Algae and seagrass survey in Hawai‘i Kai Marina, East O‘ahu

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Introduction

The Hawai‘i Kai Marina Community Association is proposing maintenance dredging of the Hawai‘i Kai Marina and entrance channel (Fig. 1). The project consists of two distinct activities: 1) dredge 11 separate areas within the marina to previously permitted depths and dispose of the dredged spoil material; and 2) dredge the marina entrance channel to previously permitted depth and nourish an adjacent beach with the recovered sand.

In 2010, *AECOS* prepared a report that describes the existing biological resources and water quality of the marina and vicinity of the marina mouth in Maunalua Bay based upon existing data and quantitative surveys conducted in November 2007 and October 2009 (*AECOS*, 2010). Since that time, the US Army Corps of Engineers (USACE) received a comment letter from US Fish and Wildlife Service (USFWS) expressing a concern regarding the invasive[1] alga, *Avrainvillea. amadelpha*, possibly dredged from the marina and deposited at an offshore disposal site. The USFWS also expressed concern that dredging operations could impact seagrass habitat. Therefore, the USFWS recommended assessments be conducted in the marina to determine presence and distribution

[1] Executive Order 13112 on Invasive Species defines an invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health,” and an alien species as “any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.” The USFWS, University of Hawai‘i Botany Department, Bishop Museum, and Hawai‘i Department of Aquatic Resources (DSLNR, DAR) refer to *A. amadelpha* as an invasive algae

of seagrass and *A. amadelpha* (USFWS, 2011). The results of the algal and seagrass surveys are contained in this report.

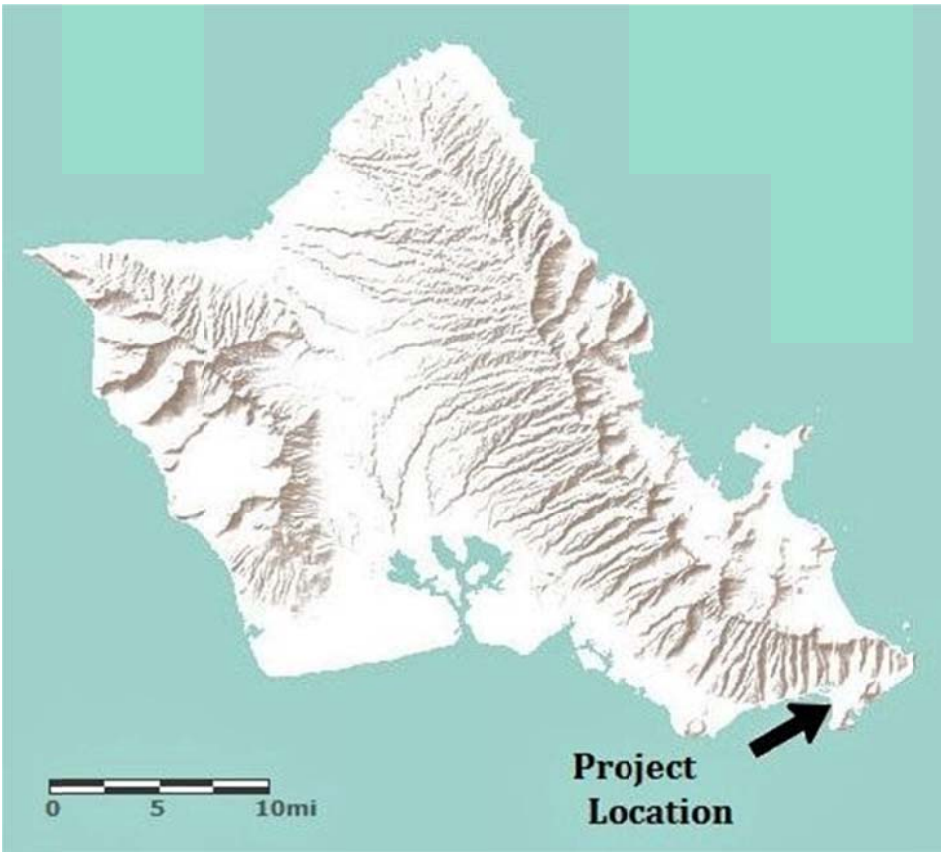

Figure 1. Island of Oʻahu showing location of Hawaiʻi Kai Marina.

Avrainvillea amadelpha

In Maunalua Bay, an introduced alga (*Avrainvillea amadelpha* or mudweed), is a dominant species on the marine bottom (USFWS, 2011; Coles et al., 2002; Fig 2). This species is considered to be one of the top five species of invasive algae in the Hawaiian Islands and is the most widespread, introduced species in nearshore areas of Maunalua Bay (Coles et al., 2002). *A. amadelpha* grows on soft sediment bottoms, in calm water areas, and can thrive at low light levels, which allows it to live in turbid waters (Smith et al., 2002). In comparison to other widespread introduced algae (for example, *Acanthophora spicifera*, *Gracilaria salicornia*, *Hypnea musciformis*), *A. amadelpha* has the lowest

potential to reproduce via fragmentation. Reproduction by fragmentation is most successful with large (3+ cm) fragments (Smith et al., 2002). This species was initially reported in 1981 at Koko Head and Kahe Point and has spread in the nearshore from Koko Head to off Kāhala and the south shore Oʻahu**.** Nearshore sand bottom areas of Maunalua Bay are now dominated by *A. amadelpha*, which is displacing native seagrass (*Halophila hawaiiana*) from these environments (Coles et al., 2002). *A. amadelpha* is present on the reef flat adjacent to the marina entrance channel (*AECOS*, 2010), and has been observed at the Marina Outlet Bridge in Hawaiʻi Kai Marina (Coles et al., 2002).

Figure 2. One of the top five invasive algae species in Hawaiʻi, *Avrainvillea amadelpha.* Here shown with an unidentified orange sponge.

Seagrasses

Three species of seagrasses are found in Hawaiʻi: one endemic, *Halophila hawaiiana*, one indigenous, *Ruppia maritima*, and one introduced, *Halophila decipiens* (Fig 3). Seagrasses, although technically not types of grass, are related to vascular plants and are not algae. In general, seagrasses thrive in areas with low sedimentation, adequate water flow, and low wave energy (Hemminga and Duarte, 2000). Seagrass is a common plant in both nearshore and offshore areas of Maunalua Bay (USFWS, 2011). Previous studies have observed *H. hawaiiana* and *H. decipiens* in the vicinity of the Hawaiʻi Kai Marina, specifically, in sandy areas offshore of Portlock Beach and Maunalua Bay Beach Park (Coles et al.,

2002; *AECOS*, 2010). Seagrass is foraged by sea turtles and constitutes a unique habitat in Hawaiian waters. Both species of *Halophila* are consumed by green sea turtles (Russell et al., 2003). The general degradation of seagrass beds by eutrophication (excessive nutrients from land runoff), sedimentation, chemical poisoning, collecting and gleaning, trampling, anchoring, etc. is a widespread threat to the recovery of depleted sea turtle stocks (NMFS and USFWS, 1998).

Seagrass beds are considered a Special Aquatic Site under the Clean Water Act (Subpart E of 40 CFR Part 230). Special aquatic sites are described in the Act as "… sanctuaries and refuges, wetlands, mud flats, vegetated shallows (seagrass beds), coral reefs, and [stream] riffle and pool complexes." When a project requiring a Clean Water Act, Section 404 permit (regulating the discharge of dredged, excavated, or fill material in wetlands, streams, rivers, and other waters of the U.S.) is proposed to be conducted in a Special Aquatic Site, as part of the permitting process, all alternatives that do not result in the discharge in a Special Aquatic Site are presumed to have less adverse impacts.

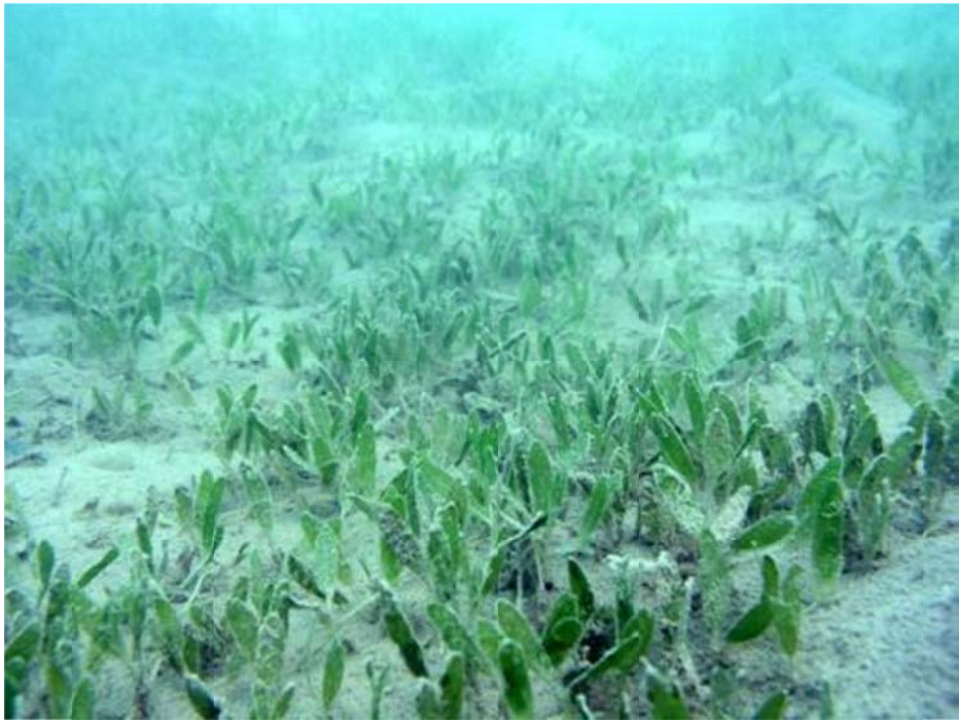

Figure 3. One of three species of seagrass in Hawaiʻi, our native, endemic seagrass, *Halophila hawaiiana.*

Methods

On July 21, 2011, *AECOS* biologists conducted an assessment of 5 proposed dredge sites (West Arm, Spinnaker Isle/Hancock Landing, Mariners Cove/Maintenance Facility, The Esplanade, and Entrance Channel; see Figs. 4 and 5) in the Hawaiʻi Kai Marina for the presence of seagrass and/or *A. amadelpha.* Also included in this survey was the Marina Outlet bridge location (Fig. 6), where *A. amadelpha* had been previously observed (Coles et al., 2002).

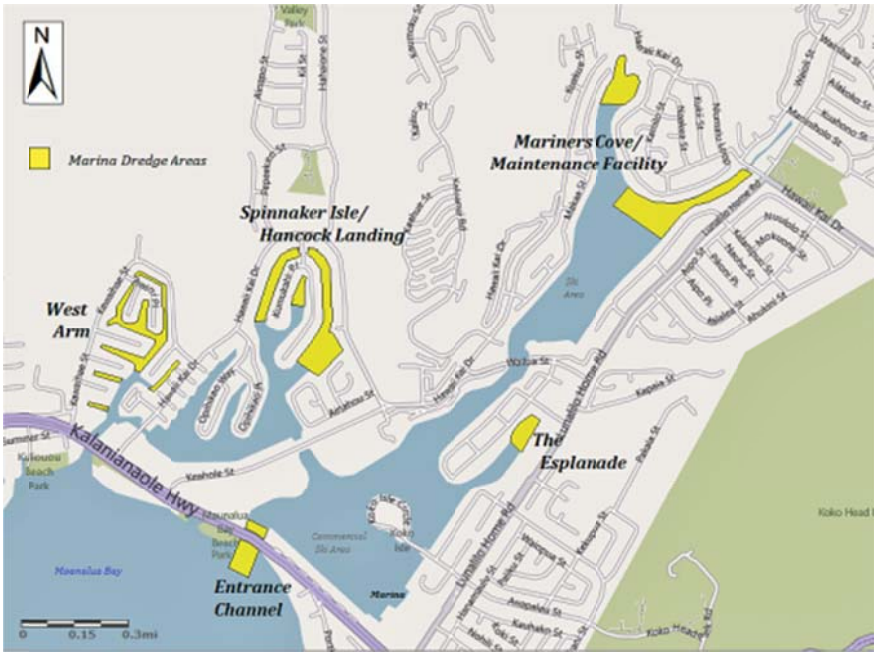

Figure 4. Hawai'i Kai Marina Dredge Areas, surveyed July 21, 2011.

Use of a drop-camera was planned at each dredge location to assess the bottom conditions to be then confirmed by divers. However, extremely turbid conditions of the marina waters prevented camera operations. Alternatively, the biologists sampled the bottom within four dredge areas (West Arm, Spinnaker Isle/Hancock Landing, Mariner's Cove/Maintenance Facility and The Esplanade) with a net (20.5 x 22 x 10 in. and 1.5 in mesh size). Substratum type and species observed in these samples were recorded. Multiple samples were collected from these four dredge areas, as shown in Fig. 5. Biologists snorkeled the entire Entrance Channel dredge area and used SCUBA to survey the bridge

pilings and bottom under the original channel from Kuapā Pond at the Marina Outlet bridge.

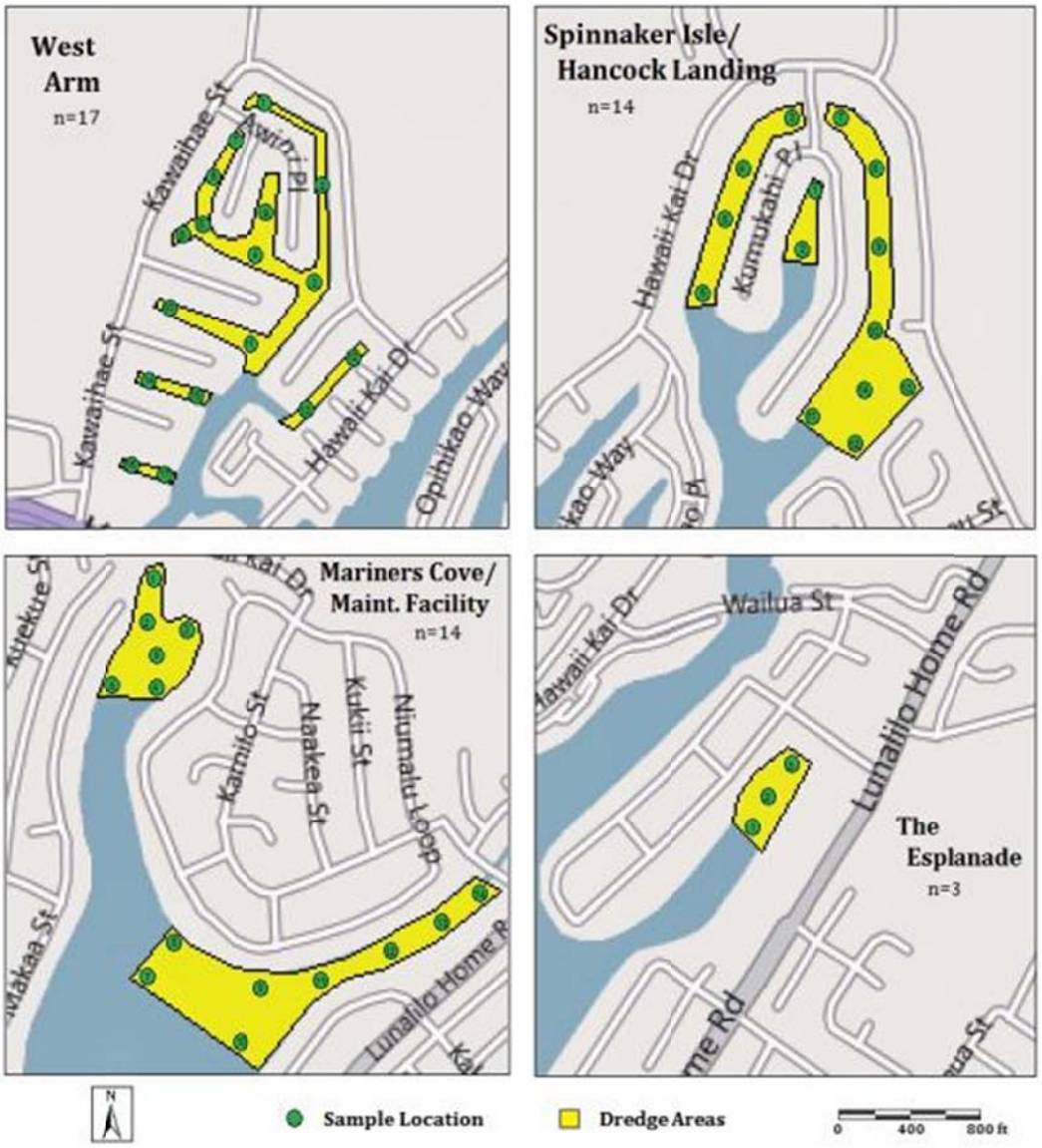

Figure 5. Approximate net sample locations from four proposed dredge areas.

Results

A checklist of marine species recorded from the surveys on July 21, 2011 is presented here as Table 1. A comprehensive listing of species throughout the area is available in the 2010 *AECOS* report (*AECOS,* 2010). The introduced alga, *A. amadelpha* was observed within the Hawai'i Kai Marina (Fig. 6), but not encountered in any of the 5 proposed dredge areas. One bed of seagrass was observed within the Hawai'i Kai Marina, in the Entrance Channel dredge area.

Table 1. Checklist of aquatic biota observed on July 21, 2011 in the waters of Hawaiʻi Kai Marina.

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status	Location
	ALGAE			
CYANOPHYTA	Blue-green algae			
Lyngbya majuscula		U	**Ind.**	5,6
Lyngbya semiplena		U	**Ind.**	5,6
Symploca hydnoides		U	**Ind.**	5,6
CHLOROPHYTA	Green algae			
Cladophora vagabunda		U	**Ind.**	5
Cladophora sericea		U	**Ind.**	5
Bryopsis hypnoides		U	**Ind.**	5
Chaetomorpha antennina		U	**Ind**	5
RHODOPHYTA	Red algae			
Acanthopora spicifera	spiny seaweed	O	Nat.	6
Gracilaria salicornia	gorilla *ogo*	O	Nat.	1,6
Avrainvillea amadelpha	leather mudweed	C	Nat.	6
***PHAEOPHYTA**	Brown algae			
Dictyota sandvicensis		U	**Ind**	5
Ralfsia expansa		U	**Ind**	5
Padina australis		O	**Ind.**	5
MAGNOLIOPHYTA	Flowering plants			
Halophila hawaiiana	Hawaiian seagrass	U	**End.**	5
	INVERTEBRATES			
PORIFERA, DEMOSPONGIAE, DYSIDEIDAE	Sponges			
Dysidea cf. *avara*	acquisitive sponge	U	?	5,6
HAPLOSCLERIDA				
Sigmadocia sp.	blue sigmadocia	U	?	5,6

Table 1 (continued).

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status	Location
CNIDARIA, SCYPHOZOA, SEMAEOSTOMEAE				
Aurelia sp.	moon jelly	?	Nat.?	1,2,3,4
ANTHOZOA, OCTOCORALLIA				
Carijoa riisei	snowflake coral	U	Nat.	5
MOLLUSCA, GASTROPODA, SIPHONARIIDAE				
Siphonaria normalis	false ʻopihi *ʻopihi-ʻawa*	C	**Ind.?**	6
CALYPTRAEIDAE				
Crepidula aculeate	slipper shell	A	Nat.	6
BIVALVIA, OSTREIDAE				
Dendostrea sandvicensis	Hawaiian oyster	U	**End.**	6
SPONDYLIDAE				
Spondylus violacescens	cliff oyster, *ʻokupe*	U	**Ind.**	5
CRUSTACEA, CIRRIPEDIA, BALANIDAE				
Amphibalanus amphitrite	Amphitrite's rock barnacle	A	Nat.	5
ANNELIDA, POLYCHAETA				
unidentified Polychaeta	worm	U	--	3
CHAETOPTERIDAE				
Chaetopterus sp.	parchment worm	U	?	5,6
SABELLIDAE				
Sabellastarte spectabilis	feather duster worm	U	**Ind.**	6
BRYOZOA, VESICULARIIDAE				
Amathia distans	bushy bryozoan	U	Nat.	5
ARTHROPODA, MALACOSTRACA, DECOPODA ALPHEIDAE				
Alpheus rapaz	goby shrimp	O	**Ind.**	6
PORTUNIDAE				
Unid.		O	--	6
	FISHES			
CHORDATA, ACTINOPTERYGII CICHLIDAE				
Sarotherodon melanotheron	blackchin tilapia	R	Nat.	1
GOBIIDAE				
Psilogobius mainland	Hawaiian shrimp goby	R	**End.**	6

Table 1 (continued).

KEY TO SYMBOLS USED:

Abundance categories:

- R – Rare – only one or two individuals observed.
- U – Uncommon – several to a dozen individuals observed.
- O – Occasional – seen irregularly in small numbers
- C – Common -observed everywhere, although generally not in large numbers.
- A – Abundant – observed in large numbers and widely distributed.

Status categories:

- End – Endemic – species found only in Hawaii
- Ind. – Indigenous – species found in Hawaii and elsewhere
- Nat. – Naturalized – species were introduced to Hawaii intentionally, or accidentally.

Location codes:

- 1 – Dredge Area 1 – West Arm (net)
- 2 – Dredge Area 2 – Spinnaker Isle/Hancock Landing (net)
- 3 – Dredge Area 3 – Mariners Cove/Maintenance Facility (net)
- 4 – Dredge Area 4 – The Esplanade (net)
- 5 – Dredge Area 5 - Entrance Channel (snorkel)
- 6 – Marina Outlet Bridge (SCUBA)

Figure 6. Location of *A. amadelpha* survey at the Marina Outlet bridge.

Marina Outlet Channel

The bottom of the marina outlet channel consists of silt and sand with some gravel. The gravel is partially covered with algal turf, unidentified sponges, and

polychaete worms (feather duster or *Sabellastarte spectabilis* and parchment worm or *Chaetopterus* sp.). The silt bottom contains burrows, which host the Hawaiian shrimp goby (*Psilogobius mainalndi*) and commensal shrimp (*Alpheus rapaz*). Consistent with earlier surveys (Coles et al., 2002), *A. amadelpha* was observed on the western side of the channel. The introduced red alga, *Gracilaria salicornia*, was abundant in this area as well.

Dredge Sites

West Arm, Spinnaker Isle/Hancock Landing, Mariner's Cove/Maintenance Facility, and Esplanade — Net samples from the West Arm, Spinnaker Isle/Hancock Landing, Mariner's Cove/Maintenance Facility, and Esplanade dredge areas showed that the bottom in these areas consists primarily of silt or clay, with small amounts of shell fragments, leaves from terrestrial plants, and sand (Fig 7). No seagrass or *A. amadelpha* were observed in any of the net samples from the four sampled dredge areas inside Hawaiʻi Kai Marina,.

Marina Entrance Channel — The bottom of the entrance channel consists of shifting sand and silt. Hard surfaces, such as areas where the channel bisects the reef flat and concrete piles of the bridge, are colonized by a variety of flora and fauna, primarily introduced fouling organisms. On the pilings, *Carijoa riisei* (snowflake coral), *Gracilaria salicornia* (gorilla *ogo*), and *Amathia distans* (bushy bryozoan) were observed. *A. amadelpha* was not observed. A small bed of seagrass, *Halophlia hawaiiana*, extends laterally from under the bridge, on the eastern side of the channel towards the banks inside the marina to form a small meadow (Fig. 8). The green area in this figure depicts the approximate location and size of the seagrass bed as observed in the July survey.

Conclusions

The introduced alga, *A. amadelpha*, was not observed in any of the proposed dredge areas. The one area within the marina where *A. amadelpha* was observed—at the marina outlet channel—is not proposed for dredging. Therefore, proposed marina dredging operations and disposal of dredged spoils offshore will pose no risk of spreading this invasive alga. Best Management Practices (as recommended by USFWS; USFWS, 2011) can minimize the chance of additional introductions and reduce the chance of contributing to existing populations of invasive species. The dredge barge should be inspected by a trained biologist prior to entering the marina for dredging operations. If invasive species are found, the barge hull should be cleaned to minimize introductions.

Figure 7. Net sample of bottom mud (typical) from four proposed dredge areas inside Hawaiʻi Kai Marina comprised primarily of silt.

Dredging is proposed for the marina entrance channel, which supports a small bed of the seagrass, *H. hawaiiana*. If impacts from dredging cannot be avoided or satisfactorily minimized, compensatory mitigation might be required for the permanent or interim loss of seagrass habitat (USFWS, 2011).

References

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Figure 8. Area of seagrass bed in Hawaiʻi Kai Marina entrance channel.

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