Hawaii National Marine Renewable Energy Center (HINMREC)

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Task 1: Management

Biological Evaluation Effects of Bathymetric Surveys Required for Wave Energy Conversion Testing Facilities Planned for Kaneohe Bay and Pauwela (Maui)

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Biological Evaluation (BE) Effects of Bathymetric Surveys Required for Wave Energy Conversion (WEC) Testing Facilities Planned for Kaneohe Bay and Pauwela (Maui)

Summary

This document considers the Biological Evaluation of the effects due to the performance of High-Resolution-Multibeam-Surveys. These are required to provide detailed bathymetry as input to the process of site selection, mooring design and submarine power cable route design for wave energy conversion devices. In addition, the survey information is required as input to the environmental impact studies that would be required for EAs and/or EISs.

The bathymetric surveys would be performed in nearshore marine waters off Pa'uwela (north-central) Maui and just outside Kaneohe Bay, Oahu. The two sites are defined by the following coordinates (see maps in pages 6 and 7 for location):

Maui Site

Site Latitude & Longitude Bounding Coordinates (four corners of trapezoidal area):

20.9543N, 156.3286W;
20.9633N, 156.3284W;
20.9541N, 156.3142W;
20.9631N, 156.3140W.

Oahu Site

Site Latitude & Longitude Bounding Coordinates: (four corners of trapezoidal area):

21.486510N, 157.756461W;
21.465940N, 157.755736W;
21.464322N, 157.740620W;
21.486654N, 157.736188W.

Based on the location of these two survey areas, we believe that green and hawksbill sea turtles, Hawaiian monk seals, and humpback whales are the ESA-listed species likely to be present in the action area (List provided in Annex 2).

The sonar equipment to be used for the surveys will operate at sound levels beyond the hearing range of these species and should not have any influence in their behavior. Dolphins hear to a maximum of about 120 kHz and a few specialist species like harbor porpoises might hear to 180 kHz. At higher frequencies there is no ESA-listed species

known that could hear the sound. The Multibeam Surveys will be conducted at a frequency of 455 kHz.

The RV Huki Pono, would be used to conduct the surveys. Home ported in Honolulu Harbor the vessel would transit to each of the two sites, where she would remain for the duration of the survey work, before returning to port. The surveys will be conducted during two separate cruises. To map the sea floor, the survey crew would employ a pole-mounted (affixed to the hull) high resolution multi beam sonar (Annex 3) operating at 455 kHz (220 dB re 1 uPa at 1 m). The vessel would operate at no more than 7 knots while conduction the survey work. Additionally, during all vessel operations, including the transits to and from the survey areas, the vessel crew and the survey team will adhere to the NMFS-recommended BMPs (Annex 1) to avoid or reduce impacts on protected marine species and their habitats, particularly as they pertain to protected species awareness and avoidance. In addition, if whales are sighted the Guidelines summarized in Annex 2 will be adhered to.

Based on the information described herein we believe that this project "may affect but is not likely to adversely affect" green and hawksbill sea turtles, Hawaiian monk seals, and humpback whales that may be encountered.

Schedule

Mobilization, transit to site, actual survey and demobilization will require seven working days for the Kaneohe site and ten working days for the Maui site. The actual surveys would be conducted over two days in situ. It is expected that appropriate weather windows would be found in the April to September period. Ideally, both surveys should be performed during May 2011.

High Resolution Multibeam Survey

The high resolution multibeam survey will provide an accurate map of water depths and the condition of the seafloor. A high-resolution multibeam survey requires the following components: stable survey vessel; multibeam sonar; a navigation system; a motion reference unit; sound velocity measurements; and navigation and processing software.

Survey Vessel

The survey vessel planned for the project is the R.V. Huki Pono. A 43-ft fiberglass boat constructed in 1985 by Delta Marine, Inc., the vessel is owned and operated by SEI, and is USCG certified for 30 passengers and two crew with berthing space for six persons. It is powered by twin 320-hp Caterpillar diesel engines, with a cruising range of 300 nautical miles.

Multibeam Sonar

The multibeam system will be used in two ways:

1. Range measurements from the multibeam will provide accurate bathymetry of the project site.
2. Measurement of the backscatter intensity will provide an acoustic image of seafloor composition, with hard objects such as rocks and reef causing more intense backscatter, and soft materials such as sand causing less intense reflections.

The system proposed for use for this work is the high resolution Reson SeaBat 8125 (Annex 3), which emits 240 beams over a 120° swath width at an operating frequency of 455 kHz. The power output of a Reson 8125 multibeam system is 220dB referenced to 1 MicroPascal at 1m range. This high frequency system utilizes a 0.5° across-track beam width and a 1.0° along track beam width resulting in up to 6mm depth resolution and 2.5cm near-field resolution. The beam footprint at a water depth of 100 feet is approximately 1x2 ft. This provides an indication of the minimum size feature the system is able to resolve. Vessel motion and other small system errors may slightly degrade this further.

The sonar system will be pole mounted in a vertical configuration, with the center beam oriented straight down. The pole-mounted system will be secured to the ship's hull to prevent any independent motions that could affect data quality.

Navigation: RTK GPS

Precise positioning of the vessel and sonar head is essential for completion of an accurate survey. Real-Time Kinematics (RTK) GPS is presently the most accurate method of precise location in real-time. RTK is a process in which GPS signal corrections are transmitted in real time from a reference receiver at a known location to one or more remote rover receivers. The RTK system proposed for use is a Leica 1200 (or equivalent). The system requires a base station set up on a surveyed benchmark with known horizontal coordinates referenced to the local datum and known vertical elevation tied into the local geoid. In addition to the base station, a rover unit is situated on the vessel to measure the offset from the base station and to provide real-time position information to the data acquisition systems.

RTK GPS also provides an accurate means of measurement in both horizontal and vertical directions. Bathymetric measurements can be corrected to the chosen vertical datum using vertical information provided by the system. This capability may be used for tide corrections.

Motion Reference Unit

The motion reference unit improves data quality by supplying the data acquisition system with heave, roll and pitch information, as well as heading and position in real time. This project will utilize the Coda-Octopus F180 or the Applanix POS MV (or equivalent).

Sound Velocity Measurements

The velocity of sound is a critical component for hydrographic survey measurement. Sound velocity changes with water temperature and salinity variations. To accurately measure the velocity of sound in the project area during the multibeam survey, an Odom Digibar Pro sound velocity probe will be deployed just prior to and immediately following the survey to correct for local conditions. The velocity probe returns a profile of the sound velocity changes with depth in the water column. It is particularly useful for recording the presence of a thermocline. Velocity probes will be completed before and after the survey, and at both inshore and offshore locations.

Data Acquisition and Processing

Data acquisition and processing systems include the following:
Hypack/Hysweep - Navigation data and multibeam data acquisition and processing
Trimble Terramodel - elevation data contouring and modeling
AutoCad - Computer aided design (CAD) for data mapping and plotting

Quality Control

Standard hydrographic survey methodology will be employed during the multibeam survey, as outlined in the U.S. Army Corps of Engineers EM 1110-2-1003, dated January 1, 2002, augmented by the April 2004 update to Chapter 11 – Multibeam Surveys for "Navigation and Dredging Support Surveys over Hard Bottom," and related standards as described in Chapter 3-15l. Control procedures include:

- survey documentation
- patch test
- vertical position check
- horizontal position check

The patch test procedure is a standard operational test to determine the installation configuration of the multibeam transducer head. The procedure consists of collecting data over short line segments at various speeds, offsets, and directions. Comparison of the data within the processing software allows calculation of the following parameters:

- system latency – the processing lag in the GPS navigation device
- multibeam pitch – the fore and aft angle of the multibeam head
- multibeam roll - the port and starboard angle of the multibeam head
- multibeam yaw- the angle of the multibeam with respect to boat heading.

Products

The multibeam data can be processed to yield high resolution depth measurements, and also backscatter intensity images. Charts will be produced showing: depth contours; color coded depth perspective charts; backscatter intensity imagery; and 3-D perspectives. Notable features will be labeled on the charts.

Side Scan Sonar Survey

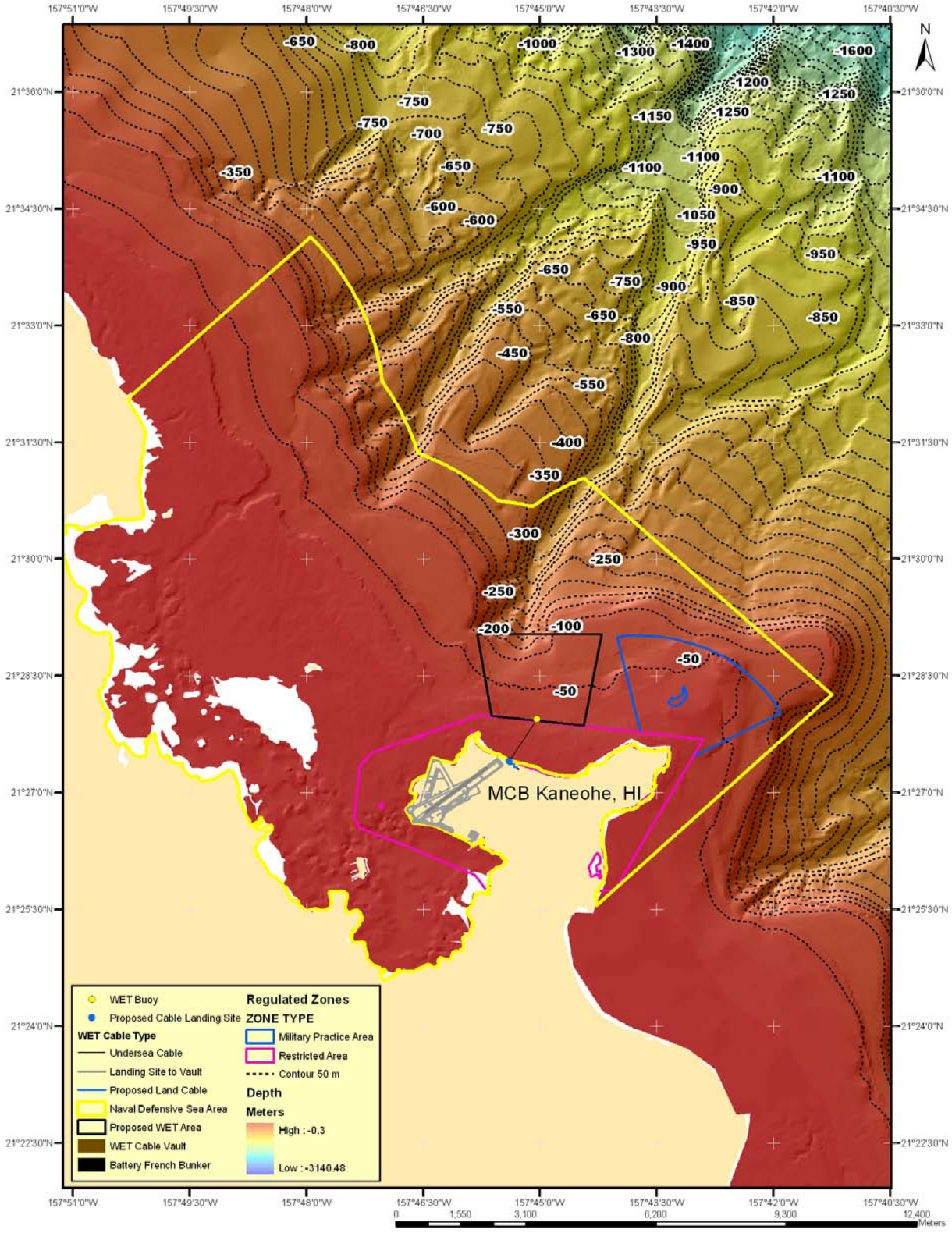
A side scan sonar transmits acoustic signals with wide vertical beam widths out to either side of a sonar towfish being towed near the seafloor behind the boat. A receiver then records the signals that are reflected back from the seafloor to the towfish. Hard bottom areas and features produce more intense reflections than sediments. The result is a plan view acoustic image of seafloor characteristics. The side scan imagery also allows identification of objects with high relief. This is similar to the backscatter imagery produced from the multibeam system described above.

The advantage of a side scan system is that the system is towed through the water behind the vessel, close to the seafloor. The sonar towfish is therefore much closer and a much lower angle of relief, thereby providing enhanced reflectivity and resolution of features on the seafloor. A side scan sonar is relatively inexpensive to deploy and operate.

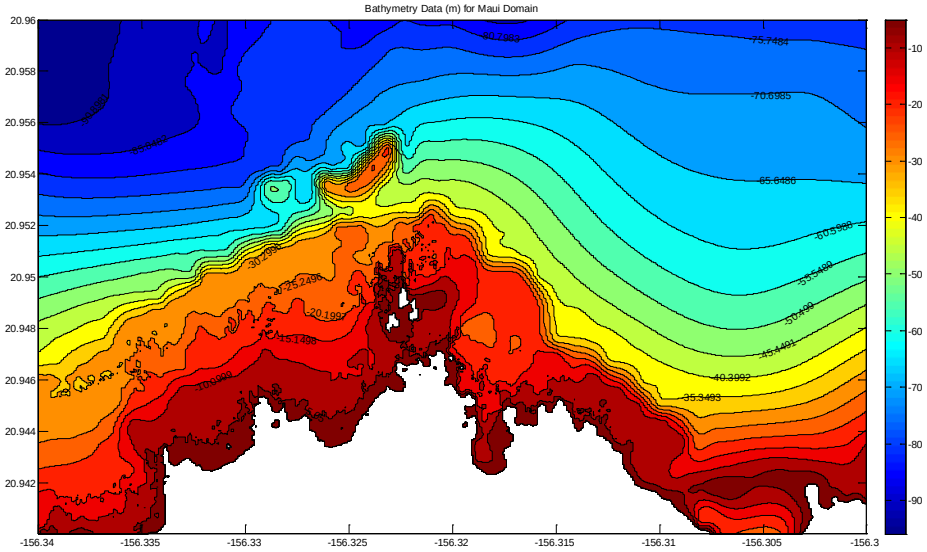
Methods

The side scan survey will require a suitable vessel, a navigation system, and the side scan unit. The Huki Pono vessel, described above, would be used for this survey. A C-MAX CM2 Side Scan Sonar system (or equivalent) will be utilized. The power output of the CMAX CM2 side scan sonar is 217dB referenced to 1 MicroPascal at 1m range. The CM2 system contains dual 325 and 780 kHz transducers. The 325 kHz transducer provides greater swath of imagery, while the 780 kHz transducer provides greater resolution. Because of the inaccuracies of towing a system behind the vessel, the positioning requirements for a side scan survey are not as stringent as for a multibeam survey. We propose to use a standard Leica or Trimble U.S. Coast Guard differential GPS system for positioning. Hypack software will be used to navigate and acquire the data.

Side scan data is processed using C-Max Maxview software and post processed into a GeoTiff mosaic imagery using SonarWiz software. The data lines with the best overall imagery will be selected for inclusion into the sonar mosaic.



Kaneohe Bay (Oahu) Survey Location



Bathymetry off Pa'uwela, Maui:
Depth in meters supplied by HINMREC to OCEANLINX/MECO from
LIDAR Data to be confirmed with Side Scan Sonar Survey

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Pa'uwela (Maui) Survey Location

ESA Effects Summary

Based on the work expected to be done, the most likely potential stressors and impacts to marine listed species are: 1) Exposure to high intensity noise from benthic survey sonar equipment 2) Disturbance from human activity and equipment operation; 3) Collision with vessels; and 4) Exposure to wastes and discharges.

1) Exposure to high intensity noise from benthic survey sonar equipment: The most high-frequency sensitive marine mammals are believed to hear up to about 180 kHz (Southall et. al. 2007), and sea turtles hearing is believed to be far below that (Ridgway et. al. 1969, Bartol et. al. 1999). Because the sonars to be used for this benthic survey operate at or above 300 kHz, they are expected to be inaudible to sea turtles and marine mammals. Consequently exposure to those sonars is expected to have no effect on sea turtles and marine mammals.

2) Disturbance from human activity and vessel operation: Marine mammals and sea turtles may avoid or flee from the survey vessel should they encounter it. However, due to the high level vessel activity that regularly occurs in and near the survey area, these animals are accustomed to the presence of vessel traffic. Consequently, the most likely reaction to an interaction would be an avoidance behavior leading to the animal temporarily departing the immediate area without injury. Additionally, the vessel operators will carefully watch for and avoid protected marine species, and alter course and speed

according to the NMFS PRD-recommended BMPs described in the proposed action. Based on this information, we have determined that disturbances from human activity and vessel operation will be infrequent and non-injurious, resulting in insignificant effects on sea turtles and marine mammals.

3) Collision with the vessel: Sea turtles and marine mammals are at risk of being struck by the survey vessels or their propellers while those animals are at or near the ocean surface. However, the vessel operators will carefully watch for and avoid protected species, and will alter course and speed according to the NMFS PRD-recommended BMPs (Annex 1). Based on the low number of vessel trips expected and on the expectation that the vessels will be operated in accordance with the BMPs we consider the risk of collisions between the survey vessels and sea turtles and marine mammals to be discountable.

4) Exposure to vessel wastes and discharges: Vessel operation could result in the discharge into the marine environment of wastes or spills of equipment-related fuel oils, gasoline, lubricants, and hydraulic fluids. These discharges could expose protected species to choking and entanglement risks or to toxic chemicals. However, local and federal regulations prohibit the intentional discharge of toxic wastes and plastics into the marine environment. Additionally, the vessel operators will comply with the NMFS PRD-recommended BMPs that include measures intended to prevent the introduction of wastes and toxicants into the marine environment. Based on this information, we expect that discharges and spills are unlikely to occur, but will be infrequent, small, and quickly cleaned if they do occur. Therefore, we have determined that exposure to wastes and discharges that may result from this action will result in insignificant effects on protected marine species.

Based on the information above we believe that this project "may affect but is not likely to adversely affect" green and hawksbill sea turtles, Hawaiian monk seals, and humpback whales that may be encountered.

References

Bartol, S.M., J.A. Musick, and M.L. Lenhardt. 1999. Auditory Evoked Potentials of the Loggerhead Sea Turtle (*Caretta caretta*). *Copeia*, Vol. No. 3. August 2, 1999. pp. 836-840.

Ridgway, S. H., Wever, E. G., McCormick, J. G., Palin, J., & Anderson, J. H. 1969. Hearing in the Giant Sea Turtle, *Chelonia mydas*. PNAS, 64, 884-890.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, & P.L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, 2007, 33(4), 411-521.

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Annex 1

Best Management Practices (BMPs) for General In-Water Work Including Boat and Diver Operations

January 5, 2011

NMFS Protected Resources Division recommends implementation of the following BMPs to reduce potential adverse affects on protected marine species. These BMPs are in no way intended to supersede or replace measures required by any other agency including, but not limited to the ACOE, USFWS, USEPA, or NMFS Habitat Conservation Division. Compliance with these BMPs is secondary to safety concerns.

A. Constant vigilance shall be kept for the presence of ESA-listed marine species during all aspects of the proposed action, particularly in-water activities such as boat operations, diving, and deployment of anchors and mooring lines.

1. The project manager shall designate an appropriate number of competent observers to survey the marine areas adjacent to the proposed action for ESA-listed marine species.
2. Surveys shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour. Periodic additional surveys throughout the work day are strongly recommended.
3. All in-water work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; divers performing surveys or underwater work would likely be permissible, whereas operation of heavy equipment is likely not.
4. When piloting vessels, 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.
5. Reduce vessel speed to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.
6. If despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.

7. Marine mammals and sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore.
8. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine species.

B. No contamination of the marine environment should result from project-related activities.

9. A contingency plan to control toxic materials is required.
10. Appropriate materials to contain and clean potential spills will be stored at the work site, and be readily available.
11. All project-related materials and equipment placed in the water will be free of pollutants. The project manager and heavy equipment operators will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
12. Fueling of land-based vehicles and equipment should take place at least 50 feet away from the water, preferably over an impervious surface. Fueling of vessels should be done at approved fueling facilities.
13. Turbidity and siltation from project-related work should be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions.
14. A plan will be developed to prevent debris and other wastes from entering or remaining in the marine environment during the project.

<u>Species Listed under Endangered Species Act (ESA) that may be encountered in Hawaiian Waters</u>

- HAWAIIAN MONK SEAL (*Monachus schauinslandi)*
- LOGGERHEAD TURTLE (*Caretta caretta)*
- LEATHERBACK TURTLE (*Dermochelys coriacea)*
- HAWKSBILL TURTLE (*Eretmochelys imbricata)*
- GREEN TURTLE (*Chelonia mydas)*
- OLIVE RIDLEY TURTLE (*Lepidochelys olivacea)*
- HUMPBACK WHALE (*Megaptera novaeangliae)*
- SPERM WHALE (*Physeter macrocephalus)*
- FIN WHALE (*Balaenoptera physalus)*
- BLUE WHALE *(Balaenoptera musculus)*
- SEI WHALE (*Balaenoptera borealis)*
- N. PACIFIC RIGHT WHALE (*Eubalaena japonica)*

Annex 2
Operational Guidelines when in Sight of Whales

WHEN IN SIGHT OF WHALES:

2 miles to 1 mile away:

• Reduce speed to 13 knots.
• Post a dedicated lookout to assist the vessel operator in monitoring the location of all marine mammals.
• Avoid sudden changes in speed and direction.

1 mile to ½ mile away:

• Reduce speed to 10 knots.

½ mile or less:

• Reduce speed to 7 knots.
• Maneuver to avoid head-on approach.

CLOSE APPROACH PROCEDURE:

600 feet or closer:

• Parallel the course and speed of moving whales up to the designated speed limit within that distance.
• Do not attempt a head-on approach to whales.
• Approach and leave stationary whales at no more than idle or "no wake" speed, **not to exceed 7 knots**.
• Do not intentionally drift down on whales.

STAND-BY ZONE

300 feet to 600 feet away:

• Two vessel limit within the 300- to 600-foot Stand-By Zone at any one time.

CLOSE APPROACH ZONE

100 feet to 300 feet away:

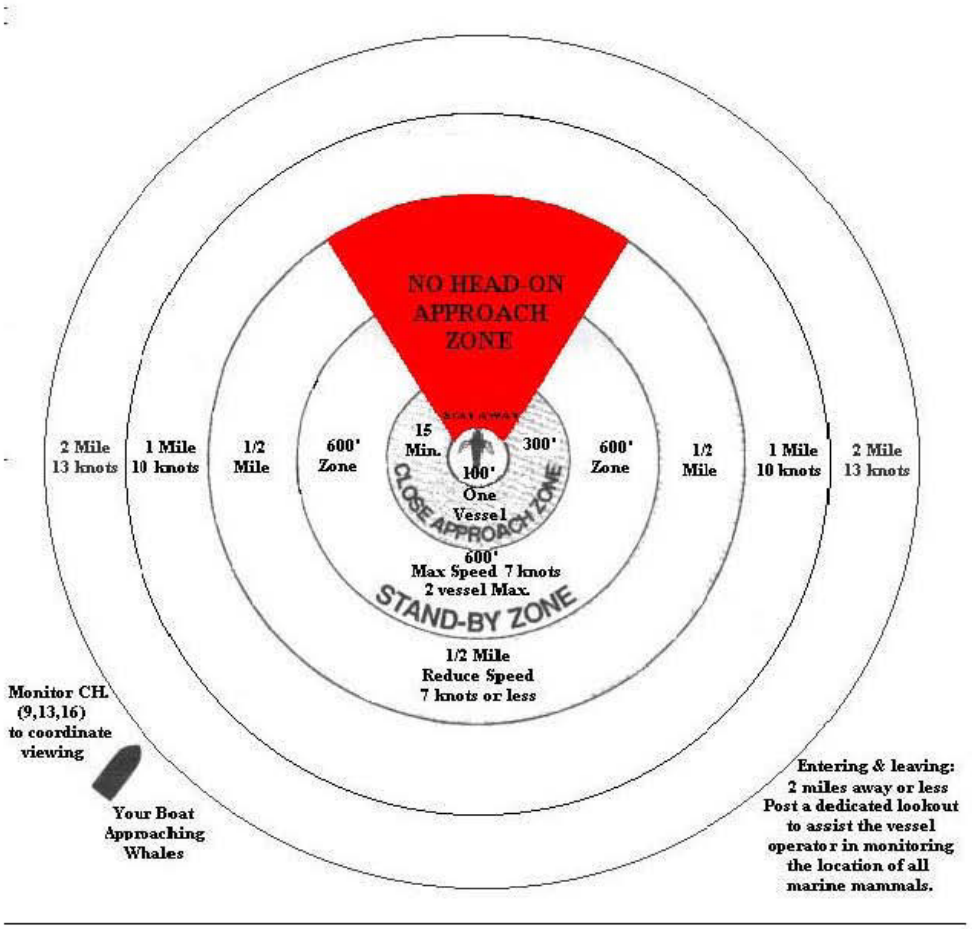
• One vessel limit.

NO INTENTIONAL APPROACH WITHIN 100 FEET.

• Do not approach within 100 feet of whales. If whales approach within 100 feet of your vessel, put engines in neutral and do not re-engage propulsion until whales are observed clear of harm's way from your vessel.

DEPARTURE PROCEDURE

• All vessels should leave the whales following the same speed and distance procedures described above.
• In order for vessels to be clear of whales before dark, vessels should cease operations and begin their return to port 15 minutes before sunset.


NO HEAD-ON APPROACH ZONE
2 Mile 13 knots
1 Mile 10 knots
1/2 Mile
600' Zone
15 Min.
300'
600' Zone
1/2 Mile
1 Mile 10 knots
2 Mile 13 knots
100'
One Vessel
CLOSE APPROACH ZONE
600'
Max Speed 7 knots
2 vessel Max.
STAND-BY ZONE
1/2 Mile
Reduce Speed
7 knots or less
Monitor CH. (9,13,16) to coordinate viewing
Your Boat Approaching Whales
Entering & leaving: 2 miles away or less Post a dedicated lookout to assist the vessel operator in monitoring the location of all marine mammals.

Annex 3
Specifications: Reson SeaBat 8125 Sonar

RESON

SeaBat 8125
ULTRA HIGH RESOLUTION FOCUSED
MULTIBEAM ECHOSOUNDER SYSTEM

SeaBat 8125

- Focused 0.5° beams
- 240 beams
- 2.5cm near field resolution
- 6mm depth resolution
- 120° swath

The SeaBat 8125 is the first wide-sector, wide-band, focused multibeam sonar ever to be deployed. Utilizing 240 dynamically focused receive beams, the system measures a 120° swath across the seafloor, detects the bottom, and delivers the measured ranges at a depth resolution of 6mm. The backscatter intensity image is displayed in real time on the sonar display.

The 8125 can be controlled through its native graphical user interface, or through an external control data collection and navigation software package.

The system can be mounted on a survey vessel or deployed on an ROV at depths down to 1500m. The high-speed data uplink is carried on a standard SeaBat copper cable for surface installation. A fiber-optical interface is available for ROV deployment.

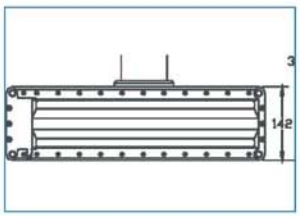
SeaBat 8125

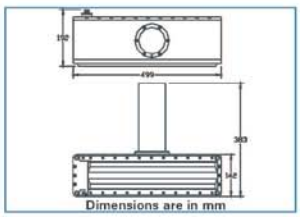
ULTRA HIGH RESOLUTION FOCUSED MULTIBEAM ECHOSOUNDER SYSTEM

SYSTEM PERFORMANCE	
Frequency:	455kHz
Depth Resolution:	6mm
Swath Coverage:	120°
Max Range:	120m
Number of Beams:	240
Along-Track Beamwidth:	1°
Across-Track Beamwidth:	0.5° (at nadir)
Operational Speed:	Up to 12 knots
Max. Update Rate:	40
Transducer Depth Rating:	400m (Standard) 1500m (Optional)

INTERFACE		
System Supply:	115V/230V 50/60Hz, 350W max	
Video Display:	SVGA, 800 x 600, 72Hz	
System Control:	Trackball	
Data Output:	10MB Ethernet or serial RS232C	
Data Uplink:	High-speed digital coax with fiber-optic option	
Sonar Head Supply:	24VDC, 5.6A Peak, 2A Average (May be supplied from sonar processor)	
Temperature:	Operating: Storage:	0° to +40°C -30° to +55°C

MECHANICAL INTERFACE		
Power Requirements:	24VDC, 5.6A Peak, 2A Average (May be supplied from sonar processor)	
Operating Depth:	400m/1500m	
Dimensions:	266 x 320mm (W / D) excluding projector	
Temperature:	Operating: Storage	-5° to +40°C -30° to +55°C
Weight (aluminum):	Dry: Wet:	26.8kg (59lbs.) 4.8kg (10.6lbs.)
Weight (titanium):	Dry: Wet:	40kg (88lbs.) 18kg (39.6lbs.)





Dimensions are in mm

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