PRELIMINARY
ENVIRONMENTAL REVIEW

FOR THE

OCEAN ERA OFFSHORE AQUACULTURE FARM

OFF ‘EWA BEACH, O‘AHU, HAWAI‘I

DRAFT ONLY

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LIST OF ACRONYMS AND ABBREVIATIONS

ACOE	- Army Corps of Engineers
CDUA	- Conservation District Use Application
DAR	- Division of Aquatic Resources, a division of DLNR
DBOR	- Division of Boating and Ocean Recreation, a division of DLNR
DLNR	- Department of Land and Natural Resources
DOA	- State of Hawai‘i Department of Agriculture
DOH	- State of Hawai‘i Department of Health
EA	- Environmental Assessment
EPA	- Environmental Protection Authority
FAD	- Fish Aggregating Device
FONSI	- Finding of No Significant Impact
HIHWNMS	- Hawaiian Islands Humpback Whale National Marine Sanctuary
HRS	- Hawai‘i Revised Statutes
MAS	- Multiple-anchor swivel
MHI	- Main Hawaiian Islands
NM	- Nautical Miles
NPDES	- National Pollutant Discharge Elimination System
NELHA	- Natural Energy Laboratory of Hawai‘i Authority
NMFS	- National Marine Fisheries Service, a division of NOAA
NOAA	- National Oceanographic and Atmospheric Agency
NWHI	- Northwest Hawaiian Islands
OHA	- Office of Hawaiian Affairs
OSWM	- Office of Solid Waste Management, a division of DOH
OTEC	- Ocean Thermal Energy Conversion
CWB	- Clean Water Branch, a division of the State Department of Health

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EXECUTIVE SUMMARY

Ocean Era is applying for the requisite permits for an offshore aquaculture farm in the Pacific waters approximately two miles south of ‘Ewa Beach, O‘ahu, Hawai’i, located midway between the Old Municipal Airport south of Barbers Point to the west, and the Honolulu International Airport to the east. This farm location is under Title 12, Conservation and Resources; Chapter 190D, Ocean and Submerged Lands Leasing, Hawai‘i Revised Statutes (HRS), as amended, and will establish and operate an aquaculture facility for marine food production of two species of native fish (nenue, *Kyphosus vaigiensis*, also known as chubs, or rudderfish); and moi (*Polydactylus sexifilis*, or Pacific threadfin) along with a variety of native limu (seaweeds). The limu species proposed include ogo (*Gracilaria*), limu kohu (*Asparagopsis taxiformis*), limu lipoa (*Dictyopteris plagiogramma*), *Halymenia* and sea grapes (*Caulerpa* spp).

The Ocean Era Offshore Aquaculture Farm will serve as a commercially viable model for environmentally sound offshore aquaculture, with minimal reliance on forage fish fisheries (such as anchovies and sardines), that provides healthful seafood and employment opportunities for the local community. The primary target market for the fish and limu will be consumers on O‘ahu.

This Environmental Review (ER) assesses the present environment and current human activities in the proposed farm area. It reviews alternative actions, and recommends the project proceed because of the relatively minor impacts of the project, and the economic and environmental benefits to be gained. The ER is designed to provide the public with an early informal opportunity to review and comment on the preliminary assessment of environmental, social, and cultural resources and subsequent potential effects associated with the proposed project. At the appropriate time and maturity of project planning, Ocean Era will revise this ER and prepare an Environment Assessment (EA) consistent with the requirements under Title 12, Conservation and Resources; Chapter 190D, Ocean and Submerged Lands Leasing, Hawai‘i Revised Statutes (HRS), as amended, and other relevant laws.

This ER assesses the potential impacts of the offshore aquaculture farm and describes means for reducing or mitigating these potential impacts. Given the depth of water, the bare sand substrate in the area, the high rate of water exchange through the area, and the distance to any nearby reef areas, the Ocean Era Offshore Aquaculture Farm will result in *de minimus* impacts on water quality and little to no detriment to benthic ecosystems.

A 15-year lease is requested to deploy the offshore aquaculture farm over the surface water area of approximately 450 acres, to accommodate two (2) separate, five (5)-net pen arrays each consisting of 30-meter (m) diameter by 14m deep (~10,000 cubic m [m^3]) floating PolarCirkel-style net pens (with submersible capability), with a trailing 30m x 75m algal growth production unit.

Each net pen array would be secured with a multiple (three [3]) anchor swivel (MAS)-point mooring configuration. Although the MAS is anticipated to only cover approximately 0.89 acres, each net pen array will swing 360° around the mooring configuration, thus covering a total of 225 acres considering the entire watch- circle. The net pen array will be submersible and will normally be operated below the water surface. The proposed net pen array will be moored to the ocean bottom in approximately 100m water depth, which provides further assurances of no significant impacts on water quality, coral reefs, or dolphin resting activity.

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Ocean Era anticipates initially scaling up production over the first several years to approximately 1,000 metric tons of fish annually (approximately 1.1 million pounds per species; 2.2 million pounds total). The large majority of these fish will be sold on Oʻahu, through established seafood distribution channels. The principals in Ocean Era have previous experience introducing new species into the market, such as the Kona Kampachi™.

The issuance of the permit for a commercial offshore aquaculture farm will have little impact on public activities in the area. The depth of water is well beyond the limits of normal recreational diving. The project will be located in the area used by boats that are trolling for ono, which typically ranges in a "lane" between the 25-fathom to 60–fathom depth lines (50 m [150 ft] – 120 m [365 ft]). This "lane" is also fished for mahimahi during spring and fall seasons. However, the array is expected to enhance the fishery for these species, and not be detrimental. Reef fishing and ʻōpelu koʻa are found well inshore of the proposed site, along the edge of the reef, in waters up to 120 feet deep (40m). Fishing grounds for ʻōpelu at night are usually deeper than 40 fathoms (80m).

The ʻEwa Limu Management Area is located in the waters off ʻEwa Beach on the south shore of Oʻahu, and extends from the western edge of the gunnery range to Muʻumuʻu Place, from the shoreline 150 feet seaward. To exercise native Hawaiian gathering rights and traditional cultural practices as authorized by law, hand-picking up to one pound of all types of limu combined per person per day from 6:00 am to 6:00 pm during the months of July, November, and December is allowed by permit only (HRS 188-22.8). The distance from shore (approximately 2 miles) of the proposed farm site is well beyond the limits of the ʻEwa Limu Management Area.

Ocean Era will not be seeking exclusive use of the offshore aquaculture farm site from fishing vessels, and as such, the public will be permitted to fish and traverse around the entire farm site area within safe operating distances from the farm infrastructure. Although the request is for a lease, Ocean Era does not intend to operate the offshore aquaculture farm on a basis for exclusivity. However, for public safety, security and liability reasons, SCUBA-diving, snorkeling, or swimming by the public will be prohibited in the permitted area.

Table ES-1 summarizes the salient issues for offshore culture of native Hawaiian *limu* in Hawaiʻi, based on public comments from Ocean Era's virtual meetings with various community organizations. The determination for each issue, and relevant page in this document, is also presented in this listing of preliminary consultation concerns.

Table ES-1. Issues for Offshore Culture of Native Hawaiian Limu in Hawaiʻi

ISSUE OR CONCERN RAISED BY PUBLIC	ANALYSIS, DETERMINATION, MONITORING AND MITIGATION	PAGE NO.
Deterioration of water quality downcurrent of project	Only minor and nearly immeasurable impacts on water quality and the substrate beneath the site are anticipated in the immediate area of the Ocean Era ʻEwa Beach Farm. The farm is incorporating an integrated multi-trophic aquaculture (IMTA) practice where the byproducts, including waste, from the net pen array serves as an input (feed source) for the algal growth production unit.	

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Table ES-1. Issues for Offshore Culture of Native Hawaiian Limu in Hawai‘i

ISSUE OR CONCERN RAISED BY PUBLIC	ANALYSIS, DETERMINATION, MONITORING AND MITIGATION	PAGE NO.
Attraction of reef fish and pelagic fishes (including sharks) to the platform array	It is not anticipated that reef fish would abandon their typical reef habitats to take up residence on the structure, as they are highly unlikely to leave the reef and move over open water. Sharks may be aggregated to the structures, but the number of sharks in the overall area will not increase.	
Components of the platform may become detached from the mooring potentially impacting benthic EFH	There is no precious coral known from or likely to be occurring in the immediate project area. GPS units on the array would send a signal to the Ocean Era staff if the net pen array were to drift outside the operating area. The mooring design is reliably used to moor ocean-going tankers, and as such minimizes risks for detachment.	
Sea turtles and marine mammals may be disturbed by array or entangled in mooring lines	Taut line moorings will eliminate risk of entanglement. The macroalgae platform array and moorings will not present an obstruction to movements.	
The platform array would likely act as a FAD, and community fishermen may be excluded from the area	The entire Ocean Era ‘Ewa Beach Farm area would remain open to fishing activities.	
Array conflicts with other recreational uses of the area	Local commercial and recreational fisher people and fishing charter boat operators were consulted in determining the final proposed siting location. The applicant is not seeking exclusivity of the project area from fishing vessels.	
Activities would inhibit or restrict Kona crab (*Ranina ranina*) and nabeta (*Iniistius pavo*) fishing	There are virtually no benthic fishing activities in this depth range, as the project site is too deep for free-diving, and for any significant SCUBA diving activity.	
Potential impacts on traditional ‘ōpelu ko‘a due to a potential to draw fish away from ko‘a.	A local ‘ōpelu fisherman with fishing experience over the proposed Ocean Era ‘Ewa Beach Farm site region was consulted in preparation of this environmental assessment, who indicated that they did not anticipate any impact to the location of the ‘ōpelu ko‘a in the shor’Eward direction.	

After the receipt of preliminary input from the public and ocean user stakeholders, an EA will be prepared, where a finding of no significant impact (FONSI) is anticipated. Findings to support this determination will be based on established “Significance Criteria” (Chapter 200, HAR) are:

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

No. The offshore area contains no resources that would be significantly affected. The only potential cultural impact considered is the possibility of changing behavior of ʻōpelu around any traditional koʻa. Previous offshore aquaculture operations have proven popular with ʻōpelu fishers.

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

No. There is little existing recreational, or subsistence use of the proposed permit area.

(3) Conflicts with the State's long-term environmental policies or goals and guidelines.

No. The Ocean Era Offshore Aquaculture Farm proposes to grow human food with ren'Ewable energies as much as practicable. The project is another example that is compliant with the amended ocean leasing law (Chapter 190 D HRS), which was specifically crafted to allow a sustainable ocean-based commercial aquaculture industry to develop in the State. The proposed project is consistent with the environmental policies established under Chapter 344 HRS.

(4) Substantially affects the economic or social welfare of the community or state.

No. The Ocean Era Offshore Aquaculture Farm will provide economic benefits from increased employment in the science and commercial fisheries sectors.

(5) Substantially affects public health.

No. The Ocean Era Offshore Aquaculture Farm will have no influence on public health.

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

No. Substantial secondary impacts would not be anticipated.

(7) Involves a substantial degradation of environmental quality.

No. There will be no degradation of environmental quality associated with the project. Only native Hawaiʻi species will be grown. There is no impact foreseen to water quality and negligible impact likely to benthic fauna.

(8) Cumulatively has a considerable effect on the environment or involves a commitment for larger actions.

No. Implementation of the proposed Ocean Era Offshore Aquaculture Farm will not cause any significant cumulative effects and does not involve any commitment for larger actions. The farm is described in its entirety in the document.

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

No. The proposed Ocean Era Offshore Aquaculture Farm will not cause any substantial detriment to a rare, threatened, or endangered species or its habitat. Humpback whales and monk seals may all transit through the farm area, but the net pen array will not represent a significant barrier to movement of marine mammals, and there is negligible risk of entanglement in the taut-line array and mooring system.

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

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No. Impacts on water quality are anticipated to be negligible, where any resultant nutrients from fish feces or feed wastes would be broadly dispersed due to the watch-like circle movement of the net pen array. In fact, the growth of *limu* uptakes carbon from the surrounding environment and would locally mitigate ocean acidification, thus potentially improving water quality. No air pollutants or noise emissions are anticipated to be generated from the net pen array.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area.

No. The Ocean Era Offshore Aquaculture Farm site is in waters that are approximately 100m (320 ft) deep, with strong currents and coarse sand substrate. The farm will not impede movement or otherwise disturb the spinner dolphins that typically spend their days resting and socializing in the bays on the Western coast of the island. At night, the spinner dolphins are typically found hunting in deeper waters further off O‘ahu shores.

(12) Substantially affects scenic view planes or vistas.

No. The Ocean Era Offshore Aquaculture Farm would be moored at a distance of approximately 1.7 nautical miles south ‘Ewa Beach and approximately 2.6 nautical miles southwest of Iroquois Point. The project will use a submerged design that will provide better security, safety, and reduced wear on the net pen array. Surface marker buoys will be deployed and lit in accordance with U.S. Coast Guard specifications, but these will not be a significant impact on the view plane, given the existing land use of the residential and commercial operations at the Old Municipal Airport south of Barbers Point to the west, and the Honolulu International Airport to the east. The only visible surface elements will be the marker buoys and the feed barge, all other elements will be submerged.

(13) Requires substantial energy consumption.

No. There will be insubstantial amounts of energy used to power the boats and equipment for the Ocean Era Offshore Aquaculture Farm. Ren’Ewable energies will be used wherever possible for deployment and operations during the farm.

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1. 1 PERMITS AND CONSULTATIONS

This section outlines the regulatory issues and coordination associated with Ocean Era's proposed offshore aquaculture farm in the Pacific waters approximately two miles south of 'Ewa Beach, O'ahu, Hawai'i, located midway between the Old Municipal Airport south of Barbers Point to the west, and the Honolulu International Airport to the east. There are multiple state and federal permits, that will be required to initiate and operate this project. The permitting process will also involve consultation and coordination with, or approval by other state or federal agencies. Additionally, meetings, consultations and public hearings have begun and will continue to occur so the public can provide input to the project.

This environmental review document, subsequent revisions and information relating to the permitting process will be made available on the Ocean Era website (www.ocean-era.com).

STATE AND FEDERAL PERMITS

Permitting procedures follow Chapter 190 D, HRS, as amended, and other relevant laws.

State permits and consultation

Hawai'i Dept. of Land and Natural Resources- Conservation District Use Permit (CDUP) [1]

A Conservation District Use Permit (CDUP) is required of any entity intending to use lands in the Conservation District. "Conservation district" means those lands within the various counties of the State and state marine waters bounded by the conservation district line, as established under provisions of Act 187, Session Laws of Hawaii, 1961, and Act 205, Session Laws of Hawaii 1963, or future amendments thereto.

The Conservation District is divided into various subzones.

The proposed project lies within the Resource subzone. The resource subzone is defined in §13-5-13 Resource (R) subzone:

§13-5-13(b)(5): The Resource subzone includes " …state marine waters seaward of the shoreline to the extent of the State's jurisdiction…"

§13-5-24 (c) (4) Identified land uses in the resource subzone…. Identified land uses beginning with letter (D) require a board permit, and where indicated, a management plan…

> R-1 AQUACULTURE (D-1) - The D-1 designation requires that the CDUP be a board permit. "Board permit" means a permit approved by the board of land and natural resources.

§13-5-34 Board permits. (a) Applications for board permits shall be submitted to the department in accordance with section 13-5-31. (b) A public hearing, if applicable, shall be held in accordance with section 13-5-40.

§13-5-39 Management plan approvals. (a) Where required, management plans shall be submitted with the board permit application

[1] From HAR Title 13 Subtitle 1 Chapter 5 https://dlnr.hawaii.gov/occl/files/2013/08/13-5-2013.pdf

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Hawai'i Department of Health Clean Water Branch- National Pollutant Discharge Elimination System

Effluent discharges from the proposed activities will require an individual permit issued by the DOH-CWB under the National Pollutant Discharge Elimination System (NPDES) of CWA, Section 402.

The State Department of Health Clean Water Branch (DOH-CWB) will require a Water Quality Certification application for the project. The proposed demonstration site is in Class A waters, which will require an individual Water Quality certification.

Hawai'i Coastal Zone Management Act

Special Management Areas and Shoreline Setback

Use of the area is not subject to County Special Management Area (SMA) permit requirements.

Aquaculture License

The current proposal is only for a research demonstration and not a commercial for-profit project. Therefore, an Aquaculture License for sale of a State regulated species (under Chapter 187A-3.5 HRS and Sections 13-74-43 and 13-74-44 HAR) will not be required.

Consulting State Agencies

OHA

State historic preservation

DLNR DAR

DLNR DBOR

<u>Federal permits</u>

U.S. Department of the Army Permit

The Rivers and Harbors Act, Section 10, requires that a Department of the Army (DA) permit be issued for any activity that obstructs or alters navigable waters of the U.S. This project will require the deployment of fish and macroalgae culture systems anchored to the seafloor by a mooring system. As such the Department of the Army will need to authorize, authorization to deployment of the farm infrastructure. Authorization will be in the form of an Individual Section 10 Permit or Letter of Permission.

Per the National Environmental Policy Act (NEPA), the USACE will consult either formally or informally with other agencies mandated to protect the resources that may be affected by this action.

- Migratory Bird Protection Act- USFWS
- ESA, MMPA, MSFCMA- NOAA Fisheries
- CZM- NOAA NOS and State agency
- Section 106 Historic Preservation Act

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- State Historic Preservation Office
- Native Hawaiian representatives

US Coast Guard- PATON

Federal Consulting Agencies

NOAA NMFS- Protected Resources Division

NMFS- Sustainable Fisheries Division

NMFS- Habitat Conservation Division

NOS- Coastal Zone Management (coordination with State Coastal Zone Management)

NOS- National Marine Sanctuaries

US FWS

Federal Aviation Administration

Dept. of Defense (Navy)

Table 1-1: Agencies and Organizations To Be Consulted

Agencies and Organizations Consulted	Date
Federal Agencies / Councils	
Federal Agencies / Councils/ Representatives	
NOAA NMFS- Sustainable Fisheries - Aquaculture Coordinator	3/10/21
Army Corps of Engineers	3/10/21
Coast Guard	
NOAA NMFS- Protected Resources and Habitat Divisions	3/10/21
Western Pacific Regional Fishery Management Council	
Office of Senator Schatz	11/13/20
Office of Senator Hirono	12/15/20
Office of Congressman Chase	12/15/20
State Agencies and Representatives	
DLNR Office of Conservation and Coastal Lands	3/10/21
DLNR, Aquatic Resources	
Department of Health, Clean Water Branch	11/22/20
Office of Hawaiian Affairs	
Department of Agriculture Aquaculture and Livestock Support Services Branch	3/10/21
Rep. Quinlan	12/15/21
Rep. Holt	12/15/21
Rep. Matayoshi	12/15/21
Rep. Tarnas	12/15/21

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Rep. Loresti	12/15/21
Senator Nishihara	12/15/21
Senator Gabbard	12/15/21
Senator Fevella	12/15/21
Senator Wakai	12/15/21
City and County Agencies	
NGO and Community Groups	
Conservation International	1/12/21
Sierra Club	1/12/21
The Nature Conservancy	1/12/21
Ocean Conservancy	1/12/21
Environmental Defense Fund	1/12/21
World Wildlife Fund	1/12/21
‘Ewa Beach Neighborhood Board	2/28/21
State Water Keepers	1/26/21
Waterkeepers O‘ahu	1/26/21
Malama Learning Center	1/26/21
Sierra Club Representative	1/26/21
Malama Puuloa	1/27/21
National Marine Fisheries Service – Aquaculture Coordinator	
Army Corps of Engineers	
Coast Guard	
National Marine Fisheries Service – Endangered Species Biologist	
Western Pacific Regional Fishery Management Council	
State Agencies	
DLNR Office of Conservation and Coastal Lands	
DLNR, Aquatic Resources	
Department of Health	
City and County Agencies	
Community and Native Hawaiian Groups	

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1.2.2 Environmental Assessment and Ongoing Consultation via Ocean Era' Web-site

Throughout the consultative process, Ocean Era will compile a mailing list (emails and other contact information) of individuals and groups to facilitate an ongoing exchange of information during the permitting process and the deployment stages. To further encourage open sharing of the results of this Environmental Review, and the subsequent Environmental Assessment, and to continue to foster the consultative process with the public, Ocean Era, LLC has made a copy of the Draft ER available through their web site (http://ocean-era.com/) in a section under "Sustainable Seafood" and sub-section "Projects." The EA will also be posted to the same website sub-section when completed.

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2. DETERMINATION

The proposed Ocean Era Offshore Aquaculture Farm will be located in the Pacific waters approximately two miles south of ʻEwa Beach, Oʻahu, Hawai'i, located midway between the Old Municipal Airport south of Barbers Point to the west, and the Honolulu International Airport to the east. The operations are not anticipated to have any significant effects in the context of Chapter 343 HRS and HAR 11-200-12. Therefore, when an EA is prepared, a finding of no significant impact (FONSI) is anticipated. A brief summary of findings to support this proposed determination follows (Table 2). Chapter 200, HAR, establishes "Significance Criteria" to be used as a basis for identifying whether significant environmental impacts will occur. These criteria are addressed in more detail below.

Table 2-1: Significance Criteria, Findings, and Anticipated Determination for Each Criterion

Significance Criteria	Does Project meet Criterion?
1. Involves an irrevocable commitment to loss or destruction of any natural or cultural resource	No
2. Curtails the range of beneficial uses of the environment	No
3. Conflicts with the State's long-term environmental policies or goals and guidelines	No
4. Substantially affects the economic or social welfare of the community or state	No
5. Substantially affects public health	No
6. Involves substantial secondary impacts such as population changes or effects on public facilities	No
7. Involves a substantial degradation of environmental quality	No
8. Is individually limited, but cumulatively has a considerable effect on the environment or involves a commitment for larger actions	No
9. Substantially affects a rare, threatened or endangered species or its habitat	No
10. Detrimentally affects air or water quality or ambient noise levels	No
11. Affects or is likely to suffer damage by being located in an environmentally sensitive area	No
12. Substantially affects scenic view planes, viewsheds, or vistas	No
13. Requires substantial energy consumption	No

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Significant environmental impacts are deemed to occur if any of the following hold true:

1. Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.
No. The offshore area contains no resources that would be significantly affected. The only potential cultural impact considered is the possibility of changing behavior of ʻōpelu around the traditional koʻa.

2. Curtails the range of beneficial uses of the environment.
No. There is little existing recreational, or subsistence use of the proposed permit area.

3. Conflicts with the State's long-term environmental policies or goals and guidelines.
No. The Ocean Era Offshore Aquaculture Farm proposes to grow human food with ren'Ewable energies as much as practicable. The project is another example that is compliant with the amended ocean leasing law (Chapter 190 D HRS), which was specifically crafted to allow a sustainable ocean-based commercial aquaculture industry to develop in the State. The proposed project is consistent with the environmental policies established under Chapter 344 HRS.

4. Substantially affects the economic or social welfare of the community or state.
No. The Ocean Era Offshore Aquaculture Farm will provide economic benefits from increased employment in the science and commercial fisheries sectors.

5. Substantially affects public health.
No. The Ocean Era Offshore Aquaculture Farm will have no influence on public health.

6. Involves substantial secondary impacts such as population changes or effects on public facilities.
No. Substantial secondary impacts would not be anticipated.

7. Involves a substantial degradation of environmental quality.
No. There will be no degradation of environmental quality associated with the project. Only native Hawaiʻi species will be grown. There is no impact foreseen to water quality and negligible impact likely to benthic fauna.

8. Cumulatively has a considerable effect on the environment or involves a commitment for larger actions.
No. Implementation of the proposed Ocean Era Offshore Aquaculture Farm will not cause any significant cumulative effects and does not involve any commitment for larger actions. The farm is described in its entirety in the document.

9. Substantially affects a rare, threatened, or endangered species or its habitat.
No. The proposed Ocean Era Offshore Aquaculture Farm will not cause any substantial detriment to a rare, threatened, or endangered species or its habitat. Humpback whales and monk seals may all transit through the farm area, but the net pen array will not represent a significant barrier to movement of marine mammals, and there is negligible risk of entanglement in the taut-line array and mooring system.

10. Detrimentally affects air or water quality or ambient noise levels.

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No. Impacts on water quality are anticipated to be negligible, where any resultant nutrients from fish feces or feed wastes would be broadly dispersed due to the watch-like circle movement of the net pen array. In fact, the growth of limu uptakes carbon from the surrounding environment and would locally mitigate ocean acidification, thus potentially improving water quality. No air pollutants or noise emissions are anticipated to be generated from the net pen array.

11. Affects or is likely to suffer damage by being located in an environmentally sensitive area.

No. The Ocean Era Offshore Aquaculture Farm site is in waters that are approximately 100m (320 ft) deep, with strong currents and coarse sand substrate. The farm will not impede movement or otherwise disturb the spinner dolphins that typically spend their days resting and socializing in the bays on the Western coast of the island. At night, the spinner dolphins are typically found hunting in deeper waters further off O‘ahu shores.

12. Substantially affects scenic view planes or vistas.

No. The Ocean Era Offshore Aquaculture Farm would be moored at a distance of approximately 1.7 nautical miles south ‘Ewa Beach and approximately 2.6 nautical miles southwest of Iroquois Point. The project will use a submerged design that will provide better security, safety, and reduced wear on the net pen array. Surface marker buoys will be deployed and lit in accordance with U.S. Coast Guard specifications, but these will not be a significant impact on the view plane, given the existing land use of the residential and commercial operations at the Old Municipal Airport south of Barbers Point to the west, and the Honolulu International Airport to the east. The only visible surface elements will be the marker buoys and the feed barge, all other elements will be submerged.

13. Requires substantial energy consumption.

No. There will be insubstantial amounts of energy used to power the boats and equipment for the Ocean Era Offshore Aquaculture Farm. Ren’Ewable energies will be used wherever possible for deployment and operations during the farm.

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3. THE RATIONALE FOR OFFSHORE MARICULTURE OF NATIVE HAWAIIAN *NENUE*, *MOI*, AND *LIMU*

3.1 THE ECONOMIC OPPORTUNITY

Global fisheries are under growing pressure. At the same time, the planet's burgeoning population, greater affluence and more consumer health awareness are all driving increased seafood consumption. The United Nations that an additional 47 million metric tons (tons) of protein from fish are needed by 2050.

Aquaculture offers a business solution to address this challenge, while also relieving further pressure on wild fish stocks. Experts, such as Conservation International, The Nature Conservancy and the United Nations High Level Panel on Climate Change and the Oceans, are also advocating for a greater shift to marine-based food production systems, to reduce the impacts on water and land-use, and greenhouse gas emissions from terrestrial agriculture.

The potential global benefits are amplified for low food-chain herbivorous fish such as nenue, because of the additional ecosystem services and reduced greenhouse gas emissions. Reducing the volume of fresh, air-freighted seafood to Hawai'i, such as opakapaka from Indonesia, would also result in a lower carbon-footprint.

Increased seafood availability is also critically important for U.S. food security. The U.S. already imports over 90% of the seafood that we consume, and around half of that is farmed. However, we have almost no control over the animal welfare or food safety standards, or the environmental impacts of aquaculture in other countries.

As an island state, Hawai'i has a special connection with the oceans, and her bounty. Hawai'i has the highest seafood consumption rate in the country, at almost 37 pounds per person. Yet 63% of seafood sold commercially in Hawai'i is imported from overseas.

Because of her location in the center of the Pacific, and the multitude of cultural connections with seafood, Hawai'i has been a pioneer in the development of innovative aquaculture, including offshore operations. Aquaculture has been posited as a potentially attractive driver for a more diversified economy, to reduce the islands' reliance on tourism and the military. Already, aquaculture production of marine shrimp, bivalves and fish in Hawai'i directly supports over 350 jobs. At a production volume of 2,000 tons/year, this operation could be expected to produce 40 direct jobs, and 200 additional indirect jobs (including equipment, feeds, processing, marketing, and food service).

Herbivorous fish

Ocean Era has undertaken extensive research on the potential for herbivorous reef fish culture in offshore net pens. Growing herbivorous fish offers two broad potential advantages: ecological, and economic. One of the frequently voiced concerns with aquaculture is that most marine fish are high on the food web, and therefore require diets rich in oils and proteins. These diets often contain fishmeal and fish oil from forage fish fisheries, such as anchovies and sardines. However, herbivorous fish at the base of the food chain can thrive on seaweeds and other plant materials high in carbohydrates. This eliminates the reliance on wild fish stocks and allows aquaculture to scale more sustainably.

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From an economic perspective, this also means that the feeds are less expensive, and the resulting product – the fish – is less costly for consumers. Furthermore, if seaweed-based diets can be developed for these species, this could provide economic incentives for expansion of seaweed farming, by stimulating demand. This could offer a broad range of benefits to island communities, by increasing employment without trade imbalances, as well as offering a wide variety of ecosystem services (absorbing carbon-dioxide and nutrients and increasing primary productivity and biological diversity).

Nenue

Nenue (*Kyphosus hawaiiensis*) are highly regarded as a food fish in Hawai'i and other Pacific Islands. *Enenue* or *nenue* in Hawaiian (rudderfish or sea chubs), and in some regions was regarded as a prized reef fish, reserved for *ali'i* (royalty) only (Ulukua, 2019). *Nenue* are found in abundant schools around Hawaii; 2-3-kilogram fish are common, while state records exceed 4.5 Kg. Stocks of nenue have declined over the course of the last century or more, as modern technologies have increased fishing pressure on all reef stocks. One of the traditional preparations for *nenue* was poke – a staple of native Hawaiian food, originally consisting of raw reef fish, sea salt, *limu* (seaweed), and kukui nuts.

Nenue have a number of advantages as a candidate for aquaculture. Ocean Era has developed methods to raise nenue in the hatchery, and so stocking a farm would require taking no fish from the wild, except for the broodstock (breeders). Because of the strong local demand for reef fish, the 'Ewa Beach operation will primarily target the local Hawai'ian market. Access to the major local market is the primary reason for locating the operation off O'ahu.

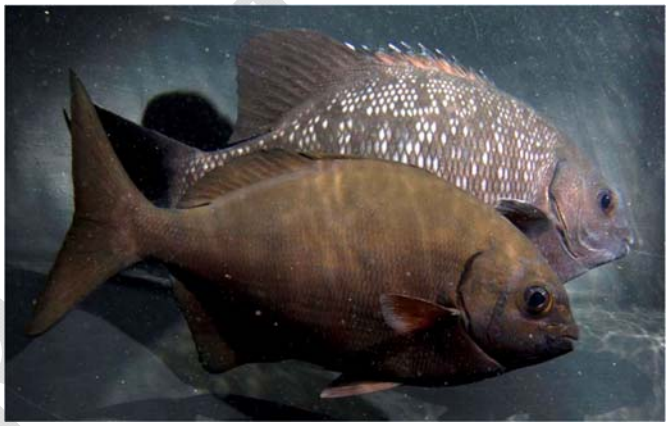

Figure 1: Two species of wild-caught nenue, used as broodstock (breeders) at the Ocean Era marine fish hatchery facility at NELHA, in Kona.

According to NOAA Fisheries Landings data (https://www.noaa.fisheries/foss) the total reported commercial harvest for all rudderfishes in the State of Hawaii in 2019 was 22,290 pounds, at a market value of $45,840 (ex-vessel value paid to the fisherman at time of first sale). This represents a 103%, 128%, and 81% increase from 2018, 2017, and 2016, respectively. The market price has increased slightly from 2016 ($1.88/pound) and 2019 ($2.06/pound). No recreational landings of rudderfishes were reported between 2015 and 2019.

NOAA Fisheries did not report any commercial import, export, or aquaculture produced rudderfish products between 2015 and 2019.

Moi

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Moi (Pacific threadfin) is known as the "fish of kings" and historically only Hawai'ian royalty were allowed to eat this fish. Moi (*Polydactylus sexifilis*) is one of the few Hawaiian fishes that experience a sex reversal (male to female) at approximately 10 inches in length. Moi is a state regulated species by the Department of Land and Natural Resources, Division of Aquatic Resources. It has a closed season from June through August, and a daily bag limit of 15 per person at a minimum size of 11 inches at all other times.

Moi were previously cultured previously cultured on the 'Ewa Beach offshore site by Cates International, Inc. (CII) and Hukilau Farms, in submerged Sea Station net pens. The fingerlings were produced from the hatchery at Oceanic Institute, using local broodstock, with technology that was developed in Hawai'i for this species. The fish were grown out to around 1 lb in size, and then sold into the local O'ahu restaurants and retail markets. The Ocean Era operation will integrate moi production into the offshore operation, alongside the nenue, in separate net pens.

Figure 2: Moi were previously cultured on the 'Ewa Beach offshore site, and sold into the local O'ahu restaurants and retail markets.

According to NOAA Fisheries Landings data (https://www.noaa.fisheries/foss) the total reported commercial harvest for all threadfins in the State of Hawaii in 2019 was 868 pounds, at a market value of $7,054 (ex-vessel value paid to the fisherman at time of first sale). This represents a 385%, 300%, and 228% increase from 2018, 2017, and 2016, respectively. The market price has remained relatively stable between 2016 ($8.05/pound) and 2019 ($8.13/pound). The recreational landings of the Moi (*Polydactylus sexifilis*), six-finger threadfin were 4,034, 853, and 13,181 pounds for 2019, 2016, and 2015, respectively.

NOAA Fisheries did not report any commercial import, export, or aquaculture produced threadfin products between 2015 and 2019.

When fully operational, the Ocean Era Offshore Aquaculture Farm will comprise two (2) separate, five (5)-net pen arrays each consisting of 30-meter (m) diameter by 14m deep (~10,000

cubic m [m^3]) floating PolarCirkel-style net pens (with submersible capability), with a trailing 30m x 75m algal growth production unit. At a maximum harvest density of 25 kg/m^3, approximately 250 tons of either moi and/or nenue would be produced and harvested from each of the net pen units on a rotational basis. This estimated production equates to a harvest of approximately 2.8 million fish per year at a gross annual value of approximately 8 million USD while employing various levels of approximately 18 to 22 professional, technical, and sales staff for a total salary estimate of $1.7 million USD.

Limu

Limu (seaweed, or macroalgae) have always been an important component of traditional Hawai'ian diets. Fresh limu is used in poke, and a number of other traditional dishes, and is now enjoying a culinary resurgence around the world. Many of the Asian immigrant groups that migrated to Hawai'i also included seaweeds in their diets. Over time, however, overfishing and other ecosystem disruptions have seen wild limu stocks decline dramatically.

There is some commercial culture of ogo in Kona and O'ahu, but most other limu species have complex life cycles and have proven difficult to domesticate. Many species offer good potential for commercial culture. *Caulerpa*, grown in Okinawa, for example, is sold as a specialty item in the Tokyo sushi trade. Ocean Era is currently preparing to establish a limu demonstration array offshore of Kaiwi Point, in Kona, which will test the utility of nutrient-rich deep-sea water as a means of stimulating the seaweed growth.

Some of the limu produced will be directed towards the human food market, and some will be provided to the nenue, as feed supplements. Limu might also be used for production of organic fertilizers, rich in nutrients such as nitrogen. Industrial production of nitrogen fertilizers requires a lot of energy, which has significant greenhouse gas emissions. Some species of limu, such as limu kohu, have also been shown to dramatically reduce the methane produced by ruminants, such as cows and sheep, when included in trace amounts in their diets.

Offshore macroalgae cultivation in the tropics is an as-yet untested commercial endeavor. Several factors contribute to the challenge: the oligotrophic nature of tropical ocean waters causes most algae to grow relatively slowly; offshore depths render fixed grid or multiple point mooring arrays too expensive and the mooring line tensions too difficult to maintain; it is challenging to operate in offshore conditions; manual labor for harvesting is not cost-effective; and the destructive power of tropical storms.

There are at least three intermediate markets for short- to medium-term commercialization, prior to achieving the scale needed for algae biomass production for energy. These intermediate markets could act as economic drivers and subsidize further technology refinement before economies of scale are achieved. These intermediate markets are:

(a) Open ocean culture of high-value seaweeds for direct human consumption (i.e., *limu* in Hawaiian);
(b) Offshore culture of seaweeds as a direct feedstock for herbivorous marine fish; and
(c) Offshore culture of seaweeds as input for biodigesters to produce single-celled proteins (SCPs) for feedstuffs for other marine fish (or other terrestrial livestock), or energy sources.

Commercialization of these technologies through these target markets can all be demonstrably achievable in Hawai'i, which offers opportunities to deploy small-scale commercial operations,

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and increase the scale of operations as refinements to the technologies allow, and as markets mature.

Hawai‘i presents abundant and ready opportunities for commercialization of macroalgae production due to the culture of the islands, and other agricultural activities already established. Macroalgal (*limu*) consumption in Hawai‘i is established and growing, with most production currently from land-based operations. Hawaiian consumers are more receptive to both direct human consumption of *limu* and consumption of herbivorous fish, such as milkfish, mullet, and rudderfish. These fish species are often devalued in mainland-U.S. markets, because of their stronger “fishy” flavor to Western palettes. However, such species are considered highly desirable in Pacific islands. There is potential to expand production, reduce costs, and increase product availability through development of small-scale offshore farms for edible *limu*.

Construction of a feed mill on East side of Hawai‘i Island has been completed, which could allow innovative macroalgae-based feedstuffs, such as single-celled proteins, to be tested in diets for fish that are currently targeted by Ocean Era (such as kampachi, *Seriola rivoliana*; mahimahi, *Coryphaena hippurus*; and *nenue* or rudderfish, Family Kyphosidae) or other freshwater, marine, or terrestrial species. Feed trials have shown encouraging growth on a diet of algae and pelleted feeds high in carbohydrates. Ocean Era is also working with researchers at University of Hawai‘i, San Diego State University, University of California San Diego, National Ren’Ewable Energy Laboratory, and Lawrence Berkeley National Laboratory to identify microflora from kyphosid gastrointestinal tracts that may be adaptable to macroalgae biodigesters to produce single-celled proteins, which could be used in terrestrial animal feeds.

The commercialization opportunities for producing high-value seaweeds for direct human consumption are seaweeds as a direct feedstock for herbivorous marine fish are discussed below:

Seaweeds for direct human consumption -
Polynesian and Asian cultures consider seaweed (*limu*) a normal component of many dishes, and seaweed cultivation for human food is practiced both in Hawai‘i and extensively in Asia (Abbot, 1978). In the Hawaiian Islands prior to Western contact, seaweed was a regular part of the diet, accompanying most meals and contributing vitamins, minerals, flavoring, as well as some protein and fiber to the diet (McDermid and Stuercke 2003). As many as 40 species may have been in general use. Local residents still gather seaweeds, although local stocks are diminishing, most likely due to habitat change and competition with invasive macroalgal species. Much more can potentially be done with Hawaiian species of macroalgae, as many local species are in demand, and are consumed by groups such as Japanese, Koreans, Filipinos, and Chinese who visit or reside in the islands. Today, Hawai‘i aquaculture includes *commercial* cultivation of about five species of macroalgae (*G. coronopifolia, G. parvispora, G. salicornia, G. tikvahiae,* and *Codium reediae*), which partially meets local demand *(McDermid et al. 2019).*

In 2011, algae sales accounted for over 60% of aquaculture sales in Hawai‘i, yet few local companies are currently engaged in commercial seaweed culture (Hawai‘i Department of Agriculture 2011). One active producer, Royal Hawaiian Sea Farms, based at the NELHA facility, sells over two tons of *Gracilaria* per week to local and mainland markets (http://nelha.hawaii.gov/). With the growing popularity of *poke* (Hawaiian-style raw fish) and sushi, demand for fresh seaweeds is expected to increase in Hawai‘i and the US mainland, with a global market forecast of $22B value by 2024 (Market Research Report 2016). An energy-

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efficient offshore array could provide copious quantities of high-priced seaweed (*Gracilaria*, *Halymenia*, and *Dictyopteris*) to capitalize on this commercial trajectory.

Seaweeds as a direct feedstock for high-value herbivorous marine fish -
Ocean Era has been working since 2012 in exploring the potential for commercial culture of *nenue* (rudderfish, or chubs; Fam. Kyphosidae). *Kyphosus* spp are reef-dwelling demersal herbivores, native to Hawai‘i, but found throughout the warmer water regions of the world, which graze on fleshy macroalgae, such as *Gracilaria* and *Sargassum* (Ocean Era, unp. obs.). This algae diet imparts a stronger “fish” flavor to the chub flesh, which is not appealing to most Western palettes. However, chubs are highly esteemed food fish in Asia and the Pacific. Feed trials at Ocean Era’ facility have shown commercially appealing growth rates. A chub that serendipitously recruited into the Aquapod in the Velella Beta-test reached a size of 1 kg in around 8 months of culture; upon harvest, this fish flesh proved to have almost sushi-grade fat levels (28% by dry weight; c.f. 30% by dry weight for cultured kampachi), with one fillet from this fish eliciting strongly favorable reviews from local seafood Chef Sam Choy.

The culture of nenue at the Ocean Era Offshore Aquaculture Farm would be greatly improved with seaweed grown offshore, at scale, and used to feed the fish for most of their grow-out period. Fish feed is a major cost in culture of marine fish. In commercial Ocean Era, feed is approximately 60% of the operating costs of the farm. If this feed cost could be reduced by inclusion of locally grown seaweed in the chub diet, then the profitability of the farm could be markedly improved. Less expensive production costs should also allow the fish to be marketed at a lower price-point, increasing the potential target market.

Principals in Ocean Era have extensive experience in developing and executing plans for offshore farming projects and they are in permitting stages of a net pen demonstration project – the Velella Epsilon – for deployment offshore of the Sarasota, Florida. The company’s experience includes the essential components of integrating offshore fish farm operations with the complexities of marine fish hatchery production, and introduction of new fish species to the U.S. market. Ocean Era possess all the essential prerequisites that prepared a financial model for an offshore Nenue farm, obtain the permits for the farm and hatchery, raise the capital to finance the project, and initiate operations and sales. These parameters can then allow evaluation of the improved profit margins if such macroalgae were to be substituted into the nenue model for imported, extruded diets.

Demonstration in O‘ahu of the profitability of offshore culture of seaweeds and nenue would allow faster farther expansion of offshore seaweed production. One of the major constraints to scale-up of existing near-shore grow-out of algae, such as *Kappaphycus* in SE Asia and the Western Pacific, is the added expense for drying and shipping the algae to the processing center (for conversion into carrageenan or agar). The culture of seaweeds and herbivorous marine fish in local waters would overcome both the need for drying the algae and the costs and inconvenience of shipping dried algae. We would therefore expect to see wide adoption of herbivorous fish culture systems supported by offshore algae culture projects throughout suitable tropical waters, such as Pacific Islands, SE Asia, and the Subcontinent, East and West Africa, and the Caribbean and tropical Pacific coasts of the Americas.

3.2 THE ENVIRONMENTAL BENEFITS

The Ocean Era Offshore Aquaculture Farm has the potential for contributing to measurable long-term environmental benefits from the development of offshore macroalgae farming. Firstly, the

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expansion of offshore culture of macroalgae would not increase demand for land or freshwater, which is particularly important in areas where these resources are limiting. Secondly, development of offshore macroalgae farming should, over time, provide local reduction in ocean acidification due to uptake of carbon from the surrounding environment. Systems such as the one proposed can achieve an energy return greater than all non-ren'Ewable energy inputs and result in a net uptake of carbon from the surrounding environment. A rising level of dissolved carbon is the cause of ocean acidification, and so by up taking carbon from the surrounding waters, the growth of macroalgae decreases dissolved carbon, thereby raising the pH. The relationship between macroalgae biomass and reduction in acidification is unknown, but this is something that could potentially be studied through future research related to this project.

The expansion of offshore macroalgae culture would be a laudable effort towards reducing the impacts of global climate change. The State of Hawai'i has set a goal to generate 100% ren'Ewable energy by 2045, which includes the application of biofuels (http://energy.hawaii.gov/ren'Ewable-energy). The principal goal of this demonstration, and indeed of the entire ARPA-E MARINER program, is to determine a suitable offshore production model to provide the amount of biomass that would be required for a biofuel industry.

The community of the Hawai'ian islands have expressed interest in the potential to use the Ocean Era Offshore Aquaculture Farm as an opportunity for data collection on fish recruitment or FAD dynamics. One stakeholder at Queen Lili'uokalani Trust, consulted in the preparation of Ocean Era's Blue Field EA, specifically asked whether Ocean Era would undertake data collection to better understand trophic dynamics of FAD-aggregating species. Oceab Era is amenable to potential partnerships with outside organizations (or the State of Hawai'i) that may wish to conduct species abundance monitoring within the safety parameters Ocean Era Offshore Aquaculture Farm. We expect the array will likely recruit larval fish from the plankton, and we will collect basic information on the types of fish that our operations crew finds on the array.

3.3 SPECIES SELECTION

In addition to culturing moi and nenue, performed a land-based tank trial work with native Hawaiian *limu* species to determine the feasibility of their offshore culture. During that time seven species were considered: *Gymnogongrus durvillei* (previously *Ahnfeltiopsis concinna), Asparagopsis taxiformis, Caulerpa lentillifera, Chnoospora minima, Gracilaria parvispora, Halymenia hawaiiana, Sargassum aquifolium,* and *Ulva fasciata*.

Based on this experimentation, four native *limu* species are proposed to be tested on the offshore array:

- *Gracilaria parvispora*
- *Caulerpa lentillifera*
- *Sargassum aquifolium*
- *Asparagopsis taxiformis*

3.3 SITE SELECTION

3.3.1 Criteria

This site was selected for its suitability, based on the following primary criteria:

1. The site is in deep-water area that will present less exposure to storm or wave damage.

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2. There is little or no public use of this area. The site lies beyond the limits of normal recreational SCUBA-diving (around 120 feet). While it is within the normal depths for offshore trolling for ono (wahoo, *Acanthocybium solandri*), the array is expected to enhance ono catches, rather than negatively impact them.

3. The site is afforded some measure of protection from strong trade winds. The proximity to shore also allows for a shore-based control and security facility, which reduces the need for vessels on site.

4. There is ready access from Pearl Harbor, which provides support facilities such as slips, ramps, and fueling.

5. The site is offshore and southeast of the Old Municipal Airport south of Barbers Point, and as such its use for aquaculture is consistent with the adjacent land uses.

3.3.2 Minimal Potential Conflict with Existing User Groups

The fact that the site is in deep water, yet shor'Eward of the normal trolling areas means that there is almost no traditional or customary use of the area. There are few fish found in sand bottoms at these depths, and large benthic organisms are scarce or absent.

The project will be located in the area used by boats that are trolling for ono, which typically ranges in a "lane" between the 25-fathom to 60–fathom depth lines (50m – 120 m). This "lane" is also fished for mahimahi during spring and fall seasons. However, the array is expected to enhance the fishery for these species, by improving catch rates around the array, and not be detrimental to the fisheries. The boating-accessible area between Barbers Point and Pearl Harbor is described as an area of little fishing interest outside of the ʻōpelu koʻa. The proposed site is also clear of the charted cruise ship channel where passenger ships transit and anchor.

Local fishing user groups support access for fishing vessels within the project area. Ocean Era prefers to keep the area open to the passage of recreational users and fisher people, within safe operating distances from the surface structures, so long as use by the public is respectful and safe for our workers. The Coast Guard consultation process will determine the marking of the area and potential for passage of boat traffic within the watch-circle. It is a primary concern to the fishing stakeholder groups (as well as to Ocean Era) that the surface and near-surface components of the array be well marked and lit because of the high recreational watercraft use in Kailua Bay.

The Coast Guard is responsible for setting standards of navigational markings, and Ocean Era is currently in contact with the Coast Guard to complete their Private Aid to Navigation (PATON) process through the Coast Guard District 14 Waterways office.

There are no historical sites that would be directly impacted by the demonstration. For further discussion of the cultural uses of the region.

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4. PROJECT DESCRIPTION

4.1 TECHNICAL AND OPERATIONAL CHARACTERISTICS

4.1.1 Location and Extent of the Farm Alternative Sites

Ocean Era is proposing to establish an offshore aquaculture farm in the Pacific waters approximately two miles south of ‘Ewa Beach, O‘ahu, Hawai’i, located midway between the Old Municipal Airport south of Barbers Point to the west, and the Honolulu International Airport to the east. The approximate date for initiating construction and deployment of the net pen and mooring array will be approximately December 2021. The three proposed alternative sites located approximately 2.5 nautical miles (NM) from one another are being considered (**Figure 4-1**). The submersible net pen and macroalgae culture array offers distinct operational and economic advantages, as the potential damage from storm surf or hurricanes is greatly reduced, normal wear-and-tear on the array and the moorings is minimized by the dampening of the day-to-day wind and wave action at the surface, and security and aesthetic concerns are alleviated.

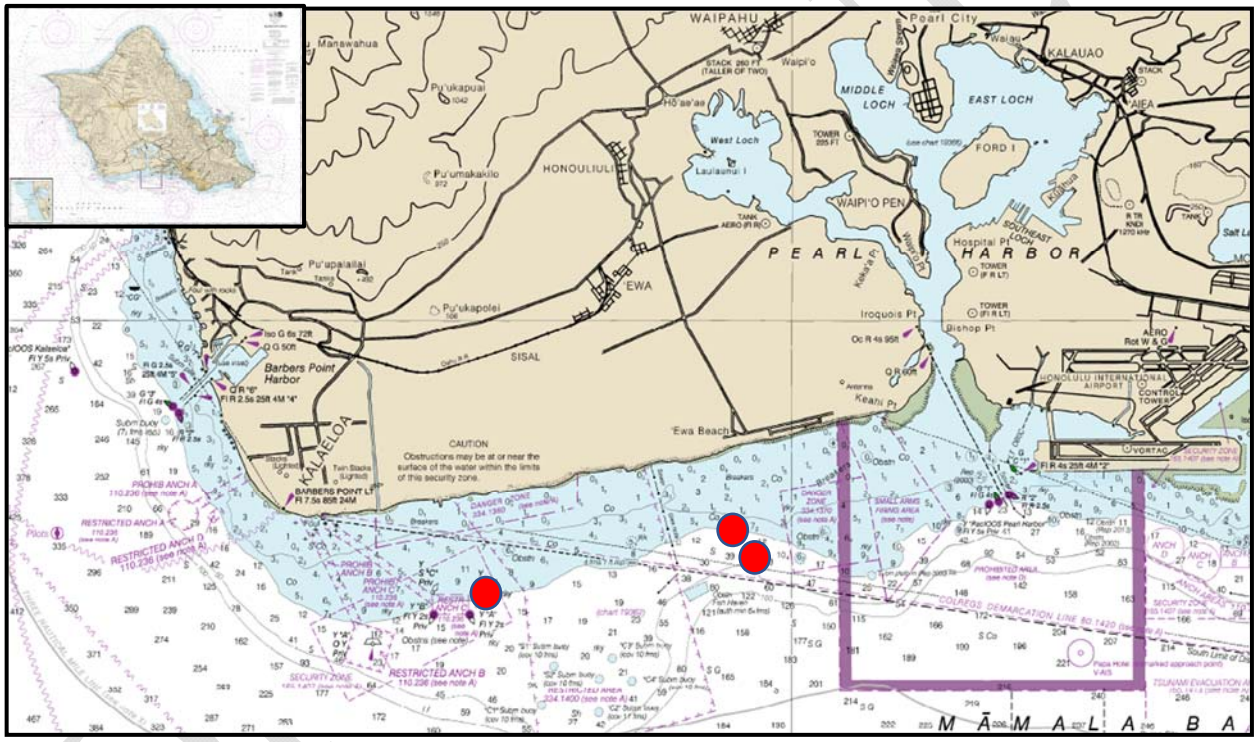

Figure 4-1: Ocean Era Offshore Farm Alternative Site Locations.
Underlying chart: 19357 Island of O‘ahu

Each of the two net pen arrays proposed for the nenue, moi and limu culture is a swivel array, produced by the Gili Ocean group, based in Israel (**Figure 4-2**). These net pens are used in the Mediterranean Sea, 8 miles offshore of Ashdod, Israel, where it has been able to withstand waves with maximum heights of up to 16.2 meters (53 feet); and significant wave heights (Hs) of 9 m (30 ft), with a wave period of 16 seconds. The net pens would be in a line that ‘weather-vanes’ with the changing current, so that the array would move through the 360 degree ‘watch-circle’. This has the advantages of providing unidirectional flow of water through the pens (which improves fish health) and ensuring that the net pens do not sit above any single seafloor area for any protracted period of time. The swivel array also provides for optimum alignment of the limu

lines, directly downcurrent of the fish net pens. This will both promote the faster growth of the limu, as well as reduce the nutrient loading in the effluent waters.

Each net pen array will be moored to the ocean bottom in approximately 40m (131 ft) to 100m (328 ft) water depth utilizing three (3) deadweight (concrete block) anchors (or embedment anchors if sufficient sand depth is identified). Each anchor will be spaced approximately 220m (722 ft) from the mooring center line and configured 120 degrees (°) from each other, with a total mooring radius of 300m (985 ft), or mooring footprint of approximately 282,744m^2 (28.3 ha). Attached to each of the mooring anchors is 230m (755 ft) of Grade 2 steel chain (36mm [13/16 in] thick licks), which in turn is attached to 110m (361 ft) of AmSteel Dyneema® blue rope (14 mm [9/16 in] diameter); collectively the chain and rope comprise the mooring line. The three (3) mooring lines are bridled at a multi-anchor swivel (MAS) point mooring buoy.

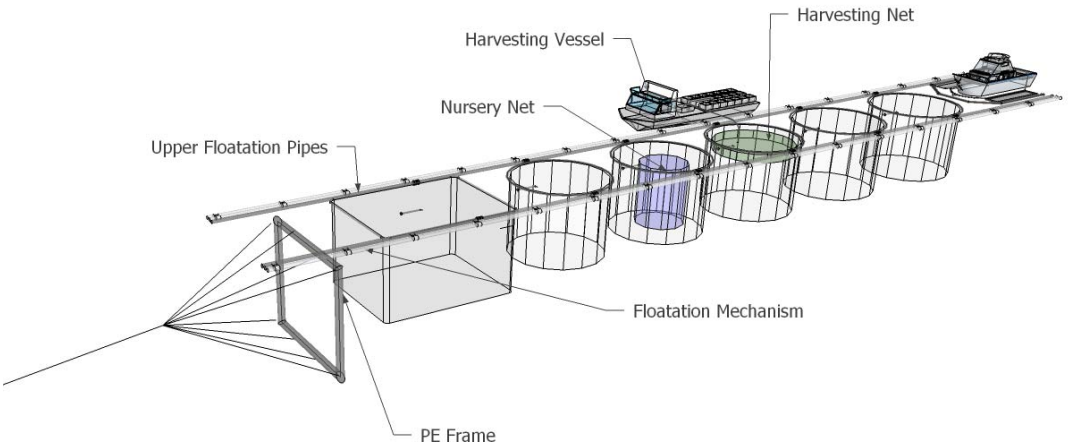

Figure 4-2: Conceptional View of the Net pen and Macroalgae Culture and Mooring Array

The three proposed alternative sites are described in greater detail in Section 5.0: Alternatives. The preliminary locations of each alternative site location are provided below:

Latitude:	Longitude:
21° 17' 15.97" N	158° 00' 23.88" W
21° 16'53.41" N	158° 00' 10.88" W
21° 16' 32.26" N	158° 00' 24.77" W

The swivel buoy is specifically designed to ensure that the anchor lines are perpetually taut, to ensure that there is no risk of entanglement by marine mammals, and to keep lines away from the surface, where they might become a hazard to navigation. All components of the net pen and macroalgae culture and mooring array were engineered by the mooring manufacturers to withstand the worse storm and surf conditions that have been recorded for this site. Ocean Era and the mooring manufacturer also have strong commercial incentives to ensure that these structures will not fail and have employed a healthy degree of over-engineering. Any emergent structures will be marked with Class C navigation lights (amber or yellow flashing, visible up to one nautical mile distant), as required by the Coast Guard.

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Two of the proposed sites are located shor'Eward of the 25-60 fathom range used for trolling ono and mahi along the "grounds" offshore of 'Ewa Beach. The other proposed site is located inside of the "lane" in the 25-60 fathom range used for trolling ono and mahi. Reef fishing and 'ōpelu ko'a are found inshore of the proposed alternative sites.

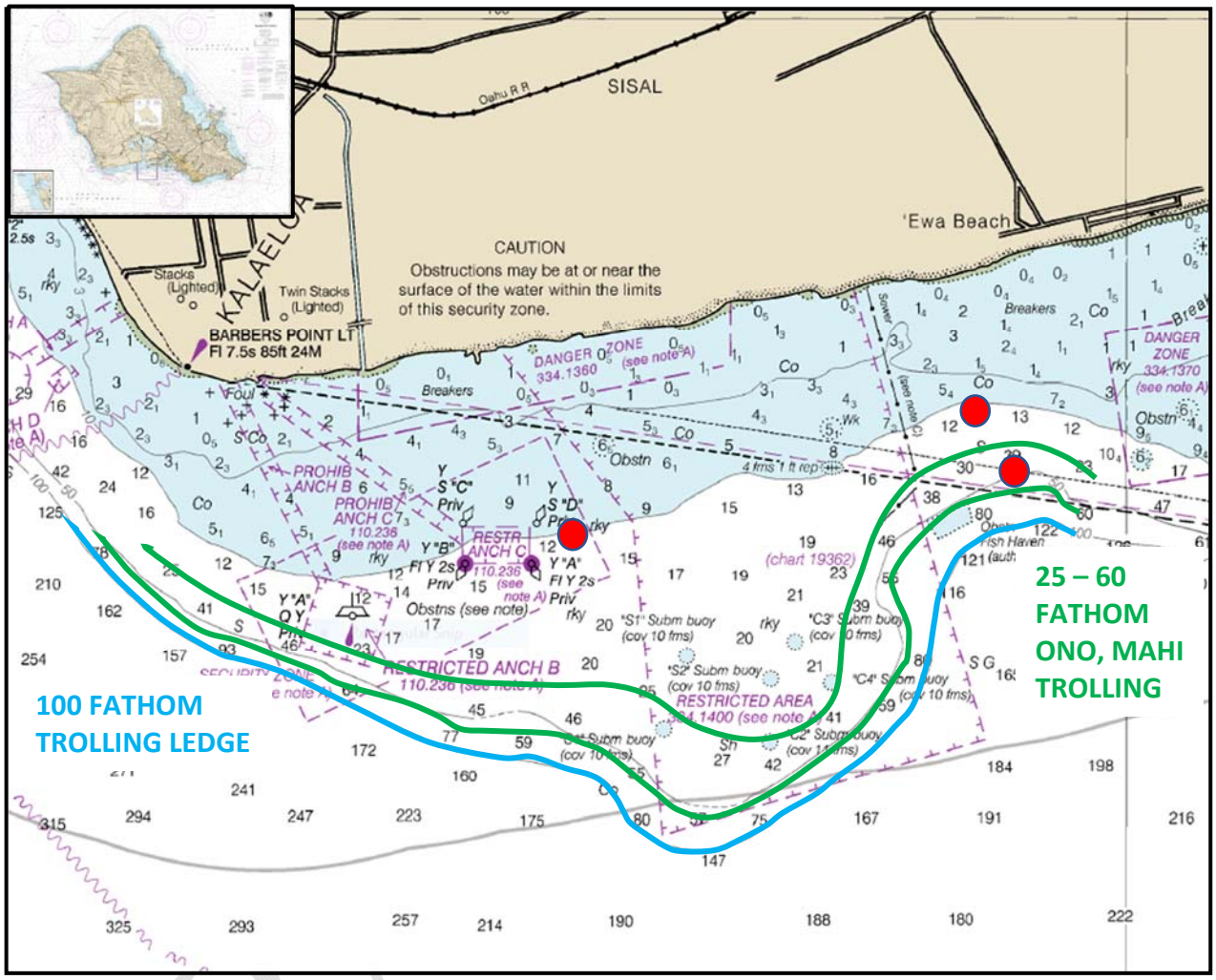

Figure 4-3: Proposed Site Locations in Proximity of Offshore Fishing Areas

4.1.2. Culture Operations

The Ocean Era Offshore Aquaculture Farm will be serviced by tender vessels which additionally will serve as the platform to support the farm. These vessels will run out of Pearl Harbor, and will shuttle the farm staff, supplies, and harvested product back and forth between the harbor and the site. Heavy work, such as deployment of the net pen arrays and mooring anchors, will be contracted out to commercial marine construction companies.

Fish Production Plan

Ocean Era envisages partnering with The Oceanic Institute (OI) for production of fingerlings to stock the offshore site. OI has an existing commercial-scale marine fish hatchery that was

previously used for producing the moi fingerlings. Broodstock will be collected from local Oahu waters.

Fingerlings from the OI hatchery, around 5 g – 20 g in size, will be transported by truck to a harbor close to the offshore site (either Honolulu Harbor or Barbers' Point Harbor), and then transferred to a vessel for movement offshore. At the offshore site, they will be stocked into a small-mesh nursery net, inside a larger grow-out net pen. Once the fish reach sufficient size (around 100 g), they will be released into the larger net pen.

Fish will initially be fed up to 5 times per day, decreasing to 2 or 3 times per day as the fish grow larger. Ocean Era anticipates feeding the nenue with a combination of pelleted feed and fresh limu (cultured on the lines downcurrent of the net pens). The pelleted feeds will be similar in composition to a catfish or tilapia diet – low in proteins and lipids, but high in carbohydrates. In feed trials in Kona, the nenue have performed exceptionally well on a diet that was comprised of around 80% duckweed (a freshwater plant that is a nuisance on many lakes on the Mainland). Moi will be fed a standard Marine Grower diet.

The fish biomass density in the net pens is projected to be around 20 kg per cubic meter at harvest weight. Once the fish reach a harvestable size (1 – 2 lbs), they will be seined and pumped out of the net pen into an ice slurry on the harvest vessel, and then taken to market. The daily activities on the farm site will primarily consist of feeding, maintenance, cleaning, harvesting, taking water samples, measuring growth of the fish and limu, and recording fishery activities surrounding the array.

Ocean Era anticipates initially scaling up production over the first several years to around 1,000 tons of fish annually (around 2 million pounds of both species, combined). The large majority of these fish will be sold on Oahu, through established seafood distribution channels. The principals in Ocean Era have previous experience introducing new species into the market, such as the Kona Kampachi™.

Limu production Plan

Limu (macroalgae) lines will extend down-current behind the last net pen in the array, so that they receive the nutrient-rich water from the fish pens. The species of limu to be cultured, and the volumes to be produced, are still to be determined. Ocean Era is still at the planning stage for the Kona offshore limu array and is still developing culture techniques for the targeted species in land-based tanks at their facilities at the Natural Energy Laboratory of Hawai'i.

Figure 7: Ocean Era is conducting land-based trials in Kona with *Gracilaria* and *Sargassum*, both of which may prove suitable for culture on lines down-current of the net pens.

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The Kona limu research is exclusively focused on native Hawai'ian limu species. Similarly, only native Hawai'ian species will be cultured at the 'Ewa Beach site. No non-native limu will be introduced or grown at either the Kona or the 'Ewa Beach sites.

The Federal Aviation Authority and the State Airport Authority in the Department of Transportation will review all security equipment, to ensure that there is no conflict with airport operations.

Support activities will be based out of Pearl Harbor. All work and equipment will be based at suitable onloading and offloading areas of the harbor. The Ocean Era Offshore Aquaculture Farm work vessels will be powered by commercially available inboard and outboard motors. Fuel supplies will be purchased as needed from the commercial fuel docks at Pearl Harbor marinas.

4.2 ECONOMIC CHARACTERISTICS

4.2.1 Economic Impacts of Farm Operations

The Ocean Era Offshore Aquaculture Farm will likely have direct impact on the local economy through employment, secondary support industries, and product availability. There will be employment of approximately 18 to 22 professional, technical, and sales staff, and some increased employment for supportive industries. The farm will support other local businesses for materials necessary to build and maintain the operations.

There are two additional companies with offices at NELHA on Hawai'i which are working on different aspects of offshore aquaculture (Forever Oceans and Blue Ocean Mariculture), employing approximately 50 people all together.

The FAD effects could also contribute to the local charter boat industry, and local subsistence and artisanal fishing activity – since there will be potential for increased catches near to Pearl Harbor.

4.2.2. Impacts on the Market

Significant commercial activity is anticipated from the sale of fish and algae grown on the Ocean Era Offshore Aquaculture Farm. When the farm is completely built out (3 to 5 years), approximately 250 tons of either moi and/or nenue would be produced and harvested from each of the net pen units on a rotational basis. This estimated production equates to a harvest of approximately 2.8 million fish per year at a gross annual value of approximately 8 million USD.

4.3 SOCIAL CHARACTERISTICS

The Ocean Era Offshore Aquaculture Farm will employ approximately 18 to 22 professional, technical, and sales staff, and some increased employment for supportive industries. These positions provide long-term income in a fisheries-related industry on O'ahu.

Offshore culture of native Hawaiian moi, nenue, and *limu* would increase the diversity of the economic base on O'ahu. This offers the capacity to strengthen the maritime support industries in coastal areas, such as dock facilities and boat maintenance, marine supplies and engineering, and seafood wholesalers. This could have broad social and economic implications in 'Ewa Beach and Honolulu, particularly in times of economic hardship.

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4.3.1 Public Use of Offshore Ocean Space

As discussed in Section 3.4 (Site Selection) the proposed area is used for transit to or from fishing areas. We will not be seeking exclusive use of the farm area. The farm site will likely operate under a lease, and DLNR will be one of the sources of guidance for compatible activities in the area. For public safety, Ocean Era will work with local boating associations to communicate the conditions of the lease to ocean users. We are proposing that the farm area be designated as no anchoring, no swimming, snorkeling or SCUBA diving, and slow low-wake speed by boats.

Ocean Era trusts that O'ahu's fisher people and divers will respect the farm site net pen array, and that pilfering or vandalism will not become a problem. If such problems do arise, Ocean Era may, at some later stage, request reconsideration of the level of exclusivity. If such a reevaluation arises, Ocean Era understands that further consultation would be needed with the community. However, the company believes that this step will not be necessary.

Ocean Era believes that the normal movement of boats within the proposed area will not be adversely affected by the presence of the Ocean Era Offshore Aquaculture Farm. Surface vessels could traverse freely through this area, so long as a slower speed was maintained as a safety precaution. Trolling and bottom-fishing could also be permitted under normal conditions in the area around the growing platform, although on the understanding that the anchor lines are present in this area, and that any fish that might be hooked may become entangled in these lines. Similarly, no anchoring of boats could be permitted within the entire site, because of the risk of entanglement of anchors in the mooring array. Free-diving, SCUBA diving, and swimming activities will need to be restricted around the mooring lines and the net pens due to public safety, security and liability concerns.

4.3.2 Commercial Offshore Aquaculture in O'ahu

Amending the ocean leasing law during the 1999 State legislative session caused much comment from State agencies and the public. Legislative committee members and many of those who testified at the hearings recognized that the future for ocean aquaculture in O'ahu required a "user friendly" permit/lease regime, to test the feasibility and impacts of such leases.

Interest in ocean aquaculture is currently rising among the conservation community, policymakers and private aquaculture entrepreneurs. However, the general public has limited experience with the issues, impacts and benefits from ocean farming in the nearshore or offshore environments. This is especially true in the State of Hawai'i, where the community wants sustainable, socially- and culturally appropriate use of marine resources. The amended ocean leasing law was specifically crafted to provide a clear mandate from the legislature for the State to assess the impacts of ocean leases on the environment and the public.

Blue Ocean Mariculture, founded in 2009, operates a fully integrated mariculture facility, growing *Seriola rivoliana* (branded as 'Hawaiian Kanpachi') to harvest size in offshore net pens. The net pens are located offshore, north of Keāhole Point. The Ocean Era Offshore Aquaculture Farm offers another opportunity to demonstrate the potential benefits that offshore aquaculture could bring, particularly when sited in an appropriate location for aquaculture.

4.3.3 Research, Training and Extension Opportunities

The Ocean Era Offshore Aquaculture Farm will promote aquaculture research and development, will increase the profile of O'ahu as a site for innovative ocean aquaculture, and will potentially

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open up opportunities for training and extension work, to broaden the benefits from these developments. Ocean Era has a demonstrated capacity for research, training, and extension of innovative aquaculture enterprises. By increasing the level of offshore aquaculture expertise among Hawai‘i’s workers, this farm will support the future growth of this industry in the State. It will also enable Hawai‘i to leverage a greater role in the expanding Pacific aquaculture industry.

4.4 ENVIRONMNENTAL CHARACTERISTICS

Environmental impacts associated with the Ocean Era Offshore Aquaculture Farm are considered negligible and benign. The proposed farm area is located in an open ocean area offshore from ‘Ewa Beach, O‘ahu.

The physical and biological attributes of the existing environment of the proposed site are described in detail below (Section 6; Environmental Setting). The area’s topography and oceanography are distinguished by the depth of water; the deep sand substrate; the strong currents through the area; the exposure to high surf and strong trade winds; and the adjacent shoreline of a narrow coral bench reef with a steep basalt (lava) cliff. The existing uses of the area are negligible, because of its depth, the paucity of fish, and the barren benthos.

Only minor and nearly immeasurable impacts on water quality and the substrate beneath the site are anticipated in the immediate area of the Ocean Era Offshore Aquaculture Farm. Further, the multi-anchor swivel (MAS) point mooring system supporting the net pen and macroalgal array reduces risk of mooring failure to *de minimus* yet orients the array into prevailing currents to reduce design loads, optimizes nutrient distribution (so that nutrient inputs always flow in one direction along the array), and conceptually allows for harnessing of current and wind energy for harvesting. Given the strong long-shore currents, the deep water, and sand substrate, farm nutrient impacts on water quality are anticipated to be *de minimus*.

The proposed farm sites lie west of the western boundary of the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) of Moanalua Bay on the southeastern tip of O‘ahu. Estimated humpback whale surface densities are low in this area. Information from National Marine Fisheries Service, and experience from other fish farming areas, indicate that the Ocean Era Offshore Aquaculture Farm itself will not interfere with the movement of the humpback whales. Some concerns have been expressed with the potential for entanglement of whales in the mooring lines of the fish farm net pens. However, records from other locations show that most entanglement events occur in slack net mesh (such as drift nets or fish weirs), slack vertical lines (such as crab pot or lobster pot floats), or surface lines (such as long-lining gear). With heavy mooring gear, and taut lines, the potential for entanglement is considered negligible (Celikkol, 1999; Wursig and Gailey, 2002).

Although other Federally listed species are known to occur in the area, the Ocean Era Offshore Aquaculture Farm does not present any potential detrimental impact on these animals. Leatherback and Green Sea Turtles and Monk Seals may occasionally stray into these deep-water areas. The proposed farm sites lie within Insular False Killer Whale designated habitat; however, the ‘Ewa Beach offshore area is not known as a daytime resting location for Hawaiian Spinner Dolphins. As with humpback whales, however, the taut-line mooring system will prevent animals from becoming entangled.

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The Ocean Era Offshore Aquaculture Farm will not impede movement or otherwise disturb the spinner dolphins that typically spend their days resting and socializing in the bays on the western coast of the island. The schools then follow an erratic zig-zag pattern in their return back to their deep-water feeding grounds. At night, the spinner dolphins are typically found hunting in deeper waters further off O‘ahu shores. The Ocean Era Offshore Aquaculture Farm site will not impede the usual pattern of movement as the proposed sites lie west of concentrated area of activity. As such, the potential for the Ocean Era Offshore Aquaculture Farm to disrupt the normal resting pattern of the dolphins is also considered remote and negligible.

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5. ALTERNATIVES

5.1 ALTERNATIVES EVALUATED

Several other areas off of O‘ahu’s south coast were examined during the site selection process. They were deemed to be unusable because of water body characteristics or other uses in the area.

5.1.1 Alternative 1- Two miles off of ‘Ewa Beach (0.5 miles south of Preferred Site)

This site is located in waters roughly 160 meters (525 feet) deep, which may be prohibitive.

5.1.2 Alternative 2- 2.25 miles WSW of Preferred Site

This alternative site location is within a restricted area.

5.2 NO ACTION ALTERNATIVE

The option of No Action is not recommended. A variety of potential social, economic, and environmental benefits could occur from development of offshore fish and macroalgae culture in Hawaiian waters. To take no action would be a step backward in the in the quest to grow a more food and energy self-sufficient Hawai’i.

If the option of No Action is taken, this would hinder the development of offshore aquaculture in Hawai‘i, and probably discourage further research or development efforts in this area. Land-based commercial scale production of marine food fish is prohibitively expensive. In regard to macroalgae aquaculture the only alternative, then, would be to continue development of land-based marine macroalgal culture. These activities are very capital and energy intensive. They are therefore only suitable for high-value marine products. They also only offer limited employment and development opportunities to the community.

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6. ENVIRONMENTAL SETTING

The proposed farm site, also referred to as the area of interest or AOI, is located in Mamala Bay, approximately two miles south of 'Ewa Beach, Oahu. The depth in the AOI ranges from 40m [130 feet] to 80m [260 feet] deep, which lies over a sandy substrate. The Mamala Bay region hosts multiple industrial uses. Significant features include the entrance to Pearl Harbor (approximately two miles to the east), Barbers Point, and Campbell Industrial Park (approximately six miles to the west). Additionally, there are two domestic wast'Ewater outfalls in Mamala Bay, the Sand Island Outfall (four miles to the east) and the Honouliuli Outfall (one and a half miles to the west). Further west is the oil tanker unloading facility off Barbers Point.

The information about the environment provided herein comes from multiple sources. Reports and a Final Environmental Assessment (2009) from fish farming activities that took place near the AOI are a primary source of information. Peer reviewed literature that was germane to the either the specific location or the region was also consulted. Additionally, publicly available environmental data sourced from Marine Cadaster was also included.

CLIMATE (WEATHER & WIND)

The weather conditions at the AOI are strongly influenced by the Tradewinds. These east and northeasterly winds occur 76% of the time. The average wind speed ranges from 4-5.6 meters per second (northeasterly winds tend to blow faster than those coming directly from the east). Kona winds, are present 15% of the time (Garza, Chu, Norton, & Schroeder, 2012) . The wind data is similar to that described in the previous FEA for Hukilau foods in 2009, that obtained the information from Juvik et al 1989. The Koolau and Waianae mountain ranges provide shelter, reducing the intensity of winds and storm systems originating from the North and East of the site.

WAVES AND CURRENTS

Waves in the AOI are often generated by the Tradewinds and come from the north and northeast, with the average significant wave height between 0.75 and 1 meter, and a wave period of 7.5-9 seconds (Office of Coastal Management). Periodically, waves coming from the south may affect the site, but previous operators in the area reported that prevailing patterns and seasonal swells did not negatively impact operations (cates EA 2009).

The oceanic currents in the vicinity of the Hawaiian Islands are believed to depend mostly on the velocity and direction of the wind. Currents in the AOI are variable. Data presented in the 2009 FEA, as well as data from NOAA's Office of Coastal Management indicate that the current speed in the AOI can range from 0.05 – 1.0 meters per second (0.1 – 2 knot). Typical current speed appears to be 0.1 – 0.25 meters per second (0.2 – 0.5 knots). The strongest, and most consistent flow is from east to west throughout the year. Tidal changes can influence the direction and velocity, indicated by a study conducted for the previous farm operators in September – October 2002. During the semi-diurnal tidal changes, twice per day, the velocity diminishes, and in some areas reverses in a circular motion.

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WATER QUALITY

The proposed farm site is waters classified as "Class A Open Coastal" (Hawaii Department of Health Amendment and Compilation of HAR 54-11 Hawaii Administrative Rules). Open Coastal Marine Waters are defined as waters bounded by the shoreline to 183 meter (600 feet) depth contour. Based on data from public sources (https://coast.noaa.gov/digitalcoast/tools/ort.html) and the water quality monitoring reports from Cates/ Huklilau, the water column is generally mixed with no distinguished thermo or pycnocline during the year. Surface waters are relatively low in nutrients, typical of tropical waters that are not regularly influenced by upwelling.

Water quality data from previous fish farming activity

A commercial fish farm was operated in close proximity to the AOI from 2002-2014. Water quality monitoring occurred regularly in and around the farm site for the entirety of it's operations. Water quality monitoring stations included two control sites. The water chemistry results obtained from monitoring these control stations can serve as a description of current conditions. There has been no activity of note in the AOI since the infrastructure from the previous occupant was removed, so data from the two control sites (presented in Table x) should be demonstrative of what the current water quality conditions are. .).

Table 0-1: The mean water quality values for the two control stations used by Hukilau Foods for NPDES water quality monitoring.

	TN (µg/L)	NH_4^+ (µg/L)	NO_3^- (µg/L)	TP (µg/L)	PO_4^{3-}	Si(OH)4 (µg/L)	O2 % sat	O2 mg/L	Turbidity NTU	pH	Temp. deg. C	Salinity ppt
C1	113.9	0.87	0.91	10.31	1.21	49.60	98.85	6.60	0.10	8.16	25.80	34.93
C2	110.47	1.08	0.87	10.47	1.32	48.37	98.97	6.61	0.10	8.16	25.90	34.99

THE SEAFLOOR

The sea floor at the AOI (preferred site) has a gently sloping sandy bottom. The water depth at the Preferred site and Alternative 2 range from roughly 40 to 80 meters. The deoth at the "Alternative 1" site is over 100 meters. To the south and west of the site, water depth drops quickly to 200 meters. Publicly available environmental data indicated a sandy sea floor at the AOI, with areas of gravel and rock to the west and south. The previous users of the site as well as academic researchers studies the sediment in the area. All of these reports confirm sandy sediment with oxygenated upper layers (positive ORP values) (Lee, Bailey-Brock, & McGurr, 2006).

BIOTA

Relevant biota can be divided into three types: terrestrial biota; marine biota; and rare, threatened, or endangered species.

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Terrestrial Biota

The proposed fish farm will not significantly impact any terrestrial biota, such as bird populations. The nearest Audubon Important Bird Area is located in Peral Harbor, over 4 miles to the northeast. It is home to three endangered species the Hawaiian Stilt (*Himantopus mexicanus knudseni*), Hawaiian Coot (*Fulica alai*), and Hawaiian Common Moorhen (*Gallinula chloropus sanvicensis*). These are wetland associated birds and are highly unlikely to ever occur in the project area.

Marine Biota

The proposed project area is located in the sunlit, well mixed epipelagic zone, and boarders on deeper oceanic waters. The epipelagic portion of the deep ocean ecosystem (0 - 656 ft) is home to a variety of primary and secondary producers (bacteria, phytoplankton, and zooplankton), forage species, and pelagic fishes (WPFMC 2009a).

Fishes –

The entirety of the Hawaiian Islands is popular for subsistence, recreational and commercial fisheries. Shor'Eward of the proposed site there is a regulated limu fishing area, consisting of there are tidepools that transition into fringing rock and coral reef. Moving offshore into deeper waters, where the proposed farm site is located, the bottom is primarily unconsolidated sediment (sand).

The fishes that are likely to occur around the farm site can be estimated by applying results of fish surveys conducted around the MHI by State and Federal agencies, coupled with the experience of the previous farm that operated in the area. Results of baited camera surveys have been reported by (Asher, Williams, & Harvey, 2017). Examples of the fish seen at depth similar to the farm site over sand bottom include: *Pristipomoides filamentosus, Caranx sp., Aprion virescens*, *Seriola rivoliana, Seriola dumerilli, Decapterus macarellus, Naso hexacanthus, Parupeneus chrysopleuron, Oxycheilinus bimaculatus*. Several of these are important commercial fish, part of the Deep Seven group of species. Fish observed by previous farm operators include broomtail file fish (*Aluterus scriptus*) mackerel scad (*Decapterus macarellus*) will congregate in the vicinity of the cages and this in turn would attract pelagic predators, such as false albacore tuna (*Euthynnus alletterates*) butterfly fish (Chaetodon sp.) and surgeon fish (*Acanthurus sp.*). Sandbar sharks (*Carcharhinus plumbeus*)

The Preferred Site and Alternatives 1 and 2 have predominantly sandy bottoms. Additionally, some rock or gravel may be present around Alternative 2. An artificial reef complex is located roughly 1.5 kilometers (1 mile) west of the proposed farm site. Here we expect that reef fishes common to the Hawaiian Island would occur. Examples include: "…surgeonfishes (Acanthuridae), triggerfishes (Balistidae), jacks (Carangidae), parrotfishes (Scaridae), soldierfishes/squirrelfishes (Holocentridae), wrasses (Labridae), octopus (*Octopus cyanea, O. ornatus*), and goatfishes (Mullidae)" (WPRFMC, 2009)

Sharks –

There are nine species of pelagic sharks commonly found in the open ocean environment around Hawai'i (WPFMC 2009b). Sharks may occur in coastal waters and in waters around the project location. Previous operators reported seeing sandbar sharks periodically below the cages. Similarly the fish farm operating off of the Kona coast also reports visits by sandbar sharks, as well as occasional visits by blacktip reef sharks (https://www.bofish.com/wp-

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content/uploads/2020/10/Wildlife_2020.pdf). Of course it is possible that other species of sharks such as tiger shark appear in the area, but their presence around offshore farms in Hawaii over the past 20 years have been rare and generally transitory.

Essential Fish Habitat –

The Magnuson-Stevens Act defines essential fish habitat (EFH) as "those waters and substrates necessary for fish spawning, breeding, feeding and growth to maturity." Additionally, the Magnuson-Stevens Act defines Habitat Areas of Particular Concern (HAPC) as "areas within EFH that are ecologically important, sensitive to disturbance, or rare." Thus, HAPCs often require more protection from activities that may adversely affect EFH. In general, marine organisms, managed in accordance with the Magnuson-Stevens Act, that occur in the water column include highly migratory species (HMS) and other pelagic fish species, and eggs and larvae of a range of species. Species associated with benthic habitats include bottomfish, seamount groundfish, precious corals and coral reef ecosystem management unit species, and crustaceans and eggs and larvae. Table X-X shows Essential Fish Habitat and Habitat Areas of Particular Concern for Management Unit Species (MUS) Occurring in Hawai‘i. Table XXX Shows the Essential Fish Habitat for the various MUS and their life stages that occur in the specific area of interest.

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Table 0-2: Essential Fish Habitat and Habitat Areas of Particular Concern for Management Unit Species (MUS) Occurring in Hawai'i		
MUS Group	**EFH for Eggs and Larvae**	**EFH for Juveniles and Adults**
Bottomfish	Water column down to 400 meters depth out to the 200-mile U.S. Exclusive Economic Zone (EEZ) boundary	Water column and all bottom from the shoreline down to 400 meters depth
Seamount Groundfish	Water column down to 200 meters depth of all EEZ waters bounded by 29°- 35° N and 171° E-179° W	Water column and bottom from 200-600 meters depth bounded by 29°- 35° N and 171° E-178° W
Pelagics	Water column down to 200m depth from the shoreline out to the EEZ boundary	Water column down to 1000m depth from the shoreline out to the EEZ boundary (also HAPC)
Precious Corals	Known precious coral beds in the Hawaiian Islands including: off Keāhole Point, between Miloli'i and South Point, The 'Au'au Channel, Makapu'u, Ka'ena Point, the southern border of Kaua'i, Wespac Bed, Brooks Bank, and 180 Fathom Bank	
Coral Reef Ecosystem	Water column down to 100 meters depth from the shoreline out to the EEZ boundary	
Crustaceans	Lobsters and Crabs: down to 150 meters depth from the shoreline out the EEZ boundary Deepwater Shrimp: The outer reef slopes between 300-700 meters depth	Lobsters and Crabs: Bottom from the shoreline down to 100 meters depth Deepwater Shrimp: Outer reef slopes between 550-700meters depth
https://www.fisheries.noaa.gov/pacific-islands/consultations/frequently-asked-questions-about-essential-fish-habitat-pacific#where-has-efh-been-designated? Accessed March 24, 2021		

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Table 0-3: Essential Fish Habitat for MUS and life stage in the area of interest				
Species/ Management Unit	**Egg**	**Post-hatch**	**Post-settlement**	**Sub-Adult/Adult**
Main Hawaiian Islands Coral Reef Ecosystem	X	X	X	X
Amberjack / Black Jack /Sea Bass	X	X	X	X
Blue Stripe Snapper / Gray Jobfish	X	X	X	X
Giant Trevally	X	X	X	X
Pink Snapper	X	X	X	X
Red Snapper / Longtail Snapper / Yellowtail Snapper / Pink Snapper / Snapper	X	X		
Silver Jaw Jobfish / Thicklip Trevally	X	X	X	X
Data obtained from NOAA Essential Fish Habitat Mapping Tool https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper March 25, 2021. The "Data Query Tool" was used for the location specified by the coordinates below: Degrees, Minutes, Seconds: Latitude = 21º17'9" N, Longitude = 159º59'38" W Decimal Degrees: Latitude = 21.29, Longitude = -158.01				

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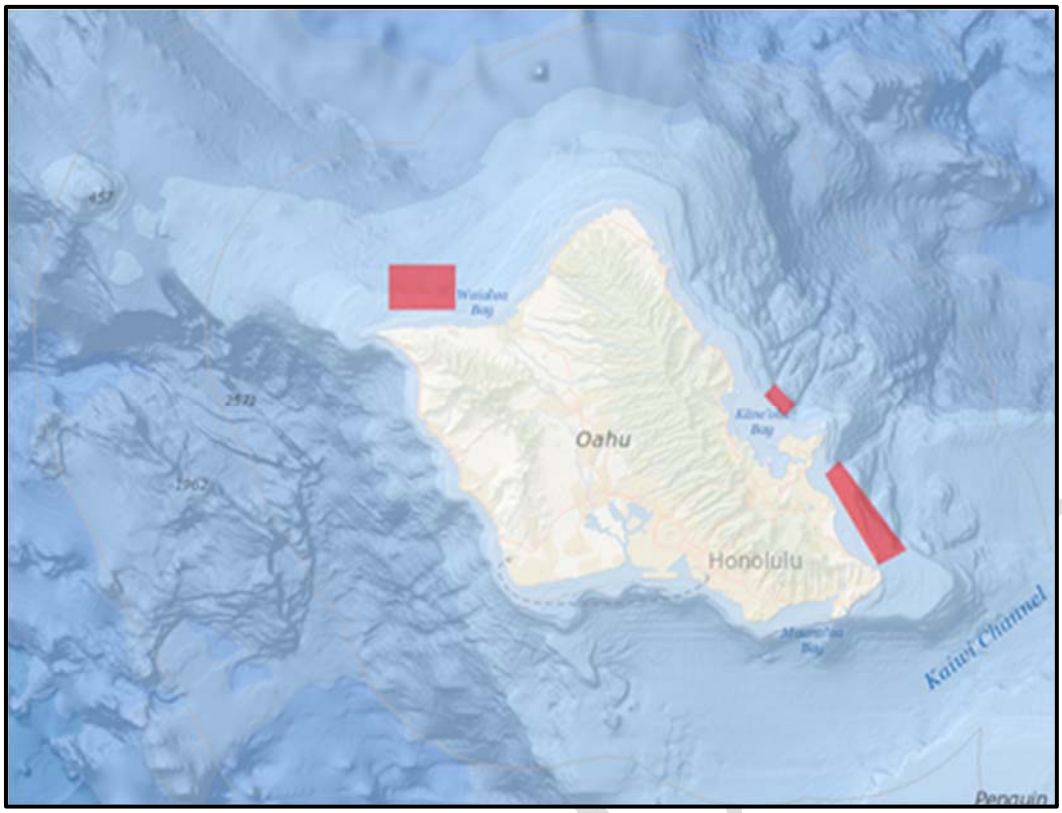

Figure 0-1:Map showing Habitat Areas of Particular Concern around O'ahu. Screenshot taken from NOAA Fisheries' EFH Mapping Tool

Rare, Threatened or Endangered Species

Rare, threatened or endangered species include those protected species that may occur in the project area year-round, or seasonally. These include sharks, sea turtles, seabirds, marine mammals, and corals. The Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), the Migratory Bird Treaty Act, and the Magnuson-Stevens Act protect many of these species. The following provides baseline information on these species that may occur in the action area.

Sharks –

Many pelagic shark species are in decline. In response, NOAA Fisheries has implemented shark conservation measures including listing some species under the ESA and identifying the bigeye thresher shark and smooth hammerhead shark as candidates for listing (80 FR 48061 and 80 FR 48053, August 11, 2015).

On March 01, 2018, NOAA Fisheries listed the oceanic whitetip shark *(Carcharinus lonigmanus*) as Federally threatened (83 FR 4153; 50 CFR 223). The oceanic whitetip shark has a cosmopolitan distribution in tropical and sub-tropical waters. As a pelagic species, it is typically found offshore in the open ocean, on the outer continental shelf, or near oceanic islands in water depths greater than 600 feet. Occupying surface waters to depths of 498 feet, the oceanic whitetip sharks are considered surface-dwelling, preferring the mixed layer in warm waters (> 20°C).

Sea turtles -

Several species of sea turtles occur in Hawaiian waters and may be present in the action area. ESA-listed threatened green turtles (*Chelonia mydas*) and endangered hawksbill turtles (*Eretmochelys imbricata*) occur in nearshore waters throughout the archipelago. NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS) are proposing to reclassify green sea turtles into 11 distinct population segments (DPSs) under the ESA (80 FR 15271). The proposed Hawaiian DPS would remain listed as threatened. Commercial fishing vessels operating beyond 50 NM from Hawai‘i have caught other sea turtle species including the endangered leatherback turtle (*Dermochelys coriacea*) and threatened olive ridley turtle (*Lepidochelys olivacea*) (Gilman et al., 2006; WCPFMC 2009). In 2011, NOAA Fisheries designated the North Pacific population of loggerhead turtles (*Caretta caretta*) as a distinct population segment (DPS). NOAA Fisheries designated this DPS as endangered under the ESA (76 FR 58868, September 22, 2011). Loggerheads occur near the action area.

A thorough review of the life history, status and trends, threats, and conservation efforts for sea turtles is available in section 5 of the September 19, 2014 Biological Opinion on the Hawai‘i-based shallow-set longline fishery (NOAA Fisheries 2014d). Information about Pacific sea turtles' range, abundance, status, and threats is in the recovery plans for each species, available from the NOAA Fisheries website:

- Olive ridley: https://www.fisheries.noaa.gov/species/olive-ridley-turtle
- Leatherback: https://www.fisheries.noaa.gov/species/leatherback-turtle
- Loggerhead: https://www.fisheries.noaa.gov/species/loggerhead-turtle
- Hawksbill: https://www.fisheries.noaa.gov/species/hawksbill-turtle
- Green turtle: https://www.fisheries.noaa.gov/species/green-turtle
- East Pacific green turtle: https://www.fpir.noaa.gov/PRD/prd_green_sea_turtle.html

Seabirds –
There are numerous protected seabird species that live in the Hawaiian Islands. The group that operated the the fish farm that was previously in the AOI stated that "Federally protected bird species do not frequent the area or forage in the vicinity"(Cates 2009 EA). While it is possible that some seabirds may periodically land on the proposed feed barge, it is unlikely that the operation will cause any negative impact. Pens are submerged several meters below the water and as such the fish within the won't be an attractant or source of food.

Seabirds may occur in the proposed action area, including these ESA-listed:

- Hawaiian petrel (*Pterodroma sanwichensis*)
- Newell's shearwater (*Puffinus newelli*)
- Short-tailed albatross (*Phoebastria albatrus*)

The Hawaiian petrel and Newell's shearwater have breeding colonies in the MHI Islands (USFWS 1983). The ESA-listed short-tailed albatross does not appear to frequent the vicinity of the proposed action site. A few short-tailed albatrosses visit Midway Atoll every year in the Northwestern Hawaiian Islands (USFWS 2008).

The applicant did not observe any ESA-listed seabirds during two offshore fish farming projects they founded on Hawai'i Island. Some seabirds (usually Brown boobies (*Sula leucogaster*) have landed on net pens and tender vessels at aquaculture operations off of both Keahole Point and

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Keauhou. Staff at either location have not observed seabirds diving on the pens, and did not observe adverse impacts on seabirds from the operation.

The Migratory Bird Treaty Act makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit. The list of migratory bird species protected by the Act is in 50 CFR 10.13 and includes most seabirds. Other migratory seabirds occurring in the project area include black-footed and Laysan albatrosses (*Phoebastria nigripes* and *P. immutabilis*); Christmas, flesh-footed, wedge-tailed, and sooty shearwaters (*Puffinus nativitatis, P. carneipes, P. pacificus, and P. griseus*); and masked, brown, and redfooted boobies (*Sula dactylatra, S. leucogaster, S. sula*). Additional information on seabird populations, distribution, life history, and status is available from the USFWS at http://www.fws.gov/birds/index.php and at http://ecos.fws.gov/tess_public/pub/SpeciesReport.do?groups=B&listingType=L&mapstatus=1

Marine Mammals -
Many species of marine mammals may occur in the proposed action area. These include pinnipeds (seals) and cetaceans (whales and dolphins). The following describes the occurrence and status of marine mammals that may occur in the action area.

Hawaiian Monk Seal
The Hawaiian monk seal (*Neomonachus schauinslandi*) is the only pinniped indigenous to Hawai‘i. This seal is listed as Endangered under the ESA. Monk seals occur throughout the Northwestern Hawaiian Islands (NWHI), with subpopulations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, Kure Atoll, Necker Island, and Nihoa Island. They also occur throughout the main Hawaiian Islands (MHI) (NOAA Fisheries 2014a). According to NOAA Fisheries (2007), monk seals have declined in the NWHI since monitoring began in 1995. Since 1981, the number of monk seals in the MHI has increased. The best estimate of the current total Hawaiian monk seal population is 1,400 seals – about 1,100 in the Northwestern Hawaiian Islands (NWHI from Nihoa to Kure Atoll), and about 300 in the main Hawaiian Islands (MHI from Ni‘ihau to Hawai‘i). The population in the NWHI has been declining annually due to low juvenile survival (NOAA Fisheries 2014a). Monk seal numbers in other parts of their range appear to be increasing, but population growth rate estimates are uncertain at this time (NOAA Fisheries 2014a). The species is depleted and well below its optimum sustainable population and is a strategic stock under the MMPA (NOAA Fisheries 2014a). Around the MHI, threats include disturbance, fishery interactions (hooking and entanglement in fishing gear or marine debris); human interactions (including feeding and other harassment); diseases (leptospirosis and toxoplasmosis), and intentional killing.

On August 21, 2015, NOAA Fisheries published a final rule for monk seal critical habitat (80 FR 50925). The predominant portion of this critical habitat occurs in the nearshore waters where the applicant would transit for deploying, retrieving, operating, and maintaining the project. Hawaiian Monk Seal critical habitat in the marine environment extends from the 200 meter depth contour line (relative to mean lower low water), including the seafloor and all subsurface waters and marine habitat within 10 meters of the seafloor, through the water's edge into the terrestrial environment where the inland boundary extends 5 meters. The proposed farm will be within this area, and is

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located offshore of an area designated as having essential features for Hawaiian monk seals, specifically Kalaeloa/ Barbers Point Harbor through to Iroquois Point[2]

A Hawaiian monk seal which swam into an open, empty net pen at the marine fish farm near Keahole Point (circa 2017), and drowned after not relocating the opening to escape. NOAA PRD and the farm operator worked together to investigate the cause and implement new operating procedures to prevent recurrence. This will be discussed in greater detail in the following section: *Potential Impacts and Mitigation.*

MHI Insular False Killer Whale

The Main Hawaiian Islands (MHI) insular false killer whale (*Pseudorca crassidens*) distinct population segment (DPS) is listed as an endangered species under the ESA (77 FR 70915, Nov. 28, 2012). The MHI insular false killer whale DPS occurs in the proposed action area. Because NOAA Fisheries listed the MHI insular FKW DPS as endangered under the ESA, it is also a depleted stock under the MMPA. According to the latest MHI insular FKW stock assessment report, the minimum population estimate is 92 animals, and the population appears to be declining (NOAA Fisheries 2018).

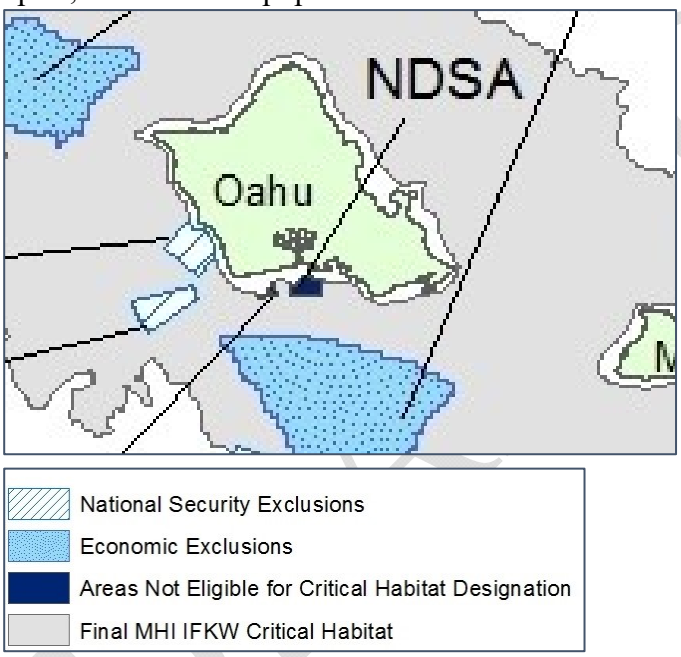

Figure 0-2: Area surrounding O'ahu delineating MHI IFKW critical habitat and exclusion areas

On July 24, 2018, NOAA Fisheries publishes a final rule to designate critical habitat for the main Hawaiian Islands insular false killer whale distinct population segment (DPS) by designating waters from the 45-meter depth contour to the 3,200-meter depth contour around the main Hawaiian Islands from Ni'ihau ast to Hawai'i[3]. The AOI for this project is within an area designated as critical habitat for MHI insular FKW, alhough it lies directly between two areas " not eligible for critical habitat designation" due to national security or military related activities[4].

Hawaiian Spinner Dolphins

Additional information is needed on presence/absence of spinner dolphins in the area.

Humpback Whale -

NOAA Fisheries has listed humpback whales as endangered under the ESA and depleted under the MMPA. Both mating and calving humpback whales may be present in or around the area from

[2] https://www.federalregister.gov/documents/2015/08/21/2015-20617/endangered-and-threatened-species-final-rulemaking-to-revise-critical-habitat-for-hawaiian-monk

[3] https://www.fisheries.noaa.gov/action/final-rule-designate-critical-habitat-main-hawaiian-islands-insular-false-killer-whale

[4] https://media.fisheries.noaa.gov/dam-migration/ifkw_ch_map_final.pdf

November through March during the calving and breeding season. Humpback whales wintering in Hawai‘i belong to the Central North Pacific (CNP) stock. The minimum population estimate for the CNP humpback whale stock is 10,103 animals and is growing seven percent annually (NOAA Fisheries 2017; https://www.fisheries.noaa.gov/species/ humpback-whale). NOAA Fisheries received a petition to list the CNP DPS under the ESA and to delist this DPS. NOAA Fisheries made a positive finding on the petition and has started a status review to determine if NOAA Fisheries should delist this DPS (79 FR 36281, June 26, 2015). If this DPS is delisted, the protections of the MMPA and the Hawaiian Islands Humpback Whale National Marine Sanctuary would continue to apply. Federal regulations prohibit persons on or in the water from approaching the whales within 100 yards (90 m) within the sanctuary and throughout waters of the Hawaiian Islands. Baird et al. (2015) found that the most biologically important areas for humpback whales around the Island of Hawai‘i are outside of the proposed action area.

Other Marine Mammals in the Proposed Action Area -
Listed below are marine mammals that are not ESA-listed and that may occur in the area. This list based on distribution information and previous sightings during other Kampachi Farms Velella trials.

- Blainville’s beaked whale *(Mesoplodon densirostris*)
- Bottlenose dolphin or common bottlenose dolphin (*Tursiops truncatus)*
- Bryde’s whale (*Balaenoptera edeni*)
- Cuvier’s beaked whale (*Ziphius cavirostris*)
- Dwarf sperm whale (Kogia sima)
- False killer whale (*Pseudorca crassidens*) Hawai‘i pelagic population
- Fraser’s dolphin (*Lagenodelphis hosei*)
- Killer whale (*Orcinus orca*)
- Longman’s beaked whale (*Indopacetus pacificus*)
- Melon-headed whale (*Peponocephala electra*)
- Minke whale (*Balaenoptera acutorostrata)*
- Northern elephant seal (*Mirounga angustirostris*)
- Pantropical spotted dolphin (*Stenella attenuata*)
- Pygmy killer whale (*Feresa attenuata*)
- Pygmy sperm whale (*Kogia breviceps*)
- Risso’s dolphin *(Grampus griseus*)
- Rough-toothed dolphin or Steno’s dolphin (*Steno bredanensis*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)
- Spinner dolphin (*Stenella longirostris*)
- Spotted dolphin (*S. attenuata*)
- Striped dolphin (*S. coeruleoalba*)

While northern elephant seals (*Mirounga angustirostris*) occasionally are sighted in Hawai‘i, these are very rare occurrences. Detailed information on these species’ geographic ranges, abundance, bycatch estimates, and status is in the most recent marine mammal stock assessment reports (SARs), which are available online at:
https://www.fisheries.noaa.gov/whales and https://www.fisheries.noaa.gov/dolphins-porpoises.

Corals -

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At last reporting, NOAA Fisheries listed 15 coral species as threatened or endangered under the ESA. While no corals are expected to be in the AOI or either alternative 1 or 2, deepwater corals have been sighted to the south west of the action area.
List corals/ sponges that were recorded

- Coral A
- Coral B
- Coral C

RECREATION

Operators of the previously permitted fish farm stated in their 2009 FEA:

> *"Ocean sports such as canoeing and kayaking, have rarely been observed in the vicinity of the sea cages and jet skiing has never been observed. Distance from shore and water depth act as a deterrent to these uses… Curious recreational snorkelers and SCUBA divers in boats have occasionally (a few times a year) approached the area when work boats were on site, but have not lingered when personnel explained what was going on and the potential for entanglement in anchor lines."*

The FEA further stated that commercial opelu fishermen occasionally fished near the site, and it was felt to be a mutually beneficial relationship. Ocean Era agrees wholeheartedly with this. In fact, the previous offshore fish farming activities that Ocean Era personnel have been involved with (on Hawai'i Island) did not exclude others from using the space for fishing, provided caution and respect for personnel, infrastructure and the farmed fish was practiced. Ocean Era agrees with the statement from the 2009 FEA that "these relationships can be mutually beneficial and even help with security on the site."

Ocean Era is not seeking exclusivity from fishing vessels in the project site, and accepts that the area will remain open to the passage of recreational users and fisherpeople within safe modes of operation and distances from the surface.

The Coast Guard consultation process will determine the marking of the area and potential for passage of boat traffic within the watch circle.

NOISE AND AIR QUALITY

The project would be located in an area with ambient noise from wind and waves, as well as periodic noise from outboard motors on boats, and commercial or military aircraft.

Air quality varies, depending on the amount of vog in the air, a result of emissions from Kilauea Volcano on Hawai'i Island. Usually the air is clear, dry and cooler in the mornings, with offshore winds predominating.

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AESTHETICS AND VIEWSCAPE

Viewscape, is very important to coastal property owners, as well as all manner of ocean users. The visual profile of the project will primarily include a feed barge, work boats, a harvest vessel and buoys. As cages will be submerged most of the time, they will not add structure to the view plane. Farm activities will likely be similar to what they were several years ago when the site was occupied by a commercial fish farm. The work boats that will be on site daily will be difficult to distinguish from normal boat traffic.

CULTURAL RESOURCES AND PRACTICES

Water depth and distance from shore prevent some culturally based recreational uses, such as outrigger canoeing. Both native Hawaiian and non-Hawaiian took advantage of the previous fish farm project that was located in the AOI.

Koʻa ʻōpelu (ʻholes' or schooling places for mackerel scad – *Decapterus macarellus*) were the most likely cultural resource that would have been, or would be impacted by farm operations. The location of these koʻa are typically considered to be part of the traditional marine lore, and are considered inappropriate for publication, or for sharing outside of the families or community groups who have traditionally fished this koʻa. An important aspect of the koʻa ʻōpelu tradition is the maintenance of these koʻa by feeding of the school. To keep fish attracted to a koʻa, a fisherman will regularly drop bags of palu - grated vegetable matter - to the school (daily, or every second day). The knowledge of the names and locations of the koʻa is considered of historical significance and is a tradition that the kupuna would like to see preserved and passed on to future generations. ʻŌpelu aggregations usually occur in water around 120 ft deep, close to reef drop-offs. During the initial and subsequent environmental assessments undertaken by the previous farming operations interviews with knowledgeable native Hawaiian fishers and cultural practitioners familiar with the location confirm there are no traditional fishing grounds or resources at the project location.

LAND USE AND ENVIRONMENTAL COMPATIBILITY

Current Usage

The immediate AOI and Alternative 1 do not appear to have any regular usage, since the removal of the previous farm installation in 2014. The applicant has requested assistance from NMFS Sustainable Fisheries personnel in identifying any current use of that area or the nearby artificial reef.

Submerged Lands Issues and the Public Trust

The proposed demonstration site constitutes part of the ceded lands trust, since all submerged lands are ceded lands. The 1999 amendments to the Ocean and Submerged Lands Leasing law (Chapter 190D HRS) directly addressed the issue of Office of Hawaiian Affairs' share of the lease revenues, by stipulating that the designated 20% of lease payments should be due to OHA. As this is a non-commercial research project *covered by permit only (not by lease), no lease fees would be payable*.

Public Perceptions of Ocean Use

The public perceptions of ocean access and ownership in Hawaiʻi are an amalgam of two conflicting cultural traditions. The legal regime has, up to now, been largely based on the ancient western concept of Mares Librum – Freedom of the Seas, or the ocean as a common property resource. The traditional Hawaiian concepts of land-use and ocean-ownership practices were

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related to the principles of the ahupua‘a, fishponds, and the konohiki fisheries. This provided for ownership of ocean resources, and was recognized as a sustainable, efficient means of managing the ocean, and reducing conflicts.

The 1999 amendments to the Ocean and Submerged Lands Leasing law (Chapter 190 D HRS) were the first major step to view the oceans as a resource that could be occupied and sustainably utilized, rather than simply exploited. This represents a sea change in the legislative and community thinking. It could be interpreted to represent a shift in current policies away from the Western Mares Librum ideas towards the more traditional Hawaiian concept. It might also reflect increasing recognition – evident in increased regulation and licensing of fishing activities in the state - that open-access fisheries, and unrestricted access to the ocean does not appear to provide sufficiently for effective management of ocean resources.

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7. POTENTIAL IMPACTS AND MITIGATION

IMPACTS DURING CONSTRUCTION

Short term impacts during construction will be caused by anchor placement and the increased activity associated with assembling the production array. The culture system will be moored to the seafloor in 80 meters of water by up to three anchors. These anchors are approximately [dimensions]. The anchor chain will also contact the seafloor impacts during the deployment. Precise anchor placement will be based on visual and or acoustic imaging to ensure that only barren unconsolidated sediment is physically disturbed. There will be temporary increases in turbidity due to anchor placement. Due to the nature of this work, it will not be undertaken when wind, wave or current conditions are extremely high. Additionally, the farm will be sited in an area that is resilient to slight increases in nutrients and suspended solids. As such, there will be little opportunity for disturbed sediment to drift into areas that can be negatively impacted.

Protected Species- Ocean Era will work with State and Federal agencies mandated with protecting marine animals to develop operational plans that are followed in case any protected species (marine mammals sea turtles) are seen in the area during deployment and construction.

Anchor lines, anchor blocks and preassembled fish cages will be moved to the site from Kalaeloa Harbor over the course of 7 – 10 days.

There will be a very slight risk of pollution from spills of fuel, oil, or hydraulic fluids from the boats used in deploying the anchors and the macroalgal growth platform array. Standard precautions (best management practices) and Coast Guard regulations for working on the ocean will be adhered to during the towing and deployment operations.

LONG TERM IMPACTS

Concerns related to the environment regarding aquaculture operations include water quality (waste, pharmaceutical applications), genetic impacts to wild fish from cultured fish escapes (e.g., loss of fitness to wild populations if wild and cultured fish interbreed), spread of disease from cultured to wild fish, entanglement of protected species in aquaculture gear, sustainability and safety of feed ingredients, risk of loss of equipment and damage to the marine environment during severe storm events (e.g., tropical storms, hurricanes), privatization of a public resource (federal waters) for profit, loss of ocean space where aquaculture operations are sited and socio-economic impacts on commercial or recreational fisheries.

Generally, open ocean aquaculture may have effects on water and sediment quality and the plant and animal communities living in the water column and those in close association with, on, or in the sediments. The two major factors which determine the negative effects of open ocean aquaculture on the surrounding natural environment are farm management practices, and farm siting. Sound farm operating practices reduce waste loading by employing efficient feeding methods and easily digested feed types. Good management practices can also limit escapes, prevent pathogen proliferation, and minimize potential for entanglements. Farm siting minimizes water column and benthic impacts by avoiding sensitive biological communities and optimizing current flow through the culture system. Optimal siting can also reduce potential marine resource use conflicts.

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Water quality

The water quality around offshore aquaculture operations is mainly affected by the release of dissolved and particulate inorganic and organic nutrients. Water column effects around offshore aquaculture operations include a decrease in dissolved oxygen and increases in biological oxygen demand, and nutrients (P, total C and organic and inorganic N), increased turbidity and potential for ammonia toxicity. Changes in water quality parameters is greatest within the fish culture structures and improves rapidly with increasing distance from cages. Recent studies have documented only limited water column impacts due to rapid dispersal (Holmer, 2010, Price and Morris 2013).

Sediment Quality

The two most significant sources of impacts to sediment quality from offshore aquaculture operations are solids deposition and nutrient enrichments of seafloor sediments from uneaten feed, biofouling and fish feces. Numerous studies have shown that organic enrichment of the seabed is the most widely encountered environmental effect of culturing fish in cages (Karakassis et al. 2000, Karakassis et al. 2002, Price and Morris 2013). The spatial patterns of organic enrichment from offshore aquaculture operations varies with physical conditions at the sites and farm specifics and has been detected at distances from meters to several hundred meters from the perimeter of the cage array (Mangion, et al., 2014). Studies of offshore aquaculture operations in the Mediterranean showed that the severe effects of organic inputs from fish farming on benthic macrofauna are limited to up to 25 m from the edge of the cages (Lampadariou et al., 2005) although the influence of carbon and nitrogen from farm effluents in sea floor can be detected in a wide area about 1000 m from the cages (Sara et al., 2004). The impacts on the seabed beneath the cages were found to range from very significant to relatively negligible depending on sediment type and the local water currents.

Need to include description of changes to infauna community that may occur

Biota

Terrestrial Flora -

There are no terrestrial flora or marine macroflora in the proposed offshore farm area.

Terrestrial Fauna -

The project would not impact terrestrial fauna. This area is not considered important for birdlife.

Marine biota -

Marine Benthic Organisms

There may be an increase in the amount of marine benthic fauna both on the mooring lines and anchors and fish cages. Fouling on mooring line and anchors would probably include macroalgae, bivalves (several species of mussels and oysters (*Pteria* and *Pinctada* spp), corals (*Pocillopora* and *Porites*), sea urchins (*Echinothrix calamaris*) nudibranchs (*Stylocheilus longicauda*) and sponges. These would all settle out of the plankton, and there would be no measurable impacts on adjacent communities. The presence of these organisms would primarily be a function of the presence of the artificial substrates, rather than any other perturbation to the environment.

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Fish pens will be cleaned periodically and some of this fouling would fall to the bottom. Monitoring changes to sediment chemistry, composition and infauna communities will be key in preventing unwanted degradation to the environment.

Fishes

The farm infrastructure will likely aggregate a mix of reef species, as well as some pelagic fish, as some fish are naturally attracted to objects floating at the surface (Fish Aggregation Devices [FAD]). Fish may also be attracted to the site due to the fouling on the structures. Schools of mackerel scad (ʻōpelu: Decapterus macarellus) may also be occasionally attracted to the area, but are not anticipated to take up permanent residence. A small population of the following species may be present after the farm is in operation. Opakapaka (*Pristipomoides filamentous),* Ulua *(Caranx sp).,* (Uku) *Aprion virescens,* Kāhala (*Seriola rivoliana amd S.dumerilli),* ʻōpelu (*Decapterus macarellus),* Kala *(Naso hexacanthus), Parupeneus chrysopleuro,* etc. Several of these are important commercial fish, part of the Deep Seven group of species. Fish observed by previous farm operators include broomtail file fish (*Aluterus scriptus*) mackerel scad (*Decapterus macarellus*) will congregate in the vicinity of the cages and this in turn would attract pelagic predators, such as false albacore tuna (Euthynnus alletterates) butterfly fish (Chaetodon sp.) and surgeon fish (*Acanthurus* sp.). Sandbar sharks (*Carcharhinus plumbeus*)

The array would not serve as a "fish sink" to pull fish away from neighboring reefs. Most reef fishes are site resident with varying home ranges (Howard et al., 2013). It wouldn't be anticipated that they would abandon their typical reef habitats, to cross open water, and take up residence on such an exotic structure located offshore. The array itself would not be likely to offer adequate food resources or nocturnal shelter. Meyer et al. (2010) documented natural boundaries that are typically situated along major habitat breaks (e.g., large sand channels between reefs) in reef ecosystems, and serve as natural barriers to reef fish movements.

Sharks

Sharks often investigate floating objects in their environment, and fish congregating around the array would present a potential food source. This effect would likely be similar to any other FAD in Hawaiʻi. Tension on the array's lines (i.e., mooring) would also preclude sharks from entangling themselves.

Need to include information from previous shark study at the Hukilau farm site and Kona site

EFH

Benthic EFH for bottomfish management unit species (BMUS), coral reef ecosystem management species (CREMUS), and crustacean management unit species exists within the general area of the project site.

During deployment and daily operations farm personnel and contractors would transit through areas with designated BMUS, CREMUS, and crustacean management unit species benthic EFH. These operations would cross through areas with benthic EFH for only a few hours at a time and vessels would use existing channels to enter and exit harbors. If, on the occasion that a catastrophe

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occurred, in which a support vessel sank or part of the culture system was lost benthic EFH could be affected.

Protected, Threatened or Endangered Species -

The following describes the potential effects that offshore farm may have on seabirds, turtles, and marine mammals.

Sharks

Sand Bar Sharks (*Carcharhinus plumberus*), have become part of the fauna around both the Hukilau Farms fish cages (previously occupied the area of interest), as well as at Blue Ocean Mariculture in Kona (OCCL 2009, OCCL 2014). Experience also shows that the numbers of sharks vary greatly over the year, with no particular pattern of attraction or avoidance. These observations are supported by scientific studies of shark movements conducted in several locations around the islands *(cite and include more detail from the UH study)*

Need to include more info from State about protected shark species

Seabirds -

Brown boobies (*Sula leucogaster*) have visited other farms locatedoff the Kona Coast (Sims 2014). Boobies commonly land on vessels and buoys. Boobies are plunge divers that capture prey on the wing or by plunge diving a few meters below the surface (Shealer 2002).

Marine Mammals and Sea Turtles -

The Hawaiian Monk Seal (*Neomonachus schauinslandi*), the Humpback whale (*Megaptera novaeangliae*) and the Main Hawaiian Island Insular False Killer Whales (*Pseudorca crassidens)*, Green Sea turtles (*Chelonia mydas*) and Hawksbill sea turtles (*Eretmochelys imbricata*) are endangered or threatened species that could occur in the project area

There are several types of potential impacts to sea turtles, monk seals, and other marine mammals from the proposed action's gear and operations.

These include:

- Entanglement in gear including mooring lines, bridles, and netting;
- Collisions with vessels including propellers;
- Impacts of fishing by others around the array;
- Impacts to critical habitat; and
- Impacts to behaviors, including habituation.

Cetacean entanglement in passive fishing gear is a well-documented problem (Reeves et al. 2013). However, there is evidence that noise and lighting help reduce the likelihood of entanglements (Carretta et al. 2008, Carretta and Barlow 2011). Cetaceans tend to actively echolocate in the presence of floating and submerged objects, avoiding direct contact with them. With lighting and some low-level sound (wave action on the buoys) coming from the macroalgae platform array, it is likely that cetaceans, especially odontocetes, would be aware of the presence of the array and avoid becoming entangled.

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MAS-Point Mooring – Ocean Era does not expect the mooring lines to entangle cetaceans, monk seals, or sea turtles, because lines would be under constant tension and free of loops. When the currents change, the mooring lines are modelled to remain taut even as the currents shift because of the negative buoyancy of the upper 240m (788 ft) of chain and 110m (361 ft) of rope.

The mooring system at the proposed project site is similar to that used for FADs deployed by the State of Hawai‘i. Over 25 years, the State has reported no entanglements with protected species with state FADs. Additionally, NMFS PIRO issued an ESA Section 7 opinion stating that similar State mooring systems would not likely adversely affect ESA-listed species (DLNR 2012). Ocean aquaculture facilities located in State waters and moored offshore of the Island of Hawai‘i, have not reported any incidents of protected species entanglements in a combined 15 years of operation (HF, 2009; KBWF, 2009).

Collisions with Support Vessels - Ship strikes also have potential to kill or injure cetaceans including false killer whales. False killer whales in waters surrounding Hawai‘i ride the bow or stern wake of vessels and may come into proximity of propellers (Oleson et al. 2010). A propeller strike from a small support vessel may cause disfigurement of the dorsal fin or other parts of the body without killing the whale (Wells et al. 2008); however, a strike could also seriously injure or kill smaller protected species (e.g. dolphins, monk seals, sea turtles). No documented ship-strike related injuries or deaths of false killer whales or humpback whales exist for Hawaiian waters. However, Baird (2009) reported a fresh head wound on one MHI insular DPS false killer whale photographed off Oahu in September 2009 that a propeller strike may have caused. Observations of monk seals with propeller wounds exist, and there have been reports of sea turtles killed or injured by propellers in waters around the State.

The following Best Management Practices, in accordance with ESA stipulations would be followed:

"BMPs required for activity types that may result in collision with vessels:

(a) Vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.

(b) Vessel operators shall reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals, and to 5 knots or less when piloting vessels in areas of known or suspected turtle activity.

(c) If approached by a marine mammal or turtle, the vessel operator shall put the engine in neutral and allow the animal to pass.

(d) Vessel operators shall not encircle or trap marine mammals or sea turtles between multiple vessels or between vessels and the shore."

Recreation

Ocean Era does not anticipate the proposed offshore farm having negative impacts to the local fishing community and ocean users. The farm structure would likely act as a FAD, attracting baitfish and pelagic fishes like any other floating object in the open ocean.

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Based on previous experience, Ocean Era expects some community fishermen (both recreational and commercial) will fish in the vicinity of the farm structure. With respect to safety and boat operations, the risk of gear entanglements or collisions with the farm array or mooring lines are not expected, provided boat operators remain a safe distance from the structure and any marker buoys. The USCG would note the array's position, as appropriate, through a USCG Notice to Mariners and the gear would *be lit at night to prevent collisions at sea*.

Noise and Air Quality

Boat engines, fish feeding systems, and cage cleaning apparatus will increase noise levels in the area of the farm site. Though in respect to the wide range of sea, land and air uses in the area, it is not expected to be significant.

The support vessels would result in minimal emissions, and these emissions would not exceed the general level of vessel air emissions that occur in the area on a regular basis and would not individually or cumulatively result in degradation to air quality. Winds at sea are expected to disperse the small amount of emissions quickly.

Aesthetics

Viewscape, is very important to coastal property owners, as well as all manner of ocean users. The visual profile of the project will primarily include a feed barge, work boats, a harvest vessel and buoys. As cages will be submerged most of the time, they will not add structure to the view plane. Farm activities will likely be similar to what they were several years ago when the site was occupied by a commercial fish farm. The work boats that will be on site daily will be difficult to distinguish from normal boat traffic.

Cultural Practices and Traditional Resources

The proposed farm site is too deep for free-diving, and for any significant SCUBA diving activity. There are no significant benthic plant or animal populations. Kona crab (*Ranina ranina*) and nabeta (*Iniistius pavo*) are the only benthic resources that occur on sand bottom near this depth.

Koʻa ʻōpelu (ʻholes' or schooling places for mackerel scad – *Decapterus macarellus*) were the most likely cultural resource that would have been, or would be impacted by farm operations. The location of these koʻa are typically considered to be part of the traditional marine lore, and are considered inappropriate for publication, or for sharing outside of the families or community groups who have traditionally fished this koʻa. An important aspect of the koʻa ʻōpelu tradition is the maintenance of these koʻa by feeding of the school. To keep fish attracted to a koʻa, a fisherman will regularly drop bags of palu - grated vegetable matter - to the school (daily, or every second day). The knowledge of the names and locations of the koʻa is considered of historical significance and is a tradition that the kupuna would like to see preserved and passed on to future generations. ʻŌpelu aggregations usually occur in water around 120 ft deep, close to reef drop-offs. During the initial and subsequent environmental assessments undertaken by the previous farming operations interviews with knowledgeable native Hawaiian fishers and cultural practitioners familiar with the location confirm there are no traditional fishing grounds or resources at the project location.

Need to include more information on Kona crab and nabeta in the area

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Land Use and Environmental Compatibility

Current Usage -

There is little usage of the current preferred farm site, as virtually all of the previous fish farm's infrastructure has been removed. Support services such as the hatchery for fingerling supply and berths for support vessels will occur at locations on O'ahu already being used for such services.

Submerged Lands Issues and the Public Trust -

The proposed demonstration site constitutes part of the ceded lands trust, since all submerged lands are ceded lands. The 1999 amendments to the Ocean and Submerged Lands Leasing law (Chapter 190D HRS) directly addressed the issue of Office of Hawaiian Affairs' share of the lease revenues, by stipulating that the designated 20% of lease payments should be due to OHA.

Cumulative Impacts

Need to discuss the stages of build out and monitoring.

Refer to the wastewater treatment out falls in the area as additional sources of nutrients.

Irreversible and Irretrievable Commitment of Resources

The proposed action does not involve an irreversible and irretrievable commitment of marine resources or State finances. A long-term lease will be requested. The lease term will be finite, and revocable for cause. Additionally, the lease will likely require the lessee to post a bond so that in the event of bankruptcy, funds will be available for the State to remove structures and return the environment to its former condition.

The open ocean environment around the main Hawaiian Islands has demonstrated an enormous capacity to rapidly assimilate and recycle excess nutrients from fish farming. Consistent, strong currents mix and disperse fish waste products into a naturally low nutrient environment. Changes that may occur to the sediment due to farm operations will likely revert to pre-farm conditions within a relatively short amount of time if the farm is removed.

A decision to issue the associated permits would not automatically result in the approval of future projects. Future permit applications, if any, would be subject to independent environmental evaluation, coordination with others, and compliance with all applicable laws, including NEPA.

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APPENDIX

PUBLIC COMMENTS AND FORMAL RESPONSES

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