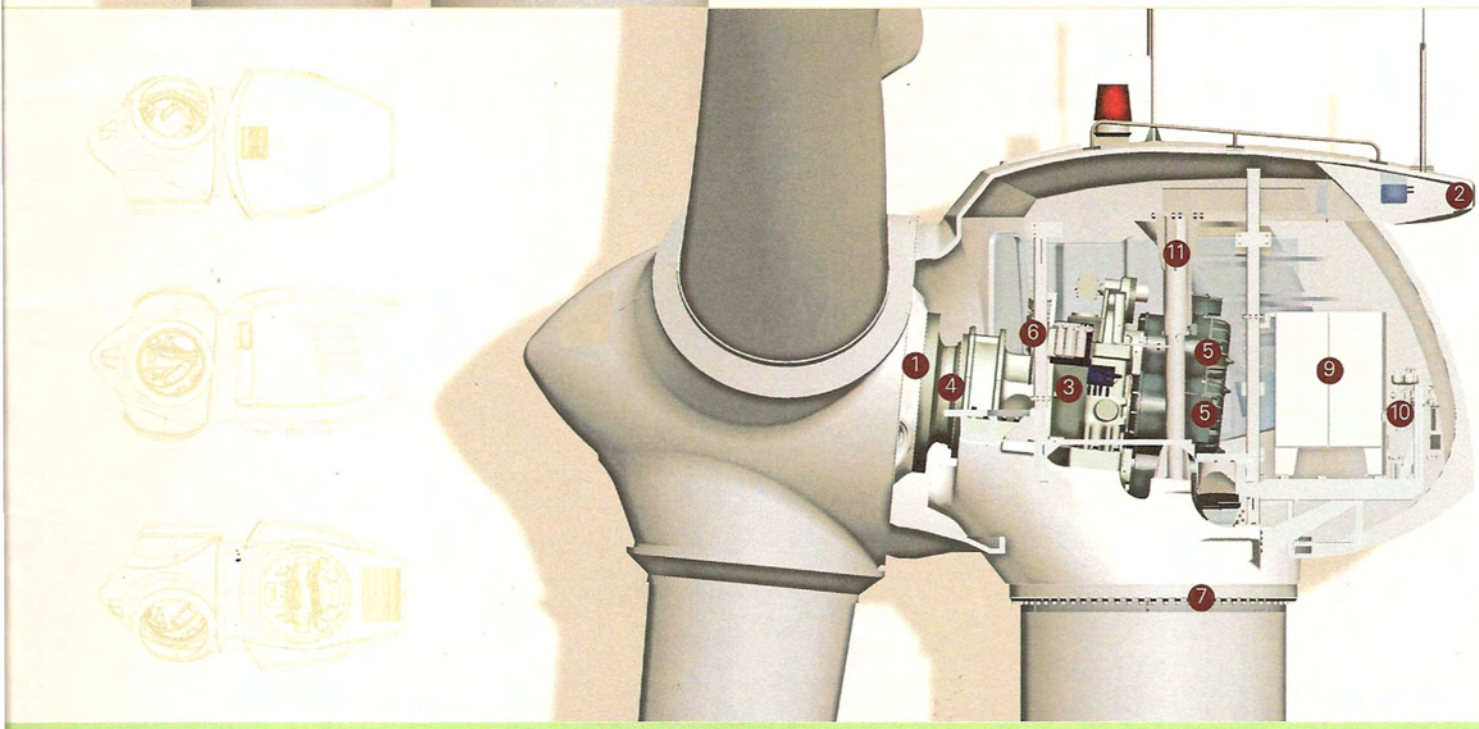
Cut-in Wind Velocity	4 m/s - 10 min. Average
Cut-out Wind Velocity	25 m/s - 10 min. Average
Pitch System	3X DC Electric-Mechanical Gear-motor, Servo Drives and Batteries
Generator	
Type	Synchronous Permanent Magnet
Rated Power Each	660 kW at 1133 rpm
Number of Units	4
Voltage	1320 VDC at Rated Power
Controller	
Type	Embedded Motorola Power PC
Voltage	3 Phase 480 VAC
Power Converter	
Type	4X, Voltage Sourced, IGBT Based 6 Pulse, Inverters
Voltage	690 VAC, 50Hz or 60Hz + 3Hz
Grid Compatibility	
Frequency-Continuous	50Hz or 60Hz + 3Hz
Line Voltage	690 VAC + 10% Continuous
Line Fault Ride-Thru	-90% of Nominal Line for 3 sec.
Line Phase Imbalance	Rated Power + 5%, Cut-in + 10%
Yaw System	4 Electro-Mechanical Motors with Planetary Drives
Yaw Bearing	Internal Gear, Ball Bearing
Yaw Brake System	Disc, 4 Active Hydraulic Brake Calipers
Parking Brake System	Dual Disc with Active Hydraulic Brake Calipers
Parking Brake Location	Intermediate Stage of Gearbox
Tower	Partial Conical - Tubular Steel, 4 Steel Plate Sections
Hub Height	80m Standard / Other Options Available
Service Hoist	On-Board, 2 Metric-ton Hoist
Maintenance	
Post Commissioning	Once at 700 Hours, Every 6 Months Thereafter

Power Curve

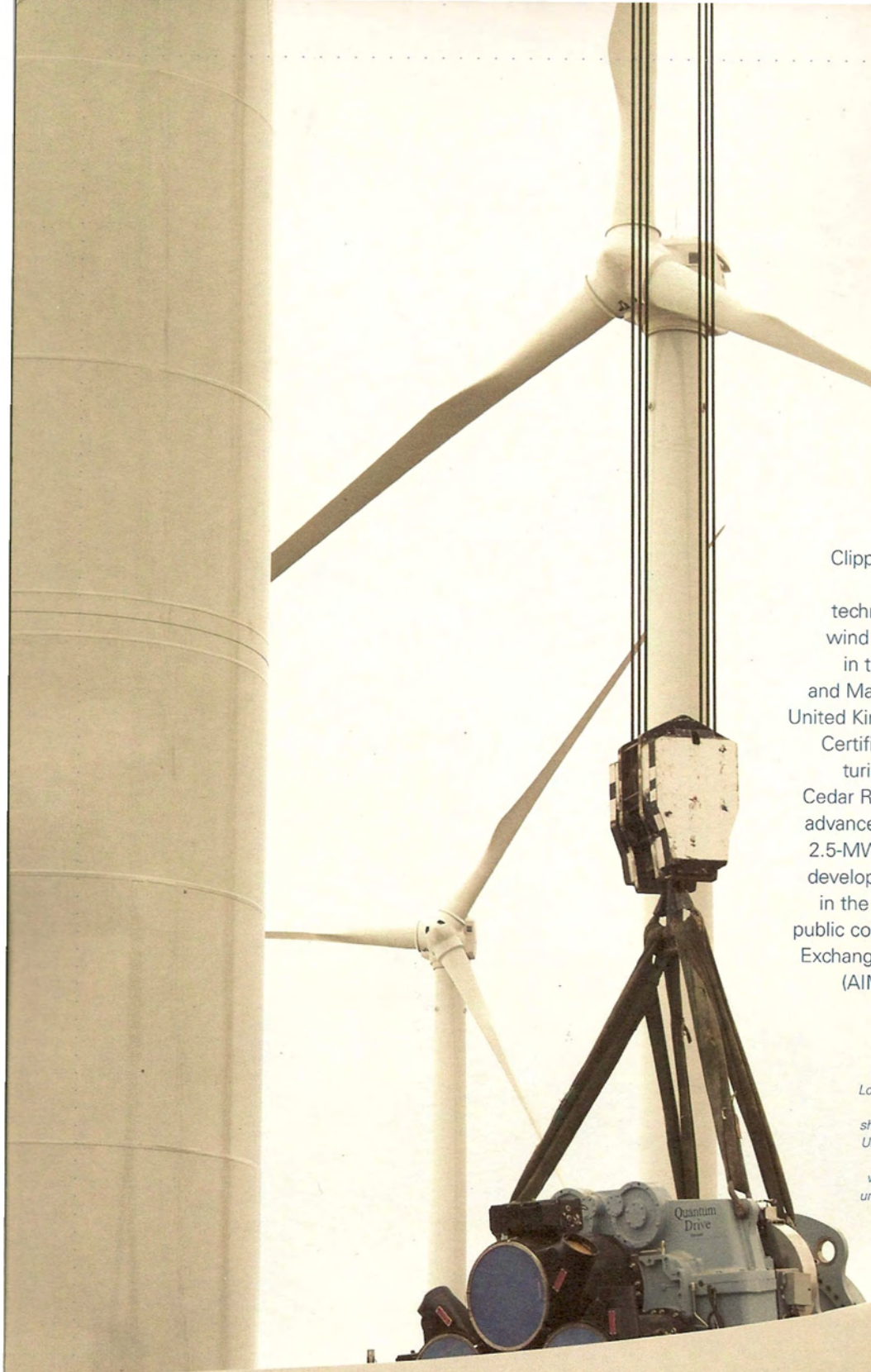




1. Hub
2. Nacelle
3. Gearbox
4. Main Shaft
5. Generators
6. Parking Brakes
7. Yaw System
8. Machine Base
9. Turbine Control Unit (TCU)
10. Hydraulic Power Unit (HPU)
11. On-Board Jib Hoist



SPECIFICATIONS



Clipper Windpower is a rapidly growing company engaged in wind energy technology, turbine manufacturing, and wind project development. With offices in the USA (California, Colorado, Iowa and Maryland), Mexico, Denmark and the United Kingdom, and a ISO9001:2000 QMS Certified, 330,000 square foot manufacturing and assembly facility located in Cedar Rapids, Iowa, the company designs advanced wind turbines, manufactures its 2.5-MW Liberty wind turbine and actively develops wind power generating projects in the Americas and Europe. Clipper is a public company listed on the London Stock Exchange's Alternative Investment Market (AIM). Clipper's ticker symbol is CWP.

The ordinary shares of Clipper Windpower Plc are traded on the Alternative Investment Market of the London Stock Exchange and are not registered under the U.S. Securities Act of 1933, as amended. Such shares may not be offered or sold to residents of the United States or to persons acting on their behalf, or to other persons who are "United States Persons" within the meaning of Regulation S as promulgated under the Securities Act of 1933, unless such shares have been registered under the Securities Act or there is an available exemption from registration.

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Clipper®

8.2

BIOLOGICAL RESOURCES SURVEY

BIOLOGICAL RESOURCES SURVEY

for the

NA PUA MAKANI WINDFARM PROJECT

KAHUKU, OAHU, HAWAII

by

Robert W. Hobdy
Environmental Consultant
Kokomo, Maui
February 2009

Prepared for: West Wind Works, LLC

BIOLOGICAL RESOURCES SURVEY
NA PUA MAKANI WINDFARM

INTRODUCTION

The Na Pua Makani Wind Farm Project lies on 232 acres of land west of Kahuku Town, Ko'olauloa, O'ahu TMK (1) 5-6-08:06. It is surrounded by agricultural farm lands to the north and by undeveloped forested lands to the west and south. This biological study was initiated in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

The project area is a U-shaped parcel consisting of two steep, dissected ridges surrounding a gently sloping valley. Elevations rise steeply behind Kahuku Town to about 250 ft., while the inland ridge rises to nearly 350 ft. Soils include Kaena Stony Clay, 12-20% slopes (KaeD), Paumalu Badlands Complex (PZ) which is highly dissected and steep, and with coral outcrops (CR) at elevations below 100 ft. (Foote et al, 1972). Rainfall averages 45 in. to 50 in. per year with a winter maximum (Armstrong, 1983). Vegetation consists mostly of low, windblown shrubs and trees on the ridge tops and larger trees and brush in the gullies.

BIOLOGICAL HISTORY

In pre-contact times the lower, more gently sloping lands would have been extensively farmed by a large Hawaiian population that lived in the lower valleys and along the sea shore. The ridges would have been covered by a dense tangle of native shrubs such as 'ülei (*Osteomeles anthyllidifolia*), 'akia (*Wikstroemia oahuensis*), 'iliahi alo'e (*Santalum ellipticum*) and 'uhaloa (*Waltheria indica*).

In the late 1800s much of the area was converted to sugar cane agriculature. The land was cleared, plowed, burned and harvested in continuous cycles for about 100 years. Much of the steeper land was used to pasture plantation horses and mules. This reduced the numbers and diversity of native plants considerably. Sugar was discontinued in the 1980's and the land was put into truck crop agriculture or left idle. Today the area is a largely non-native shrubland and forest consisting of a diverse array of aggressive weedy species and a few tough and persistent native plants that have been able to compete and survive.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Na Pua Makani Windfarm Project which was conducted during February, 2009. The objectives of the survey were to:

1. Document what plant, bird and mammal species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

5. Note which aspects of the proposed development pose significant concerns for plants or for wildlife and recommend measures that would mitigate or avoid these problems.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used following multiple routes to ensure complete coverage of the area. Areas most likely to harbor native plants such as gullies or rock outcrops were more intensively examined. Notes were made on plant species, distribution and abundance as well as terrain and substrate.

DESCRIPTION OF THE VEGETATION

The vegetation on this property is a mixture of aggressive weedy species that have taken over since the abandonment of sugar cane agriculture, but there is also a complement of native shrubby species remnant on windy ridge tops. Most abundant throughout the project area is the common ironwood (*Casuarina equisetifolia*). Other common species are Chinese violet (*Asystasia gangetica*), octopus tree (*Schefflera actinophylla*), (*Bidens alba*) no common name, Guinea grass (*Panicum maximum*), Dallis grass (*Paspalum dilatatum*), pitted beardgrass (*Bothriochloa pertusa*), parasol leaf tree (*Macaranga tanarius*), niruri (*Phyllanthus debilis*), Formosa koa (*Acacia confusa*), kaimi clover (*Desmodium incanum*), ‘uhaloa, Koster’s curse (*Clidemia hirta*), Java plum (*Syzygium cumini*), strawberry guava (*Psidium cattleianum*), huehue haole (*Passiflora suberosa*), ‘ulei, ‘akia and Jamaica vervain (*Stachytarpheta jamaicensis*).

A total of 100 plant species were recorded during the course of the survey. Of this total, 17 were common native species: ni’ani’au (*Nephrolepis exaltata* subsp. *hawaiiensis*), kilau (*Pteridium aquilinum* var. *decompositum*), ‘uki’uki (*Dianella sandwicensis*), (*Carex wahuensis*) no common name, ‘akia, pala’a (*Sphenomeris chinensis*), uluhe (*Dicranopteris linearis*), moa (*Psilotum nudum*), pi’ipi’i (*Chrysopogon aciculatus*), pili grass (*Heteropogon contortus*), pukiawe (*Leptecophylla tameiameiae*), kauna’oa pehu (*Cassytha filiformis*), ‘uhaloa, huehue (*Cocculus orbiculatus*), ‘ulei, alahe’e (*Psydrax odorata*) and ‘iliahi alo’e (*Santalum ellipticum*). None of these are rare species and all are known from multiple islands. The native species are mixed in with non-native species for the most part with the exception of a few spots on the lower ridged where ‘ulei forms large monotypic patches.

DISCUSSION AND RECOMMENDATIONS

The vegetation on this property is dominated by non-native agricultural weeds and tree species, although a fair number of common native species occupy some of the ridge tops. No officially listed Endangered or Threatened plant species (USFWS, 1999) were found on the property, nor were any found that are proposed for such status. No special habitats were found either.

Due to the lack of unique or sensitive species or habitats there is little of botanical concern with regard to this property and the proposed project is not expected to have a significant negative impact on the botanical resources in this part of O’ahu.

If, however, there is any re-vegetation planned along road cuts or on the margins of tower pads, it is suggested that some of the native species listed above be selected for propagation and outplanting.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (1999) and Staples and Herbst, 2005). Ferns follow Palmer, (2003).

For each species, the following information is provided:

1. Scientific name with author citation

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:
   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:
   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
BLECHNACEAE (Chain Fern Family)			
Blechnum appendiculatum Willd.	----------	non-native	uncommon
DENNSTAEDTIACEAE (Bracken Fern Family)			
Pteridium aquilinum (L.) Kuhn *var. decompositum* (Gaud.) R.M.Tryon	kilau, bracken fern	endemic	rare
GLEICHENIACEAE (False Staghorn Fern Family)			
Dicranopteris linearis (Burm.f.) Underw.	uluhe	indigenous	rare
LINDSAEACEAE (Lindsaea Fern Family)			
Lindsaea ensifolia Sw.	----------	non-native	rare
Sphenomeris chinensis (L.) Maxon	pala'a	indigenous	rare
NEPHROLEPIDACEAE (Sword Fern Family)			
Nephrolepis brownii (Desv.) Hovencamp & Miyam.	Asian sword fern	non-native	rare
Nephrolepis exaltata (L.) Schott *subsp. hawaiiensis* W.H. Wagner	ni'ani'au	endemic	uncommon
POLYPODIACEAE (Polypody Fern Family)			
Phlebodium aureum (L.) J. Sm.	rabbit's foot fern	non-native	rare
Phymatosorus grossus (Langsdon&Fisch.) Brownlie	laua'e	non-native	uncommon
PSILOTACEAE (Whisk Fern Family)			
Psilotum nudum (L.) P. Beauv.	moa	indigenous	rare
PTERIDACEAE (Brake Fern Family)			
Cheilanthes viridis (Forssk.) Sw.	green cliff brake	non-native	uncommon
Pityrogramma austroamericana Domin	gold fern	non-native	rare
Pityrogramma x *mckenneyi* W.H. Wagner	hybrid gold fern	non-native	rare
THELYPTERIDACEAE (Marsh Fern Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Christella parasitica (L.) H. Lev.	----------	non-native	rare
MONOCOTS			
ARECACEAE (Palm Family)			
Phoenix x dactylifera	hybrid date palm	non-native	rare
ASPARAGACEAE (Asparagus Family)	----------	non-native	rare
Agave sisalana Perrine	sisal	non-native	rare
COMMELINACEAE (Spiderwort Family)			
Commelina diffusa N.L. Burm.	honohono	non-native	rare
CYPERACEAE (Sedge Family)			
Carex wahuensis C.A. Meyen	----------	endemic	rare
HEMEROCALLIDACEAE (Hemerocallis Family)			
Dianella sandwicensis Hooker & Arnott	'uki'uki	indigenous	uncommon
ORCHIDACEAE (Orchid Family)			
Arundina graminifolia (D.Don) Hochr.	bamboo orchid	non-native	rare
POACEAE (Grass Family)			
Andropogon virginicus L.	broomsedge	non-native	uncommon
Axonopus fissifolius (Raddi) Kuhlm.	narrow-leaved carpetgrass	non-native	uncommon
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	non-native	common
Brachiaria mutica (Forrsk.) Stapf	California grass	non-native	rare
Chrysopogon aciculatus (Retz) Trin.	pi'ipi'i	indigenous	uncommon
Digitaria ciliaris (Roetz.) Koeler	Henry's crabgrass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Heteropogon contortus (L.) Beauv.	pili grass	indigenous	rare
Hyparrhenia rufa (Nees) Stapf	thatching grass	non-native	rare

Melinis minutiflora P. Beauv.	molasses grass	non-native	rare
SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Melinis repens (Willd.) Zizka	Natal redtop	non-native	rare
Oplismenus hirtellus (L.) P.Beauv.	basketgrass	non-native	uncommon
Panicum maximum Jacq.	Guinea grass	non-native	common
Paspalum conjugatum Bergius	Hilo grass	non-native	uncommon
Paspalum dilatatum Poir.	Dallis grass	non-native	common
Paspalum fimbriatum Kunth	Panama grass	non-native	rare
Paspalum scrobiculatum L.	ricegrass	non-native	rare
Pennisetum polystachion (L.) Schult.	feathery pennisetum	non-native	uncommon
Pennisetum purpureum Schumach.	Napier grass	non-native	rare
Saccharum officinarum L.	sugar cane	non-native	rare
Setaria parviflora (Poir.) Kerguelen	yellow foxtail	non-native	rare
Sporobolus africanus (Poir.) Robyns & Tournay	African dropseed	non-native	uncommon
DICOTS			
ACANTHACEAE (Acanthus Family)			
Asystasia gangetica (L.) T.Anderson	Chinese violet	non-native	common
ANACARDIACEAE (Mango Family)			
Schinus terebinthifolius Raddi	Christmas berry	non-native	uncommon
ARALIACEAE (Ginseng Family)			
Schefflera actinophylla (Endl.) Harms	octopus tree	non-native	common
ASTERACEAE (Sunflower Family)			
Bidens alba (L.) DC	----------	non-native	common
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	uncommon
Crassocephalum crepidioides (Benth.)S.Moore	redflower ragleaf	non-native	rare
Cyanthillium cinereum (L.) H. Rob.	little ironweed	non-native	uncommon
Emilia fosbergii Nicolson	red pualele	non-native	uncommon
Emilia sonchifolia (L.) DC.	violet pualele	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Pluchea carolinensis (Jacq.) G.Don	sourbush	non-native	rare
Sonchus oleraceus L.	pualele	non-native	uncommon
BIGNONIACEAE (Bignonia Family)			
Spathodea campanulata P.Beauv.	African tulip tree	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina equisetifolia Stickm.	common ironwood	non-native	abundant
CUCURBITACEAE (Melon Family)			
Momordica charantia L.	balsam pear	non-native	rare
ERICACEAE (Heath Family)			
Leptecophylla tameiameiae (Cham.&Schlect.) C.M. Weiller	pukiawe	indigenous	rare
EUPHORBIACEAE (Spurge Family)			
Aleurites moluccana (L.) Willd.	kukui	Polynesian	rare
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	non-native	rare
Macaranga tanarius (L.) Mull. Arg.	parasol leaf tree	non-native	common
Phyllanthus debilis Klein ex Willd.	niruri	non-native	common
FABACEAE (Pea Family)			
Acacia confusa Merr.	Formosa koa	non-native	common
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	uncommon
Crotalaria pallida Aiton	smooth rattlepod	non-native	rare
Desmodium incanum DC.	ka'imi clover	non-native	common
Desmodium triflorum (L.) DC.	three-flowered beggarweed	non-native	uncommon
Falcataria moluccana (Miq.) Barneby & Grimes	albizia	non-native	rare
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Mimosa pudica L.	sensitive plant	non-native	rare
LAMIACEAE (Mint Family)			
Hyptis pectinata (L.) Poit.	comb hyptis	non-native	rare
LAURACEAE (Laurel Family)			
Cassytha filiformis L.	kauna'oa pehu	indigenous	rare
Cinnamomum burmanni (Nees) Blume	Padang cassia	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Waltheria indica L.	'uhaloa	indigenous	common
MELASTOMATACEAE (Melastoma Family)			
Clidemia hirta (L.) D.Don	Koster's curse	non-native	common
MENISPERMACEAE (Moonseed Family)			
Cocculus orbiculatus (L.) DC.	huehue	indigenous	uncommon
MORACEAE (Mulberry Family)			
Ficus microcarpa L.	Chinese banyan	non-native	rare
MYRSINACEAE (Myrsine Family)			
Ardisia elliptica Thunb.	shoebutton ardisia	non-native	rare
MYRTACEAE (Myrtle Family)			
Pimenta dioica (L.) Merr.	allspice	non-native	uncommon
Psidium cattleianum Sabine	strawberry guava	non-native	common
Psidium guajava L.	common guava	non-native	uncommon
Syzygium cumini (L.) Skeels	Java plum	non-native	common
PASSIFLORACEAE (Passion Flower Family)			
Passiflora edulis Sims	passion fruit	non-native	rare
Passiflora foetida L.	love-in-a-mist	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Passiflora suberosa L.	huehue haole	non-native	common
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	narrow-leaved plantain	non-native	uncommon
POLYGALACEAE (Milkwort Family)			
Polygala paniculata L.	----------	non-native	rare
ROSACEAE (Rose Family)			
Osteomeles anthyllidifolia (Sm.) Lindl.	'ulei	indigneous	common
RUBIACEAE (Coffee Family)			
Morinda citrifolia L.	noni	Polynesian	rare
Psydrax odorata (G.Forst.) A.C. Smith & S.P. Darwin	alahe'e	indigenous	rare
Spermacoce assurgens Ruiz & Pav.	buttonweed	non-native	rare
SANTALACEAE (Sandalwood Family)			
Santalum ellipticum Gaud.	'iliahi alo'e	endemic	uncommon
SAPOTACEAE (Sapodilla Family)			
Chrysophyllum mexicanum T. Brandegee	satin leaf	non-native	rare
THYMELAEACEAE ('Akia Family)			
Wikstroemia oahuensis (A. Gray) Rock	'akia	endemic	common
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	uncommon
Stachytarpheta australis Modenke	owi	non-native	rare
Stachytarpheta cayennensis (Rich.) Vahl	nettle-leaved vervain	non-native	uncommon
Stachytarpheta jamaicensis (Jacq.) Vahl	Jamaican vervain	non-native	common

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Three species of mammals were observed during two site visits to the property. Taxonomy and nomenclature follow Tomich (1986).

Feral pig (*Sus scrofa*) – A number of pig diggings were observed in gullies on the north end of the upper ridge. These animals come down from the mountains in the evenings to root for worms and succulent roots, but avoid man and his activities.

Domestic dog (*Canis familiaris*) – A few dogs were seen and heard in the lower elevations where they are associated with farming activities and residences.

Hawaiian hoary bat, ‘Ope’ape’a (*Lasiurus cinereus semotus*) – An evening survey detected a few of these Endangered bats within the agricultural fields below the study area but also there were faint signals on the lower margin of the upper ridge as well. The survey was conducted on the evening of Feb.03, 2009 between 6:45pm and 7:45pm, using a Batbox IIID detecting device. Bat calls were detectable between 21,000 and 32,000 hertz but were clearest in the 25,000 – 27,000 hertz range which is the frequency these bats are known to use. Echolocation calls were produced in about 2 second bursts of modulated sound and were repeated every few seconds as the bats located and homed in on flying insects. Bat calls were infrequent and very faint at the lower edge of the project area as though coming from several hundred feet distance, but the direction the calls were coming from could not be determined. In the center of the agricultural area which was about 0.4 mile down the valley and closer to the lower ridge at least 2 or 3 bats were heard at close range. Further down the valley and approaching Kamehameha Highway no bat activity was detected.

Dense vegetation prevented good visibility of other ground dwelling mammals, but a significant population of rats (*Rattus spp.)* and mice (*Mus domesticus*) would be expected, as they are known to frequent this type of habitat. Mongoose (*Herpestes auropunctatus*) and feral cat (*Felis catus*) are also known to frequent such habitat where they hunt for rodents and birds.

BIRDS

There was moderate birdlife diversity observed within the project area during two site visits. Thirteen species of non-native birds were recorded. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

Zebra dove (*Geopelia striata*) – Flocks of these small doves were seen throughout the project area feeding on seeds along roads and in grassy clearings.

Common myna (*Acridotheres tristis*) – Pairs of mynas were seen and heard throughout the property.

Red-vented bulbul (*Pycnonotus cafer*) – Individual bulbuls were seen and heard calling in most parts of the property.

House finch (*Carpodacus mexicanus*) – House finches were seen in small groupings around ironwood trees where they feed on seeds.

Japanese white-eye (*Zosterops japonicus*) – Individuals and pairs of these small green birds were seen and heard making their scolding calls in trees.

Red-whiskered bulbul (*Pycnonotus jocosus*) – A few of these sharply crested bulbuls were seen in dense forest cover.

Hwamei (*Garrulax canorus*) – A few of these shy birds were seen in gully forests where their melodious calls were heard.

Northern cardinal (*Cardinalis cardinalis*) – Two of these bright red birds were seen in trees in the lower part of the project area.

Spotted dove (*Streptopelia chinensis*) – Two of these large doves were seen in flight on the upper ridge.

Japanese bush-warbler (*Cettia diphone*) – One of these secretive birds was heard in dense undergrowth making its distinctive call.

White-rumped shama (*Copsychus malabaricus*) – One of these long-tailed thrushes was seen and heard in beautiful voice in a damp gully forest.

Cattle egret *(Bubulcus ibis)* – One cattle egret was seen in a grassy clearing in the lower part of the project area.

Mallard *(Anas platyrhynchos)* – One of these large ducks was seen in flight high over the property.

This study area is situated about ¾ mile above the substantial wetlands of the James Campbell National Wildlife Refuge that provides habitat for three Endangered Waterbirds, the ‘alae ‘ula or common moorhen (*Gallinula chloropus sandvicensis),* the ‘alae ke’oke’o or Hawaiian coot (*Fulica alai*) and the ae’o or Hawaiian stilt (*Himantopus mexicanus knudseni*) as well as other commoner waterbirds and shorebirds. These birds fly substantial distances and could overlfy the project area enroute to other wetland habitats. This area, however, has no wetland habitat to attract such waterbirds and none were seen.

INSECTS

While insects in general were not tallied, they were common throughout the property. Although not found on the property, one native sphingid moth, Blackburn’s sphinx moth (*Manduca blackburni*), has been put on the Federal Endangered species list and this designation requires special focus (USFWS, 2000). Blackburn’s sphinx moth was known to occur on O’ahu in the past, although it has not been found here recently. Its native host plants are species of ‘aiea (*Nothocestrum spp*.) and alternative host plants are tobacco (*Nicotiana tabacum*) and tree tobacco (*Nicotiana glauca*). There are no ‘aiea on or near the property, and no tobacco or tree tobacco were found on the property. No Blackburns’ sphinx moth or their larvae were found.

DISCUSSION AND RECOMMENDATIONS

Most of the wildlife observed on the property is non-native and generally unremarkable from an environmental protection standpoint. One native species, however, the Hawaiian hoary bat which was detected near the lower margins of the project is a federally Endangered species with all of the protections that are associated with this status.

The Hawaiian hoary bat is currently known from the six largest islands, but is considered rare on the island of O'ahu where few recent confirmed sightings have been made. That it was detected here in the Kahuku area is thus notable. One Kahuku resident when queried about these bats mentioned that her son had seen them during the evening on more than one occasion at the Pupukea Boy Scout Camp about 3 ½ miles west of the project area. It makes sense that they would occur in such a rural part of this highly urbanized island.

The Hawaiian hoary bat is a highly mobile creature that is known to move about in response to temperature changes and insect population spikes. They are solitary (rather than colonial) bats whose roosting sites appear to be opportunistic and ever changing. They have been recorded from almost every conceivable habitat including high and low elevations, forests, pastures, lava flows, bogs and even rural communities. They can occupy one area when flying insects are abundant and be absent when feeding opportunities have moved elsewhere. Thus no critical habitats have been established for them. The more we focus on these cryptic, nocturnal bats, the more of them we find and the more widespread we find them to be.

None-the-less, the presence of these Endangered flying mammals in the vicinity of proposed wind turbines is of concern and merits consideration as to how to minimize threats to their well being.

In the same vein there is also a small possibility that Endangered waterbirds from the not too distant James Campbell National Wildlife Refuge might overfly the project area and place themselves in harms way. The situations with both the waterbirds and the bats may need to be addressed in consultation with the U.S. Fish and Wildlife Service.

No other concerns regarding the wildlife in this project area are anticipated.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within two groups: Mammals and Birds. For each species the following information is provided:

1. Common name

2. Scientific name

3. Bio-geographical status. The following symbols are used:

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.

   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

   non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.

   migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

   abundant = many flocks or individuals seen throughout the area at all times of day.

   common = a few flocks or well scattered individuals throughout the area.

   uncommon = only one flock or several individuals seen within the project area.

   rare = only one or two seen within the project area.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Pig	*Sus scrofa*	non-native	rare
Dog	*Canis familiaris*	non-native	rare
Hawaiian Bat, Ope'ape'a	*Lasiurus cinereus semotus*	endemic	rare
BIRDS			
Zebra dove	*Geopelia striata*	non-native	common
Common myna	*Acridotheres tristis*	non-native	common
Red-vented bulbul	*Pycnonotus cafer*	non-native	common
House finch	*Carpodacus mexicanus*	non-native	uncommon
Japanese white-eye	*Zosterops japonicus*	non-native	uncommon
Red-whiskered bulbul	*Pycnonotus jocosus*	non-native	rare
Hwamei	*Garrulax canorus*	non-native	rare
Northern cardinal	*Cardinalis cardinalis*	non-native	rare
Spotted dove	*Streptopelia chinensis*	non-native	rare
Japanese bush-warbler	*Cettia diphone*	non-native	rare
White-rumped shama	*Copsychus malabaricus*	non-native	rare
Cattle egret	*Bubulcus ibis*	non-native	rare
Mallard	*Anas platyrhynchos*	non-native	rare

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8.3

Archaeological Background Report

Archaeological Background Report for the Proposed Na Pua Makani Windfarm Project, Kahuku, O'ahu

(TMK 5-6-008:006)

Prepared by:

Alex E. Morrison

Prepared for:

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INTERNATIONAL ARCHAEOLOGICAL RESEARCH INSTITUTE, INC.
MAY 2009

ARCHAEOLOGICAL BACKGROUND REPORT FOR THE PROPOSED NA PUA MAKANI WINDFARM PROJECT, KAHUKU, O'AHU (TMK 5-6-008:006)

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May 2009

INTRODUCTION

In accordance with the scope of work for the proposed Na Pua Makani Windfarm project (TMK 5-6-008:006) by West Wind Works LLC, Oregon, International Archaeological Research Institute Inc. preformed the following work tasks:

1. Review the relevant archaeological investigations that have been conducted in the project area, including surveys, reports, and other materials prepared by the State Historic Preservation Division, Department of Land and Natural Resources; the Army Corps of Engineers, and the Navy.
2. Prepare a summary report, including an assessment of the adequacy and relevance of the previous surveys, to the proposed Windfarm project.

The report fulfills the scope of work, summarizes previous land use in the project area relevant to the preservation of cultural resources, and presents the results of a previous archaeological survey in the project area. It is concluded that previous and existing land use activities have likely impacted much of the area's cultural resources. The previous archaeological survey also failed to locate cultural resources within the majority of the project area. A few remaining areas that were not covered in the previous survey and do not show clear signs of disturbance should be surveyed for cultural resources if future construction activities will be conducted in these areas. A brief summary of land use and survey results is presented below.

PREVIOUS LAND USE IN THE PROJECT AREA

The Na Pua Makani Windfarm project area (TMK 5-6-008:006) is located on the northeast coast of O'ahu, in the traditional land division *ahupua'a* of Kahuku and Keana near the town of Kahuku (Figure 1). The project area is approximately 2 kilometers inland from the coast on a steep sloping ridge. The total project area is 231.9 acres. The present landscape reflects a diversity of land uses including pre-Contact agricultural activity, early historical cattle and sheep ranching, and historical agro-economic cultivation. Stride et al. (2003) note that most of the upland areas above Kahuku were previously planted in sugarcane and pineapple. Ranching and agricultural activities have affected the landscape in various ways ultimately impacting the preservation of cultural resources within the project area.

Early Land Use

Initial historic accounts of Kahuku in the journal of the British vessel *Resolution* on February 24, 1779 indicate that the area once had a large indigenous population and the landscape was under visible cultivation:

> Run round the Noern (Northern) Extreme of the Isle [O'ahu] which terminates in a low point rather projecting [Kahuku Point]; off it lay a ledge of rocks extending a full Mile into the Sea, many of them above the surface of the Water: the Country in this neighborhood is exceedingly fine and fertile: here is a large Village, in the midst of it is run up a high pyramid doubtlessly part of a Morai [Beaglehole 1967: 572].

However, by the time Vancouver visited O'ahu in 1794, the population of the Kahuku area had apparently declined dramatically and agricultural practices had diminished substantially (Vancouver 1798 (3):71). These early historic accounts suggest that the probability of activities associated with agriculture within the project area was probably high during the pre-Contact period. However, demographic changes perhaps associated with

population decline soon after European contact altered traditional subsistence practices in the area substantially.

Ranching in Kahuku

In 1850 and 1851, soon after the land division known as "the Great Mahele of 1848", Charles Gordon Hopkins acquired a large amount of land from Kamehameha III, including the *ahupua'a* of Kahuku and began a cattle and sheep ranching operation known as Kahuku Ranch (Figures 2-3) (Stride et al. 2003:16). The unfortunate consequence of these ranching activities was a transformation of the landscape from one heavily populated with trees to a deforested area. Bryan (1915: 226-227) notes:

> Since the coming of the whites there have been many causes…that have been at work bringing about a change in the natural conditions. Chief among the disturbing elements, however have been cattle…Roaming at will through the forests they and other animals have done untold damage and brought about conditions that have been most serious in many places…

One likely additional consequence of extensive animal grazing would have been the destruction of archaeological features existing on the surface through constant trampling. By 1889 Kahuku Ranch extended 14 miles along the Kahuku coast and occupied 23,608 acres (Bowser 1880: 409).

The Kahuku Sugar Plantation

Perhaps the most significant land use operation to occur within the current project area was the development of the Kahuku Sugar Plantation beginning in January of 1890 (Figure 4). The Kahuku Ranch land was originally sold to James Cambell in 1874. Cambell leased most of the ranch land to Benjamin Franklin Dillingham in 1889. Dillingham immediately sub-leased a 2,800-acre portion of the land to James B. Castle who started the Kahuku Plantation Company which was primarily used for cultivating sugarcane (Stride et al. 2003; O'Hare et al. 2005).

The development of the railroad from Kahuku to Honolulu had a significant impact on the production of sugarcane at the Kahuku plantation. The exact starting date for the railroad at Kahuku Plantation is not known as no annual reports appeared before 1893. However, construction probably started soon after the original charter in 1890 (Stride et al. 2003: 18). Harvested acreage on the plantation ranged from 1,034 in 1900 to 2,979 during the last year of sugarcane production in 1971 (O'Hare et al. 2005: 14).

In summary, the history of land use in the project area includes pre-Contact agricultural and residential activities, historical cattle and sheep ranching, and finally historical sugarcane and pineapple plantation agriculture. The consequences of the historical activities undoubtedly destroyed most archaeological remains that were once present within the project area, a conclusion supported by the archaeological survey by Stride et al. (2003), discussed below.

PREVIOUS ARCHAEOLOGICAL SURVEY IN THE PROJECT AREA

In May and June of 1992, Cultural Surveys Hawaii (Stride et al. 2003) conducted pedestrian survey and limited subsurface testing for the proposed 785-acre Kahuku agricultural park in the *ahupua'a* of Kahuku and Kaena (Figure 5). The survey covered the majority of the current project area excluding two small areas towards the western extremes. The current project area coincides with area 2 designated by Cultural Surveys Hawaii. Stride et al. (2003: 1) note:

> Area 2 presently consists of fallow sugarcane and/or pineapple fields. Some southern portions of the project area, on steep hillsides and on the crests of ridges and on knolls remain uncultivated. No archaeological sites were observed in these areas.

While the survey conducted by Stride et al (2003) covered the majority of the current proposed project area, two inland areas (53.5 acres) were not surveyed.

To further assess the potential occurrence of archaeological resources within the Windfarm project area, a cartographic GIS approach was employed. The following section summarizes these findings.

CARTOGRAPHIC GIS ANALYSIS OF UNSURVEYED AREAS

A series of historical USGS maps and aerial photographs of the project area spanning the time period 1906 to 1968 were geo-referenced and overlain on each other. These maps include, a map of O‘ahu made by John M. Donn, June 30 1906 (Hawai‘i State Survey Office Registered Map 2374), a 1913 USGS topographic map acquired from the map archives at the University of Hawai‘i at Manoa, a 1943 Army Corps of Engineers Terrain map acquired from the Bishop Museum archives, and two 1968 aerial photographs of the Kahuku area, also acquired from the Bishop Museum archives. Visual inspection of these maps and aerial photographs was conducted in order to assess whether past land use activities reduced the preservation of cultural materials in the project area.

Figures 6 and 7 shows the distribution of the unsurveyed areas and the locations of previous pineapple cultivation indicated on a 1913 USGS topographic map. The results suggest that significant portions of the landscape were previously used for pineapple cultivation and if archaeological sites were once present, they were likely destroyed during the initial clearing of the area. For example, when speaking of the survey area Stride et al. (2003: 31) suggest:

> It was evident that much of the area was impacted by bulldozing for commercial agricultural interests (p. 4)…most or all of the archaeology occurring on the none sloping portions of the project area would have been bulldozed for late historic agriculture.

Aerial photographs taken in 1968 were acquired in order to inspect the degree of visible disturbance from bulldozing and other activities in the project area. Figure 8 shows the extent of recognizable landscape disturbance within the unsurveyed portion of the project area. The presence of large disturbed portions of the landscape as well as evidence for previous pineapple cultivation within the project area makes the probability that cultural resources still exist very low.

RECOMMENDATIONS

The review of previous land use patterns in the survey area as well as the visual inspection of maps of the cultivated areas and previous archaeological survey suggests that cultural remains are not likely to be encountered within the project area. Consequently, it is recommended that archaeological survey and testing need not be conducted in the areas already surveyed by Cultural Surveys Hawaii. Additionally, the areas indicated as disturbed and/or under previous pineapple cultivation are not likely to contain cultural resources. However, if activities associated with the construction of the Windfarm are to be conducted in other unsurveyed portions of the project area, it is recommended that pedestrian survey be conducted. The total unsurveyed portion of the project area is 53.5 acres.

Figures

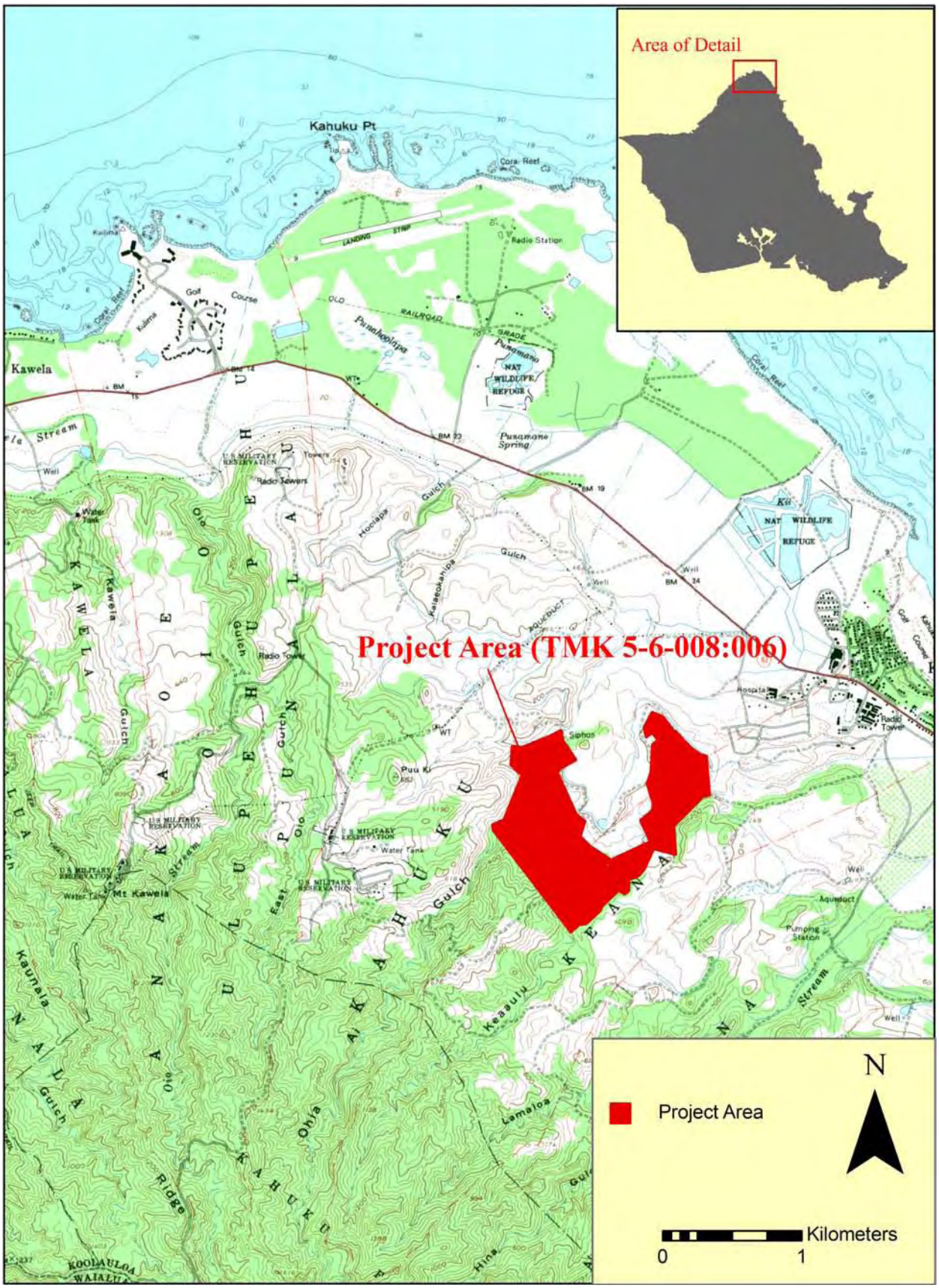

Figure 1. Location of the project area near Kahuku on a USGS Map.

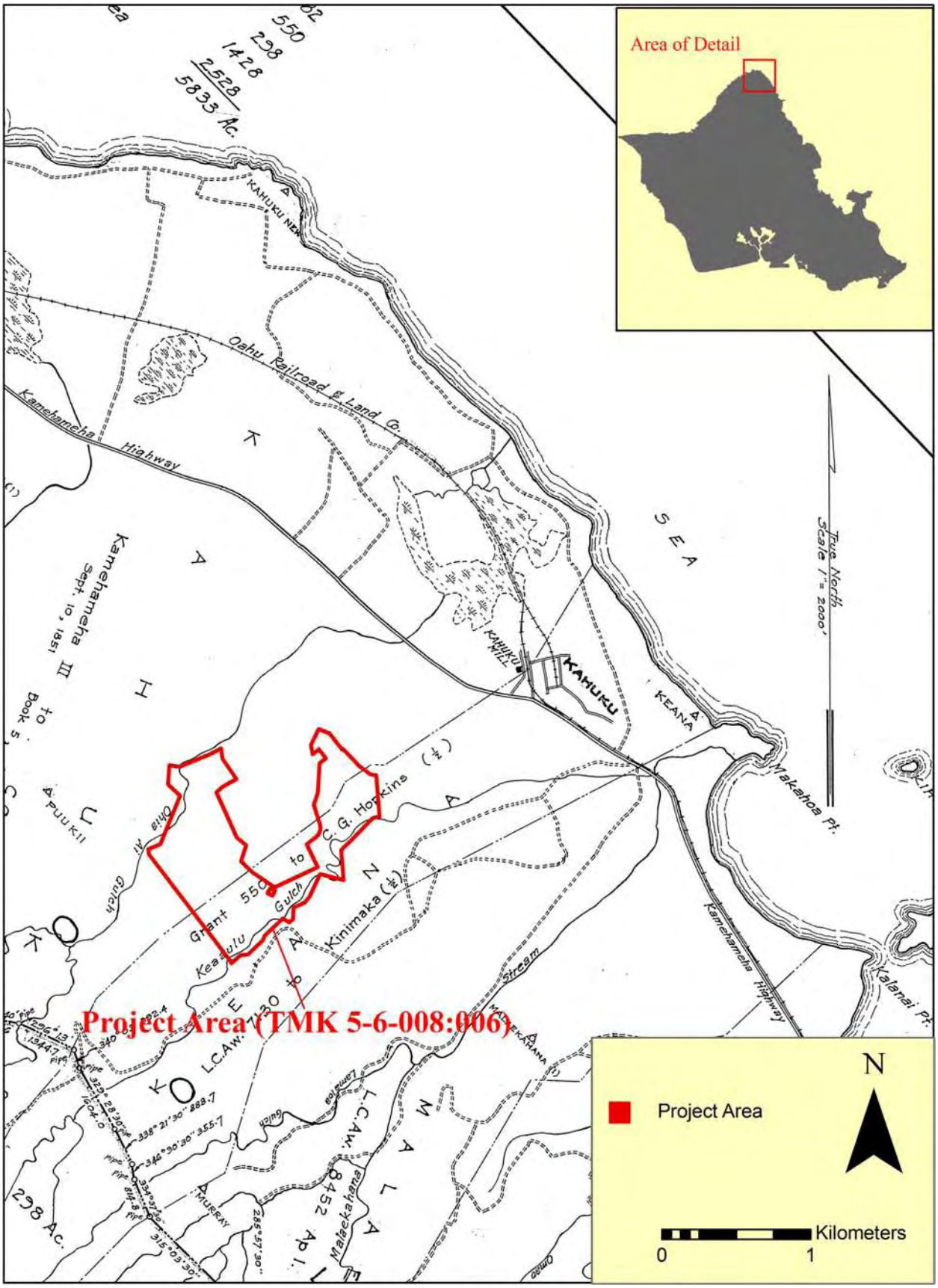

Figure 2. Location of the project area overlain on Map Plat-2068-A[1] showing LCA divisions.

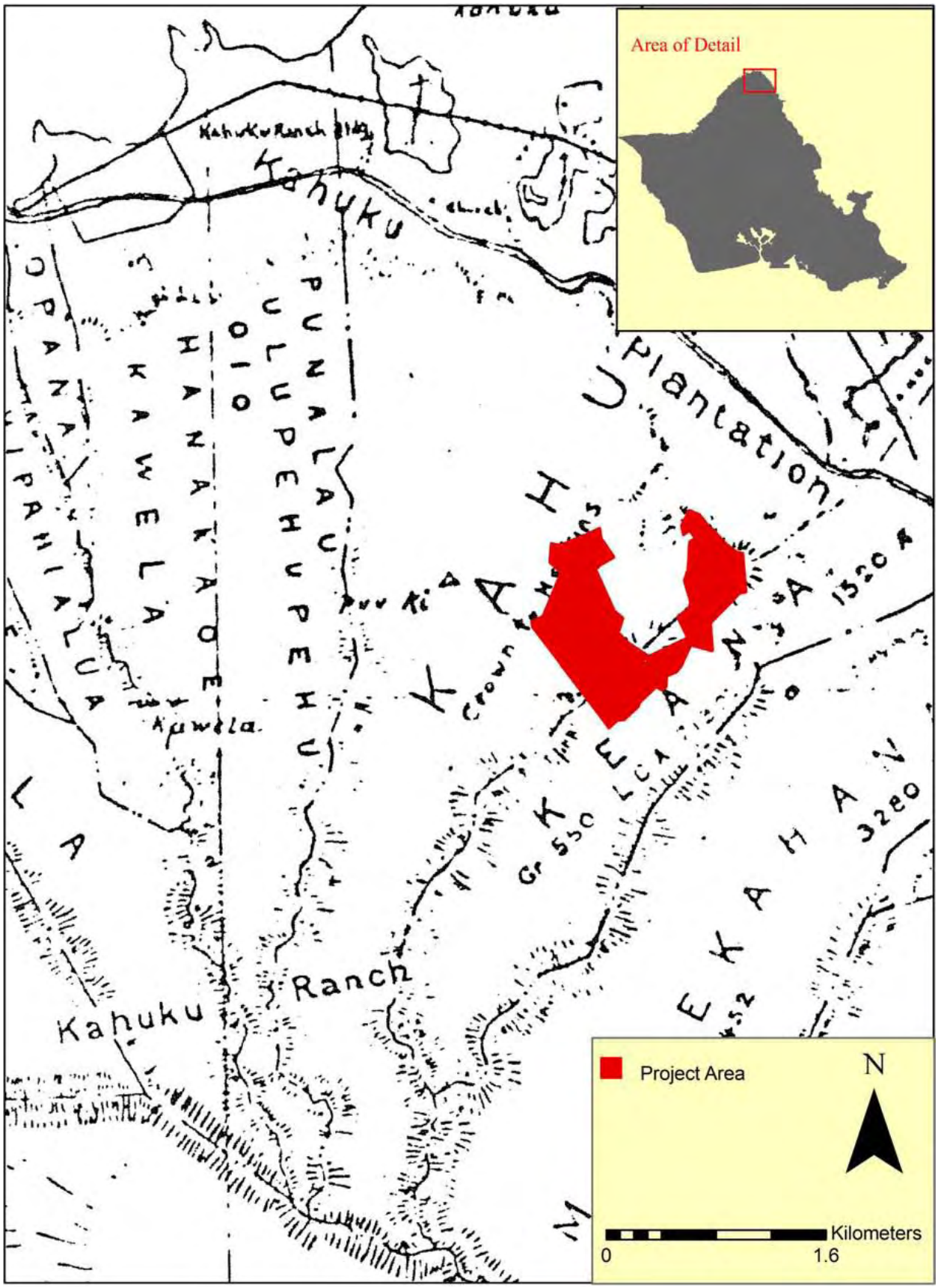

Figure 3. Location of the project area overlain on a 1906 map made by John M. Donn, June 30 1906 (Hawai‘i State Survey Office Registered Map 2374) showing the locations of Kahuku Ranch and Kahuku Plantation.

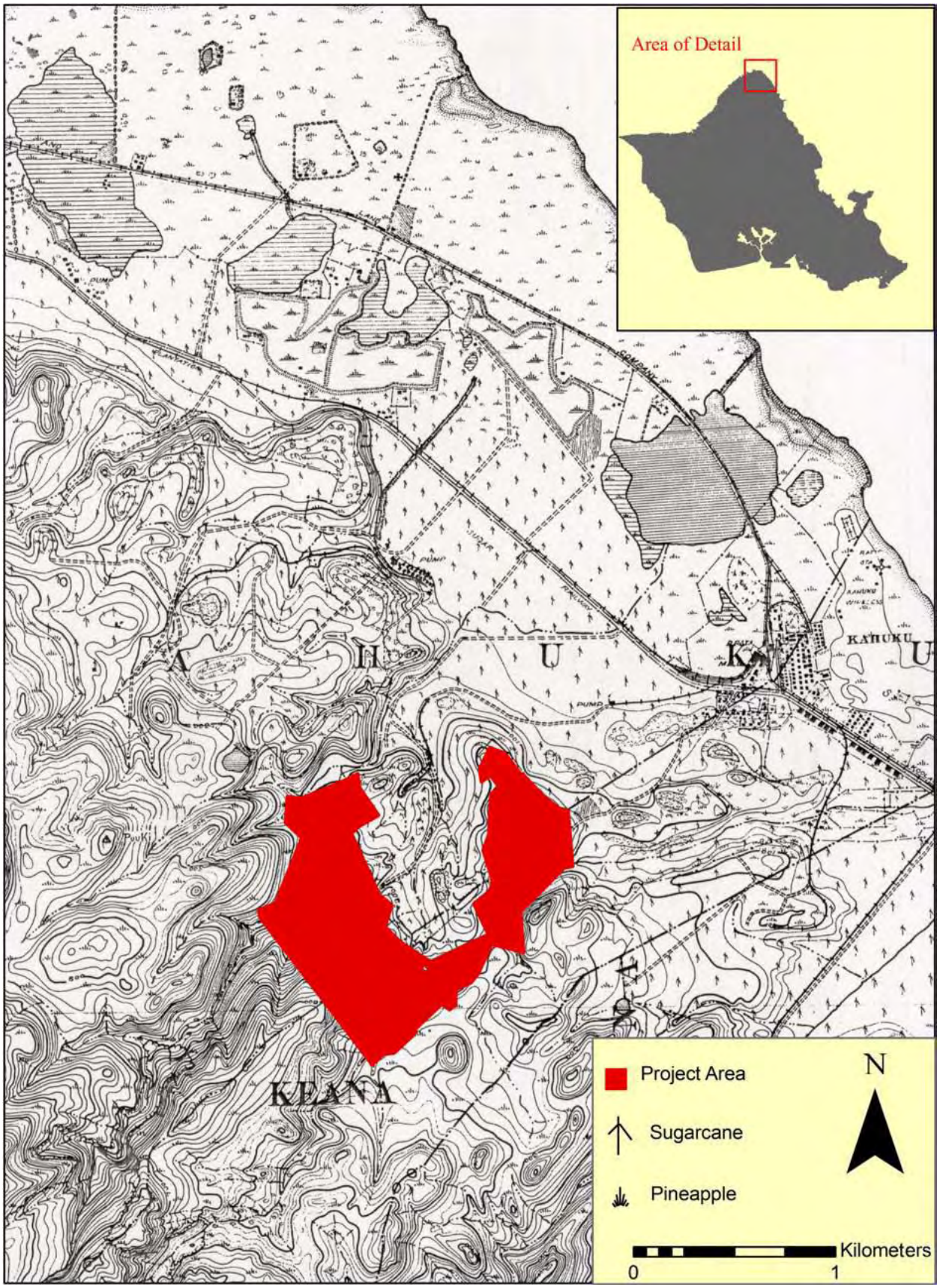

Figure 4. Location of project area on a 1913 USGS Map. USGS map indicates the locations of cultivated sugarcane and pineapple.

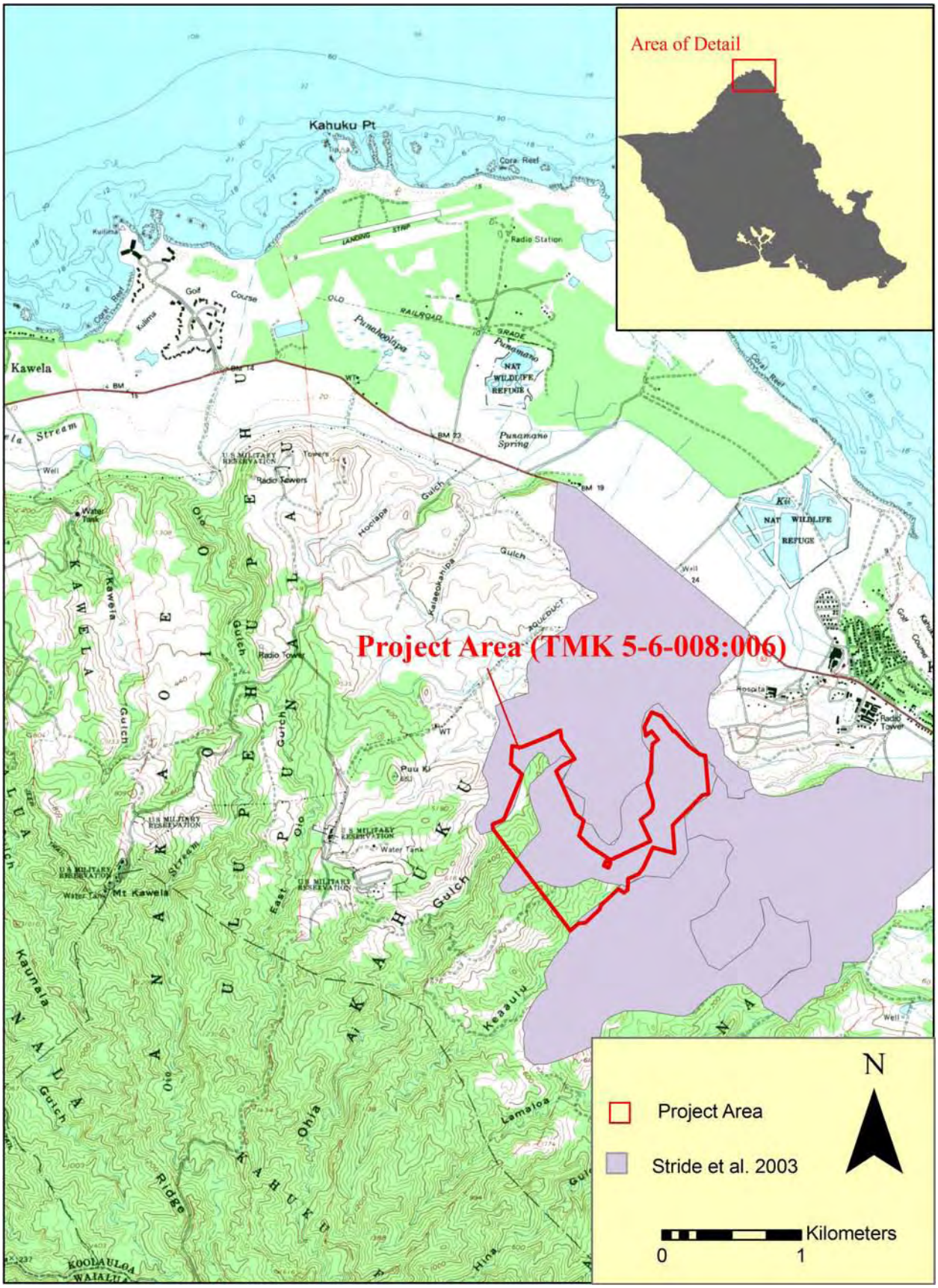

Figure 5. Location of previous archaeological survey in the project area.

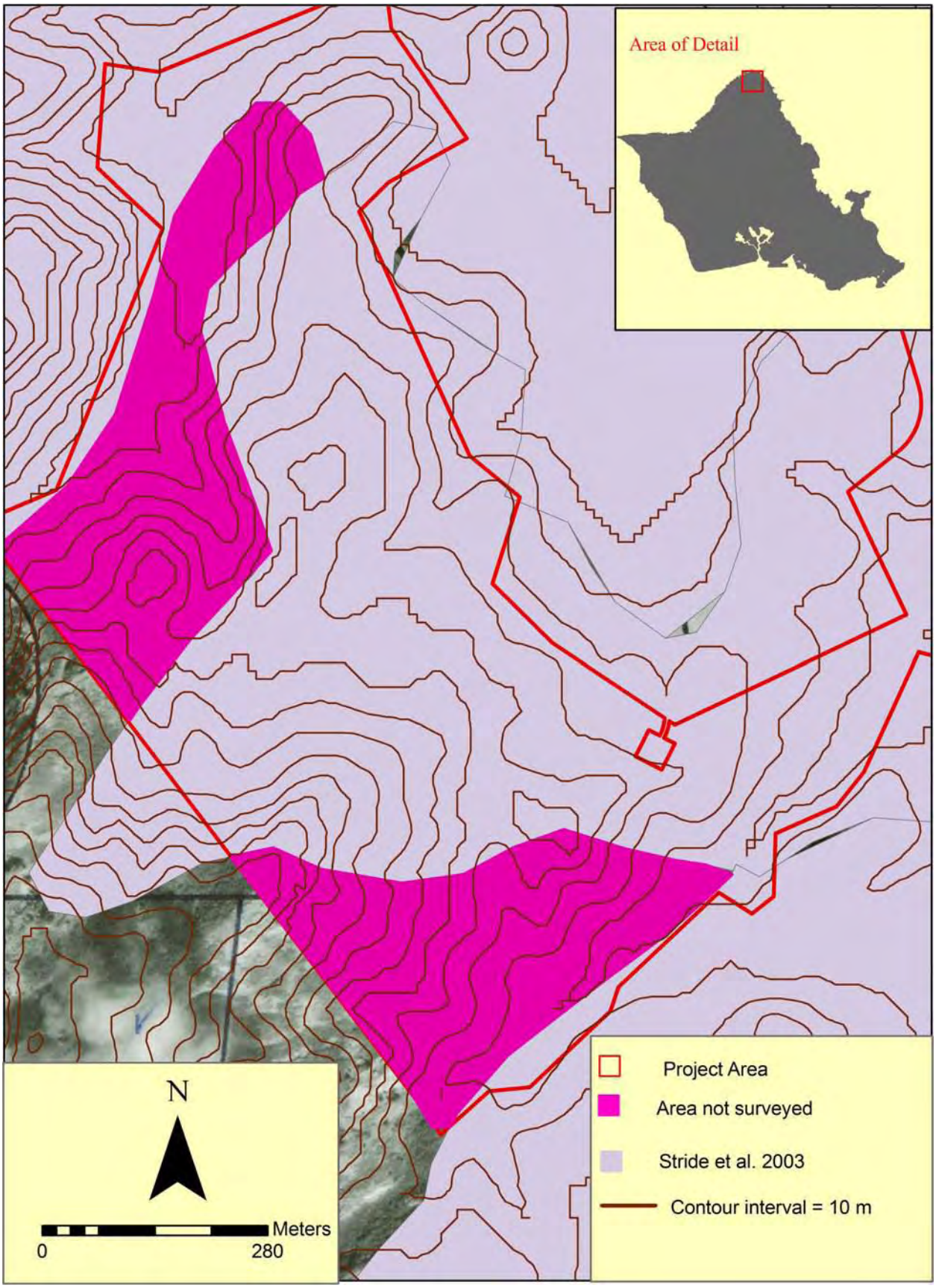

Figure 6. Location of the portions of the project area that have not been previously surveyed.

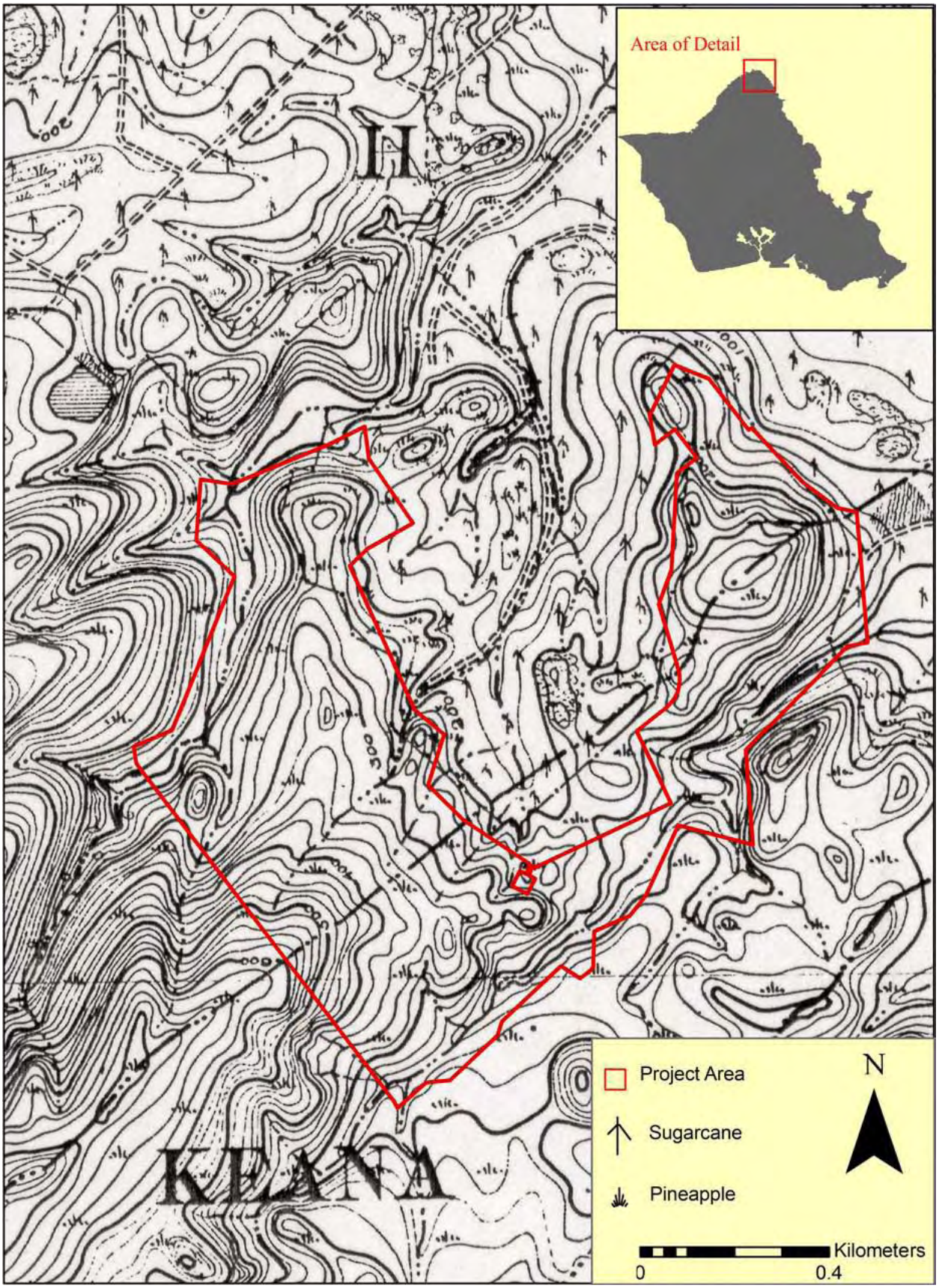

Figure 7. Close up of project area on a 1913 USGS Map. USGS map indicates the cultivation within the project area.

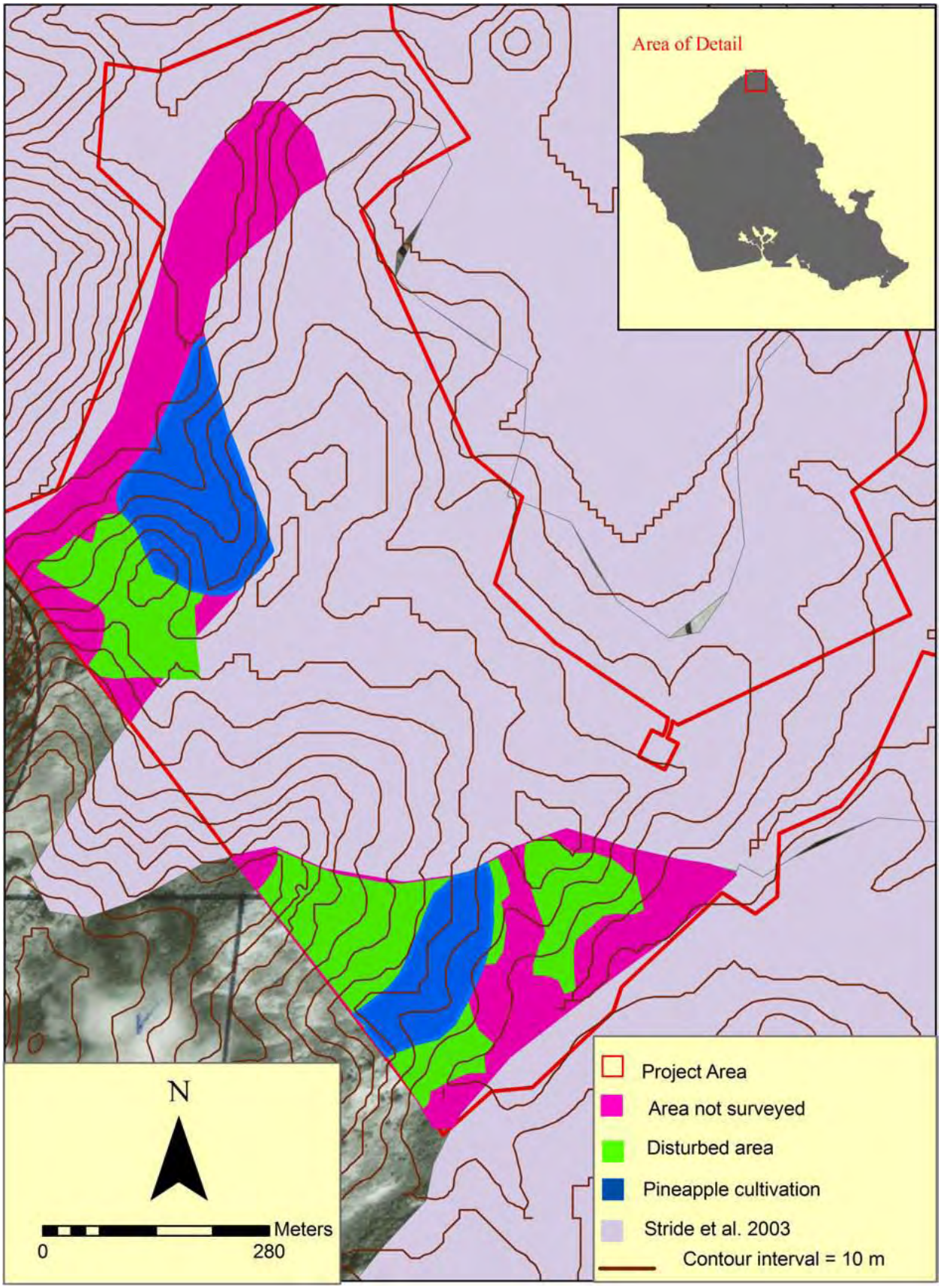

Figure 8. Location of the project area, previously surveyed area, pineapple cultivation, and area disturbed by recent activity.

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