STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
STATE PARKS
WATER RESOURCE MANAGEMENT

MAY - 1 1998

Ref.:PB:THE File: CDUA OA-2866

Mark Ericksen
Sea Engineering, Inc.
Makai Research Pier, Suite 8
Waimanalo, Hawaii 96795-1820

Dear Mr. Ericksen,

SUBJECT: Final Environmental Impact Statement for Voyager Submarines Hawaii Artificial Reef Installation

I am pleased to accept the Final Environmental Impact Statement (EIS) for the Voyager Submarines Hawaii Artificial Reef Installation project as satisfactory fulfillment of the requirement of Chapter 343, Hawaii Revised Statutes. This EIS will be a useful tool in the process of deciding if the action described therein should be allowed to proceed. My acceptance of the EIS is an affirmation of the adequacy of this EIS under the applicable laws and does not constitute an endorsement of the propopsed action.

When the decision is made regarding the proposed action itself, I expect the appropriate legislative bodies and governmental agencies to consider if the societal benefits justify the economic, social, and environmental impacts that will likely occur. These impacts are adequately described in the statement, and together with the comments made by reviewers, provide a useful analysis of the proposed action.

Sincerely,

for Michael D. Wilson, Chairperson
Board of Land and Natural Resources

cc: Voyager Submarines Hawaii
OEQC
At-large Board member

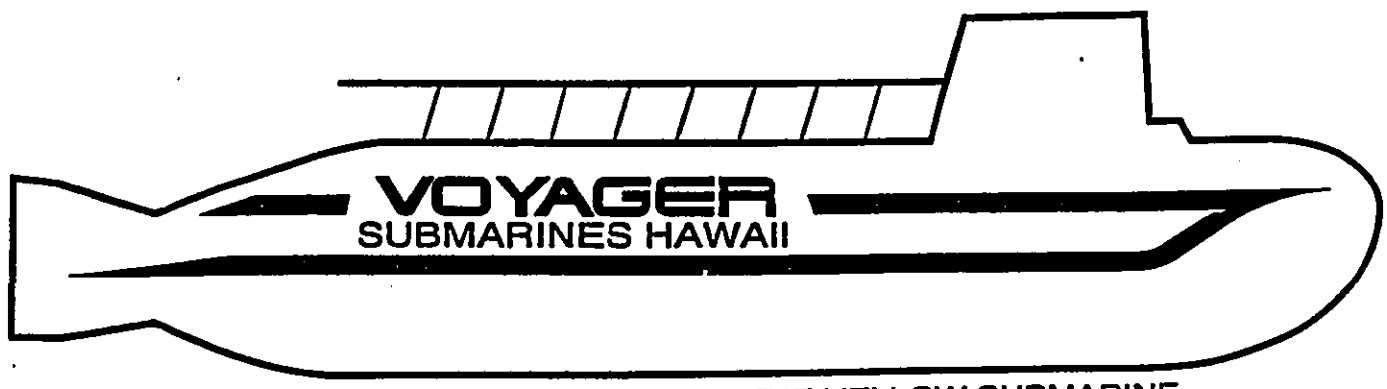
1998 - Oahu - FEIS -

Voyager Submarines

FILE COPY

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOYAGER SUBMARINES HAWAII
ARTIFICIAL REEF INSTALLATION



OFFICIAL SUBMARINER OF THE YELLOW SUBMARINE

Prepared for:

Voyager Submarines Hawaii
680 Iwilei Road, Suite 720
Honolulu, Hawai'i 96817

Prepared by:

Sea Engineering, Inc.
Makai Research Pier
Waimānalo, Hawai'i 96795

April 1998

FINAL ENVIRONMENTAL IMPACT STATEMENT

VOYAGER SUBMARINES HAWAII
ARTIFICIAL REEF INSTALLATION

Edward E. Boot

Mr. Edward E. Boot, Senior Vice President

4/21/98

Date

Voyager Submarines Hawaii
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Prepared By:

Sea Engineering, Inc.
Makai Research Pier
41-202 Kalaniana'ole Highway
Waimānalo, Hawai'i 96795

April 1998

#97-08

This document addresses document content requirements as set forth in Section 11-200-18, Hawaii Administrative Rule, pursuant to Chapter 343, Hawaii Revised Statutes.

SUMMARY SHEET

Project Description: Voyager Submarines Hawaii Artificial Reef Installation
Install two artificial reefs (sunken ships) approximately 3/4 of a mile offshore of Ala Moana Beach Park (TMK offshore of 2-3-37) in water depths of 90 to 100 feet to enhance the habitat and promote fish and coral growth.

Install six submerged buoys to facilitate site access and prevent anchor damage to the marine environment.

Applicant: Voyager Submarines Hawaii, 680 Iwilei Road, Suite 720, Honolulu, Hawai'i 96817

Agent: Sea Engineering, Inc., Makai Research Pier, Waimānalo, Hawai'i 96795

Accepting Authority: State of Hawai'i, Department of Land and Natural Resources

Significant Beneficial and Adverse Impacts: Significant beneficial impacts include habitat enhancement to promote coral and fish growth, and use of mooring buoys to prevent anchor damage to coral, and increased public access and recreational opportunities. Adverse impacts should be minimal, and may include a small loss of sand habitat, and temporary disruption of boating traffic during vessel deployment. Possible adverse impacts include conflicts between Voyager and other site users, unforseen introduction of pollutants into the water during deployment, damage to the sea floor during deployment, vessel movement during storms, and increasing the susceptibility of fish to being caught.

Proposed Mitigation Measures: Proposed mitigation measures include thorough vessel cleaning, preparation and inspection prior to deployment; careful site selection in barren sandy substrate at least 100 feet away from sensitive coral areas; tightly controlled vessel sinking in the designated location; use of concrete to ballast the ships; use of conservative design waves in the anchoring analysis that will prevent movement of the ships even during severe storms and hurricanes; six mooring buoys at the site, two of which will be dedicated for public use; and a multi-year biological monitoring program to evaluate impacts.

Alternatives Considered: Alternatives considered included use of the Atlantis reef site, deploying the vessels at alternative sites, use of alternative reef structures, and maintaining operations as they currently are.

Unresolved Issues: An unresolved issue is whether artificial reefs locally enhance production, or simply aggregate resources already present in the area and increase their susceptibility to being caught and depleted.

The project also involves the use of submerged lands which are designated as ceded lands. Ceded lands are held in trust by the State, and the appropriate use of ceded lands remains an unresolved issue.

Compatibility with Land Use Plans and Policies, and a Listing of Permits: This project involves the use of submerged lands classified in the resource subzone, and will require a board permit. The objective of the resource subzone is "to develop, with proper management, areas to ensure sustained use of the natural resources of those areas" (Hawaii Administrative Rules, 13-5-13). The proposed project includes identified land uses permitted in the resource subzone (R): R-2, artificial reefs D1; and R-6, marine construction (installation of mooring buoys anchors/anchor pins, D1 (HAR, 13-5-24). A board permit is required for this use. *Voyager's understanding is that land disposition will be by a direct non-exclusive easement to Voyager, and that, prior to the issuance of the easement, Voyager will be required to obtain Legislative approval by concurrent resolution and Governor approval.* The project is also consistent with main aspects of the State's Environmental Policy (Hawaii Revised Statutes 344-3), and State and National artificial reef programs. The project permits and status are outlined below.

- Department of Land and Natural Resources, Conservation District Use (CDUA) - The CDUA was accepted for processing on August 5, 1997.
- Department of the Army, Section 10 and Section 404 - The DA PROVISIONAL PERMIT was issued on September 24, 1997. Following receipt of the signed permit documents from Voyager Submarines, the Corps is prepared to issue a valid DA permit authorizing the reef installation to proceed. The DA permit correspondence is included in Sections 14 and 15.
- Department of Health, Section 401 Water Quality Certification - The Section 401 WQC was issued on October 13, 1997.
- Office of Planning, Coastal Zone Management Program Certification of Consistency - On August 25, 1997 the project was determined to be consistent with Hawaii's CZM program (see Section 15 for correspondence), on the conditions that the project features outlined in the Environmental Assessment and this Environmental Impact Statement are implemented.

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Note: *All changes to this document resulting from comments to the Draft Environmental Impact Statement are printed in italics.*

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1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

Voyager Submarines Hawaii commenced operations in November 1994 to provide passenger submarine tours of Hawaii's marine aquatic and reef ecosystems. The company currently operates two 48-passenger submarines out of Kewalo Basin, offering submarine tours at a site located approximately 3/4 mile offshore of Ala Moana Beach Park, in water depths of 60 to 110 feet (Figures 1.1 and 1.2). The 45 minute tour follows the edge of a limestone shelf with a 5 to 10 foot ledge at the seaward margin. There is little live coral growth on the limestone platform; seaward of this is barren sand. Because of the depleted fishery and limited live coral in the sand bottom area, Voyager proposes to sink two vessels on the site to serve as artificial reefs to enhance the habitat and promote coral and fish growth. The vessels will be cleaned and prepared according to State and Federal regulations, will be placed in the barren, sandy areas at locations approved by the reviewing agencies, and will be ballasted with concrete to prevent movement during extreme storm conditions. The deployment procedure will be carefully designed to ensure that the ships settle in the selected location. In addition, Voyager proposes to install six submerged mooring buoys at the site; one on each sunken ship, and four others in the immediate vicinity of the ships. The two buoys on the ships will be dedicated for public access by other site users. Two other buoys will be used to moor the Voyager support vessels. The remaining two will be shared by Voyager and other site users. Day-use surface mooring buoys will be attached to the submerged buoy daily by the Voyager personnel. The surface buoys will alert divers and fishermen to the position of the ships, and will provide them with an easy and safe alternative to anchoring, which is destructive to coral reefs, and also might endanger divers and the submarines below. The addition of these features to the area should benefit the marine environment and commercial and recreational users. The addition of these features will not substantially change the current operating procedures.

Submerged lands in Hawai'i are deemed to be in the Conservation District, and are governed by the Department of Land and Natural Resources through the submittal of Conservation District Use Applications (CDUA), and issuance of board or departmental permits. This project involves the use of submerged lands classified in the resource subzone, and will require a board permit. The Department of Land and Natural Resources is therefore the approving agency.

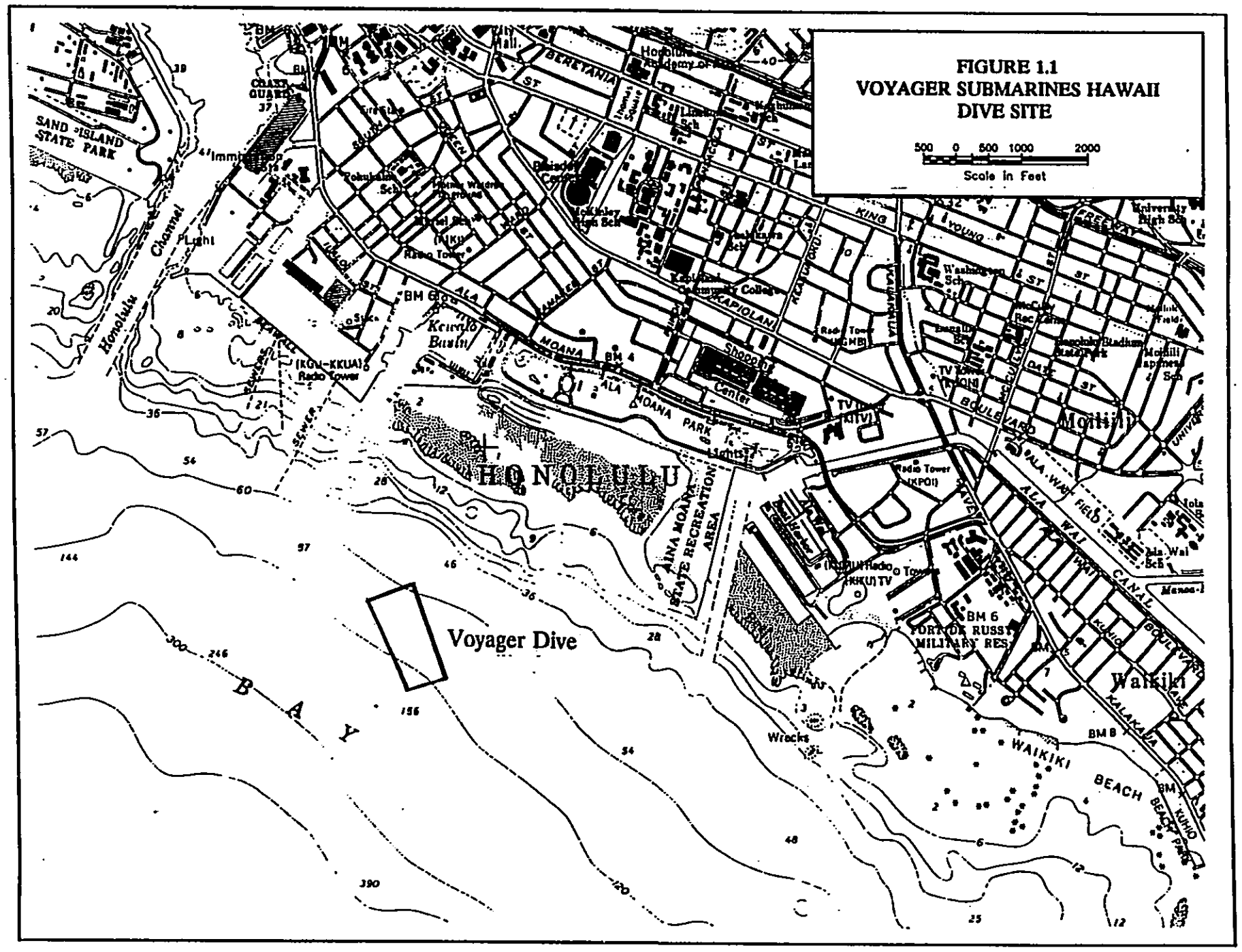


FIGURE 1.1
VOYAGER SUBMARINES HAWAII
DIVE SITE
500 0 500 1000 2000
Scale in Feet
HONOLULU
Voyager Dive
BAY
Waikiki
Moiliili
SAND ISLAND STATE PARK
Honolulu Channel
Light
Kewalo Basin
ALA MOANA
KAPIOLANI
KING
BERETANIA
ALA WAI CANAL
WAIKIKI BEACH
Wrecks
Fort DeRussy Military Res.
Ala Moana Shopping Center
Ala Moana State Recreation Area
(KGU-KKUA) Radio Tower
(KHVH) TV
(KPOI) Radio Tower
(KITV) TV
BM 6
BM 8

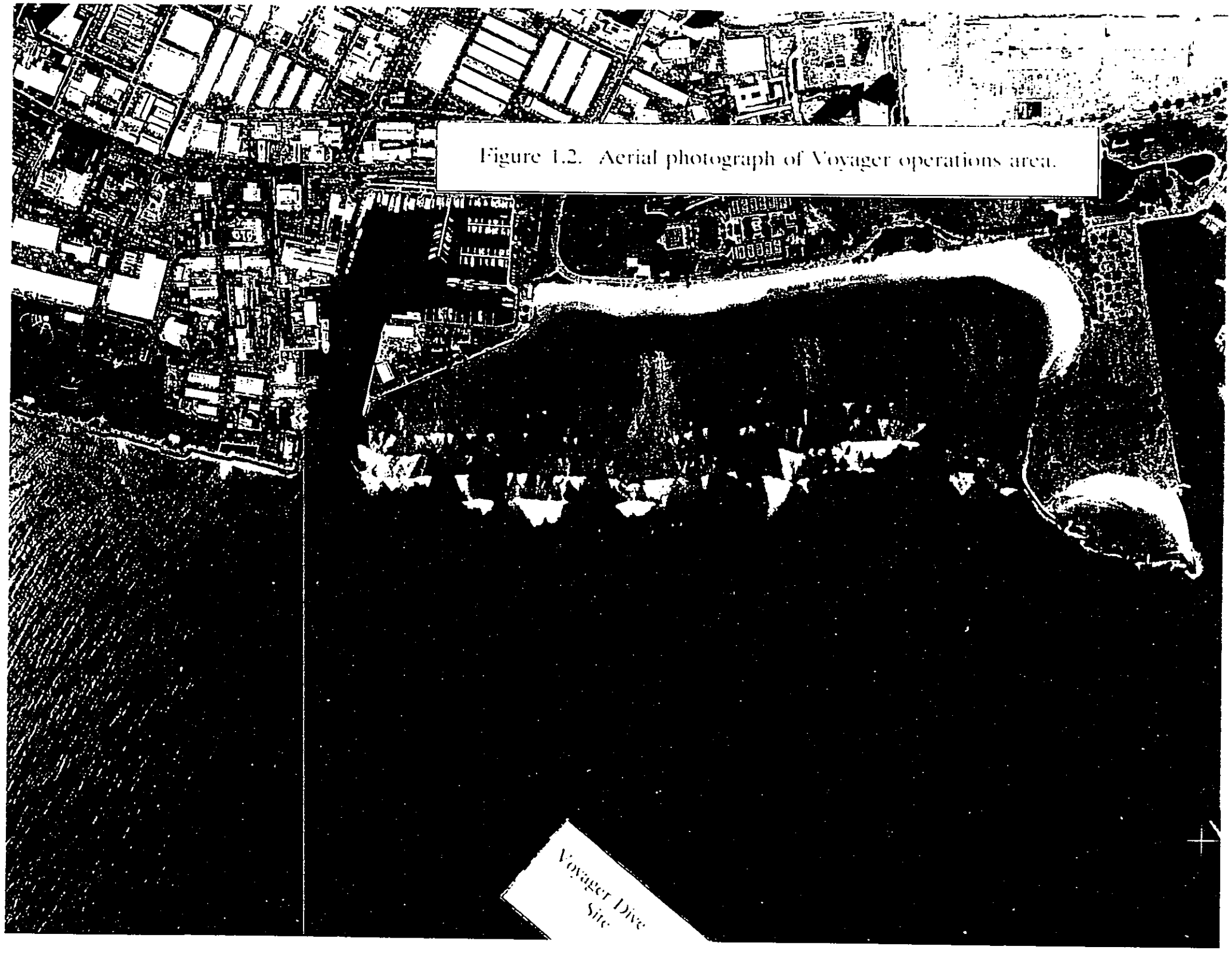


Figure 1.2. Aerial photograph of Voyager operations area.

The objective of the resource subzone is "to develop, with proper management, areas to ensure sustained use of the natural resources of those areas" (Hawaii Administrative Rules, 13-5-13). Land uses permitted in the resource subzone (R) include artificial reefs (HAR, 13-5-24, R-2) and marine construction (installation of mooring buoy anchors/anchor pins, R-6. A board permit is required for this use. *Voyager's understanding is that land disposition will be by a direct non-exclusive easement to Voyager, and that, prior to the issuance of the easement, Voyager will be required to obtain Legislative approval by concurrent resolution and Governor approval.*

Submerged lands are designated as ceded lands. Ceded lands are held in trust by the State, and the appropriated use of ceded lands remains an unresolved issue.

2.0 PROJECT DESCRIPTION

The objective of this project is to install two artificial reefs (sunken ships) at the Voyager dive site in water depths of approximately 90 to 100 feet to enhance the habitat and promote coral and fish growth, and to install six submerged buoys to facilitate site access and prevent anchor damage to corals. This section describes the proposed project, including: current Voyager operations, and the proposed artificial reef and submerged buoy installation and project schedule.

2.1 Current Voyager Operations

2.1.1 Daily Operations

Voyager currently operates two 48-passenger submarines out of Kewalo Basin, offering submarine tours at a site located approximately 3/4 mile offshore of Ala Moana Beach Park (Figures 1.1 and 1.2), in water depths of 60 to 110 feet. Daily operations begin at Pier 41 in Honolulu Harbor, where Voyager's two support vessels and two submarines are docked and maintained. The support vessels, named Lopaka and Ho'okele, are work/crew boats 38 feet and 40 feet in length, respectively. Equipped with twin diesel engines, they are designed to provide the power and maneuverability required to tow the submarines to and from the dive site as well as provide comfortable quarters for offshore crew members throughout the day. They are equipped with an underwater communications system, VHF radio, emergency dive gear and divers, position markers, life rafts and floats, and an emergency locating device. The support vessels can shadow the submarine during its dive to manage surface traffic. However, they typically anchor at the edge of the operating area, and a inflatable hard bottom skiff is used to divert surface traffic away from the surfacing area.

Each morning, after completion of the pre-operational vessel checks and daily briefings, the support vessels tow the submarines out to the dive site. Also in tow behind one of the submarines is a rubber inflatable equipped with twin outboard engines. This vessel is used to transport crew members to and from the submarine and support vessels throughout the day. During the tow, crew members are stationed on the decks of both the submarine and the tow vessel to act as lookouts, a pilot is at the control of the submarine, and a licensed captain operates the towing vessel. An offshore supervisor is charged with all daily operations, including all submarine and surface vessel activity during transiting and diving operations. A designated surface controller is responsible for the descent and ascent procedures during daily operations, and reports to the offshore supervisor.

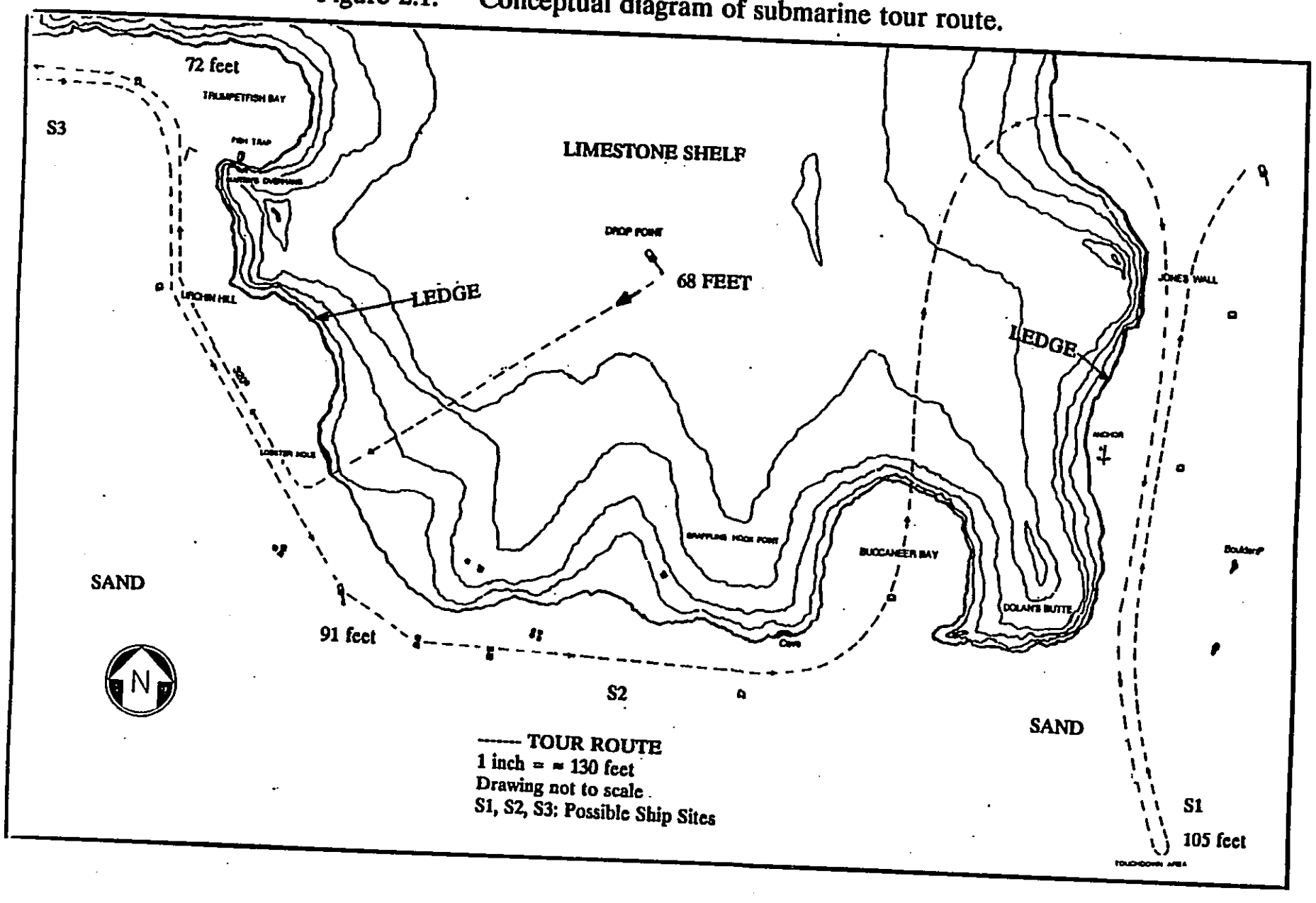
Upon arrival at the dive site, the tow lines are disconnected and the Lopaka and Ho'okele transit to their mooring locations approximately 50 yards inshore from the submarine submerged operating area, where they drop anchor on a sandy bottom in approximately 60 feet of water. They remain at their stations throughout the day. The Lopaka, serving as the main support vessel, is manned by Voyager personnel at all times. The submarine, once disconnected from the support vessel, is maneuvered to a holding area to await the arrival of the passenger transfer vessel.

Passengers are transported to the dive site from Kewalo Basin aboard the Voyager transfer vessel Palani. The Palani is a 72-foot wooden/fiberglass catamaran with a U.S. Coast Guard approved maximum capacity of 149 passengers and 6 crew members. The transfer vessel departs Kewalo for the dive site every hour, on the hour, between the hours 8 a.m. and 4 p.m., transferring passengers to the submarines. The Palani crew consists of a captain, deck hands, a deck supervisor, a narrator and a retail customer service representative. All personnel on-board the vessel are trained in basic line handling, customer service skills and basic first aid and CPR.

The captain of the Palani must receive clearance from the surface controller before entering the vicinity of the dive site. The Palani is designed to tie-up alongside the submarines. Modifications to facilitate this include hydraulic winches to control the spring lines and the bow line between the submarine and the Palani, and a custom built ramp design to safely transfer passengers to and from the vessels. After carefully approaching the submarine, the transfer vessel is tied up securely to the submarine to allow unloading of the passengers. Crew members and attendants man positions at both ends of the boarding ramp, and at the fore and aft hatches, to assist passengers and ensure safe onloading and offloading.

Typically, sixteen dives, of approximately 45 minutes duration each, are conducted daily between 7 a.m. and 4 p.m. The dive route is conceptually illustrated in Figure 2.1. It follows the edge of the limestone shelf and ledge. Water depths along the route vary from 68 to 105 feet. The dive is accompanied by live narration and a video presentation. During the dive, the submarine pilot must maintain regular radio communication with the surface controller, and must maintain a minimum distance of 15 feet from any object and 6 feet from the seafloor. The submarine's speed is typically 0.5 knots. Ballast is kept slightly positive, ensuring that the submarine will automatically float to the surface in the event of power loss. The pilot informs the surface controller when he is three minutes away from the designated surfacing area. Upon receiving clearance to surface, he maintains contact with the controller while surfacing. Upon surfacing, the passenger transfer vessel ties up to

Figure 2.1. Conceptual diagram of submarine tour route.



the submarine and passengers disembark from the submarine. At the end of the day's operations submarines are towed back to Pier 41. On routine days one submarine departs the dive site at 3:15 p.m. and the second submarine departs the dive site at 4:15 p.m. Upon docking at its slip at Pier 41, comprehensive post-operational checks and debriefings are conducted on all vessels.

2.1.2 Submarine Description

Voyager utilizes two SM 100/50 submarines to conduct 16 dive tours daily. Technical specifications of the submarine are presented in Table 2.1; a schematic diagram of the sub is presented in Figure 2.2. The submarines, purchased in 1994 from SEAPATH, are 73 feet long, weigh 98 tons and are capable of carrying 48 passengers and 3 crew. The submarines have been designed to meet the requirements of the American Bureau of Shipping (ABS), Rules for Building and Classing Underwater Vehicles, as well as criteria established by the United States Coast Guard. Although the design depth of the submarines has been rated at 328 feet by the ABS, Coast Guard regulations limit the passenger operating depth to 150 feet.

The submarines are fitted with aft and forward entry/exit hatches. The pilot is stationed in the bow of the pressure hull, where there is an acrylic viewport for navigation, and where all control systems (electrical, steering, air, thrusters, ballast, life support, and communications) are located. The air-conditioned passenger compartment is 10 feet wide, with a center aisle dividing the port and starboard side passenger seats. Twelve 30 inch diameter acrylic viewports are located on each side; during full tours, two passengers share one viewport. Video screens by each viewport monitor views from four external cameras.

The submarines incorporate numerous safety features. The minimum system requirements are presented in Table 2.2. All life support systems are designed for use by 51 people for 72 hours. The oxygen system consists of sixteen 40.3 liter cylinders, of which three are for daily use and the remaining 13 are kept in reserve for the required 72 hours of emergency life support. Additional safety features include a Coast Guard approved fixed Halon fire fighting system, a manually released drop weight system with two 2,200 pound drop weights, respirators that meet the standards of the Mine Safety and Health Administration, inflatable personal flotation devises, a manually released signal buoy, and an emergency transponder attached to the top of the sail of the submarine.

2.1.3 Safety Procedures

Voyager maintains a comprehensive operations manual that provides a detailed description

Figure 2.2. Schematic diagram of the Voyager SM 100/50 Submarine.

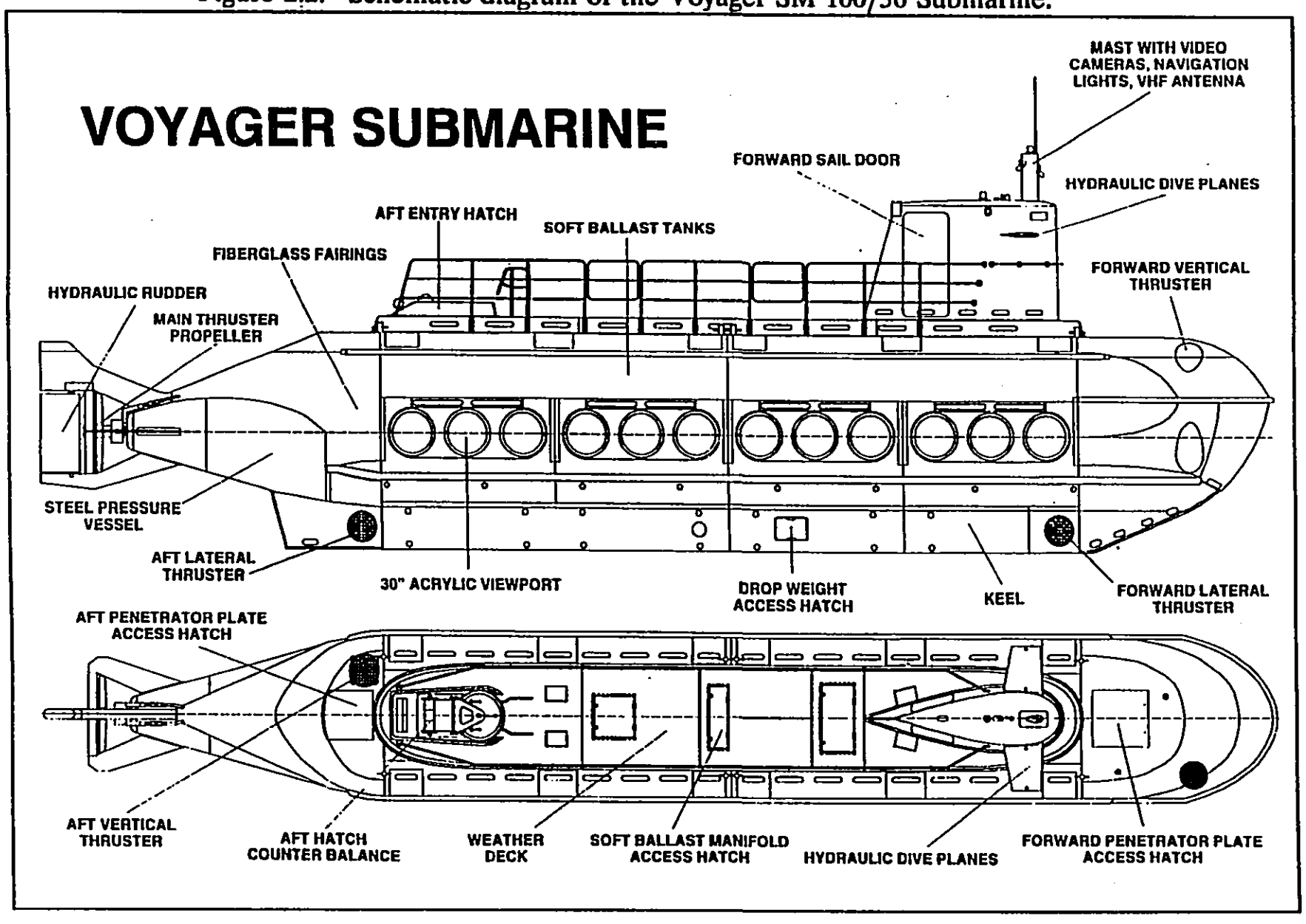


Table 2.1. SUBMARINE TECHNICAL SPECIFICATIONS

Passenger Capacity	48
Minimum Crew	3
Design Depth	328 Feet
Maximum Operation Depth	150 Feet
Gross Tons	98
Hull Material Thickness	1 Inch
Surface Displacement	3,290 Cubic Feet
Submerged Displacement	3,505 Cubic Feet
Payload Capacity	11,000 Pounds
Length Overall	72.8 Feet
Length Pressure Vessel	64.37 Feet
Width Overall	9.9 Feet
Width Pressure Vessel	9.2 Feet
Width Pressure Deck	7.2 Feet
Draft	10.4 Feet
Height Keel to Deck	12.4 Feet
Height Overall	22.5 Feet
Freeboard (waterline to top of hatch)	2.8 Feet
Height Waterline to Passenger Deck	2.8 Feet
Sail Height	6.9 Feet
Hatch Opening Size	2.56 Feet
Hatch Weight/Counter Weight	155 kg/185 kg
Width Pilot Viewport	3.6 Feet
Thickness Pilot Viewport	1.5 Inches
Width Passenger Viewports	29.2 Inches
Thickness Passenger Viewports	4.4 Inches
High Voltage Battery Capacity	248 Volts/1080 AH
Low Voltage Battery Capacity	24 Volts/880 AH
Emergency Battery Capacity	24 Volts/640 AH
Max. Speed Surface	7 Knots
Max. Speed Submerged	5 Knots
Main Thruster	105 HP
Lateral Thrusters (2)	13 HP each
Vertical Thrusters (2)	13 HP each
Rudder	1
Dive Planes	2
HP Air Cylinders	2/3000 psi35.3 Cu. Ft.; 7,204 AT PRESSURE
Oxygen Cylinders	16/3000psi/1.42 Cu. Ft.; 4,665 AT PRESSURE
Soft Ballast Tanks	8/40.37/322.96 Cu.Ft.
Hard Ballast Tanks	1321 gallons total; Aft=727 gallons; Fwd=594 gallons
Emergency Drop Weights	2/2,200 Lbs. each

Table 2.2. Minimum Submarine System Requirements

SYSTEM	MINIMUM QUANTITIES	SIZING CRITERIA
<u>O2 Storage System</u>		
Operating bank	300 psig	51 people x 2 hrs
Reserve Bank	2800 psig	51 people x 72 hrs
<u>Air Storage</u>		
Operating bank	* 500 psig in Port cylinder	2 complete air ballast tank blows
Reserve bank	* 250 psig in stbd cylinder	complete air ballast tank blow
<u>Power Supplies</u>		
248VDC Bus	230Volts	20% Charge
24 VDC Bus	22.2Volts	20% Charge
24 VDC emergency	27 Volts	100% Charge
<u>Emergency Supplies</u>		
CO2 Absorbent Material	880 lbs	51 people for 72 hours
Inflatable life Jackets	51 Life Jackets	1 per person
Respirators	51 Rebreather units	1 per person
Food Packages	51 Datrex Red Ration 2,400 cals total each package	1 per person per 3 days
Water	204 sachets Drinking water (4.227 oz each sachet)	4 per person per 72 hr period
Gas analyzer	1 pump + analyzer tubes:CO2 O2, H2, Cl	84 20 each

* 150 psi per blow with 100psi cushion

of both normal and emergency operational procedures. It also describes the command structure, including authority, responsibilities and duties of all staff positions. The normal operational procedures section of the manual presents a step-by-step description of all activities occurring during daily operations, and the specific staff responsibilities during those operations. Specific operating restrictions are outlined to ensure safe operations. These include the following:

- submarine operations shall not commence unless there is a support vessel for each submarine on site
- the submarine shall only operate at the dive site specified on the vessels Certificate of Inspection
- the maximum dive depth is 150 feet
- the submarine shall not operate in sea conditions greater than sea state 3
- the submarine shall not operate when underwater visibility drops below 50 feet
- the submarine shall not operate when currents exceed 2.5 knots
- the submarine shall not operate if surface visibility is less than one nautical mile
- the submarine shall not operate at such a speed that it cannot be completely stopped within 75% of the actual visibility
- underwater telephone and VHF communications must be in operating condition throughout submarine operations.

The emergency section of the manual contains emergency response plans developed by Voyager, as well as detailed descriptions of specific emergency operating procedures. The response plans include a self-help plan and an outside help plan. The self-help plan is for minor problems that can be solved by company personnel and equipment, therefore not requiring outside assistance. A least two rescue certified divers, and two complete sets of emergency dive gear plus spare scuba tanks are always on board the support vessel in the event of an emergency situation. When outside assistance is needed, the outside help plan lists local sources of assistance for the following: diving services; crane and tug services, U.S. Coast Guard Search and Rescue, marine inspection services, diving medical services (hyperbaric chamber), and hospital services. A specific personnel contact list is also provided.

The operations manual describes in detail the procedures and initial responses to be followed by the crew during an emergency. Possible emergency situations include communications loss, fire, flooding, entanglement, collision, lost submarine, and equipment and systems failures. The emergency procedures that should be followed for each of these situations are described in detail, and include the following: emergency ascent, diver assisted

ascent, position marking, emergency buoy release, drop weight jettison, submarine recovery, surface evacuation, and 72 hour life support system activation.

2.2 Proposed Artificial Reefs, Submerged Buoys and Mooring Pins

Voyager proposes to place two artificial reefs (vessels) on their dive site offshore of Ala Moana Beach Park. This section describes the proposed artificial reefs and buoy, potential sites, and emplacement operations.

2.2.1 Artificial Reef Description

Voyager proposes to sink two vessels to serve as artificial reefs on their dive site offshore of Ala Moana Beach Park. Only steel ships are being considered because they are more durable, more dense and therefore more stable than wooden or fiberglass boats. Ships are effective artificial reefs because they offer complex internal spaces, large amounts of surface area, high profiles and promote rapid coral growth (NOAA, 1985; Bailey-Brock et al, 1994). The preferred vessel size is approximately 180 feet long, 40 feet wide, and 40 feet high. Smaller ships on the order of 100 to 140 feet long are also being considered for placement on the shallower site. Candidate vessels currently being considered include the ex-Tunica (ATA-178, approximately 190 feet long) presently moored at the Naval Inactive Ship Maintenance Facility in Pearl Harbor, the U.S. Coast Guard BT Mallow (180 feet long) presently being decommissioned, and the fishing vessel Betty Ann (90 feet long), currently moored at Honolulu Harbor.

The ships to be used as artificial reefs are not planned to be procured until permits for the project have been granted because of the expense of maintaining and docking such vessels. Once the ships have been procured, detailed descriptions, photographs, and preparation and deployment plans will be submitted to the U.S. Coast Guard, DLNR and other interested agencies.

2.2.2 Artificial Reef (Ship) Preparation

Preparation for sinking will entail a thorough cleaning to U.S. Coast Guard, EPA and State DOH standards. Petroleum products, other possible pollutants and floatable debris will be removed. Cleaning methods to be used include the following:

- Pumping out fuel, fluids and sludge from all tanks and holds using a vacuum truck.
- Pressure steam cleaners or hot water blasters to clean all residual fuel, material and debris. This residual material is then pumped out with a vacuum truck.

- For double bottom tanks that are inaccessible, the vessel will be listed (tilted) to allow all material to be pumped out. The listing will be controlled using water tanks on board the ship to ballast the ship in the appropriate manner. If residual material remains in inaccessible tanks and holds, then these areas can be filled and sealed with concrete.
- Floatable debris will be removed by pumping out all tanks and holds, and by physically removing all debris in all accessible areas of the ship.
- All fluids and waste will be disposed of by a firm specializing in hazardous waste treatment and disposal. Fuel and petroleum products will be recycled, if possible.

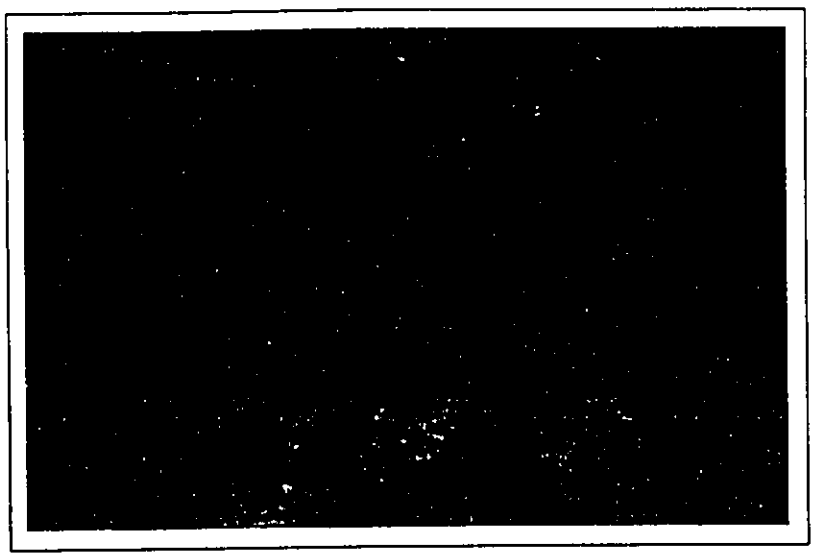
In addition, holes at least 4 feet by 4 feet in size will be cut into compartments and decks to promote water circulation through the ship, increase light penetration, enhance habitation by fish, and permit safe access by divers. All doors and hatches will be removed, entanglement hazards by objects such as cables and wires will be minimized, and hazardous compartments (such as the engine room) will be sealed off. A thorough inspection of the vessel will be conducted by all interested agencies prior to deployment.

2.2.3 Proposed Locations

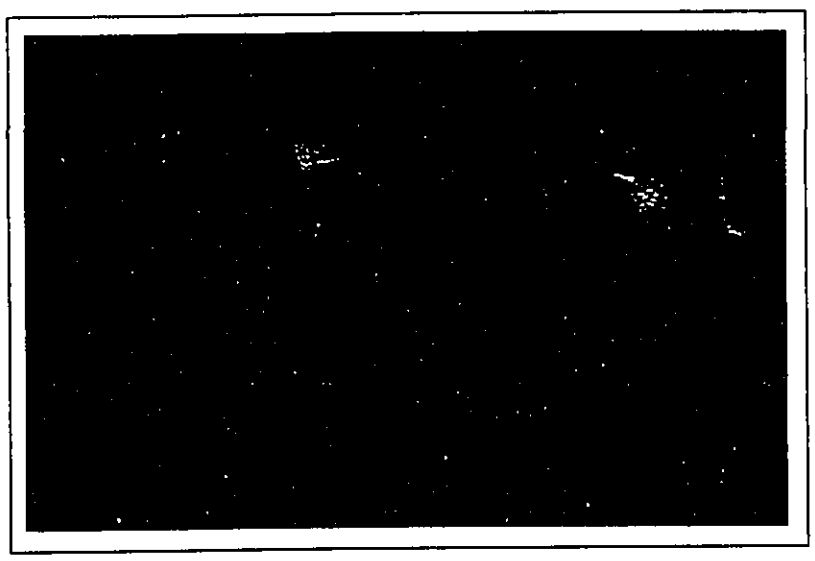
Figure 2.1 illustrates the submarine tour route, and three possible locations of the artificial reefs. The dive tour follows a limestone shelf and ledge (Figure 2.3A). It is estimated that the limestone shelf is composed of an ancient coral reef that formed 79,000 to 110,000 years ago. This ancient reef was subsequently exposed and eroded during periods of lower sea level, and then drowned by sea level rise. Wave action during periods when the shelf was approximately at sea level probably cut the ledge (Fletcher and Sherman, 1995). The limestone shelf now harbors sparse coral growth. The artificial reef sites are located in the barren sand bottom seaward of the limestone shelf and ledge. The preferred site (Location S1) is at the southeast end of the dive tour, at a water depth of approximately 100 feet. Alternative sites include Location S2 (Figure 2.1), at a water depth of approximately 100 feet, and Location S3 (Figure 2.1) at the northwest end of the dive tour at a depth of approximately 90 feet. These possible sites have been selected for the following reasons:

- They are located on barren, unproductive sand located seaward of the limestone shelf and ledge. Artificial reefs located in these sites have little environmental impact, and will provide a new habitat in previously unproductive areas. Figures 2.3B&C illustrate the sandy, barren bottom at these sites.
- Depths are at least 100 feet, thereby minimizing storm wave impacts, and impacts to sensitive coral areas.

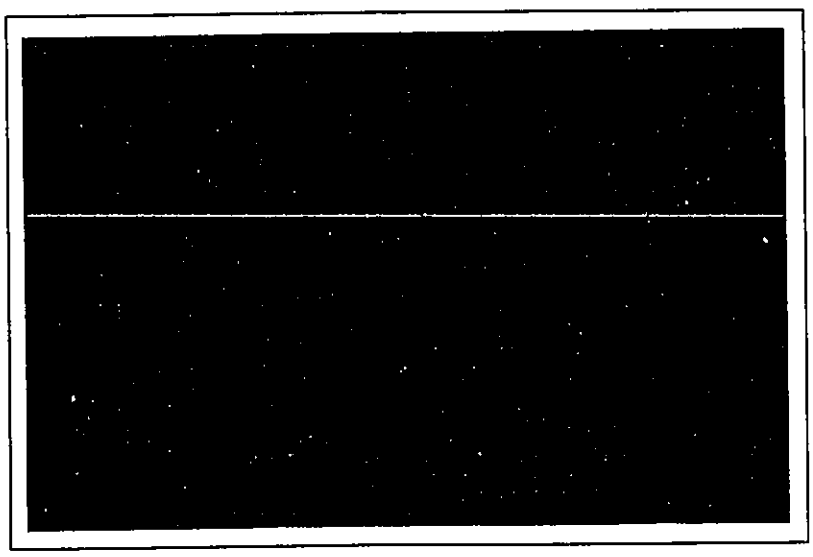
FIGURE 2.3



A: Ledge at edge of limestone shelf



B: Coral rubble, sand boundary



C: Barren sand at artificial reef site

- Depths do not exceed 105 feet, thereby minimizing depth related hazards to recreational divers.
- Water depths are great enough so that the ships will not protrude within 40 feet of the water surface. The ships will therefore not be navigational hazards.
- In the general vicinity of the ledge, so that one tour can encompass all the features.
- The ships will placed a distance of 100 feet or greater from the ledge to ensure that the ledge will not be affected by deployment of the reef.

2.2.4 Artificial Reef Deployment, Sinking and Ballasting

Once the vessels have been procured and cleaned, preparation may proceed for vessel deployment, sinking and ballasting. An engineering analysis of storm wave forces on the ship will be conducted to determine the amount of concrete ballast required. The first step in this process will be to determine the appropriate design wave height for the project site.

Recent analyses conducted by Sea Engineering (SSFM Engineers, Inc., 1994) using information from Hurricanes 'Iwa and 'Iniki have shown that the appropriate deepwater design wave heights for the south shore of O'ahu are up to 70% higher than those that have been used in the past. For example, the design wave that was used in the anchoring analysis of the sunken yard oiler at the Atlantis Submarine dive site was proven to be insufficient to prevent movement of the ship during Hurricane 'Iniki. To prevent this, the analysis for the Voyager dive site will use the conservative design waves that have been developed in light of the severe waves generated by Hurricanes 'Iwa and 'Iniki. A numerical model will then be used to simulate the refraction and shoaling that occurs as these deepwater waves propagate to the project site. Wave forces at the project site will then be calculated to determine the vessel weight required for stability.

The ballasting will be accomplished by pouring concrete into the ship hulls until the weight required for stability is reached. If possible, the concrete will be emplaced entirely at dock side and the pre-weighted vessel will be towed out to the deployment site. Weighting the vessel to the maximum extent possible at dockside is preferable for two important reasons: first, it minimizes more difficult, hazardous, and time-consuming at-sea operations, and associated environmental impacts; second, a heavier vessel can be controlled far more accurately during sinking. The deployment site will be prepared by buoying the exact location, and securing the vessels on site with a three point mooring. The mooring anchors will be widely spaced with a great deal of scope on the lines to allow tight control during sinking. It is anticipated that the vessels can be sunk to within 20 feet of the desired location. At sea operations should last only one day per ship.

The sunken vessels will be oriented perpendicular to bottom contours, or the shoreline (that is, in an onshore/offshore direction). This orientation is desired for two reasons. First, it minimizes wave forces acting on the ship by minimizing the exposed surface area. Second, an inshore/offshore vessel orientation maximizes water circulation through the vessel. Since currents at the project site flow parallel to the depth contours, a vessel oriented in this way will have greater circulation in the interior spaces, and will offer more habitat in the lee of the current. Divers also benefit from increased areas in the lee of the current.

2.2.5 Buoys and Mooring Pins

Six submerged mooring buoys will be permanently installed at the site; one on each sunken ship, and four others in the immediate vicinity of the ships. The two buoys on the ships will be exclusively open for other site users. Two other buoys will be used to moor the Voyager support vessels. The remaining two will be shared by Voyager and other site users; Voyager anticipates occasionally using these to moor a submarine when it is not in use. The buoy configuration will be a taut line array, with the buoy located 30 to 40 feet below the water surface. This is a Coast Guard requirement so that there is no interference with navigation when the site is not in use. The two arrays marking the ships will be directly shackled into the ship, with 18-inch Polyform mooring buoy attached by 1-1/2 inch line. The other four arrays will be anchored to the bottom using either Manta Ray anchors (for sand bottom areas) or anchor pins drilled and epoxied into the bottom (for limestone bottom areas). Manta Ray anchors are driven into the sand bottom and upon partial retraction, flukes open up which give the anchor its holding power. They are easily installed and once in place, only the connecting rod or cable protrudes above the sand bottom. Both of these anchor systems are in widespread use at heavily used dive sites in Hawai'i, for example, Molokini Islet, and they protect the bottom from the damage associated with frequent anchoring. Many of them have been installed by The Ocean Recreation Council of Hawaii (TORCH) at many popular dive sites in the state.

At the start of each operational day, Voyager personnel will secure surface buoys to the six submerged buoys in order to provide visual markers and easy access for other users. A 20-foot long tag line will be attached to each surface buoy for use by vessels wishing to tie up to the buoy. The buoys will be removed by Voyager each day just prior to securing operations. These anchor systems will eliminate the need for the Voyager support vessels or other users to deploy anchors, thus protecting the ocean bottom from anchor impact and dragging.

2.3 Project Schedule

Voyager Submarines intends to proceed with the artificial reef installation upon completion of the environmental review process and receipt of the Conservation District Use Permit. All other necessary permits have been obtained, as outlined in Section 4.0. Voyager anticipates procuring vessels, and beginning vessel preparation and deployment operations immediately after obtaining all necesary permits.

3.0 ENVIRONMENTAL SETTING

3.1 Physical Marine Environment

3.1.1 General Setting

The project area is centered off Ala Moana Beach Park, at the east end of Māmala Bay (Figure 3.1). Barbers Point and Diamond Head form the boundaries of Māmala Bay, a long shallow embayment of the shoreline that is approximately 33 kilometers (km) long.

The coastline from Barbers Point to Pearl Harbor is relatively straight and unbroken, with no embayments or perennial streams. An exceptionally broad, shallow reef platform lies offshore. East of the entrance channel, a shallow fringing reef extends from the entrance channel to Sand Island. Sections of the reef have been significantly altered by construction. Extensive dredging created the Pearl Harbor entrance channel, the Hickam Harbor channel and basin, and the entrances to Ke'ehi Lagoon. Massive fill was used to create the Honolulu International Airport Reef Runway.

The shoreline from the Reef Runway to Diamond Head, the eastern boundary of Māmala Bay, is predominantly artificial. Some areas have been extensively altered by dredging while in other locations the shoreline has been extended seaward by filling the reef. Many structures have been built on this reclaimed land. Sand Island is a man-made feature that was constructed over the years by deposition of material from harbor dredging operations. Ala Moana and Magic Island are also man-made features. The swimming area for Ala Moana was dredged from the reef, while Magic Island was created by filling in the reef. The shoreline of Honolulu Harbor fronts downtown Honolulu, the commercial and industrial center of the state. The shoreline east of Honolulu includes Kewalo Basin, Ala Moana Beach Park, the Ala Wai Yacht Harbor, and Waikīkī. Kewalo Basin is primarily used by commercial fishing vessels and tourist-oriented cruise vessels. Ala Moana Beach Park is an important recreational site heavily used for swimming and surfing. Waikīkī Beach, located 3 km east of Honolulu Harbor, is the center of tourism for the island and is extensively used for ocean recreation activities, including swimming, surfing, and canoeing.

3.1.2 Climate and Winds

The Hawaiian Islands have a mild climate due to their tropical latitude and isolated position in the middle of the Pacific Ocean basin. Hawai'i is located more than 3,200 km away from the nearest continental land mass, and the ocean has a buffering effect, supplying moisture and moderating the air temperatures.

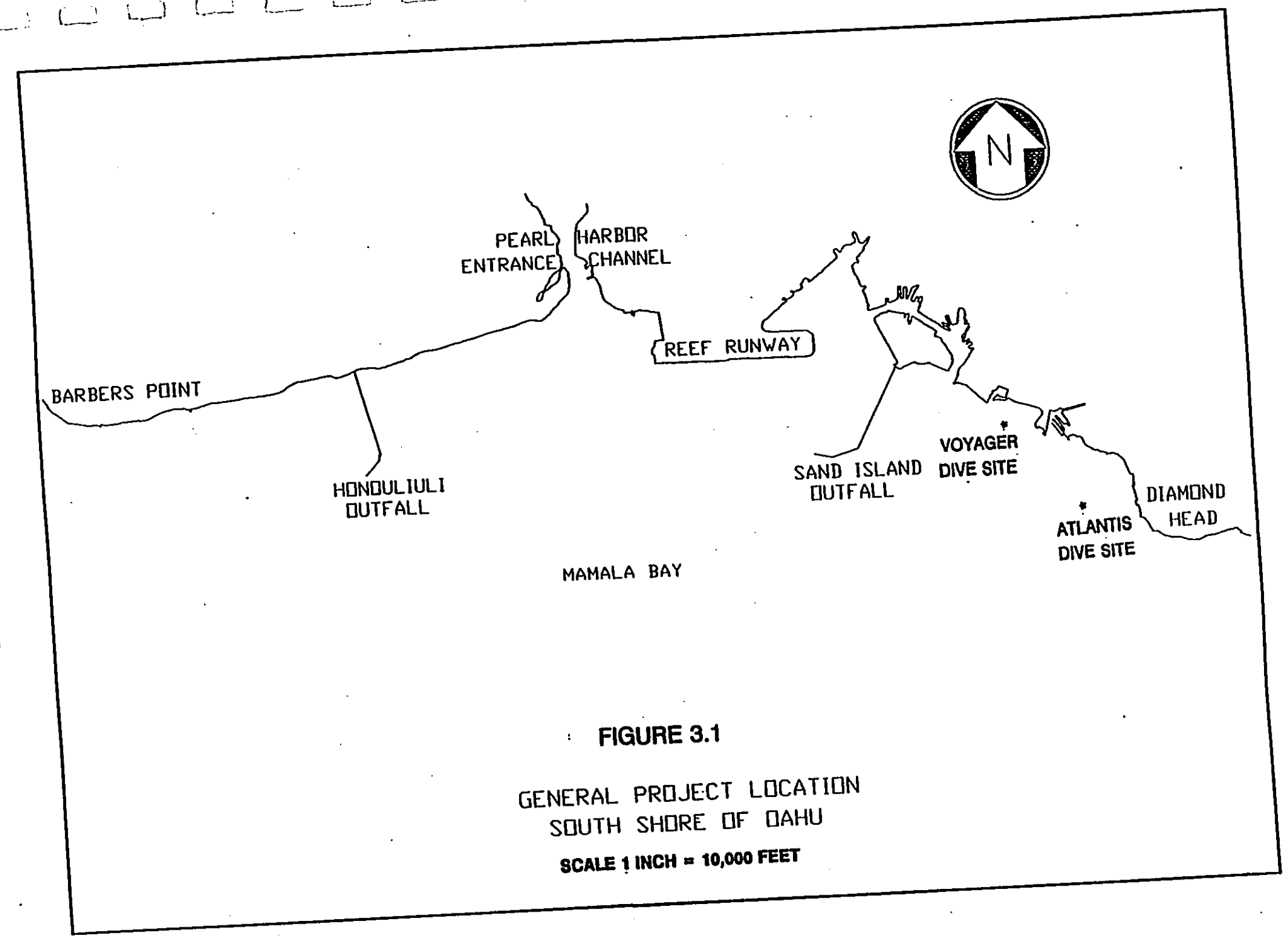


FIGURE 3.1

GENERAL PROJECT LOCATION
SOUTH SHORE OF OAHU

SCALE 1 INCH = 10,000 FEET

The weather in Hawai'i is dominated by the influence of the Pacific High, a persistent zone of high atmospheric pressure that typically lies northeast of the islands. The northeast trade winds are generated by air flowing out from the Pacific High. The wind climate in the Hawaiian islands can be divided into two distinct seasons based upon the annual variation in persistence of the prevailing northeast tradewinds. Tradewinds predominate in the summer months of April through October, blowing 80 to 90 percent of the time with typical speeds of 10 to 25 miles per hour. They tend to weaken in persistence during the winter months of November through March, blowing approximately 35 percent of the time. Tradewinds show a slight diurnal variation, with the winds slightly stronger in the afternoon than at night.

During the winter months, winds from the sector south through west occur intermittently. These are known as Kona winds, and accompany the passage of storm fronts associated with low pressure systems travelling across the North Pacific ocean. The strongest winds occur during severe Kona storms and hurricanes.

The project site is on the south, or leeward, coast of O'ahu and is thus sheltered from direct tradewind effects. Wind data from Honolulu International Airport represent long-term wind records applicable to the project area. A summary of wind statistics from the airport is provided in Table 3.1 for the 29-year period from 1939 to 1967. The typical wind direction is from the sector northeast to east, and occurs more than 60 percent of the time. Typical wind speeds range from 7 to 16 knots, with an overall mean wind speed of 9.7 knots.

Monthly peak wind speeds at the Honolulu International Airport are shown in Table 3.2. The data show the highest one-minute-averaged wind speeds derived from continuous wind records. In the 12-year period of record the monthly peak winds ranged from 27 to 53 knots, with the typical monthly peak wind being approximately 35 knots.

Precipitation greatly varies with location in Hawai'i, with higher elevations generally receiving greater rainfall. Heaviest rainfalls occur during the winter months with the passage of weather fronts. Honolulu and the southern shore of O'ahu have high precipitation during the winter months of October through April, and typically dry summers.

3.1.3 Storms

Two major storm types can affect the Hawaiian Islands, Kona storms and intense tropical storms or hurricanes. Kona storms are weather disturbances associated with frontal activity

Table 3.1. Percent frequency of winds at Honolulu airport (Period: 1939-1967)

Wind Dir.	Wind Speed (knots)									Total	Mean Speed
	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41-47		
N	1.5	1.8	1.1	0.3	0.0	0.0				4.8	5.7
NNE	0.8	1.2	0.9	0.5	0.1	0.0				3.6	7.0
NE	1.2	2.0	6.4	7.8	2.7	0.5	0.0	0.0	0.0	21.5	11.2
ENE	0.6	3.0	9.9	12.6	4.2	0.6	0.0	0.0		30.9	11.8
E	0.7	1.9	5.3	4.6	1.6	0.2	0.0			14.3	10.7
ESE	0.2	0.4	0.6	0.3	0.1	0.0	0.0	0.0	0.0	1.5	8.9
SE	0.2	0.4	0.8	0.7	0.1	0.0	0.0	0.0		2.2	9.8
SSE	0.1	0.3	0.8	0.6	0.2	0.0	0.0	0.0	0.0	2.2	10.1
S	0.2	0.6	1.3	0.6	0.1	0.0	0.0			2.9	9.0
SSW	0.1	0.2	0.6	0.3	0.0	0.0	0.0			1.3	9.2
SW	0.1	0.2	0.6	0.3	0.1	0.0	0.0			1.3	9.3
WSW	0.1	0.1	0.2	0.2	0.1	0.0	0.0			0.6	10.3
W	0.2	0.2	0.2	0.1	0.0	0.0	0.0			0.8	7.3
WNW	0.2	0.3	0.1	0.0	0.0	0.0	0.0			0.7	5.3
NW	1.4	1.6	0.7	0.1	0.0	0.0				3.9	5.1
NNW	0.8	1.2	0.6	0.1	0.0	0.0	0.0			2.8	5.5
Calm										4.7	
Total	8.3	16.4	30.1	29.3	9.4	1.5	0.1	0.0	0.0	100	9.7

from strong mid-latitude cyclones that move across the north Pacific during the winter months. A severe Kona storm can be accompanied by precipitation, high winds from the south and west, and locally generated steep, high waves.

During the early hurricane season of July, August, and September, hurricanes generally form from intense low pressure vortices in the eastern tropical Pacific off the west coast of Mexico and move westward across the central Pacific. These tropical storms or hurricanes usually pass south of the Hawaiian Islands, curving northward as they approach. However they generally stay far enough offshore to only cause high surf and heavy rainfall as they pass. Late season tropical storms and hurricanes follow a somewhat different track, forming south of Hawai'i and moving north toward the islands.

Table 3.2. Monthly peak winds at Honolulu airport (knots)

Year	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
46	E 30											NE 35	
52											ENE 42	ENE 35	
53	W 32	WSW 33	ENE 33	E 29	E 32	ENE 33	E 36	E 33	ENE 29	ENE 33	ENE 38	NE 36	ENE 38
54	NE 42	SW 39	NE 31	E 32	NE 33	ENE 30	NE 32	ENE 30	ENE 32	E 37	ESE 40	SW 42	NE 42
55	NE 53	SE 39	ENE 37	NE 39	NE 40	NE 35	NE 38	NE 37	NE 32	ENE 33	ESE 37	NNW 44	NE 53
56	SSW 47	NE 40	ENE 41	NE 33	ENE 35	NE 34	ENE 31	ENE 33	E 30	ENE 34	S 34		SSW 47
57	E 34	W 42	ENE 40	E 34	ENE 30	E 34						NE 37	
66								NE 32	NE 31	NE 35	SE 35		
67	NE 37	NE 37	NE 32	E 36	NE 27							NE 42	
68									NE 28	NE 31	N 41	NE 39	
69	NE 33	NE 45	E 34	E 40	NE 35	E 32	E 34	NE 32	NE 30	NE 28	NE 37	ENE 35	NE 45
70	SW 39	NE 38	NE 34	NE 41	NE 32	NE 33	NE 34		NE 29	NE 26	NE 27		
Mean	39.3	38.3	35.7	33.8	32.8	33.2	34.3	33.0	30.8	34.4	37.7	38.2	45.0
Stand. Dev.	8.440	3.007	4.274	3.430	4.446	1.924	3.304	2.550	1.304	1.673	3.011	3.869	6.481
Total Obs.	217	169	186	180	186	150	124	156	149	155	180	186	2037

Although many tropical storms or hurricanes have approached the Hawaiian Islands, most passed well south or west of the islands, or weakened in intensity as they reached Hawai'i. There have been notable exceptions, however. Hurricanes Hiki, Della, Nina, and Fico passed within about 320 km of the islands, 'Iwa passed within 45 km of Kaua'i, and Dot and 'Iniki passed over Kaua'i. Hurricane Dot in August 1959, and 'Iniki in September 1992 had a typical southwest path, while 'Iwa, in November 1982, was typical of late season hurricanes, forming south of Hawai'i and moving north.

3.1.4 Waves

Four primary wave types describe the wave climate of the Hawaiian Islands. These are northeast tradewind waves, southern swell, Kona storm waves, and north Pacific swell. Hurricane generated waves, although infrequent, are also important.

The waters off Ala Moana are almost completely protected from north Pacific waves but are directly exposed to south swell, Kona storm waves and hurricane generated waves. They are also indirectly exposed to tradewind generated waves refracting around the east end of the island.

South swell is generated by storms in the southern hemisphere and is most prevalent during the summer months of April through October. These waves are typically long and low with periods of 12 to 20 seconds and deepwater heights of 1.5 to 6.5 feet. South swell is fairly common, occurring approximately 53 percent of the time during a typical year.

Kona storm waves are generated by intense winds associated with locally occurring Kona storms. These waves approach from the south to the west, with the largest waves usually from the southwest. Deepwater wave heights during the severe Kona storm of January, 1980 were approximately 16.4 feet; with a period of 9 seconds.

Hurricane generated waves occur infrequently with the nearby passage of an intense tropical storm or hurricane. A hurricane wave hindcast of Hurricane 'Iniki prepared by Sea Engineering, Inc. for SSFM Engineers, Inc. (1994) estimated a maximum deepwater significant wave height of 39 feet for the south coast of O'ahu.

3.1.5 Design Waves

The most severe wave conditions on Oahu's south shore occur during the passage of hurricanes. Prior to the relatively recent occurrences of Hurricanes 'Iwa (1982) and 'Iniki (1992) design waves were commonly based upon characteristics of Hurricanes Nina (1957)

and Dot (1959), which were the two worst hurricanes on record to affect O'ahu. A 50-year design hurricane based upon Nina and Dot was developed by Dr. Charles Bretschneider and used to compute a design wave for the Barbers Point and Sand Island outfalls. The recommended maximum deepwater design wave height was 46.0 feet, and the significant wave height was 27.0 feet. The maximum wave height is defined as the largest single wave generated during the passage of the hurricane, and the significant wave height is the average of the highest one-third of the waves.

During the passages of 'Iniki and 'Iwa the design waves used previously were in some cases found to be insufficient. Damage occurred to oil delivery pipelines at Barbers Point in 100-ft water depth during Hurricane Iwa, and numerous artificial reefs on the south shore were moved or destroyed during Hurricane 'Iniki. Ballasting of the sunken yard oiler at the Atlantis Submarine dive site in Waikīkī Beach, based upon a 50-year hurricane significant wave height of 24.7 feet and wave period of 12 seconds, was found to be insufficient to prevent movement of the ship during Hurricane 'Iniki.

Sea Engineering, Inc., hindcast the waves generated by Hurricanes 'Iwa and 'Iniki as part of the inspection and design of repairs to the Barbers Point outfall (SSFM Engineers, Inc., 1994). The wind and wave fields were computed using a numerical hurricane model and the measured parameters of the two hurricanes. The closest point of approach of 'Iwa to the south shore of O'ahu was 125 miles; that of 'Iniki was 110 miles. Worst case conditions for design wave calculations were achieved by transposing the storm center locations of Iwa and 'Iniki so that south shore sites were within the radius of maximum winds of the hurricanes, where the highest wave heights occur. The resulting design waves are presented in Table 3.3. These are up to 70-percent higher than those originally used for the design of the Sand Island and Barbers Point outfalls.

For further engineering calculations, a site-specific numerical model for refraction and shoaling will be applied to the waves in Table 3.3 in order to select the final design wave. That wave will then be used to calculate resultant forces on the sunken vessels.

3.1.6 Tsunamis

Tsunamis are very long period ocean waves generated by earthquakes, submarine landslides, and volcanic eruptions. Tsunamis are typically inconspicuous in the deep ocean, but can significantly increase in height as they approach the coastline. Interaction with local bathymetric and topographic features by the processes of shoaling, refraction, and bay or harbor resonance can dramatically influence the impact of a tsunami at a particular location.

Table 3.3. Selected 'Iwa and 'Iniki Deepwater Waves

Storm	Av. Wave Period (sec)	Significant Wave Height	Maximum Wave Height
'Iniki	9.0	35.9	58.3
'Iniki	9.2	38.1	61.6
'Iniki	9.5	40.1	64.9
'Iniki	9.8	41.7	67.2
'Iwa	10.8	45.3	78.9

Hilo Bay, on the island of Hawai'i, has historically been the site of great destruction due to the localized amplification of tsunami wave heights. The south coast of O'ahu has historically
been relatively safe from the destructive effects of tsunamis. The major tsunamis of 1946, 1952, 1957, and 1960 caused tsunami wave heights of only 3 feet in the Hickam area, close to the project site (Loomis, 1976).

Tsunamis wavelengths are typically on the order of 200 kilometers, and deep water amplitudes are less than a meter. An analysis of wave orbital velocities in 100 feet of water reveals that tsunamis generate orbital velocities that are less than one-tenth the strength of velocities resulting from hurricane design waves. The hurricane design waves discussed in Section 3.1.5 will result in much stronger wave forces at the site, and are the appropriate design conditions for this project.

3.1.7 Circulation and Currents

The circulation of Māmala Bay is complex, with both seasonal and localized variations superimposed on the prevailing patterns. The major components of circulation in the bay are the North Pacific Equatorial Current which flows in a general westerly direction through the Hawaiian Islands, and the tidal currents which result from the passage of the semidiurnal and diurnal tide waves.

The nearshore circulation in Māmala Bay and at the project site is primarily tide driven. The currents in the bay have a strong semidiurnal tidal component and reverse twice daily. Peak tidal currents are typically around one-half knot. Figure 3.2 illustrates tidal current ellipses measured during the Māmala Bay Study (1995) at several locations. The ellipses show the predominant direction of tidal current movement, which is parallel to the depth contours.

These reversing tidal flows control short term current and transport patterns. They are superimposed on weaker underlying unidirectional currents that are driven by large scale circulation patterns. However, the underlying flows are occasionally strong enough to override the tidal flow and cause unidirectional flow with no reversal.

The underlying flows are important because they influence the long term transport patterns. The Māmala Bay Study (MB-6) concluded that there are two seasonal patterns as shown schematically in Figure 3.3. However, the authors do not give an explanation for the seasonal differences, and stress that both modes can occur in either season.

In general, the currents at the dive site can be expected to reverse with the semidiurnal tide, with the reversing currents paralleling the bottom contours. The overall transport, or net transport, may be toward either Diamond Head or Barbers Point depending upon the prevailing long term pattern. Net transport speeds are in the range of 0.1 knot or less.

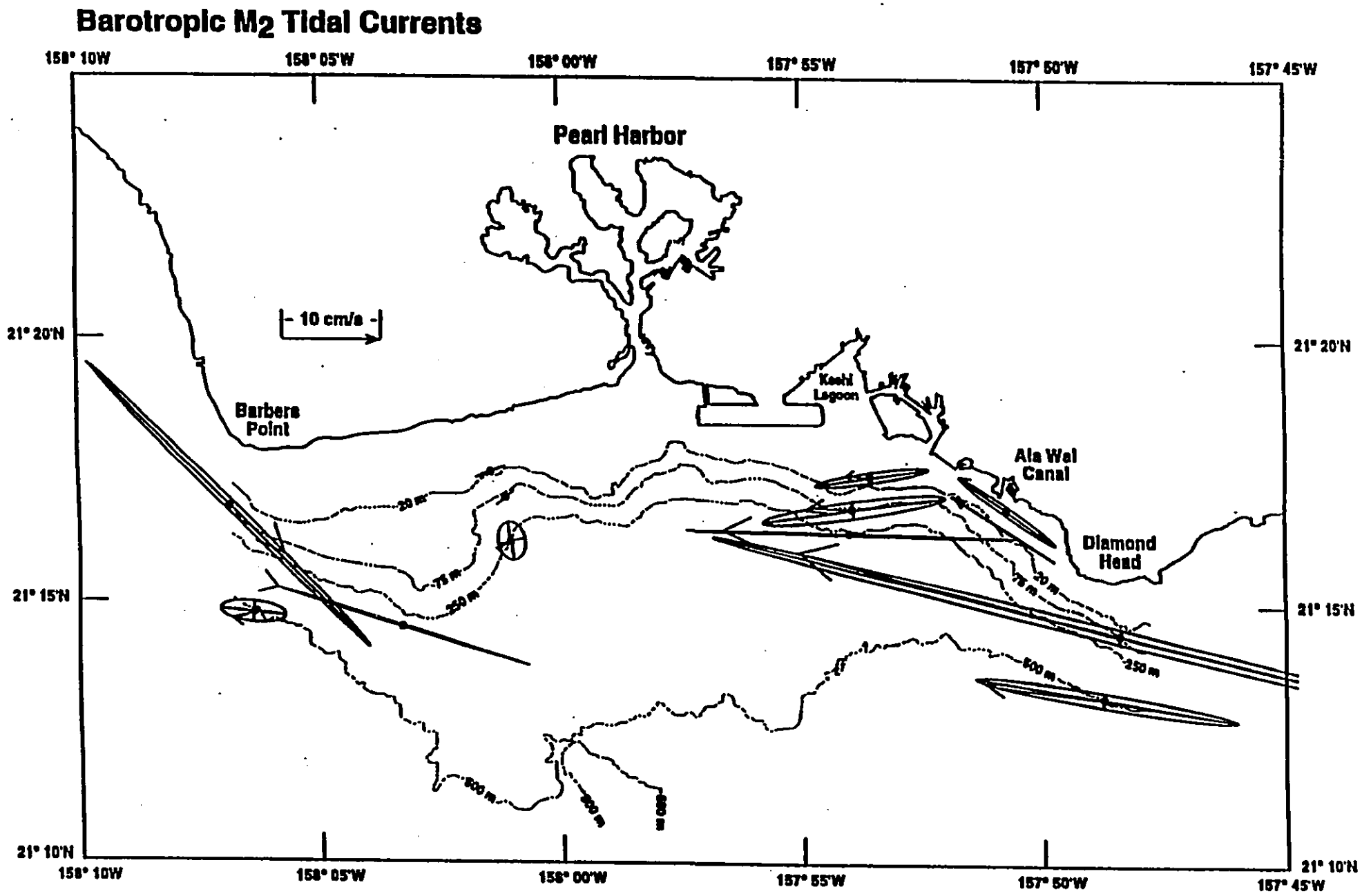
During heavy rainfall events, highly turbid discharge from the Ala Wai Canal can occur for several days. This discharge, which can be high in pollutants, can then be dispersed to the east and west by the tidal currents, and can occasionally degrade water quality at the Voyager dive site.

The prevailing winds influence approximately the top 15 feet of the water column. Surface currents can therefore be expected to move consistently offshore during the summer, when the northeast tradewinds occur 80 to 90 percent of the time. During the winter, the tradewind frequency decreases to 60 percent of the time, and the surface flow will be more variable, reflecting either the prevailing winds or the underlying tidal currents.

3.1.8 Temperature Structure in Māmala Bay

The surface temperature in Māmala Bay shows little variability, and changes slowly with the seasons. There are higher temperatures in the summer months, with a yearly maximum of about 27°C in September, and cooler temperatures in the winter, with a yearly minimum of

Figure 3.2. Depth mean tidal current ellipses measured during the Māmala Bay Study (1996).



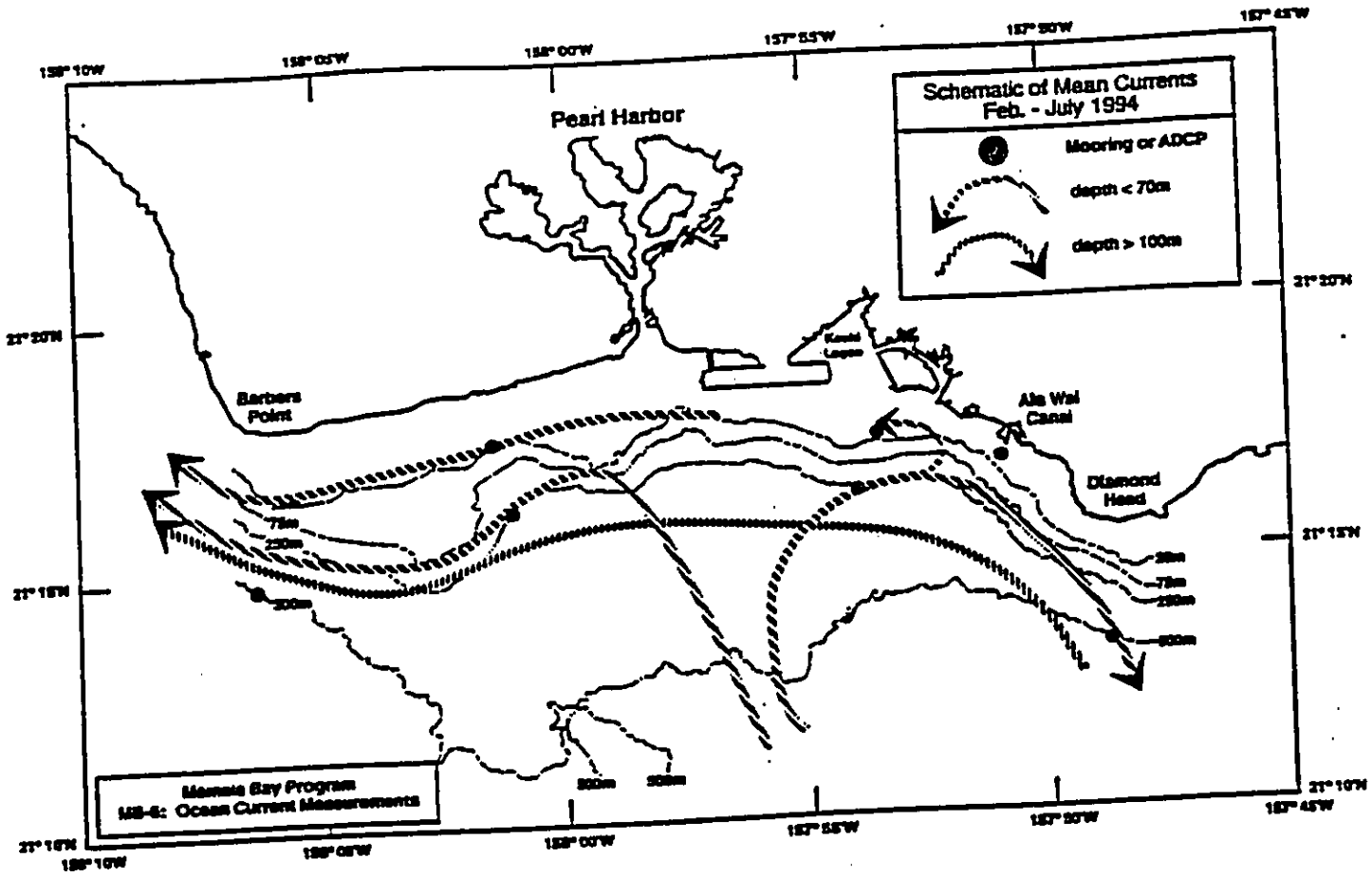


Figure 3.3. Two seasonal circulation modes in Māmala Bay: February to June (top), and July to October (bottom). From the Māmala Bay Study (MB-6), 1995.

about 24°C in March. The thermocline defines the bottom of the surface layers, and water temperatures decrease significantly at the thermocline and below. The thermocline is 300 or more feet deep in the winter, and varies from 100 to 180 feet deep during the late summer. The thermocline depth fluctuates up and down with the semidiurnal tides, so the bottom water temperatures at the Voyager site can be expected to vary daily during the late summer months, when the top of the thermocline may penetrate upward to the 100 foot depth. The daily temperature change should not exceed 3 to 4°C.

3.1.9 Bottom Characteristics

The area off Ala Moana Beach Park that comprises the Voyager dive site can be described as an exposed limestone shelf and ledge roughly semi-circular in shape with diagonal distance across of approximately 1,350 feet (Figures 2.1 and 2.3). It is estimated that the limestone shelf is composed of an ancient coral reef that formed 79,000 to 110,000 years ago. This ancient reef was subsequently exposed and eroded during periods of lower sea level, and then drowned by sea level rise. Wave action during periods when the shelf was approximately at sea level probably cut the ledge (Fletcher and Sherman, 1995). In some areas, the vertical relief of the ledge is on the order 6 to 10 feet. Sections of the ledge contain undercuts and small ledges which serve as desirable shelter areas for fish. The top of the limestone shelf was covered with a veneer of coarse calcareous sand and rubble fragments. Most of the rubble fragments were identified as pieces of reef corals that had likely been broken from the living colonies by storm waves. The depth of sand on the top of the shelf feature was very thin; one sweep of a hand cleared the sand away to reveal solid limestone substratum.

The proposed sites for deployment of the vessels lie generally seaward of the limestone shelf (see Figure 2.1). These sites consist of relatively barren sand flats. The character of the sand surface at site S3 was somewhat different than at sites S2 and S1. Site S3 is the shallowest site and lies just to the immediate west of the shelf edge. The sand surface in this region consisted of only a very thin layer, and was easily brushed away to reveal a solid limestone platform. At Sites S1 and S2, the sand surface was substantially thicker and digging by hand revealed a depth of at least several inches.

During the underwater surveys of the ship deployment areas, the sand plains did not have ripples indicative of wave or current motion. Rather, the sand surfaces were covered with a thin green veneer that likely consisted of benthic diatoms or benthic algae. The presence of this green film is indicative of quiet water conditions with water velocities insufficient to create sediment resuspension.

3.2 Marine Biology

A marine biological study was conducted to assess the marine ecosystems in the vicinity of the Voyager dive site, as well as on sunken vessels located at the Atlantis dive site. The study report is enclosed in Appendix A.

3.2.1 Macrobenthos

Figure 3.4 shows the locations of 7 stations that were surveyed for biotic community composition. These areas were selected as representative of the main biotype in the dive site. Below is a description of the communities that occupy each of the survey stations.

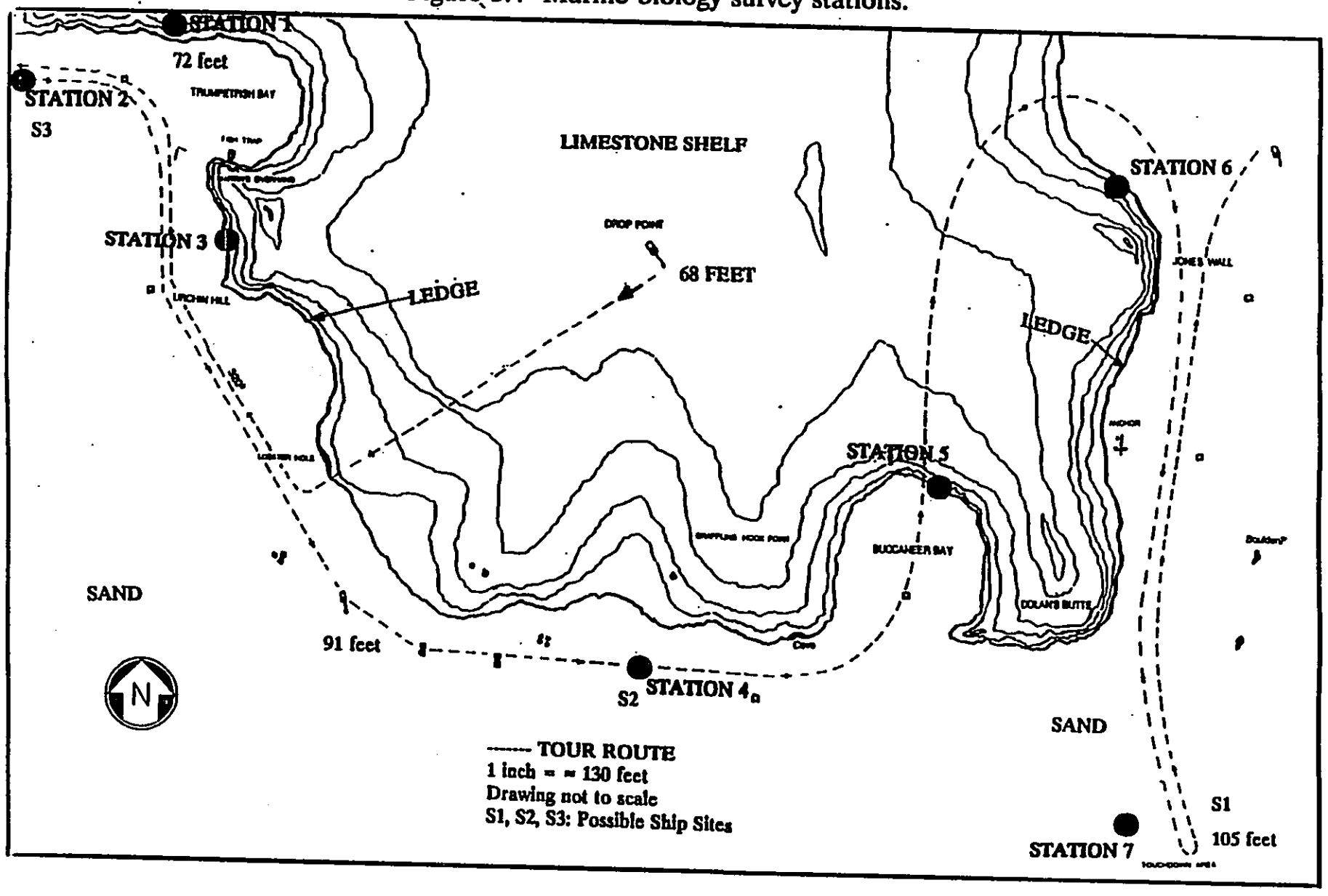
Station 1: Upper surface of the fossil reef consisting of a flat sand-covered shelf. The predominant biota were heads of the stony coral *Pocillopora meandrina*. This coral grows as separate hemispherical colonies with short blunt branches. Other corals were small flat encrustations of *Porites lobata* and *Montipora verrucosa*. Coral cover in the area was estimated at less than 5%. Other conspicuous macrofauna included the sea urchins Echinothrix diadema, *Echinometra matheai* and *E. chinostrephus aciculatus*. *Echinothrix diadema* are long-spined urchins commonly called wana. Throughout the dive site, numerous *E. diadema* were observed on the reef surface, often occurring in large aggregations of up to 50-100 individuals. *Echinometra matheai* and *Echinostrephus aciculatus* are smaller, shorter spined urchins that burrow into the limestone surface of the reef. *E. matheai* and *E. aciculatus* were not as abundant as *E. diadema* at Station 1 with only several individuals present.

Filamentous benthic algae were not abundant at any area of the dive site. Algae that were noted included *Lyngbya majuscula*, *Halimeda opuntia*, and *Enteromorpha spp*. Encrusting calcareous algae including *Peyssonellia rubra* and *Porolithon spp*. were common covering rubble fragments and parts of the exposed limestone reef structure.

Station 2: This is the proposed location of one of the sunken ships. The site is seaward of the edge of the fossil reef slope on a flat sand-covered plain. As discussed above, the sand deposit in this area is very thin, and barely covers a solid limestone platform. Biota in the area consists of widely scattered heads of *P. meandrina*, and small encrustations of *P. lobata*. Few sea urchins or other macrobiota were observed.

Station 3: This area consists of a relatively steep vertical relief with an undercut ledge approximately 6 feet high. The area is known as "urchin hill" by the Voyager personnel

Figure 3.4 Marine biology survey stations.



owing the large aggregations of *E. diadema*. It appears that the high numbers of urchins occurring in the area are relatively consistent as opposed to periodic spawning aggregations. Large heads of *P. meandrina* occurred on the edge of the reef ledge.

Station 4: This area is another of the proposed locations for deployment of the sunken vessel. Bottom composition in this region consisted of a flat sand surface covered with a patina of green benthic algae. Few macrobiota or burrows were observed on the sand surface.

Station 5: This area, known to the Voyager personnel as "Buccaneer Bay" consists of a semi-circular reef ledge with steep vertical walls. The top of the reef contained the highest percentage cover of the hemispherical coral colonies of the species *Pocillopora meandrina* and *P. eydouxi* growing on hard flat bottom. Compared to most other areas of the dive site, these corals were abundant, covering up to approximately 40% of the bottom along the crest of the reef ledge.

Station 6: Located at the northeastern end of the dive site reef, this area is somewhat atypical in that the top of the reef ledge is covered with large colonies of *Porites lobata*. *P. lobata* is the most common coral throughout the Hawaiian Islands, and assumes a variety of growth forms. On the ledge at the Voyager site, most of the large colonies appear as flattened hemispherical lobes up to a meter in dimension. As at the other locations along the reef ledge, *P. meandrina* was also abundant. The combination of these two species resulted in peak coral cover of approximately 50-70% along sections of the reef top.

Station 7: The third prospective site for sunken ship deployment consists of a sand flat with interspersed rubble fragments. No macrobiota were observed during the survey.

3.2.2 Fish Communities

Table 3.4 lists the abundance of reef fish observed at the same seven stations investigated for macrobenthos. Number of species ranged from 3 to 17, while number of individuals ranged from 4 to 133 at the seven stations. In general, fish were more abundant and the assemblages more diverse in areas with higher vertical relief, while abundance was lowest on the flat sand areas. There was also a distinct association between location on the reef and the feeding guilds of fishes. The dominant fishes upcurrent of the reef ledge were midwater plankton feeders including the butterfly fishes *Chaetodon miliaris* and *Hemitaurichthys polylepis*, and the surgeon fish *Naso lituratus*. Along the ledge, the most dominant species were benthic feeders, including goat fishes (e.g. *Parupeneus multifasciatus*),

Table 3.4. Abundance of reef fish at representative locations at the Voyager Submarine dive site.

FAMILY Genus species	Survey Station 1	2	3	4	5	6	7
MULLIDAE							
Mulloidichthys pflugrei		1					
Parupeneus multifasciatus	7		7	6	5	5	9
P. pleurostigma			2		9		2
P. bifasciatus					12		
CARANGIDAE							
Caranx melamphygus	1						
CHAETODONTIDAE							
Chaetodon miliaris	14		3	4	30	3	24
C. ldeini						3	
Heniochus diphreutes							2
Hemitaurichthys polylepis			20				
POMACENTRIDAE							
Dascyllus albisella	29					27	12
LABRIDAE							
Novaculichthys taeniourus				1			
Coris gaimard	2						
Thalassoma duperrey	7						
SCARIDAE							
Scarus sordidus			1				
S. perspicillatus	1			1			
S. rubroviolaceus			1				
juvenile Scarus	10		3			8	
ACANTHURIDAE							
Acanthurus achilles			3				
A. triostegus	3						
A. olivaceus	3			4	3	3	8
A. nigrofuscus	12		7	5		8	3
Naso lituratus	30		50		50	15	20
N. unicornis	5	2	1		6	3	3
ZANCLIDAE							
Zanclus cornutus	2					1	1
MONOCANTHIDAE							
Alutera scripta	2		1		2		
BALISTIDAE							
Rhinecanthus rectangulus				2			
Sufflamen bursa	2	1	2	3	2		
Melichthys vidua	3		2			3	2
NUMBER SPECIES	17	3	14	8	9	11	11
NUMBER INDIVIDUALS	133	4	103	26	119	79	88
SPECIES DIVERSITY	2.33	1.04	1.75	1.93	1.65	2.00	1.98

wrasses (e.g. *Thalossoma duperrey*) and parrot fishes (*Scarus spp.*) Trigger fishes (Family Balistidae) were common wherever holes or depressions occurred on the hardpan surface of the reef.

While not included in the quantitative survey, a large school of ʻōpelu (*Decapterus macarellus*) was observed in the water column and appeared to follow the submarine throughout the dive. Several large kahāla (*Seriola dumerili*) also appeared to be attracted to the submarine. A blacktip shark (*Carcharhinus limbatus*) was sighted on several occasions traversing the dive site.

3.2.3 Endangered and Protected Species

Three species of marine animals that occur in Hawaiian waters have been declared threatened or endangered and are under Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly in the nearshore areas of Hawai'i, and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) is infrequently observed in Hawaiian waters.

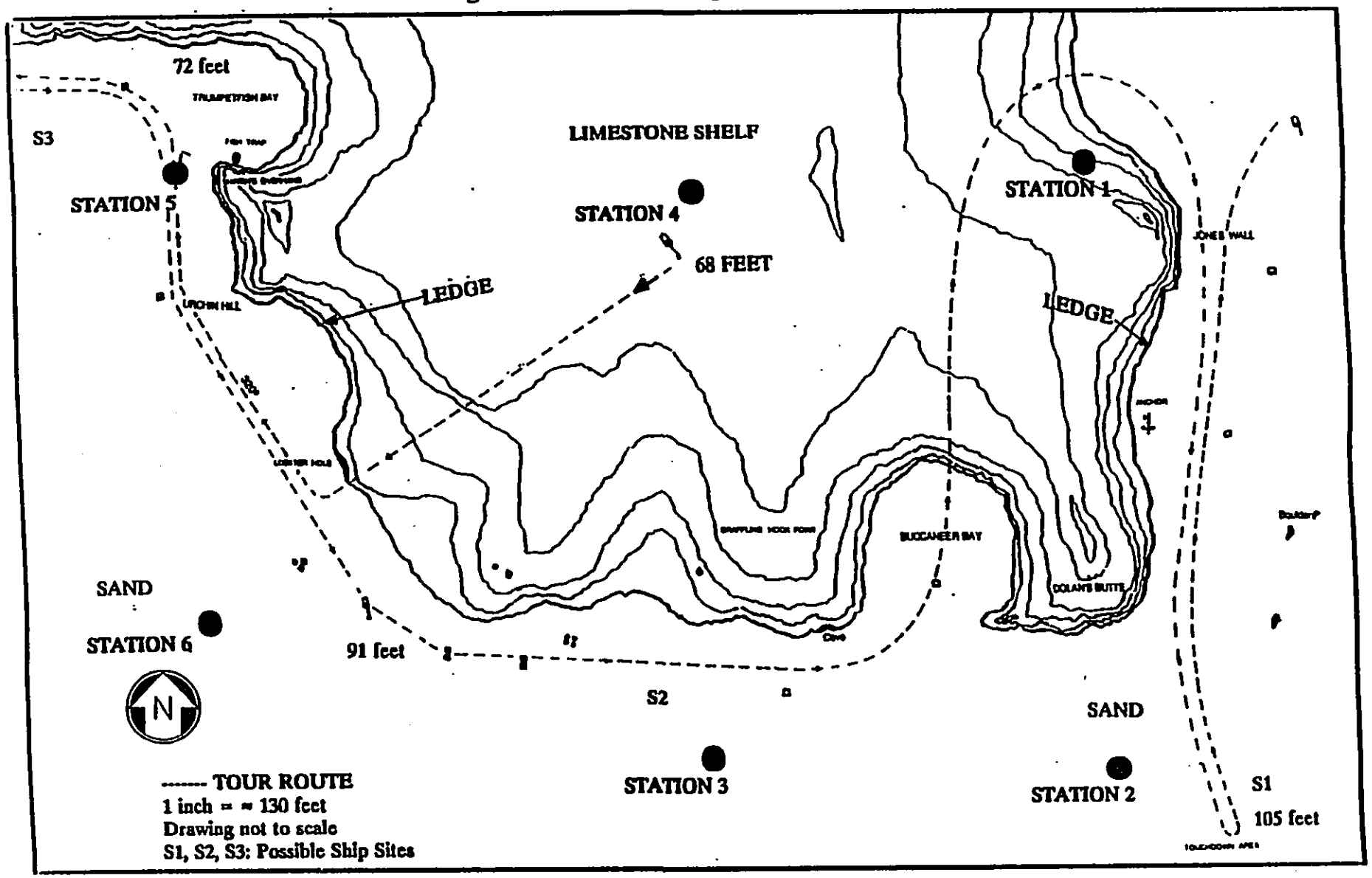
The major nesting site in the Hawaiian Islands for the green turtle is French Frigate Shoal (Balazs 1980). Sporadic rare nesting events have occurred in the main islands (J. Naughton, personal communication). One turtle was observed on the bottom during the course of the submarine survey dive. The turtle had multiple tumors on its head and front appendages. Voyager personnel report sightings of two turtles, including the one with tumors, on a regular basis.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) are known to winter in the Hawaiian Islands from December to April. The Hawaiian Monk Seal (*Monachus schauinslandi*) also has been observed sporadically in the main Hawaiian Islands.

3.3 Water Quality

One consideration of the proposed activity is potential alteration of existing water chemistry caused by placement of the vessels. In order to determine if such alterations occur, a baseline of present water chemistry composition at the dive site was established. This report is enclosed in Appendix A. Water samples were collected at the surface, at mid-water, and near the bottom at 6 stations in the vicinity of the dive site. Figure 3.5 is a diagram of the Voyager dive area showing the locations of the 6 water sampling stations.

Figure 3.5 Water sampling stations.



Water quality constituents that were evaluated include the 10 specific criteria designated in Chapter 11-54 of the Water Quality Standards, Department of Health, State of Hawai'i. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-), ammonium (NH_4^+), total phosphorus (TP), chlorophyll a (Chl a), turbidity, salinity, pH and temperature. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) are also reported. This suite of constituents will provide the basis for the initial phases of any water quality monitoring programs that might be required for regulatory compliance by State or Federal agencies. Standard laboratory procedures were followed and are described in Appendix A.

Table 3.5 shows results of all water chemistry analyses for samples collected in the vicinity of the Voyager Dive site. Table 3.6 shows of State of Hawai'i Department of Health water quality criteria for open coastal waters under both wet and dry conditions. Inspection of Table 3.5 indicates little evidence of vertical stratification of the water column at any of the sample locations. In addition there is little indication of variation between sample sites.

Comparison of the values measured at the Voyager site and State of Hawai'i water quality standards (Table 3.6) reveals that none of the measured values exceed the "not to exceed the given value more than 10% or 2% of the time" criteria for either wet or dry conditions. Based on these comparisons, it appears that at present typical water quality in the dive site area is well within DOH standards, and does not appear to be affected by any factors associated with the current activities in the area.

3.4 Ocean Activities

A comprehensive ocean activities survey was conducted during March and April, 1997 with the following objectives:

1. Observing and identifying the ocean activities at the specific project site, and in the general vicinity, the waters between Ala Wai Boat Harbor Channel and the Honolulu Harbor Main Channel (survey area).

2. Interviewing members of user groups who use the waters in the survey area, including businesses, yacht clubs and groups engaged in consumptive and non-consumptive activities.

Table 3.5. Results of water chemistry measurements from samples collected in the vicinity of the Voyager Submarine dive sites. "S" indicates surface samples; "M" indicates mid-water sample; and "B" indicates bottom samples.

SAMPLE STATION	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	DOP (µg/L)	DON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (ntu)	SALT (o/oo)	pH (rel)	Chl-a (µg/L)
1-S	4.98	0.28	1.40	65.52	11.78	111.86	16.74	113.54	0.22	34.757	8.14	0.211
1-M	4.98	0.14	1.40	64.40	11.78	107.24	16.74	108.78	0.14	34.751	8.16	0.223
1-B	4.65	0.42	1.12	65.24	10.85	112.28	15.50	113.82	0.20	34.768	8.17	0.235
2-S	4.34	0.42	0.42	61.32	11.47	121.52	15.81	122.36	0.14	34.773	8.17	0.230
2-M	4.03	0.42	0.84	61.32	9.92	82.18	13.95	83.44	0.11	34.757	8.17	0.216
2-B	4.03	0.42	0.84	61.32	11.47	106.82	15.50	108.08	0.19	34.760	8.17	0.238
3-S	4.03	0.28	0.84	63.00	11.16	89.74	15.19	90.86	0.11	34.758	8.17	0.240
3-M	3.72	0.28	0.84	59.08	11.16	96.88	14.88	98.00	0.09	34.771	8.17	0.233
3-B	4.34	0.14	1.26	57.96	9.61	83.58	13.95	84.98	0.11	34.761	8.16	0.238
4-S	3.72	0.28	0.56	76.44	10.54	106.82	14.26	107.66	0.11	34.698	8.17	0.218
4-M	3.72	0.28	0.84	70.00	10.23	86.38	13.95	87.50	0.11	34.723	8.17	0.233
4-B	3.72	0.14	1.54	68.36	11.47	100.68	15.19	102.34	0.11	34.725	8.17	0.211
5-S	3.72	0.42	0.56	60.76	10.54	114.38	14.26	115.36	0.11	34.758	8.17	0.225
5-M	3.72	0.56	1.54	58.80	10.85	103.60	14.57	105.70	0.10	34.751	8.17	0.228
5-B	3.72	0.84	0.70	56.56	10.85	123.76	14.57	125.30	0.20	34.744	8.17	0.228
6-S	3.72	0.84	0.56	61.32	10.23	116.02	13.95	119.42	0.12	34.726	8.17	0.208
6-M	3.72	0.70	1.96	61.88	10.23	117.60	13.95	120.26	0.11	34.757	8.17	0.235
6-B	4.03	0.98	1.26	60.20	12.40	186.20	16.43	188.44	0.11	34.741	8.17	0.235

Table 3.6. Specific criteria for open coastal waters based on Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards which apply to Receiving Water Limitations.

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Total Nitrogen (µg N/L)	150.00* 110.00**	250.00* 180.00**	350.00* 250.00**
Ammonia Nitrogen (µg NH4-N/L)	3.50* 2.00**	8.50* 5.00**	15.00* 0.90**
Nitrate+Nitrite Nitrogen (µg [NO3+NO2]-N/L)	5.00* 3.50**	14.00* 10.00**	25.00* 20.00**
Total Phosphorus (µg P/L)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Chlorophyll a (µg/L)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Turbidity (NTU)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**

pH units - shall not deviate more than 0.5 units from a value of 8.1.

Temperature - shall no vary more than 1 deg.C from "ambient conditions".

Salinity - shall not vary more than 10% from natural or seasonal changes considering input and oceanographic factors.

Dissolved oxygen - not less than 75% saturation.

* "wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile.
** "dry" criteria apply when open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.

3. Identifying the potential impacts of the project on the user groups in the survey area.

Information for this survey was gathered from a visits to the project site and the survey area, from interviews with people familiar with the waters and activities in the survey area, and from personal observations. Site visits and interviews were conducted during March and April 1997. The study report is enclosed in Appendix B.

3.4.1 Survey Area

The survey area includes the nearshore waters between the Ala Wai Boat Harbor Channel and the Honolulu Harbor Main Channel and extends from shore to approximately 3/4 mile offshore. The project site, the specific location where Voyager Submarines is proposing to deploy an artificial reef, is located within the survey area and is approximately 3/4 mile from the west food concession in Ala Moana Beach Park.

The survey area lies within East Māmala Bay. This shoreline is primarily artificial, the result of extensive dredging of reef area, the construction of artificial structures, and the filling of former mudflats, fishponds and shallow reefs. In spite of the alterations and artificial structures, the shoreline of the survey area still provides many opportunities for ocean activities, especially swimming, surfing, kayaking, outrigger canoe paddling, fishing and boating. It also adjoins the major shipping lanes for commercial boating traffic moving in and out of Honolulu to and from all ports east of O'ahu.

The survey area includes one boat harbor, Kewalo Basin, and is bordered by Honolulu Harbor and Ala Wai Boat Harbor. Most of the shoreline of the survey area consists of beach parks: Ala Moana Beach Park, the City and County of Honolulu's most important urban beach park, is immediately inshore of the project site and comprises the majority of the survey area shoreline; and two state parks, Kewalo Basin Park and Kaka'ako Waterfront Park, are located to the west of Ala Moana Beach Park.

Ala Moana Reef, directly inshore from the site, is approximately 1/2 mile long and 200 yards wide, extending from Magic Island to Kewalo Channel. A small portion of the reef is also found on the west side of Kewalo Channel fronting Kaka'ako Waterfront Park.

No surf breaks in the project area because of its depth, but several surfing sites are located 3,000 feet inshore along the seaward edge of the Ala Moana Reef. These sites are among the most popular and heavily used on the south shore of O'ahu. There are at least 11

primary surfing sites, and several secondary ones. They are used by surfers, bodyboarders, and bodysurfers.

Surf on the south shore is normally biggest and best for surfing during the summer months from May to August when high surf of 6 feet or greater strikes the south shores of all Hawaiian islands. However, small trade wind-generated surf of 1-3 feet breaks consistently throughout the year at all of the sites in survey area, and occasionally, high winter surf from the west or northwest will wrap into the south shore.

The entire survey area is heavily used for both commercial and non-commercial ocean activities. Most of the commercial activities take place in the open ocean offshore Ala Moana Reef, while most of the non-commercial activities take place at the edge of, on or inshore of Ala Moana Reef.

3.4.2 Fishing

Fishing is a popular activity that takes many forms in the survey area, including fishing from boats, from shore, from the edge of Ala Moana Reef, and especially along the edges of the harbor channels. A number of free swimming and schooling species are found nearshore and in the boat channels and the swimming channel at Ala Moana Beach park, including pāpio, mullet, and halalū, when they are in season. Many common reef species are found offshore of Ala Moana Reef.

- Squidding. Squidding is a local term for fishing for octopus which are commonly called "squid" by local fishermen. Squidding usually consists of wading across a shallow reef flat with a glass-bottomed look-box and spearing octopus hiding in the rocks. The number of users depends on the day of the week and the level of the tide. The most popular days are Saturdays, Sundays and holidays during daylight hours when the tide is at its lowest. The number of users averages approximately 2 per day on weekdays and 5 per day on weekends and holidays.

- Surfboard fishing. Surfboard fishing is a form of boat fishing in which a motorized surfboard is substituted for a small boat. The boards are 13 feet long, 40 inches wide and weigh about 60 pounds. They are powered by a 5 horsepower outboard engine. The fishermen motor along at a slow speed and scout for fish by hanging over the edge of the board while wearing a mask and snorkel. Whey they spot a fish, they use a rod and reel to lower a hook to tempt the fish.

The surfboard fishermen in the survey area do not target fish. They fish exclusively for octopus or "tako" as they call them, the Japanese word for octopus, using a star hook instead of a regular fishing hook. They launch their surfboards at the Ala Wai Boat Harbor ramp and search for productive octopus grounds in waters from 30 to 120 feet deep anywhere from Waikīkī to Sand Island. They note that the ocean bottom in the survey area is generally regarded as marginally productive for reef fish, but that it provides good habitat for octopus. They consider the entire survey area to be good octopus grounds, but in the area of the project site, they usually fish in the shallower waters closer to shore and not where the submarines are operating. The number of surfboard fishermen averages 1 per day on the weekdays, and 2 per day on the weekends and holidays.

- Netting. Very little subsistence gill net fishing and thrownet fishing occur in the survey area. Both types of net fishing are normally practiced on at the west end of Kaka'ako Waterfront Park. The number of thrownet fishermen averages approximately 1 per day on weekdays, and 2 per day on weekends and holidays.

Commercial surround net fishing operations to catch migrating schooling fish such as akule are an infrequent activity in the survey area.

Commercial underwater surround net fishing is also an infrequent activity in the survey area. Instead of using surround nets on the surface, the fishermen use scuba gear to set up surround nets underwater into which they herd schooling reef fish such as weke, mū, kūmū and ta'ape. These commercial operations occur in waters from 40-100 feet.

Crab netting inshore for crabs such as Samoan crabs or offshore for deep water crabs such as Kona crabs is an infrequent activity. In addition, the boulder seawalls in the survey area are populated with a'ma crabs, a popular luau food, but the populations are not large enough to encourage large scale gathering.

- Pole fishing. A number of free swimming and reef species are found nearshore and in the boat channels and the swimming channel at Ala Moana Beach Park, including pāpio, mullet, and halalū when they are in season. Pole fishing, especially whipping, occurs along the boulder seawalls, the harbor channels, the Ala Moana Beach Park swimming channel and along the edges of Ala Moana Reef, especially at low tide. Other pole fishermen such as shore casters fishing for ulua are found at Kaka'ako Waterfront Park. Some pole fishing for 'oama occurs in Ala Moana Beach Park during the summer months when these juvenile goat fish school in shallow, sandy areas around the island. The number of pole fishermen averages approximately 5 per day on weekdays and 10 per day on weekends and holidays.

Some pole fishing occurs from boats offshore. These are primarily small boats less than 20 feet long which are allowed to drift with the wind while fishing with a rod and reel. This type of drift fishing normally occurs seaward of the survey area.

Some catamaran sailors and kayak paddlers attach fishing poles or handlines to their crafts and troll for pāpio and other species as they transit the area.

- Spear fishing. Spear fishing primarily by subsistence fishermen occurs at the edge of Ala Moana Reef and offshore Kaka'ako Waterfront Park. The spear fishermen access the area offshore Ala Moana Reef by boat, while at Kaka'ako Waterfront Park they usually swim out from shore. Spear fishing also occurs on the University of Hawai'i Look Laboratory's artificial reef which is in 40 fee of water on the west side of Kewalo Basin Channel. Spearing for fish and octopus by commercial fishermen averages approximately 10 per day on weekdays and 20 per day on weekends and holidays.

Torch fishing is an infrequent activity on Ala Moana Reef. It normally occurs on dark, moonless nights, for night octopus and reef fish such as weke and kūmū.

- Trapping. The only trapping in the survey area is done by one commercial trap fisherman. He is a Hawaiian who, with his family and friends, has been trapping for fish there for over 30 years. One of his trap sites is located along the present submarine tour route. He notes that this is the only place in the area that is productive for fish. Other trap fishermen are located to the west of him. They have an informal agreement to stay out of each other's areas. His area is from Waikīkī to the Reef Runway.

- Tropical fish collecting. Tropical fish collecting is an infrequent activity in the survey area. The number of tropical fish collectors averages approximately 1 per day on weekdays, weekends and holidays.

- Commercial cruise boat fishing. Approximately two years ago, one of the cruise boats from Kewalo Basin started offering nearshore night fishing charters. Catering almost exclusively to Japanese tourists, the tour goes into the survey area seaward of Ala Moana Reef in 50 feet of water and lets their passengers fish for reef fish such as ta'ape and menpachi with rods and reels. Now there are approximately four cruise boats who offer similar night fishing cruises in the same location. These cruises usually run for several hours in the early evening just after the sun sets.

- Commercial charter boat fishing. Commercial charter boat fishing is an infrequent activity in the survey area. Most commercial charter fishing boats only pass through the survey area when they enter or exit Kewalo Basin. They normally do not fish near shore and may range as far as 20 miles offshore the island.

3.4.3 Gathering

Certain sections of the survey area's shoreline are artificial and consist of massive boulder seawalls. In other areas similar boulder structures provide habitats for 'opihi and other gathered shellfish, but few are found in the survey area. In addition, the extensive reef flat of Ala Moana Reef provides a habitat for various species of seaweed, but the two most popular species for consumption, manauea and ogo, are so scarce that seaweed gathering is regarded as an infrequent activity for the survey area.

3.4.4 Outrigger Canoe Paddling

Outrigger canoe paddling is Hawaii's official ocean team sport, and annually attracts approximately 10,000 participants statewide. The short course regatta season begins in the spring and ends with the state championships in August. Then the long distance racing season begins, ending with the Moloka'i-to-O'ahu race in October.

Approximately 12 of Oahu's canoe clubs train in the survey area. The majority of them are headquartered along the Ala Wai Canal and use the canal for training until August. After August they begin long distance training and leave the canal to paddle in the open ocean. A popular training course is from the outside harbor markers at the Ala Wai to the outer markers at Kewalo Basin. Training runs on this course can be easily timed, and several clubs are frequently present at once. Since this is a clean water area, it is also used to practice crew changes. Changes occur during long distance races when one paddler replaces another. An escort boat will drop one paddler (or more) into the ocean ahead of the canoe. When the canoe comes abreast of the paddler(s) in the water, the paddler(s) in the boat who are being replaced jump out and their alternates climb in. The escort boat then retrieves the paddler(s) in the water. Most practices occur after 5 PM in the evening, and the course runs inshore of the proposed wreck site.

Outrigger canoes also transit the waters of the survey area during the races. During the long distance season approximately 10 races are held, a few of which transit the survey area.

3.4.5 Kayaking

The waters in the survey area are a transit area for kayakers who have launched their craft

in other areas. During the spring and summer months long distance kayak races are held on O'ahu; one formerly used course finished at Kewalo Basin Park and passed through the survey area.

3.4.6 Recreational Power Boats

Recreational power boats are common throughout the survey area. The majority of them are owned by fishermen and are launched from either Ala Wai Boat Harbor or Ke'ehi Boat Harbor.

3.4.7 Parasailing

Parasailing, towing someone in a parachute with a high speed power boat, is a commercial activity that occurs seaward of the survey area. The Hawaii Administrative Rules, Part III, Ocean Waters Navigable Streams and Beaches (effective Feb. 24, 1994) by the State Division of Boating and Ocean Recreation regulates the activity and confines it to specific areas around the island. Paragraph 13-256-92 South Shore Parasail Area states the following for the area seaward of the survey area:

1. The boundaries of the South Shore Parasail Area are from the buoy R-2 of Kalihi Channel entrance; then by straight line to buoy G-1 of the Ala Wai Channel; then by straight line to buoy R-2 off Diamond Head. All operating parasail vessels shall operate seaward of the boundary line.
2. No person shall operate a parasail aloft within 1000 feet of any channel entrance buoy.
3. No more than 4 commercial operating area use permits shall be authorized in this area.
4. No permittee shall operate more than one vessel with a parasail aloft at any one time.
5. This area shall be closed to parasail operations from January 6 to May 15 of each year.
6. The boundaries of the South Shore Alternate parasail Area are from the buoy R-2 of Kalihi Channel entrance; then by straight line to buoy R-2 off Diamond Head. All operating parasail vessels shall operate seaward of the boundary line.
7. The South Shore Alternate Parasail Area is designated for parasail operations from January 6 to May 15 of each year. (The same restrictions listed above for the South Shore parasail Area apply to the alternate area.)

3.4.8 Reef Walking

Reef walking is an infrequent low tide activity on Ala Moana Reef. Some individuals and families go on their own, but most of the reef walks are organized and conducted by an experienced leader, usually a school teacher. The reef flat is recognized by the Department of Education as an educational reef walking site and is listed in its manual A Compendium of Coastal Field Sites as "Kewalo Basin". The site is accessed from Kewalo Basin park and is considered to be a good area for viewing fish, seaweed and invertebrate organisms such as sea anemones, shells, sea urchins, and brittle stars.

3.4.9 Scuba Diving

Recently, the City and County of Honolulu, Department of Parks and Recreation stopped issuing permits for commercial introductory scuba diving classes in the Ala Wai Channel at the east end of Magic Island. Prior to this, the introductory scuba diving for visitors, primarily Japanese visitors, was a common scuba diving activity in the survey area. Introductory classes were held in the Ala Wai Channel at the east end of Magic Island in Ala Moana Beach Park. The channel offered one of the few scuba diving sites near Waikīkī that is easily accessible by land. Introductory classes were offered by: Sunshine Scuba, Hawaii Pro Dive, Breeze Hawaii, Ocean Concepts, Fantasea and Island Divers. Aaron's Dive Shops, other diver shops and independent dive instructors offered introductory and advanced classes to visitors and residents, especially during the winter months when high surf precludes the use of west and North Shore dive sites. Some dive shops also offer boat dives in the survey area, but this was a less frequent activity than the introductory shore dives.

Other survey area users who scuba dive include spear fishermen, underwater surround net fishermen and members of the Honolulu Fire Department's rescue squads conducting training. HFD has two heavy rescue squads. Rescue 1 and Rescue 2, and their members periodically do training dives seaward of Ala Moana Reef.

3.4.10 Sailing

Both the Hawaii Yacht Club and the Waikīkī Yacht Club are headquartered in the Ala Wai Boat Harbor, and their members regularly transit the survey area. In addition to general sailing traffic, every Friday night at 5:30 p.m. Waikīkī Yacht Club members hold their Friday Night Race. The race course goes from the outside buoy of Ala Wai Channel to the outside buoy of the Honolulu Harbor Main Channel and back. The course of this race, however, usually keeps their boats outside the survey area. Some night sailing occurs in the survey area by boats from the yacht clubs.

Competitive sailing in Honolulu takes three forms: local yacht club races, large scale professional competitive race series based out of Honolulu such as the Kenwood Cup and races in which Honolulu is the final destination such as the Transpac. The Transpac and the Kenwood Cup occur on alternate years. Competitive sailing yachts transit the water offshore the survey area during certain legs of their races.

3.4.11 Research Activities

For the past 15 years the Look Laboratory of Oceanographic Engineering, University of Hawai'i has had an in-water Test Range in approximately 40 feet of water on the west side of Kewalo Basin Channel . The range includes two artificial reefs, one constructed of automobile tires and one constructed of concrete blocks, and two flat 8' x 8' platforms constructed out of fiberglass I-beams and PVC decking that are used for mounting instruments. This site and other nearby sites within the general area have been used by members of the Look Laboratory staff to conduct a variety of ocean engineering tests, including instrumentation tests, drogue and dye studies, and sampling water for turbidity, salinity and temperature. Many of these activities are conducted each summer by students who are taking ocean engineering classes.

Prior to the commencement of Voyager's submarine tours, limited research activities were conducted on the east side of the Kewalo Channel, in the immediate vicinity of the present submarine operations. Look Lab's activities in this area consisted of attaching taut line moorings and instrument strings to concrete blocks on the ocean bottom and monitoring the wave and current measurement instruments.

3.4.12 Sunbathing and Swimming

Sunbathing and swimming are the two most popular activities in the survey area. Sunbathers and swimmers are concentrated primarily at Ala Moana Beach Park, including the Magic Island lagoon at the east end of the park. The City and County of Honolulu's Water Safety Division normally staffs all five of its lifeguard towers daily to watch the large numbers of swimmers. The beach is especially attractive to families with children.

- Open Ocean Swimming. Ala Moana Beach Park is fronted by a 1000 meter long channel that was originally dredged as a boat channel between Ala Wai Boat Harbor and Kewalo Basin. The portion of the channel fronting the park was isolated by the construction of landfills at either end, and now offers an excellent venue for protected open ocean swimming. It is used daily by members of the Waikīkī Swim Club, Hawaii Swim Club Masters, other swim clubs and by many independent swimmers. However, the ocean

swimming in the survey area is confined to the channel, and no open ocean swimming occurs outside Ala Moana Reef. An annual five mile, long distance swim starts at Kaimana Beach at Diamond Head and turns around at the Ala Wai Channel buoy at eastern edge of the survey area, but the swim does not enter the survey area.

3.4.13 Surfing

At least 11 primary surfing sites are located along the seaward edge of Ala Moana Reef, and they are from east to west: Islands, Americas, Bombora, Baby Hale'iwa, Big Lefts, Courts, Concessions, Big Rights, Shallows, In Betweens, and Kewalos. Each of these sites may attract from 20-40 surfers and bodyboarders, so during periods of high surf there may be over 400 surfers in the water offshore Ala Moana Beach Park. Surfing contests are occasionally held at Courts and Kewalos.

One primary surfing site, Point Panic, is found to the west of Kewalo Channel fronting Kaka'ako Waterfront Park. It is reserved exclusively for bodysurfing and is the site of an annual bodysurfing championship put on by the Honolulu Bodysurfing Club. The Hawaii Administrative Rules, Part III, Ocean Waters, Navigable Streams and Beaches (effective Feb. 24, 1997) by the State Division of Boating and Ocean Recreation regulates the activities there. Paragraph 13-254-13 contains the rules governing the Point Panic Ocean Waters which includes the following: a. No person shall operate a surfboard in the restricted area of the Point Panic Ocean Waters, and b. Point Panic Ocean Waters are primarily reserved for bathing, swimming, bodysurfing and paipo board riding.

3.4.14 Tour Boats

Most of the O'ahu tour boat industry operates between Hawai'i Kai and Pearl Harbor. The vessels range from tourist catamarans to 100 foot cruise vessels that offer tourists dinner cruises and various excursions. Some of the largest vessels are berthed in Honolulu Harbor, but the majority of them are kept in Kewalo Basin, a 126-slip harbor used exclusively to berth commercial boats. The balance of the slips are filled by commercial fishing boats that do not offer cruises or charters. In general, the majority of the boats in Kewalo Basin pass through the survey area only when the enter or exit the harbor through Kewalo Basin Channel. The charter fishing boats may fish out to 20 miles offshore of the island, and the cruise boasts usually tour seaward of the survey area. However, there are several exceptions, one of which was noted previously. Several cruise boats now offer night fishing tours immediately seaward of Ala Moana Reef. In addition, some of the cruise boats that conduct evening dinner and nightclub cruises also come closer to shore at night and transit the same area. Other exceptions during the day include boats that offer glass bottomed boat tours. They tour immediately seaward of Ala Moana Reef, but inshore of the project site.

3.4.15 Boating Traffic

A survey of boating traffic in the vicinity of the Voyager dive site was conducted on May 1, and December 16, 17 and 21, 1997. All vessels passing within 1500 feet of the Voyager site were logged and described. The data is presented in Appendix C and summarized in Table 3.7. Weather and sea conditions were typical of nice boating weather on the south shore of O'ahu--- clear to partly cloudy skies with light to normal northeast tradewinds and small surf, with the exception of 12/17/97, when morning skies were overcast. Survey days included Tuesday, Wednesday, Thursday and Sunday. The number of vessels recorded passing within 500 feet of the site ranged from an average of 4.6 per hour on 12/21/97 to 1.8 per hour on 12/17/97 when skies were overcast. Vessel sizes ranged from the 232-foot long "Star of Honolulu" tour boat to 8-foot long pleasure kayaks.

Also included in the Table 3.7 are similar survey data collected in the area in 1986, when Atlantis Submarines was investigating possible operating sites (AECOS, 1987). That survey recorded slightly greater numbers of vessels passing through the area, averaging 4.9 vessels per hour during submarine operating hours. This data suggests that vessel traffic has declined slightly between 1986 and 1997.

Table 3.7 Vessel Traffic Survey in the Vicinity of the Voyager Submarines Dive Site

Date and Day	Survey Time	No. of Vessels Within 500 Ft.	Vessels/Hr	Total Vessels
Thursday, 5/1/97	8:30-15:55	28	4.1	56
Tuesday, 12/16/97	8:00-14:52	25	3.6	35
Wednesday, 12/17/97	7:05-14:16	13	1.8	23
Sunday, 12/21/97	8:30-15:55	31	4.6	90
Tuesday, 12/23/86	9:15-16:00	33	4.9	67
Sunday, 12/28/86	9:15-16:00	33	4.9	66

4.0 RELATIONSHIP TO LAND USE PLANS, POLICIES AND CONTROLS

Submerged lands in Hawai'i are deemed to be in the Conservation District, and are governed by the Department of Land and Natural Resources through the submittal of Conservation District Use Applications (CDUA), and issuance of board or departmental permits. This project involves the use of submerged lands classified in the resource subzone, and will require a board permit. The Department of Land and Natural Resources is therefore the approving agency. The objective of the resource subzone is "to develop, with proper management, areas to ensure sustained use of the natural resources of those areas" (Hawaii Administrative Rules, 13-5-13). The proposed project includes identified land uses permitted in the resource subzone (R): R-2, artificial reefs D1; and R-6, marine construction (installation of mooring buoy anchors/anchor pins, D1 (HAR, 13-5-24). A board permit is required for this use. *Voyager's understanding is that land disposition will be by a direct non-exclusive easement to Voyager, and that, prior to the issuance of the easement, Voyager will be required to obtain Legislative approval by concurrent resolution and Governor approval. Submerged lands are designated as ceded lands. Ceded lands are held in trust by the State, and the appropriate use of ceded lands remains an unresolved issue.*

The permits required for the proposed project and their status are outlined below:

- Department of Land and Natural Resources, Conservation District Use (CDUA) - The CDUA has been submitted, and was accepted for processing on August 5, 1997.

- Department of the Army, Section 10 and Section 404 - The DA permit application was submitted on May 15, 1997. A PROVISIONAL PERMIT was issued on September 24, 1997. Following receipt of the signed permit documents from Voyager Submarines, The Corps is prepared to issue a valid DA permit authorizing the reef installation to proceed. The DA permit correspondance is included in Sections 14 and 15.

- Department of Health, Section 401 Water Quality Certification - The Section 401 WQC was issued on October 13, 1997. The 401 WPC correspondance is included in Section 15.

- Office of Planning, Coastal Zone Management Program Certification of Consistency - The CZM Consistency Certification was submitted on June 4, 1997. On August 25, 1997 the project was determined to be consistent with Hawaii's CZM program

(see Section 15 for correspondance), on the conditions that the project features outlined in the Environmental Assessment and this Environmental Impact Statement are implemented. These features included: thoroughly cleaning the ships; compliance with State DOH water quality standards; use of concrete ballast; orienting the ships perpendicular to shoreline to minimize wave forces on the vessel; and that mooring buoys on the sunken vessels are dedicated for public use.

Main aspects of the State's Environmental Policy (Hawaii Revised Statutes, 344-3) are to conserve natural resources, enhance the quality of life through industries which are stable and in balance with the environment, and enhance the quality of life by establishing a commitment on the part of each person to protect and enhance Hawaii's environment and reduce the drain on nonrenewable resources. This project and the Voyager submarine tours are good examples of projects and an industry that are consistent with the State's Environmental Policy, particularly those facets of the policy listed above. The vessels sunk on the site will be carefully prepared to serve as artificial reefs to promote coral and fish growth. The mooring buoys placed in the vicinity will eliminate the need for anchoring in the area, which is extremely destructive to corals. These steps will not only help conserve Hawaii's underwater marine resources, but will also enhance them. By promoting fish and coral growth, the reefs will also improve the submarine tours, thereby encouraging an industry that is in harmony with the environment. The submarine tours educate visitors on Hawaii's unique environment, and help foster a commitment to protect and enhance these resources.

The proposed project is also consistent with State and National programs and policies. Hawai'i initiated artificial reef development in the late 1950s to increase and improve fishing opportunities for local fisherman (Kanenaka, 1994). This program continues today, and has resulted in the creation of four artificial reefs, three around O'ahu and one in Maui. The program has also included the sinking of 5 vessels in nearshore waters around O'ahu, and several others in deeper water.

In 1985, a National Artificial Reef Plan was developed at the direction of the National Fishing Enhancement Act of 1984 to enhance and diversify fishery resources, increase fishing opportunities, and contribute to coastal economies. The plan presents technical quidelines for creating and deploying artificial reefs. Steel ships are described as having been successfully used as artificial reefs worldwide, and that they can provide excellent diving and fishing opportunities (NOAA, 1985). The proposed project follows guidelines presented in this national plan.

5.0 PROBABLE IMPACTS

Potential impacts of the proposed project can be categorized into initial impacts associated with artificial reef and buoy installation, and longer term impacts associated with the established artificial reef and diving operations. These are discussed below.

5.1 Impacts During Installation

As discussed in Section 2.2.4, the at-sea artificial reef deployment and installation should be completed in one day per ship. Impacts should therefore be minimal. Possible impacts include the introduction of pollutants into the water during sinking, damage to organisms on the seafloor; and disruption of boating and ocean activities.

5.1.1 Introduction of Pollutants Into the Water During Sinking

The ships will be cleaned to U.S. Coast Guard, EPA and State DOH standards. Petroleum products, potentially toxic materials and floatable debris will be removed. The ships will be subject to inspection prior to deployment. A containment plan will be developed as a precautionary measure in the event that unforseen pollutants are introduced into the water.

5.1.2 Damage to Seafloor

A possible impact during installation is damage to marine organisms on the seafloor by uncontrolled sinking of the ship. This will be minimized by carefully locating and preparing the reef deployment site and ship prior to sinking. The reef sites have been carefully selected on barren sand characterized by very limited macrobiota and fish occurrence (Dollar, 1997; Appendix A) at least 100 feet from sensitive coral areas. Furthermore, the few bottom dwelling organisms that may occur on the specific ship sites should be a very minor component of the community. Sand flats extend nearly continuously across Māmala Bay at a depth of 100 to 130 feet.

The precise location of the reef site will be marked with taut buoy, and a three or four point mooring system for the ship will be emplaced prior to towing the ship to the site. The ship will be ballasted to the maximum extent possible prior to towing to the site. The anchors will be widely spaced, with a great deal of scope on the mooring lines. The pre-weighting of the vessel and the widely spaced mooring system will allow precise control during sinking; it is estimated that the vessel can be sunk within 20 feet of the desired location.

5.1.3 Disruption of Boating Traffic and Other Ocean Activities

There may be temporary disruption of boating traffic and ocean activities during the day of the towing of the vessel and sinking operations. The ocean activities survey conducted for this project indicated that these impacts would be minimal. The present area users are primarily fishermen, sailors, and canoe paddlers who are only transiting the area in their respective boats. They typically pass either seaward or shoreward of the Voyager support boats. Impacts will be further minimized by preparing the reef site and ship prior to towing the ship to the site. For example, the ship will be ballasted to the maximum extent possible at dockside, and the ship mooring system will completed prior to towing the ship to the site. At sea operations should be completed in one day. The sinking and towing operations will be closely coordinated with the U.S. Coast Guard.

Installation of the mooring pins and submerged buoys will entail the use of hand-held hydraulic tools. This small scale work can be undertaken from a small boat and will be completed by scuba divers in one or two days. Impacts should be therefore be minimal.

5.2 Long Term Impacts

Voyager proposes to place two vessels on their dive site off of Ala Moana Beach Park to serve as artificial reefs to enhance the marine habitat and promote coral and fish growth. Long term impacts of this project include those to the marine environment, to other ocean activities and users in the area, and economic impacts. These are discussed below.

5.2.1 Marine Environmental Impacts

Artificial reefs have been extensively used around the world, in the U.S., and in Hawai'i to enhance fisheries. Between 1984 and 1994, for example, 21 coastal states in the U.S. deployed over 220 artificial reefs in marine and estuarine areas; in total, there are over 650 artificial reef sites in U.S. coastal waters (Berger et al., 1994). The State of Hawai'i began an artificial reef deployment program in the late 1950s that now includes shallow water sites offshore of Wai'anae, O'ahu, in Maunalua Bay, O'ahu, offshore of Keawakapu, Maui, and a deepwater site in 'Ewa, O'ahu. These reefs have included several vessels.

Numerous studies have been completed on the impacts to the marine environment of artificial reefs. The study results have consistently shown artificial reefs to be effective for enhancing reef habitat and increasing fish biomass within the reef site. For this reason, and to combat habitat destruction due to overfishing and environmental degradation, the National Fishing Enhancement Act of 1984 directed the National Oceanographic and Atmospheric Administration (NOAA) to develop and publish a long-term National Artificial

Reef Plan to promote and facilitate responsible and effective artificial reef use (NMFS, 1985). The plan states that "properly constructed artificial reefs can enhance fish habitat, provide more accessible quality fishing grounds, benefit anglers and the economies of shore communities, increase total fish biomass within a given area, and provide managers with another option for conserving and/or developing fishery resources" (NMFS, 1985).

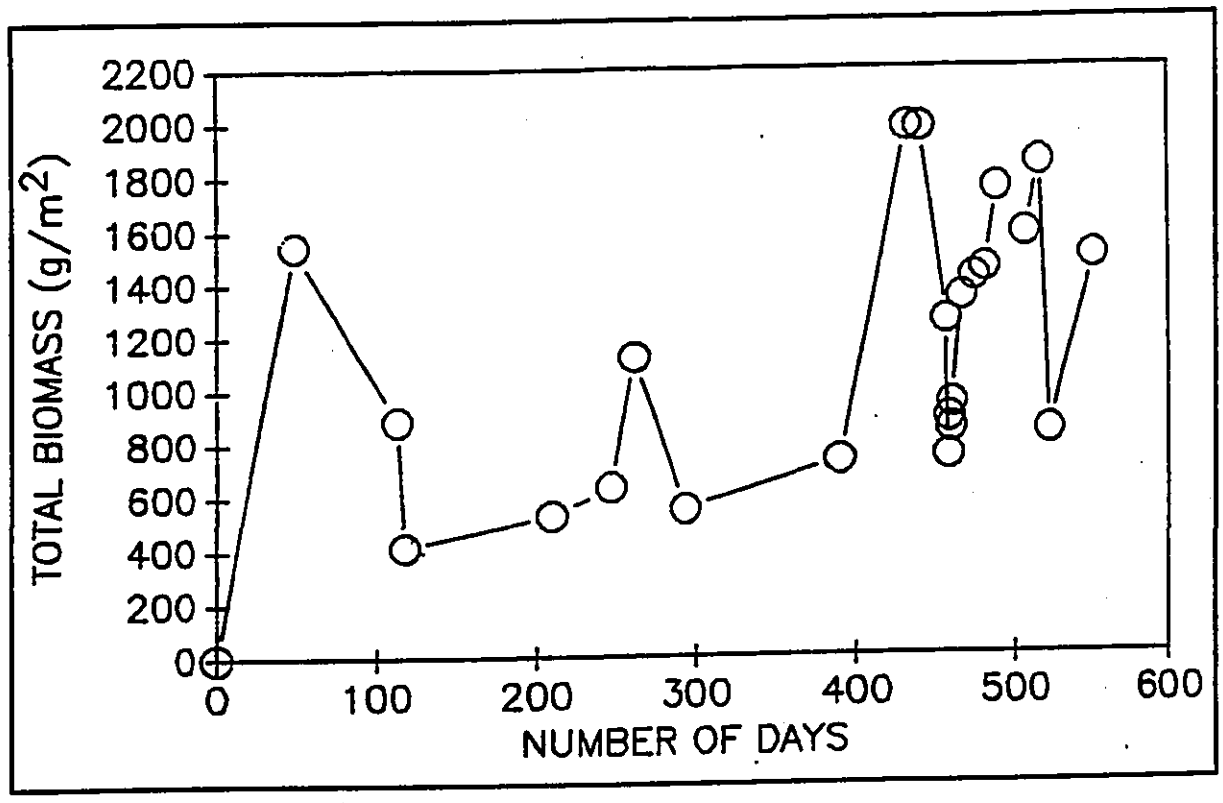
Locally, research has focused on the effects of the State artificial sites, and the Atlantis site. The State program includes artificial reefs constructed of vessels, tire modules, concrete building materials, concrete pipes, mid-water fish aggregation devices (FADs), auto bodies and specially constructed modules. Surveys conducted periodically at the four State artificial reef sites have shown that the reefs have attracted and sustained large numbers of fish and other marine life to previously barren areas (Kanenaka, 1991).

In 1989, because of poor fish community development at their dive tour site, Atlantis Submarines sank a 174-foot long ship at the site to develop additional benthic habitat and enhance the abundance of marine resources. The Atlantis project provides a unique basis for evaluating the possible impacts of the Voyager project because of the many similarities between the Atlantis project and the proposed Voyager project. The similarities include the following: 1) the same general location --- at a depth of 100 feet in eastern Māmala Bay (Figure 3.1); 2) similar reef materials are being used --- vessels properly prepared by opening up the hulls and decks to water circulation and light; 3) the same use activity --- submarine dive tours.

Brock (1994) has monitored the effects of the sunken Atlantis vessel on fish communities in the area. Visual censuses of the fish community were conducted prior to ship sinking, and for 550 days following ship sinking (Brock, 1994). These results are presented in Figure 5.1. Prior to the artificial reef deployment, the visual censuses measured an estimated standing crop of only 0.6 g/m^2 at the ship site, and 44 g/m^2 on the limestone flat adjacent to the site. Following the ship deployment, the abundance of fish dramatically increased; the mean standing crop of fishes during the 550 days of measurement was estimated to be 1165 g/m^2, an increase of more than three orders of magnitude at the ship site, and a more than 25-fold increase relative to the adjacent limestone flat (Brock, 1994). Great fluctuations were also observed in the estimated fish crop due to fishing activity.

Recruitment and growth of corals on the sunken vessel were also monitored on the sunken ship for five hundred and nine days after deployment (Brock et al, 1994). This study found rapid growth of coral; approximately 250 colonies of *Pocillopora meandrina* and *Porites lobata* were measured on upper surfaces of the ship, the largest measuring 129-299 cm^2 and

Figure 5.1. Estimate fish biomass from September 1989 to January 1991 on the Atlantis sunken ship (from Brock, 1994).



the smallest 5-28 cm^2. The metal surface, strong currents and heavy grazing may promote rapid growth on the sunken ship (Bailey-Brock et al, 1994).

Inspection of the wreck in April 1997 to assess possible impacts of the proposed Voyager artificial reef revealed continued coral growth and colonization (Dollar, 1997; Appendix A) High densities of corals were colonizing the horizontal decks of the sunken ship. Colonizing corals were primarily *Pocillopora meandrina* and *P. eydouxi*, with an estimated density of 3 colonies per square meter. The only other corals noted were small (less than 10 cm in diameter) colonies of *Porites lobata*. Corals were also observed on the vertical surfaces of the ship's hull, and in the interior spaces. However, only a few such corals were noted, and their occurrence on these surfaces was very rare compared to abundance on the horizontal decks. Similarly, corals on the natural substratum surrounding the ship were rare, in part because basalt gravel used to anchor the hull had spilled out of the ship and covered the surrounding bottom.

Sunken vessels have also been observed to be a resting place for green sea turtles.

An unresolved issue is whether artificial reefs actually increase the production of fish, or simply aggregate fish from the surrounding area. Numerous studies indicate that they probably do both (Brock, 1987). Brock cited circumstantial evidence from studies conducted in Maunalua Bay, O'ahu, suggesting that artificial reefs do enhance local fishery stocks. This enhancement occurs because the systems are probably shelter limited, rather than food limited; the artificial reefs provide much needed shelter to the fish communities. More recent research conducted on the Atlantis sunken ship, however, also revealed that the high fish catch around the ship is probably far in excess of in situ production (Brock, 1994). This suggests that much of what is being caught are fish that have been attracted to the reef.

There is also a concern that the aggregation of fish in the area will attract sharks, and may therefore increase the risk of attack to users in the area. Data available on artificial reefs in Hawaiian waters indicates that this concern is unfounded. This worry was voiced in particular during the period when Atlantis personnel were feeding fish at their site. In response to this perceived risk, fish feeding was limited, and the State of Hawai'i Legislature requested that DLNR study the correlation between artificial reefs, fish feeding and shark risks to inshore recreational users. This study was completed in 1994 (DLNR, 1994), and could not show a relationship between artificial reefs, fish feeding and risks from sharks. In fact, the DLNR study did not observe any sharks at the Atlantis site, but did observe sharks at a nearby natural reef that was used as a control site. Similarly, Brock (1995) states that in 31 years of underwater surveying, representing hundreds of censuses, he has sighted

a number of sharks over natural substratum, but never around an artificial reef. This includes over 300 manhours deploying, constructing and monitoring the artificial reefs in Moanalua Bay from 1985 to 1989, and over 200 manhours surveying the Atlantis artificial reef. Only a small whitetip reef shark was sighted at the Atlantis reef (Brock, 1995). Furthermore, from 1779 through 1995, there have been 112 encounters with sharks; none have occurred on any of the Hawaiian artificial reefs (Brock, 1995). The only documented shark encounter in the Waikiki area occurred in the 1950s and was apparently provoked.

The most comprehensive data set has been compiled by the Atlantis submarine pilots (Brock, 1995). Beginning in 1993, they have compiled 20,200 hours observing and logging unusual marine sitings, including sharks. Only 8 large, potentially dangerous sharks (defined as all sharks 8 feet or greater, and all tiger sharks of any size) have been sited. This is equivalent to one shark per 2527 hours of observation (Brock, 1995). Only 27 potentially aggressive sharks have been sited, equivalent to one shark per 749 hours of observation. These are defined as tiger, gray reef and hammerhead sharks, as well as any unidentified shark greater than 4 feet in length and any unidentified shark where size was not noted.

Brock (1995) concludes that although there is no controlled study with which to definitively evaluate the shark observation data described above, the data collected to-date suggests that the Atlantis artificial reef is not particularly attractive to large sharks or shark species that are dangerous to humans.

In summary, artificial reefs have been shown to be effective in enhancing reef habitat and increasing fish biomass in the reef site. A National Artificial Reef Plan has been developed to promote and facilitate effective use of artificial reefs because artificial reefs have been shown to increase fish habitat and fish biomass within a given area, and provide managers with options for conserving or developing fishery resources (NMFS, 1985). Sunken ships have been successfully used as artificial reefs, acting as a high profile benthic reef, and providing excellent diving and fishing opportunities (NMFS, 1985). Research conducted on the Atlantis sunken ship has revealed dramatic increases in fish populations in an area that was nearly featureless and devoid of substantial biotic community. The ships also resulted in rapid coral growth. On the decks of the ships at the Atlantis site, coral abundance is substantially higher than on the surrounding natural substratum. The proposed Voyager project to sink two ships to serve as artificial reefs, and place submerged mooring buoys at the site, should therefore result in a long term beneficial impact to the marine environment.

5.2.2 Possible Impacts During Storms

The Atlantis artificial reef has illustrated two possible impacts to the marine environment

that could occur during storm conditions: displacement of gravel ballast from the ship to the surrounding seafloor, and movement of the ship itself. The sunken yard oiler at the Atlantis reef site was ballasted with gravel. During Hurricane 'Iniki, much of the gravel was transported out of the ship's hull and deposited on the surrounding bottom. Movement of this gravel during future storms may result in damage to surrounding benthos. This problem will be avoided in the Voyager artificial reefs by using concrete to ballast the sunken ships. Concrete has been found to be an excellent artificial reef material. It is highly durable and stable, and can be cast into a variety of shapes (NMFS, 1985). Experiments conducted in Kāne'ohe Bay also found concrete to be highly favorable for growth of coral and other sessile organisms (Fitzhardinge and Brock, 1989). This study recommended concrete for reef construction because it has a similar texture and chemical composition to coral, and is durable in seawater.

Storm waves produced by Hurricane 'Iniki also caused the Atlantis sunken ship to move. Movement by a sunken ship could cause damage to coral and other benthic organisms in the area. Recent hurricanes and analyses conducted by Sea Engineering (SSFM, 1994) indicate that previously used design wave heights may be significantly undersized. These analyses have shown that the appropriate deepwater design wave height for the south shore of O'ahu (Table 3.3) may be up to 70% higher than those used in the past.

Voyager will avoid possible impacts to the marine environment caused by ship movement during storms by utilizing the much more conservative wave heights (Section 3.1.5) for the ship anchoring analysis. This should result in sufficient concrete ballast being placed in the ships to prevent movement during severe storms and hurricanes.

5.2.3 Economic Impacts

Voyager is part of the rapidly growing recreational diving industry and ocean recreation industry. The ocean recreation industry was projected to generate $748 million in 1995 (Tabata and Reynolds, 1995). The recreational diving industry (excluding submarine operators) grew from $7 million in revenues in 1982 to $27 million in 1990. Atlantis submarine revenues in 1990 were estimated to be $8.05 million in O'ahu alone (Brock, 1994). Thus, Voyager is part of a rapidly growing and increasingly important industry group in the Hawai'i economy. The rapid growth underscores the importance of protecting and managing the ocean resources that support the industry. Priority areas for improvement and assistance that were cited in a survey of industry members include creating artificial reefs for habitat enhancement, and promoting the use of day-use moorings to prevent anchor damage to corals (Tabata and Reynolds, 1995). The proposed Voyager project will help fulfill these needs, and thus benefit the industry.

Brock (1994) also conducted an economic analysis of the use of the Atlantis sunken ship reef. He concludes that deployment of the artificial reef for non-consumptive uses such as a dive tour destination is the best use of the artificial reef. Returns from consumptive uses are estimated to be only 4% of the annual net profit of the dive tours at the Atlantis site. Furthermore, siting artificial reefs for non-consumptive purposes in unproductive areas with poorly developed marine communities serves to decrease use and pressures on nearby more productive and pristine habitats (Brock, 1994).

5.2.4 Ocean Activities Impacts

Table 3.7 presented results of vessel traffic surveys conducted in submarine operating area for this project and also in 1986 for Atlantis Submarines. The recent surveys illustrated that the number of vessels transitting within 500 feet of the site ranged from 4.6 per hour to 1.8 per hour on a day with overcast morning skies. This activity was slightly less than activity recorded in 1986, when an average of 4.9 vessels per hour were recorded.

Future additional traffic at the site can be estimated utilizing current activity at the Atlantis artificial reef sites. Atlantis reports that an average of 6 vessels daily utilize their reef sites. A similar number can be expected to utilize the Voyager reef sites. This increase is equivalent to slightly less than 1 boat per hour, and is not expected to impact public safety or cause hazards. Voyager intends to minimize possible hazards by facilitating access to the site. Surface bouys will be attached daily to submerged bouys marking the artificial reef locations. The surface bouys will show boaters and users where the sites are, and will provide safe, easy mooring. The surface bouys will also prevent anchoring, which is destructive to coral, and hazardous to divers. Furthermore, in the event of an emergency, Voyager has support vessels continuously stationed at the site during operating hours, equipped with first aid equipment and operators, and constant communications to shore.

Possible impacts to existing users and futures site users are further discussed below.

Existing Site Users: At present there are only two users who conduct activities on the ocean bottom in the immediate area of the project site: the ocean engineering students and staff of the University of Hawaii's Look Laboratory, and one commercial trap fisherman.

The Look Lab staff has already resolved any potential conflict by simply abandoning the sites along Voyager's route and has re-established them elsewhere. The placement of the two vessels will have no further impact on the Look Lab operations.

The second area user who conducts activities on the ocean bottom in the immediate area of the project site is a Hawaiian commercial trap fisherman, one of three who operate between Waikīkī and Barbers Point. He is a retired employee who traps on a part time basis for supplemental income. His area, defined by an informal agreement with the other two fishermen, is from Waikīkī to the Reef Runway. One of his traps is set at the base of a ledge along the submarine tour route, a site that he has been using for over 30 years. He notes that this particular site is the only productive one in this area. *He checks his traps once a week, usually on a Saturday, typically spending 30 to 60 minutes at the site. When he comes to check his trap, the Voyager support vessels notify the submarines below. The trapper operates with a small boat, and uses a SCUBA diver to empty the trap or bring it to the surface. There have been no conflicts between his activities and the Voyager operations. Voyager's operations are not expected to change as a result of this project, and therefore, there should continue to be no conflicts between Voyager and the trapper. The placement of the ships should enhance his catch by increasing the biomass in the area. There will also be an increase in the number of divers and fisherman in the general area; Atlantis reports that an average of 6 boats utilize their site daily. The diving activity should be focused on the sunken ships, which will be located in barren sandy seafloor at least 100 feet away from the reef ledge where the trap is located. In addition, Brock's (1994) study of the Atlantis artificial reef showed even in the presence of increased fishing at the site, the overall fish crop at the site increased dramatically following installation of the artificial reef. Thus the overall impacts of the project on the trap fisherman are expected to be positive by increasing the biomass in the area.*

Other users of the water in the general area include canoe paddlers, and surfers and swimmers. The site is seaward of the most commonly used training runs between Ala Moana and Kewalo Harbors. In addition, most canoe training takes place either before or after normal working hours. Impacts should therefore be minimal. Some paddlers, and others as well, expressed concern that the increased biomass on the artificial reef will include more sharks and, therefore, increase their chances of being attacked while they are in the water practicing their long distance changes. However, another very popular training course is from the Ala Wai Canal to the Diamond Head Buoy. This route crosses the Atlantis dive site, and there have been no reported shark incidents associated with that artificial reef installation.

In Voyager's three years of operations at the site, there have been no conflicts with the existing tour boat industry. The vessels simply adjust courses to pass inshore or offshore of the site. After 5 p.m. even this step becomes unnecessary. The installation of the artificial reef should assist the local tour boat industry by enhancing diving and fishing opportunities.

Ala Moana Beach Park, including Magic Island and Ala Moana Reef are two of the most heavily used shoreline recreational sites in the survey area and in the city of Honolulu. The project site, however, is 3/4 mile seaward from the park and its nearshore swimming area (Figure 1.2). Placement of the sunken ships should not produce any negative long term effects on any on the activities on the reef or shoreward of it. If anything, the artificial reef may contribute to the overall biomass in the area and provide more nearshore consumptive possibilities, especially for fishermen.

Surfing: Numerous popular surfing sites are located along the seaward edge of Ala Moana Reef, and they include from east to west: Islands, Americas, Bombora, Baby Hale'iwa, Big Lefts, Courts, Concessions, Big Rights, Shallows, In Betweens, Kewalos, Point Panic and Flies. The general location of these surf sites is shown in Figure 5.2, and also in Figure 1.2 (the whitewater illustrates where the waves are breaking). The figures show that the project location is 1/2 mile seaward from the nearest surfing site on Ala Moana reef, and thus will not directly affect surfers. Voyager has been operating at the site since 1994 without negatively impacting surfers. Operations will not notably change after the artificial reefs are installed, and thus there should be no operational impacts to surfers resulting from this project.

Some surfers, however, have expressed a concern that the sunken ships may change the contour of the ocean bottom and, therefore, change the characteristics of the surfing waves at the edge of the Ala Moana reef. A surfing wave is the result of complex interactions between the wind, water, seafloor, other waves and currents. As all surfers know, waves at a particular site may change many times over the course of a day, either subtly or dramatically due to changes in the tide level, wind, swell direction and wave period. Waves entering shallow water are transformed by shoaling, refraction, breaking and energy dissipation. All of these factors would have to be considered to assess possible impacts on surfing waves. There are three general ways to assess possible impacts: physical modeling, numerical modeling, and comparison with existing similar situations. Physical modeling involves the construction of a linear scale hydraulic model that replicates the area of interest. It requires detailed reconstruction of the site bathymetry, bottom characteristics and wave characteristics. Refraction analyses are then required to transform deepwater waves to shallow water values at the location of the wave generator in the model. There are several major problems associated with applying physical models for this project. First, it would be extremely difficult to exactly replicate bathymetry in the area. Surfing waves are sensitive to the intricate bottom features at the point of breaking which would be difficult to recreate. Second, physical models incorporate numerous scale effects which are difficult

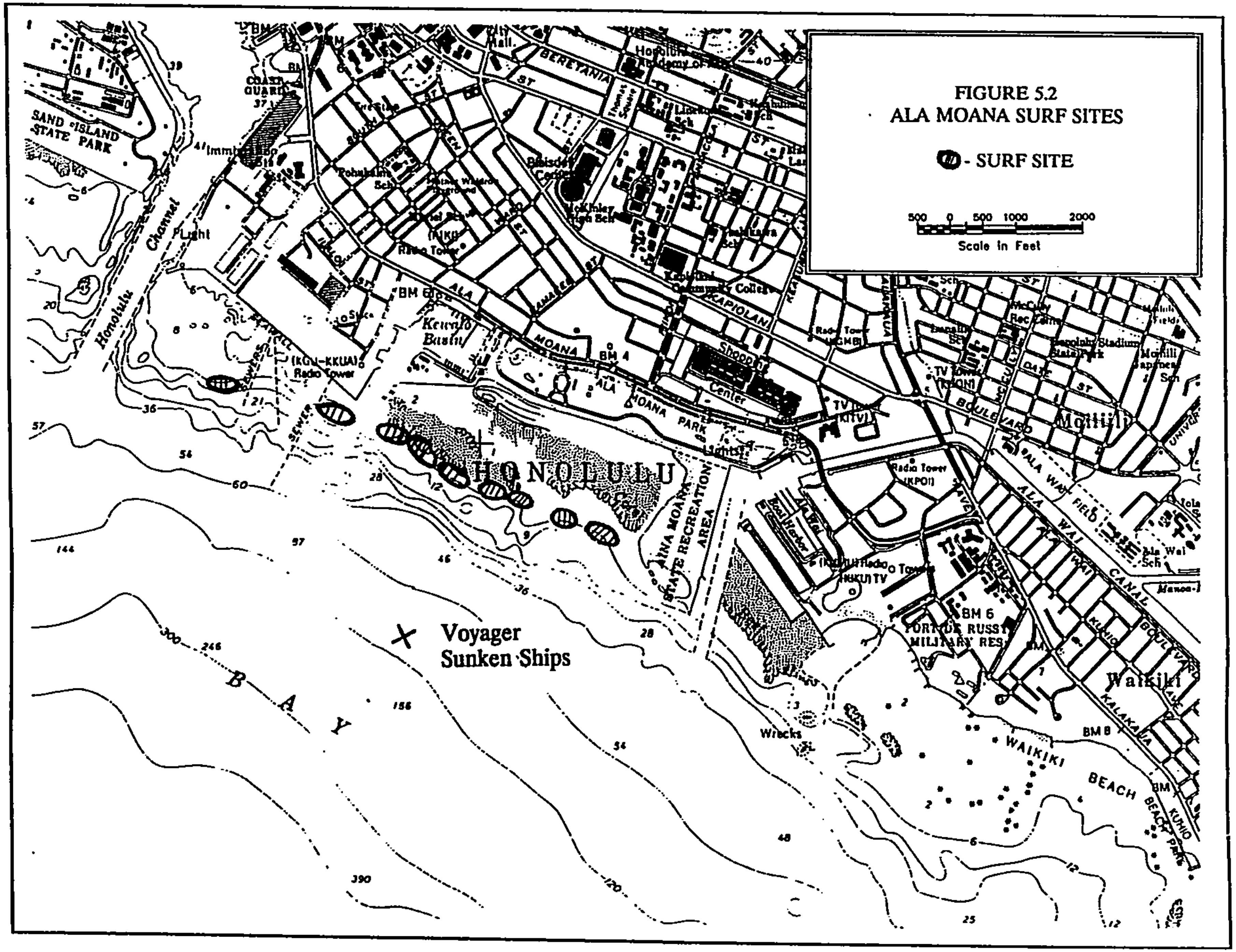


FIGURE 5.2
ALA MOANA SURF SITES

to eliminate. For example, viscous scale effects usually require that the model bottom be fixed and as smooth as possible (Bottin, 1992). This may introduce inaccuracies in wave generation. In addition, bottom attenuation effects, including friction, sediment movement and percolation are difficult to replicate in a physical model (Bottin, 1992). Thus, it would be almost impossible to construct a physical model which would accurately replicate the surfing characteristics at Ala Moana reef, let alone determine any subtle changes the sunken ships might have on the waves.

Numerical modeling entails using mathematical equations, coded into computer programs, to simulate wave generation and transformation. Because wave theories are inexact, numerical modeling of waves incorporates numerous assumptions. These assumptions are designed to simplify the mathematical formulations, but they also introduce errors into the results. For surfing, breaking is the most important stage in the wave transformation. At a certain depth, a wave will become unstable and break, dissipating its energy in the form of turbulence and bottom friction. Yet because of the complexities of turbulence and wave nonlinearities, this is an area of active research (Dean and Dalrymple, 1984) that is not currently well represented mathematically. Empirical formulations based on wave tank studies are used to determine critical wave breaking parameters in most models (Sorenson, 1993). Furthermore, in a numerical model, bathymetry is represented by a numerical grid. This, by definition, requires smoothing of the bottom features, and introduces errors into modeling of wave transformation. In general, the inaccuracies introduced by the numerous assumptions inherent in numerical models would obscure delineation of any many minor changes that could occur to surfing waves due to a distant relatively small, offshore feature.

Possible impacts of this project on surfing waves can be best assessed by evaluating similar existing situations. Concerns about effects on surfing waves has been expressed prior to the sinking of other vessels for artificial reefs around the O'ahu. Table 5.1 lists eight vessels that have been sunk in nearshore waters around O'ahu to serve as artificial reefs.

Each of these vessels is located offshore of surf breaks. Figure 5.3 illustrates the general location of surf sites inshore of the Atlantis sunken ships. The Atlantis site also includes artificial reef modules and airplanes. At least 18 surf breaks exist inshore of the Atlantis vessels. These include several famous breaks such as Rice Bowls, Castles, Old Mans, Publics, Canoes and Queens. Similarly, Figure 5.4 illustrates surf sites located inshore of the Mahi sunken ship off of Ma'ili Beach. Approximately 7 breaks are located in this area. A 110 foot long barge is also located in the general vicinity of the Mahi. In addition, four barges have been sunk in nearshore waters in Maunalua Bay.

Table 5.1. Sunken Vessel Artificial Reefs in O'ahu

Vessel	Site	Length	Depth	Year
YO257	Atlantis-Waikīkī	174'	100'	1989
San Pedro	Atlantis-Waikīkī	110'	80'	1996
Mahi	Wai'anae	165'	90'	1982
barge	Wai'anae	110'	90'	1984
barge	Maunalua Bay	160'	85'	1985
barge	Maunalua Bay	100'	70'	1985
barge	Maunalua Bay	113'	70'	1994
barge	Maunalua Bay	26'	70'	1994

There have been no reported impacts of any of these vessels on the surfing waves (Division of Aquatic Resources, DLNR; personal communication). This incorporates 8 years of surfing at some of the most popular surf sites in Waikīkī, which are also probably some of the most heavily surfed spots in the world, and 15 years of surfing in Ma'ili. Depth is the most important factor affecting waves. The proposed Voyager ships will be placed in relatively deep water, approximately 90 to 105 feet, and thus will be deeper than the San Pedro at the Atlantis site and all of the barges in Maunalua Bay. The Voyager sunken ships will also be oriented perpendicular to the shoreline to present minimal surface area to approaching waves. These ships should therefore also have no impact on surfing waves inshore of the site.

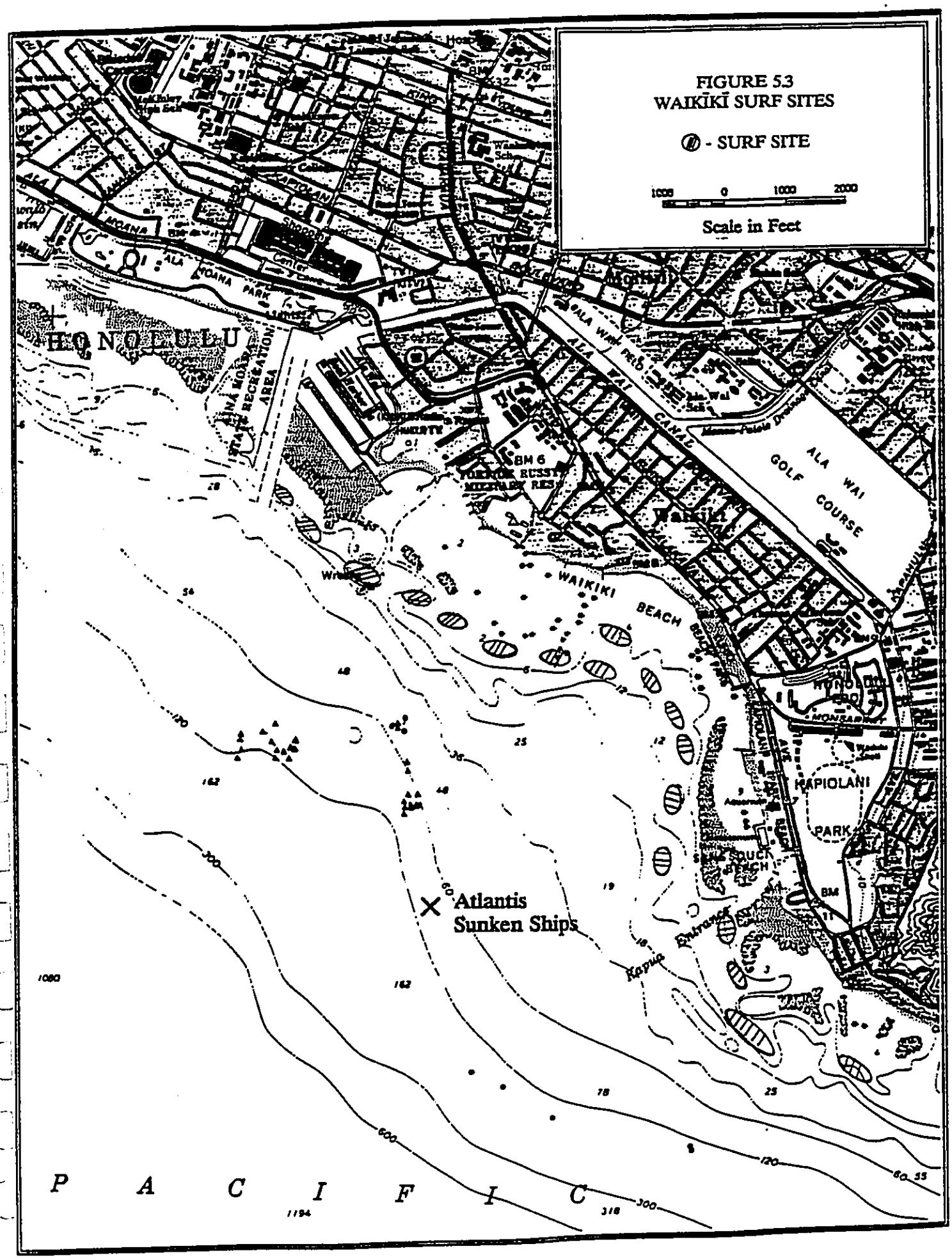
Future Site Users: The situation with the trap fisherman's activities and the Voyager operations is representative of a larger situation which may occur after the artificial reef is established: the potential conflict between future consumptive and non-consumptive activities. Voyager is establishing the artificial reef to enhance the growth of coral, fish and invertebrate species in an area that is presently barren and unproductive. The reef in turn will provide a unique viewing opportunity for Voyager's passengers and other dive groups. Diving on sunken ships is a major attraction for scuba divers. Sunken ship diving is also an important option for scuba tour operators to offer their customers. The artificial reef with its two vessels will be a focal point for resident recreational divers and for commercial scuba tours. It will be easily accessible by boat with its close proximity to the two major public boat ramps in Honolulu, the Ala Wai Boat Harbor and the Ke'ehi Boat Harbor ramps. The reef's depth at 90 to 100 feet will preclude introductory divers, but will be accessible to divers of intermediate and greater ability. At the same time, the ships will attract

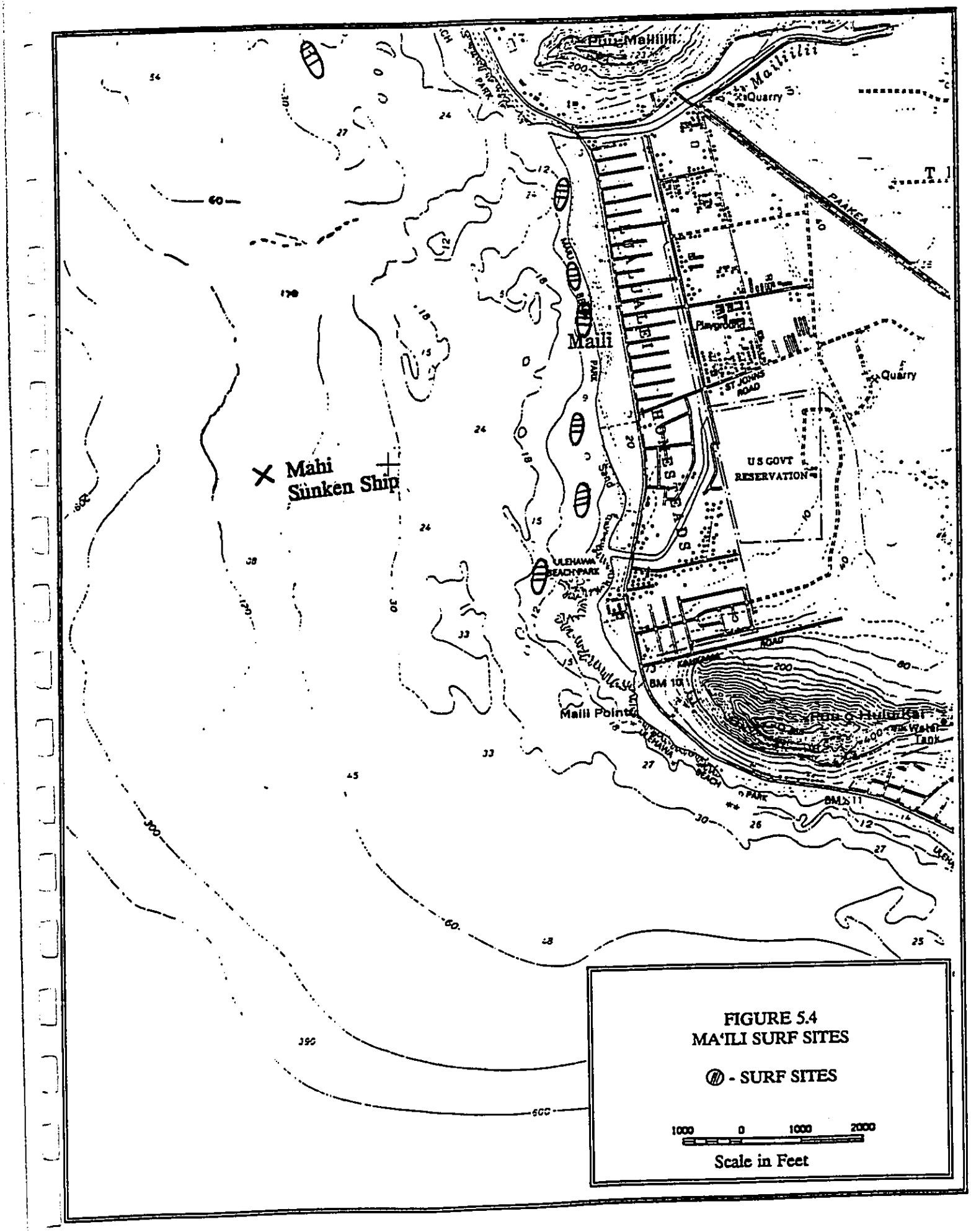
FIGURE 5.3
WAIKĪKĪ SURF SITES

- SURF SITE

1000 0 1000 2000

Scale in Feet




Puu MaHiJi
Mailiili
Quarry
PAIKEA
Maili
Playground
ST JOHNS ROAD
Quarry
U S GOVT RESERVATION
Mahi
Sunken Ship
ULEHAWA BEACH PARK
KAMEHAME ROAD
BM 10
Maili Point
Puu o Hulinkai
Water Tank
BM 11
FIGURE 5.4
MA'ILI SURF SITES
- SURF SITES
1000 0 1000 2000
Scale in Feet

consumptive users such as underwater spear, net and trap fishermen. Consumptive users are typically fairly experienced divers who will have no difficulty accessing the site. *Atlantis reports that an average of 6 boats utilize their reef site daily. A similar number is expected to utilize the Voyager site.*

The potential conflicts will be minimized by facilitating access to the artificial reef sites for all users. Voyager understands it will have non-exclusive use of the area in which it operates and will not limit access to the area. In fact, Voyager will encourage recreational use of the site. To facilitate access, Voyager proposes to install six submerged mooring buoys at the site: one on each sunken ship, and four others in the immediate vicinity of the ships. The two buoys on the ships will be exclusively open for other site users. Two other buoys will be used to moor the Voyager support vessels. The remaining two will be shared by Voyager, and other site users; Voyager anticipates occasionally using these to tie off a submarine when it is not in use. Day-use surface mooring buoys will be attached to the submerged buoys daily by the Voyager personnel. The surface buoy will alert divers and fishermen to the position of the ships, and will provide them with an easy and safe alternative to anchoring. Anchoring is destructive to coral reefs, and also might endanger the divers and submarines below. The mooring buoys available to the general public will also be available to consumptive users in the hope of encouraging environmentally benign anchoring.

The artificial reef may also attract surface fishermen who presently pole or bottom fish rom boats either seaward or shoreward of the project site. One of the night fishing cruise boats has already expressed interest in fishing on the site after dark. This should not present a problem, since Voyager does not operate after dark. Experience with the intermittently closed or "kapu" areas off Waikīkī has shown that pole fishing has a relatively low impact on the biomass at a site.

5.3 Significance Criteria

The Significance Criteria defined in the Environmental Impact Rules (Hawaii Administrative Rules, 11-200-12) are typically applied during an environmental assessment to determine if a project may have a significant effect on the environment, and thus require preparation of an environmental impact statement. Although the significance criteria indicate that the proposed project is not expected to have significant environmental impact, Voyager has elected to follow the entire environmental review process, and complete Draft and Final Environmental Impact Statements to provide agencies and the public with every possible opportunity for input and review.

The significance criteria findings for the project are as follows:

a. The proposed project should not involve loss or destruction of any natural or cultural resource. The project site is barren, unproductive sand flats. Placement of an artificial reef should enhance the natural resource by enhancing marine habitat and promoting coral and fish growth.

b. The proposed project should not curtail the range of beneficial uses of the environment. Rather, the project should enhance beneficial uses of the environmental by promoting fish and coral growth, and providing sites for diving and fishing activities.

c. The proposed project does not conflict with the State's long-term goals or guidelines. Rather, the project is consistent with the State's policy to conserve natural resources, enhance the environment and create opportunities for the residents of Hawai'i to improve their quality of life through diverse economic activities which are in balance with the physical and social environment. The proposal artificial reefs should enhance the marine environment and should encourage the environmentally safe diving industries that showcase Hawaii's unique environment.

d. The proposed project should not adversely affect the economic or social welfare of the community or state. The project should benefit the State's ocean recreation industry, and also recreational divers and fisherman.

e. The proposed project should not substantially affect public health.

f. The proposed project should not involve substantial secondary effects, such as population changes or infrastructure demands. Voyager currently operates at the proposed site. The proposed project should have little effect on their existing operations.

g. The proposed project should not involve substantial degradation of environmental quality. The project should improve the environment by enhancing habitat and promoting fish and coral growth.

h. The proposed project should not cumulatively have considerable effect on the environment, or involve a commitment to larger actions.

i. The proposed project should not affect a rare, threatened or endangered species or its habitat. The artificial reefs will provide additional habitat and resting places for green sea turtles.

j. The proposed project should not detrimentally affect air or water quality or ambient noise levels.

k. The proposed project should not affect an environmentally sensitive area. The project site is barren, unproductive sandy seafloor at depths of 80 to 100 feet that should benefit from placement of an artificial reef.

l. The proposed project should not affect scenic vistas and viewplanes identified in

county or state plans or studies. The artificial reefs will be installed in 80 to 100 feet of water, in barren, sandy seafloor.

m. The proposed project should not require substantial energy consumption. The energy required for this project is only that required to prepare the vessels - cleaning, ballasting, towing to the site, and sinking. After deployment, there should be no energy consumed.

6.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The short term uses of the environment for this project are primarily associated with the deployment and installation operations. This includes towing, mooring and sinking the vessels at the designated locations. At sea operations should be completed in one day per ship. Installation of the mooring pins and submerged buoys can be undertaken from a small boat and will be completed by scuba divers in one or two days. Short term uses of the environment will therefore be negligible.

The proposed project should result in numerous long-term benefits and enhancements of productivity. These include the following: enhanced fish and coral populations in the area; great reduction in coral damage caused by anchoring; increased recreational fishing and diving opportunities for the public; an improved submarine tour for visitors resulting in increased economic opportunities for Hawai'i residents; additional diving attractions for the dive industry. In addition, the multiyear biological monitoring program that will be conducted will provide valuable information on Hawaii's marine environment that can be used in the future to effectively manage this resource.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed project entails sinking two steel ships in 90 to 100 feet of water onto sandy substrate in the Voyager Submarines dive site. Due to the extreme degree to which the ships will be weighted down to prevent movement during severe storms, this action can be considered irreversible and irretrievable. The sites have been carefully selected on barren sand characterized by very limited macrobiota and fish. These sandy areas, the size of the length and width of the ships, will be permanently lost as habitat. However, the few bottom dwelling organisms that might occur on the specific ship sites should be a very minor component of the community; sand flats extend nearly continuously across Mamala Bay at depths of 100 to 130 feet.

The proposed action will not make use of non-renewable resources and will not irreversibly curtail the range of potential uses of the environment. To the contrary, the project will increase the range of potential uses of the area by providing improved diving and fishing opportunities, and increased access through the use of mooring buoys.

Environmental accidents that may occur in this project include the following:

- The unforseen release of pollutants into the water during deployment - the vessels will be thoroughly cleaned and inspected prior to deployment, and a containment plan will be in place to counter the unforseen release of pollutants into the water.

- Damage to coral on the seafloor during vessel sinking - the reef sites will be carefully located in barren sand substrate, a minimum of 100 feet away from sensitive coral areas. The sinking process will be carefully controlled to ensure the ship settles in the designated location.

- Damage caused by movement during storms - Voyager will prevent possible impacts caused by ship movement during storms by ballasting with concrete, and utilizing very conservative design wave heights determined following Hurricanes Iwa and Iniki. This should result in sufficient concrete ballast being placed in the ships to prevent movement during severe storms and hurricanes.

8.0 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The adverse environmental effect of this project which cannot be avoided is the loss of a small area of sandy seafloor that may serve as habitat for bottom dwelling organisms. This area is only 100 to 200 feet long and 40 feet wide. The few bottom dwelling organisms that may occur in this area represent a very minor portion of the community. Sand flats extend nearly continuously across Māmala Bay at a depth of 100 to 130 feet.

Minor unavoidable impacts may also include the temporary disruption of boating traffic and ocean activities during towing of the vessel and sinking operations. The ocean activities survey conducted for this project indicated that these impacts would be minimal, and at sea operations should last only one day per ship.

9.0 MITIGATION MEASURES

Numerous mitigation measures have been incorporated into this project to minimize possible impacts. These include the following:

1) The sunken ships will be thoroughly cleaned to U.S. Coast Guard, EPA and State DOH standards. Hazardous holds will be sealed, all doors and hatches will be removed, and cables, lines and wiring that pose entanglement hazards will be removed. The ships will be inspected by all interested agencies prior to deployment.

2) The reef sites will be carefully selected on barren sand substrate, and will be a minimum of 100 feet away from sensitive coral areas. The sites will be approved by interested agencies prior to deployment.

3) The ship sinking procedure will be carefully controlled to precisely drop the ship on the designated location. This will be accomplished by preweighting the ship at the dock, precisely locating the reef site with taut buoy, and controlling the sinking with a three-point *mooring system.*

4) Concrete will be used to ballast the ships. The gravel used to ballast the Atlantis spilled out of the ship and spread on the seafloor during Hurricane 'Iniki. Use of concrete will prevent this impact.

5) The anchoring analysis will use the conservative design waves that have been developed as a result of the severe waves generated by Hurricanes Iwa and Iniki. These waves are up to 70% higher than those that have been used in the past. This should prevent movement of the ships during severe storms and hurricanes.

6) Six submerged mooring buoys will be permanently installed at the site; one on each sunken ship, and four others in the immediate vicinity of the ships. The two buoys on the ships will be dedicated for public use, two will be shared by Voyager and the public, and two will be dedicated for use by the Voyager support vessels. This will provide a minimum of two, and up to four, mooring locations for interested site users. This open access to the site will mitigate possible use conflicts at the site, and should greatly reduce possible anchor damage to coral.

7) A comprehensive biological monitoring program will be implemented upon reef deployment. This program will last a minimum of three years, and will include surveys every 3 to 4 days during the first two weeks, every week for the next two weeks, every 10 days for the next 2 months, and every 2 weeks thereafter. The monitoring will include semi-quantitative surveys of fish communities, and estimates of crop values, turnover and community stability. The monitoring will provide important information on the marine biological community in the area, and habitat enhancement.

10.0 ALTERNATIVES CONSIDERED

Voyager considered three alternatives to the proposed project: 1) establishing the ship artificial reef at another site; 2) utilizing a different type reef structure; and 3) continuing present operations with no artificial reef. Use of the Atlantis artificial reef site was not an alternative considered for this project for the reasons outlined in 10.1 below. Evaluation of these alternatives must consider Voyager's present operational status. Voyager currently offers submarine tours at a site approximately 3/4 mile offshore of Ala Moana Beach Park (Figures 1.1 and 1.2). Their facilities have been planned to support operations at this site, and include: a maintenance facility in Pier 41 Honolulu Harbor where the two submarines and two support vessels are docked and maintained; an operations office in Kewalo Basin; a passenger embarkation pier in Kewalo Basin where the Voyager passenger transfer vessel --- a 72 foot wooden/fiberglass catamaran ---loads and unloads passengers; and a corporate office in the Dole Cannery.

10.1 Atlantis Artificial Reef

When Voyager commenced operations in 1994, their initial preference was to operate at the established Atlantis artificial reef site. U.S. Coast Guard safety concerns about operating more than three submarines at a particular site, and additional concerns about two competitive companies operating at the same site led Voyager to agree to select an alternative dive site --- their present dive site offshore of Ala Moana Breach Park.

10.2 Alternative Reef Sites

The major factors considered in selecting a submarine operating site include a harbor capable of accomodating the submarines, support vessels and maintenance facilities; a loading area close to a tourist center; a dive site sufficiently close to the loading area (within 10 to 20 minutes transit time); relatively calm sea and current conditions; underwater attractions within a depth range of 60 to 150 feet; and good underwater visibility. These factors were all considered to select the current operating setup described above. Operations out of Honoulu/Waikiki were deemed essential for establishing a financially viable tourist attraction. The north and windward shores of O'ahu do not have adequate harbor facilities and are characterize by rough sea conditions. Alternative operating sites on the leeward coast or 'Ewa could operate out of Barbers Point Harbor, but would entail long travel time either on land or in the water or both. This would increase transportation

costs, reduce the number of submarine trips possible during the day and reduce the customer base, thereby jeopardizing the financial viability of the submarine operation. Thus, the only feasible alternative sites considered for this artificial reef project are those with reach of the current operational setup --- passenger loading and transit out of Kewalo Basin, and submarine operations out of Honolulu Harbor. Alternative sites include areas offshore of Waikīkī, Kaka'ako, Sand Island and Ke'ehi Lagoon. Offshore of the Reef Runway west of Ke'ehi Lagoon, waters are restricted by the Navy. Areas offshore of Kaka'ako, Sand Island and Ke'ehi Lagoon are closer to major shipping channels of Honolulu Harbor. Sites offshore of Waikīkī are currently heavily used by commercial operators and recreational users. The current operating area offshore of Ala Moana is therefore the preferred operating site in the general vicinity. Voyager has been successfully operating at their site for three years. In addition, the barren, sandy bottom conditions at this site are ideal for placement of an artificial reef.

10.3 Alternative Reef Structures

There are two basic types of artificial reefs: those made from materials of opportunity, and those made with specially fabricated materials. Materials of opportunity include such items as ships and vessels, surplus concrete, tires, and rocks and stones. Fabricated reef materials include such objects as multi-chambered modules of various shapes made of concrete or fiberglass reinforced plastic. Although there have been numerous studies evaluating the effectiveness of various artificial reefs in enhancing fishery resources, there have been no comparisons of the effectiveness of ships versus other reef configurations. Steel ships have been found to be excellent artificial reefs (NOAA, 1985). They are durable, provide high relief, are open to water circulation (when holes are cut into the hulls), have large amounts of surface area per unit volume, and offer complex internal spaces --- all important criteria for reef effectiveness. Studies conducted on the Atlantis sunken ship have shown dramatic increases in fish population, and rapid coral growth (Brock, 1994). Specially fabricated modules also meet these criteria and can serve as effective artificial reefs.

There is an additional important requirement for this project --- the reefs should be visually attractive to viewing passengers. Sunken ships are uniquely appealing to viewing passengers, and divers. The ship Mahi, sunk in 90 feet of water off the Wai'anae coast in 1982, was the most popular dive site on O'ahu in a survey conducted in 1986 (Tabata, 1992). An informal survey of Atlantis passengers who view both the sunken ship and the reef modules at the site indicates that the modules were not visually attractive.

Because of the percieved lack of appeal of fabricated modules, Voyager has elected to install two ships as artificial reefs on their dive site.

10.4 Maintain Present Operations

Maintaining operations as they are at present is an alternative to the proposed project. Much of the present submarine tour route, however, is relatively barren, unproductive sand flats. An artificial reef in this area could enhance the marine habitat and promote fish and coral growth, and provide an additional attraction for submarine passengers. This would benefit the marine environment, Voyager and other commercial and recreational users. Mooring buoys in the area would prevent coral damage caused by anchoring. Maintaining operations as they are will provide none of the environmental benefits contained in this project, and will result in a less attractive tourist product for Voyager Submarines. This could possibly result in a less viable business, and loss of jobs. Voyager currently employs 100 in their submarine business.

11.0 UNRESOLVED ISSUES

An unresolved issue associated with this project is whether artificial reefs locally enhance sustainable production or simply aggregate resources already present in the area. Japanese studies generally report that properly designed and sited artificial reefs can increase production of fishes (Brock, 1984). Other researchers are concerned that artificial reefs aggregate fish to one location, increasing their chance of being caught. Brock (1994) has completed detailed surveys of fishery resource enhancement at the Atlantis sunken ship artificial reef. His results showed dramatic increases in fish abundance at the site, punctuated by rapid declines caused by net and other type fishing at the site. The fish catch at the site exceeds reef production estimates, indicating that many of the fish being caught have aggregated to the site. Although reefs may aggregate fish to the site increasing their susceptibility to being caught, artificial reefs sited in presently unproductive areas may also be relieving use and pressure on more productive and pristine habitats nearby (Brock, 1994). Brock concludes that the exploitation (fishing) and viewing of marine life at a single location may not be compatible activities. However, artificial reefs established as dive tour destinations provide economic returns that are much greater than fishing, serve to diversify the economic base, and can have substantial beneficial impacts through marine education (Brock, 1994).

A multi-year comprehensive biological monitoring program will be undertaken when the artificial reefs for this project are installed. This program will evaluate the effects of the reef on the marine biology in the area, will help address the issues discussed above, and will provide important information for effectively managing Hawaii's marine biological resources.

Another unresolved issue is that the project involves use of submerged lands, which are designated as ceded lands. Ceded lands are held in trust by the State, and the appropriate use of ceded lands remains an unresolved issue.

12.0 AGENCIES AND ORGANIZATIONS CONSULTED

Federal

Environmental Protection Agency
National Marine Fisheries Service, NOAA
Naval Base, Pearl Harbor
U.S. Geological Survey
U.S. Coast Guard
U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers, Pacific Ocean Division

State

Department of Defense
Department of Land and Natural Resources, Boating and Ocean Recreation Division
Department of Land and Natural Resources, Division of Aquatic Resources
Department of Land and Natural Resources, Land Division
Department of Land and Natural Resources, State Historic Preservation Division
Department of Business, Economic Development and Tourism, Ocean Resources Branch
Department of Transportation, Harbors Division
Department of Health, Clean Water Branch
Environmental Center, University of Hawai'i
Office of Environmental Quality Control
Office of Hawaiian Affairs
Office of Planning, Coastal Zone Management Program
Representative, 25th District
Senator, 12th District

City

Ala Moana Kaka'ako Neighborhood Board
City Councilmember, District V
Department of Land Utilization
Department of Parks and Recreation
Department of Planning
Department of Transportation Services
Fire Department

Local Organizations and User Groups

Aaron's Dive Shops
Ala Moana Beach park lifeguards
Ala Moana Beach Park park supervisor
Aloha parasail
Honolulu Bodysurfing Club
Honolulu Fire Department rescue personnel
Kewalo Basin and Ala Wai Boat Harbor agents
Koa Kai and Lokahi Canoe Clubs
Long-time (25 years plus) Ala Moana Reef area surfers
Motorized surfboard fishermen
Navatec captains
Night fishing cruise boat "Elua"
Ocean Innovators
Save Our Surf
Trap fishermen
University of Hawai'i, Department of Ocean Engineering and Look Laboratory
Various Kewalo Basin cruise and charter boats
Voyager Submarine operations staff
Waikiki Roughwater Swim Committee
Waikiki Yacht Club and Hawaii Yacht Club

13.0 PREPARERS

Sea Engineering, Inc. - preparation of the Draft Environmental Impact Statement.

Marine Research Consultants - Marine Biological and Water Quality Assessment.

John Clark Planning Consultant - Ocean Activities Survey and Impacts.

14.0 COMMENTS AND RESPONSES TO DRAFT ENVIRONMENTAL IMPACT STATEMENT

List of Organizations and Individuals Commenting

- Ala Moana/Kaka'ako Neighborhood Board No. 11
- City and County of Honolulu, Chief Planning Office
- Department of the Army, Planning and Operations Division
- State of Hawaii, Department of Business, Economic Development & Tourism, Office of Planning
- State of Hawaii, Department of Defense, Office of the Director of Civil Defense
- State of Hawaii, Department of Health, Director of Health
- State of Hawaii, Department of Health, Deputy Director for Environmental Health
- State of Hawaii, Department of Land and Natural Resources, Historic Preservation Division
- State of Hawaii, Department of Land and Natural Resouces, Division of Aquatic Resources
- State of Hawaii, Department of Land and Natural Resources, Land Division
- State of Hawaii, Office of Environmental Quality Control
- State of Hawaii, Office of Hawaiian Affairs, Land and Natural Resources
- State of Hawaii, Public Works Administrator
- United States Department of the Interior, U.S. Geological Survey - Water Resources Divsion
- United States Department of Commerce, National Oceanic and Atmospheric Administration - National Marine Fisheries Service
- United States Department of the Interior, Fish and Wildlife Service
- University of Hawai'i at Mānoa, Environmental Center

Reproductions of all Comments and Responses

Fax Note 7671	Date 12/31/97 Pages 2
To ED HENRY	From STEVE THOMPSON
Co./Dept. LAND MGMT DIV	Co.
Phone #	Phone # 587-1973
Fax # 587-0455	Fax #

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF BOATING AND OCEAN RECREATION
333 QUEEN STREET, SUITE 308
HONOLULU, HAWAII 96813

DEPUTY DIRECTOR
GILBERT S. COLOMA-AGARAN

RECEIVED
DEC 31 3 PM '97
LAND MANAGEMENT DIV.

December 30, 1997 BOR 0521.98

MEMORANDUM

TO: Dean Y. Uchida, Administrator
Land Division

FROM: Howard R. Gehring, Acting Administrator
Division of Boating & Ocean Recreation

SUBJECT: Request for Comments, CDUA, Voyager Submarines Hawaii
File OA-2866, Artificial Reefs, Mooring Buoys, 4 Miles
Offshore Ala Moana Beach, Oahu

Thank you for the opportunity to review the draft EIS for this project. We support this project. Our concerns are noted below.

Section 2.2.4 We had some concern with respect to the ballasting and anchoring of the submerged vessels which we found to be addressed in Section 2.2.4 of the draft EIS. We recommend that the concrete "pours" be as large as possible so that should portions of the ship's hull deteriorate and a hull section is lost, the concrete remains in place.

Section 3.1.6- What would be the smallest estimated size of a tsunami wave that could pass the artificial reef with an expected adverse impact? It seems that the potential effect of a tsunami has been dismissed. Has an analysis process resulted in this conclusion?

Section 3.4.9- Per our request to the City & County of Honolulu, Department of Parks & Recreation dated March 5, 1997 and their response dated March 18, 1997, the City & County of Honolulu, Department of Parks & Recreation no longer issues permits for commercial introductory scuba diving classes in the Ala Wai Channel at the east end of Magic Island.

We strongly recommend that a financial instrument which acts as a "security deposit" be required to be provided to the State by Voyager Submarines Hawaii for the purposes of cleaning up and/or removing the artificial reef should Voyager Submarines Hawaii no longer exist or is not solvent and the State has no desire to continue its existence.

There is currently some controversy over scuba diving activities at the Atlantis site which have resulted in safety concerns for both the divers, dive boat, and the submarines. We recommend that the proposed buoys and the shared operations be evaluated by the Marine Safety Office of the U.S. Coast Guard and by The Ocean Recreation Council of Hawaii (TORCH).

Sea Engineering, Inc.
Makai Research Pier, 41-202 Kalaniana'ole Hwy, Suite 8, Waimānalo, Hawai'i 96795-1820
(808) 259-7966/FAX (808) 259-8143 E-MAIL: seaeng@lava.net

January 5, 1998

Mr. Howard Gehring
Department of Land and Natural Resources
Division of Boating and Ocean Recreation
333 Queen Street, Suite 300
Honolulu, Hawaii 96849

Subject: Voyager Submarines Artificial Reef Installation

Dear Mr. Gehring:

We have received a copy of your memorandum dated December 30, 1997 concerning the Voyager Submarines Artificial Reef Installation project. Thank you for your comments. We have incorporated these comments into the Final Environmental Impact Statement (FEIS). Responses to your comments are provided below.

Section 2.2.4 - The ship ballasting will be determined using conservative design waves that have been developed in light of the severe waves generated by Hurricanes Iwa and Iniki. Wave forces at the project site will be calculated to determine the amount of ballast required for stability. The required volume of concrete will be poured directly into hull sections, in quantities sufficient in volume and size that they will remain in place, even if hull sections deteriorate.

Section 3.1.6 - Tsunamis are long water waves generated by seafloor movements associated with earthquakes. Their wavelengths are typically on the order of 200 kilometers, and deep water amplitudes are less than a meter. An analysis of wave orbital velocities in 100 feet of water reveals that tsunamis generate orbital velocities that are less than one-tenth the strength of velocities resulting from hurricane design waves. The hurricane design waves discussed in Section 3.1.5 of the FEIS will result in much stronger wave forces at the site, and are the appropriate design conditions for this project. This discussion has been added to Section 3.1.6 of the FEIS.

Section 3.4.9 - This section of the FEIS has been amended to state that permits are no longer issued for commercial introductory scuba diving classes in the Ala Wai Channel at the east end of Magic Island.

Voyager Submarines understands that one of the conditions of the Conservation District Use permit for this project will be that Voyager is responsible for any clean-up or restoration of the artificial reef site. Voyager is willing to work with DLNR on establishing the appropriate means of ensuring such responsibility, provided such responsibility is similar for all existing and future artificial reefs within State waters.

The Marine Safety Office of the U.S. Coast Guard has been involved in the planning of this project since its inception. They have conducted site visits for this project, which have included touring the specific artificial reef locations in the submarine, and have reviewed the project Environmental Assessment, Draft Environmental Impact Statement (DEIS) and Department of the Army Permit application. As stated in their September 22, 1997 letter to Land Division, DLNR (Section 15 of FEIS), the Marine Safety Office strongly supports the proposed project. The Ocean Recreation Council of Hawaii (TORCH) has also been informed of the project and provided a copy of the DEIS. TORCH supports the proposed plan to install the reefs coupled with mooring buoys dedicated for public use.

Thank you for your input on the proposed project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

PHONE (808) 594-1888

FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

December 5, 1997

J.C. Merrill
Voyager Submarines Hawaii
680 Iwilei road, Suite 720
Honolulu, Hawaii 96817

Subject: Draft Environmental Impact Statement for the Voyager Submarines Hawaii Artificial Reef Installation

Dear Mr. Merrill:

Thank you very much for allowing us to review and comment on the above-referenced Draft Environmental Assessment (DEIS). Voyager Submarines Hawaii proposes to install two artificial reefs (sunken ships) at the Voyager dive site (approximately 3/4 mile off-shore of Ala Moana Beach Park) in water depths of approximately 90 - 100 feet. The purpose of the proposed project is to enhance the habitat and promote coral and fish growth and provide an additional dive site.

The Office of Hawaiian Affairs (OHA) has two major concerns with the proposed project. These concerns deal with the use of ceded lands, and with the public's use of the area's resources.

Firstly, the proposed project site is located on "submerged lands" which are officially designated as ceded lands. The DEIS should clearly state that the use of ceded lands is intended, that ceded lands are "held in trust" by the State, and that the appropriate use of ceded lands remains an unresolved issue.

OHA believes it is imperative that any proposed action requiring the use of ceded lands should be made with careful consideration of the state's responsibility to the ceded lands trust. OHA feels that the proposed project by the applicant is not an appropriate use of ceded lands under section 5f of the Admissions Act.

Secondly, there is the potential for conflicts between non-consumptive and consumptive users of the areas resources to arise and/or increase. Furthermore, increased recreational use and traffic in the area could compromise public safety.

The conclusion that the proposed action will not adversely impact boat traffic is based on the data presented in the Submersible Operating Area Boat Traffic Survey (Appendix C). The Survey data may be accurate for the day on which the survey was conducted (Thursday, May 5, 1997 between 8:30am and 3:55pm), but the data may not be representative of "everyday" boating activity in the project area.

The problem a one-day site visit presents is that it does not take into account temporal variability, and thus renders a skewed assessment. A survey conducted over a specific period of time would provide a more representative sample of boat traffic in the area.

The Traffic Survey indicates that a total of 56 vessels passed within 1500 feet of the proposed project site and 1/2 of these vessels passed within 300 feet or less of the site. This data raises two issues which require further clarification.

1) The number of vessels (56) recorded during the survey were recorded during a 7 1/2 hour period on a weekday. The number of vessels on weekend and/or holiday could be significantly greater and should be considered in assessing traffic impacts.

2) By design, the artificial reef will presumably increase the area's resources which will in turn lead to increased recreational/commercial use, and increased boat traffic. The degree to which future resource use and boating traffic may increase (and public safety be compromised) should be projected.

An area of particular concern is that the proposed project area is currently being utilized by a native Hawaiian commercial trap fisherman and his family. The DEIS states that he has been using the site for over 30 years and that the fisherman notes that "this particular site is the only productive one in the area". The DEIS further explains that there has been no conflicts between his activities and Voyager operations, and "the placement of the ships should enhance his catch by increasing the biomass in the area" (pg 5-8).

The proposed action may indeed have the potential to enhance the fisherman's livelihood by increasing his resource base. However, the proposed action also has the potential to jeopardize his livelihood by increasing the risk of conflict between himself and non-consumptive recreational users. The applicant should

inform the fisherman of the potential risks involved and not just potential benefits.

In summary, OHA feels that the waters of Mamala Bay and specifically the waters off Ala Moana Beach Park are special to the people of Oahu. These waters are extensively used for recreational, traditional, and commercial purposes. The proposed project may have some potential beneficial impacts. However, all potential cumulative adverse impacts on the area's resources should be more carefully assessed. Resource use by island residents should not be overlooked in efforts to further develop a tourist enterprise.

Please contact Colin Kippen, Land and Natural Resources Division Officer, or Richard Stook, EIS Planner at 594-1755, should you have any questions regarding this matter.

Sincerely yours,

Randall Ogata
Administrator

Colin Kippen, Officer
Land and Natural Resources

cc: Tom Eisen, DLNR Land Division
Marc Ericksen, Sea Engineering, Inc.
Gary Gill, OEQC
Board of Trustees

Sea Engineering, Inc.
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January 5, 1998

Mr. Colin Kippen
Land and Natural Resources Division Officer
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813

Subject: Draft Environmental Impact Statement for the Voyager Submarines Artificial Reef Installation

Dear Mr. Kippen:

We have received a copy of your letter dated December 5, 1997 to Mr. Merrill of Voyager Submarines concerning the Voyager Submarines Artificial Reef Installation project. Thank you for your comments. We have incorporated these comments into the Final Environmental Impact Statement (FEIS). Responses to your comments are provided below.

1) Ceded lands - We have incorporated the following statements into the appropriate sections of the FEIS: the proposed project uses submerged lands, submerged lands are designated as ceded lands, ceded lands are held in trust by the State, and the appropriate use of ceded lands remains an unresolved issue. These statements have been inserted into the project summary sheet, Section 1.0, Section 4.0 and Section 11.0 of the FEIS.

2) Boat traffic survey - We have completed three additional days of traffic surveys and analyzed two days of survey data for the same area completed in 1986 for Atlantis Submarines. This data is presented in Table 3.7 and discussed in Sections 3.4.15 and 5.2.4 of the FEIS. The survey days included May 1, and December 16, 17 and 21, 1997, and December 23 and 28, 1986. All vessels passing within 1500 feet of the approximate Voyager site were logged and described. Survey days included Tuesday, Wednesday, Thursday and Sunday. Weather and sea conditions included typical nice boating weather on the south shore of O'ahu--- clear to partly cloudy skies with light to normal northeast tradewinds and small surf, and one morning of overcast skies on 12/17/97. In the 1997 survey, the number of vessels recorded passing within 500 feet of the area ranged from an average of 4.6 per hour on 12/21/97 to 1.8 per hour on 12/17/97 when morning skies were overcast. Vessel sizes ranged from the 232-foot long "Star of Honolulu" tour boat to 8-foot long pleasure kayaks. The 1986 data were collected when Atlantis Submarines was investigating the area as a possible operating site. The data were collected from the same area, on the same days of the week, during the same seasonal period and for similar weather and sea conditions, and thus provide a good comparison with present traffic conditions. The 1986 survey

recorded slightly greater numbers of vessels passing within 500 feet of the area, averaging 4.9 vessels per hour during submarine operating hours.

3) Future increase in vessel traffic and resource use - Future additional traffic at the site can be estimated utilizing current activity at the Atlantis artificial reef sites. Atlantis reports that an average of 6 vessels daily utilize their reef sites. A similar number can be expected to utilize the Voyager reef sites. This increase is equivalent to slightly less than 1 boat per hour and is not expected to impact public safety or cause hazards. Voyager intends to minimize possible hazards by facilitating access to the site. Surface buoys will be attached daily to submerged buoys marking the artificial reef locations. The surface buoys will show boaters and users where the sites are, and will provide safe, easy mooring. The surface buoys will also prevent anchoring, which is destructive to coral, and hazardous to divers. Furthermore, in the event of an emergency, Voyager has support vessels continuously stationed at the site during operating hours, equipped with first aid equipment and operators, and constant communications to shore. This discussion has been added to Section 5.2.4 of the FEIS.

Additional resource use can also be assessed by analyzing the Atlantis artificial reef sites. This was previously discussed in Section 5.2.1 of the DEIS. Brock (1994) found that the abundance of fish dramatically increased following deployment of the Atlantis ship reef. Although great fluctuations in fish crop were observed due to fishing activity, the mean fish crop at the site was estimated to have increased 1000-fold at the ship site, and more than 25-fold relative to the adjacent limestone flat.

4) Non-consumptive and consumptive users - Atlantis reports that 6 vessels utilize their reef site daily. A similar number can be expected to use the proposed Voyager site. This increased use raises the potential of conflict between consumptive and non-consumptive users. At present, the only user of the site, other than Voyager, is a Hawaiian commercial trap fisherman whose area is from Waikīkī to the Reef Runway. He is a retired employee who traps on a part time basis for supplemental income. One of his traps is set at the base of a ledge along the submarine tour route. He checks his trap once a week, usually on a Saturday, typically spending between 30 and 60 minutes at the site. When he comes to check his trap, the Voyager support vessels notify the submarines below. The trapper operates with a small boat, and uses a SCUBA diver to empty the trap or bring it to the surface. There have been no conflicts between his activities and the Voyager operations. Voyager's operations are not expected to change as a result of this project, and therefore, no future conflicts are expected between Voyager and the trapper. The placement of the ships should enhance his catch by increasing the biomass in the area. There will also be an increase in the number of divers and fisherman in the general area; Atlantis reports that an average of 6 boats utilize their site daily. The diving activity should be focused on the sunken ships, which will be located in barren sandy seafloor at least 100 feet away from the reef ledge where the trap is located. In addition, Brock's monitoring of the Atlantis artificial reef has shown that although fishing at the site increased, the overall fish crop at the site increased dramatically following installation of the artificial reef. Thus the overall impacts of the project on the trap fisherman are expected to be positive by increasing the biomass in the area. This discussion is included in Section 5.2.4 of the FEIS. The trap fisherman was contacted, interviewed and presented a project summary at the onset of this project in March 1997. A copy of the FEIS is being sent to the trap fisherman to inform him of all impacts of the project.

Future potential conflicts will be minimized by facilitating access to the artificial reef sites for all users. Voyager understands it will have non-exclusive use of the area in which it operates and will not limit access to the area. In fact, Voyager will encourage recreational use of the site. Two buoys at the site will be dedicated for public use, and two others will be shared by Voyager and the public. This discussion is included in Section 5.2.4 of the FEIS.

Voyager Submarines depends on a healthy marine environment. Voyager is therefore committed to long term conservation and enhancement of the marine environment. We believe this project provides substantial public and environmental benefits, in addition to enhancing the Voyager submarine tour. Thank you for your input into the project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

University of Hawai'i at Mānoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawai'i 96822
Telephone: (808) 956-7361 • Facsimile: (808) 956-3980

December 8, 1997
RE:0684

Mr. J.C. Merrill
Voyager Submarines Hawaii
680 Iwilei Road, Suite 720
Honolulu, HI 96817

Dear Mr. Merrill:

Draft Environmental Impact Statement
Voyager Submarines Artificial Reef
Honolulu, Oahu

To improve the quality of their submarine tours, Voyager Submarines Hawaii proposes to sink two vessels to serve as artificial reefs approximately ¼ mile offshore of Ala Moana Beach Park. Presently the submarine tours operate near the edge of a limestone platform with little live coral growth and relatively barren sand. Before deploying the vessels in water depths of 60 to 110 feet, the ships will be cleaned and prepared according to State and Federal regulations, and will be ballasted with cement to prevent movement during extreme storm conditions. The applicant plans to install six buoys around the site for mooring and safety purposes.

We reviewed this draft EIS with the assistance of Richard Grigg, Oceanography; and Paul Berkowitz of the Environmental Center.

General Comments

In general, the document is comprehensive and proposed project does not appear to have any major negative impacts. If the vessels are cleaned thoroughly, weighted adequately, and placed in the sandy area below the shelf, then the project should not adversely affect the surrounding environment. Our reviewers suggested that, in terms of site selection, "the deeper the better" as these sites would be more stable. Also, given the size and volume of the reef material, the proposed project should not affect nearby surfing sites.

Finally, our reviewers recommended a ban on commercial and recreational fishing near the artificial reef. Such a ban would reduce the possibility of overfishing, eliminate most user conflicts, and minimize potential safety hazards.

Thank you for the opportunity to comment on this draft EIS.

Sincerely,

John T. Harrison
Environmental Coordinator

cc: OEQC
Roger Fujioka
Richard Grigg
Tom Eisen, DLNR
Marc Ericksen, Sea Engineering, Inc.
Paul Berkowitz

Sea Engineering, Inc.
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January 5, 1998

Mr. John T. Harrison
University of Hawaii at Manoa
Environmental Center
Crawford 317
2550 Campus Road
Honolulu, HI 96822

Subject: Voyager Submarines Hawaii Artificial Reef Installation Project

Dear Mr. Harrison:

We have received a copy of your letter dated December 8, 1997 to Mr. Merrill of Voyager Submarines regarding the Voyager Submarines Artificial Reef Installation. Thank you for your comments.

Your general comments included a suggestion that for vessel stability, the deeper the site, the better, and a recommendation that fishing be banned near the artificial reef. The artificial reef site is constrained to a depth range of 90 to 100 feet. Water depths greater than 100 feet are considered hazardous for diving. Water depths shallower than 90 feet are not allowed by the Department of Army permit to protect coral substrate and maximize vessel stability.

Concerning the recommendation to ban fishing, Voyager Submarines has no authority to ban fishing at the site. Submerged lands are controlled by the State. Voyager is requesting non-exclusive use of the site. The site will therefore be open to all interested users, without restriction.

Thank you for reviewing and commenting on the Draft EIS. Please contact me if you have any questions or need additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND DIVISION
STATE PARKS
WATER RESOURCE MANAGEMENT

Ref: LM-SL

DEC 16 1997

MEMORANDUM

TO: Dean Y. Uchida, Administrator

FROM: Cecil B. Santos, Oahu District Land Agent

Subject: CDUA For Voyager Submarines Hawaii For Artificial Reefs and Mooring Bouys 3/4 mile offshore of Ala Moana Beach, Oahu.

We are responding to your memorandum dated November 20, 1997, regarding the above captioned matter.

The above subject property involves State Submerged Lands which are Ceded Lands to OHA. Request for comments should be obtained from OHA.

Land Division has several concerns regarding the CDUA to Voyager Submarines Hawaii to place artificial reefs and mooring bouys 3/4 mile offshore of Ala Moana Beach.

Ala Moana Beach is considered to be one of the more popular of all the beaches on the island and is highly used by the tourist and local people. Land Division feels that by permitting the Voyager Submarines to operate 3/4 mile offshore, will increase recreational uses and traffic in that area and therefore could endanger public safety.

Thank you for allowing us the opportunity to review this Conservation District Use Application (CDUA). Should you have any questions, please contact Steve Lau at 587-0409.

cc: Mr. C. Matsumoto

Sea Engineering, Inc.

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(808) 259-7966/FAX (808) 259-8143 E-MAIL: seaeng@lava.net

January 5, 1998

Mr. Cecil Santos
Oahu District Land Agent
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Voyager Submarines Artificial Reef Installation

Dear Mr. Santos:

We have received a copy of your letter dated December 16, 1997 to Mr. Dean Uchida of DLNR, Land Division concerning the CDUA for the Voyager Submarines Artificial Reef Installation project. Thank you for your comments. Responses to your comments are provided below.

1) Ceded lands - We have received comments from the Office of Hawaiian Affairs (OHA) and incorporated their comments into the Final Environmental Impact Statement (FEIS) for the project (see OHA letter dated December 5, 1997, and Sea Engineering response dated 12/22/97 in Section 14 of the FEIS).

2) Increased recreational uses and traffic - Voyager Submarines has been operating at their dive site since 1994. There have been no conflicts between Voyager and other area users. A comprehensive ocean activities survey has been conducted for this project and is presented in Section 3.4 of the FEIS. This survey included all activities conducted in the area including fishing, swimming, surfing, paddling, boating, gathering and reef walking. The survey found that in the project area, only one commercial trap fisherman operates. The site is too far offshore to impact swimmers, surfers and beach users.

Boating traffic in the area was surveyed on May 1 and December 16, 17, and 21, 1997. This data is presented in Table 3.7 and discussed in Sections 3.4.15 and 5.2.4 of the FEIS. All vessels passing within 1500 feet of the approximate Voyager site were logged and described. Survey days included Tuesday, Wednesday, Thursday and Sunday. Weather and sea conditions included typical nice boating weather on the south shore of O'ahu--- clear to partly cloudy skies with light to normal northeast tradewinds and small surf, and one morning of overcast skies on 12/17/97. In the 1997 survey, the number of vessels recorded passing within 500 feet of the site ranged from an average of 4.6 per hour on 12/21/97 to 1.8 per hour on 12/17/97 when skies were overcast. Vessel sizes ranged from the 232-foot long "Star of Honolulu" tour boat to 8-foot long pleasure kayaks.

Survey data were also collected December 23 and 28, 1986 in the same area when Atlantis Submarines was investigating the area as a possible operating site. The 1986 survey recorded slightly greater numbers of vessels passing within 500 feet of the area, averaging 4.9 vessels per hour during submarine operating hours. Future additional traffic at the site can be estimated utilizing current activity at the Atlantis artificial reef sites. Atlantis reports that an average of 6 vessels daily utilize their reef sites. A similar number can be expected to utilize the Voyager reef sites. This increase is equivalent to slightly less than 1 boat per hour, and is not expected to impact public safety or cause hazards.

Voyager intends to minimize possible hazards by facilitating access to the site. Surface buoys will be attached daily to submerged buoys marking the artificial reef locations. The surface buoys will show boaters and users where the sites are, and will provide safe, easy mooring. The surface buoys will also prevent anchoring, which is destructive to coral, and hazardous to divers. Furthermore, in the event of an emergency, Voyager has support vessels continuously stationed at the site during operating hours, equipped with first aid equipment and operators, and constant communications to shore. This discussion has been added to Section 5.2.4 of the FEIS.

Thank you for your input into the project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

Suspense Date:12/11/97

State of Hawaii
Department of Land and Natural Resources
Division of Aquatic Resources

Date: 12/04/97

TO: William Devick, Acting Administrator
THROUGH: Richard Sixberry
FROM: Brian Kanenaka, Aquatic Biologist
SUBJECT: Comments on Draft EIS, File No.: OA-2866

Comment Requested by: D. Uchida, Land Division
Date of Request: 11/20
Date Rec'd: 11/20

Summary of Proposed Project

Title: Voyager Submarines Hawaii Artificial Reef Installation

Project by: Voyager Submarines Hawaii

Location: Offshore of Ala Moana Beach, Honolulu, Hawaii

Brief Description:

The applicant proposes to sink two derelict vessels 3/4 miles offshore from Ala Moana Beach Park in 90-100 foot depths over sandy barren bottom. The vessels being considered are between 100-180 feet in length. Adhering to State and Federal regulations the vessels will be cleaned of pollutants, prepared for safe entry/exit by divers, and ballasted with concrete. Also six submerged mooring buoys are proposed to be installed at the site.

Comments:

Previous comments on this project provided in a letter dated July 17, 1997, remain applicable. In addition, we note in APPENDIX B, *Ocean Activities Survey* under "Future Site Users," the statement that "reef's depth at 100 feet will preclude introductory divers, but will be accessible to divers of intermediate and greater ability." This should be true for most introductory divers, but we continue to be concerned about sinking vessels at depths around 100 feet which may create an attractive hazard especially for tourist and resident beginning divers.

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January 5, 1998

Mr. Brian Kanenaka
Division of Aquatic Resources
Department of Land and Natural Resources
1151 Punchbowl Street, Room 330
Honolulu, HI 96813

Subject: Voyager Submarines Hawaii Artificial Reef Installation, Oahu

Dear Mr. Kanenaka:

We have received a copy of your letter dated December 4, 1997 regarding the Voyager Submarines Artificial Reef Installation Draft Environment Impact Statement. Thank you for your comments.

Your comment once again concerned the possible hazards to divers of a ship placed in 100 feet of water. Voyager recognizes the diving safety concerns of placing an artificial reef in relatively deep water. However, the Department of the Army permit for the project restricts vessel placement to water deeper than 90 feet. This restriction is to protect coral substrate in the shallower waters, maximize vessel stability on the bottom, and prevent hazards to navigation. Voyager is therefore limited to a water depth range of only 90 to 100 feet for the artificial reef location.

To reduce possible hazards to divers, the vessels will be carefully prepared prior to deployment. This includes cutting openings at least 4 feet by 4 feet in all holds and decks, removing all doors and hatches, sealing off hazardous compartments, and removing entanglement hazards by lines, cables and wires. In addition, the vessel will be ballasted with concrete placed in the lower levels of the ship. The vessels will be thoroughly inspected by interested agencies prior to deployment. This is discussed in Section 2.2.2 of the EIS.

Thank you for your input into the project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

BENJAMIN J. CAYETANO
GOVERNOR

GARY GILL
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

December 5, 1997

Mr. Michael Wilson, Chair
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Wilson:

Subject: Draft EIS for Voyager Submarines Hawaii Artificial Reef Installation, Oahu

Thank you for the opportunity to review and comment on the subject document. We have the following comment.

1. The Voyager Submarine tour includes viewing a large abandoned ship anchor. As a feature greater than 50 years old, is there historic significance to the anchor? Should the State Historic Preservation Division make a determination on this matter? How did the anchor come to be abandoned in waters off Ala Moana?

Should you have any questions, please call Jeyan Thirugnanam at 586-4185.

Sincerely,

Gary Gill
Director

c: Sea Engineering Inc.

Sea Engineering, Inc.
Makai Research Pier, 41-202 Kalanianaʻole Hwy, Suite B, Waimānalo, Hawai'i 96795-1820
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January 5, 1998

Mr. Gary Gill
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, HI 96813

Subject: Draft EIS for Voyager Submarines Hawaii Artificial Reef Installation, Oahu

Dear Mr. Gill:

We have received a copy of your letter dated December 5, 1997 to the Department of Land and Natural Resources concerning the Voyager Submarines Artificial Reef Installation. Thank you for your response.

Your only comment concerned the historical significance of a large abandoned ship anchor lying along the Voyager submarine tour route. The age and source of this anchor are unknown. It was at the site when Voyager began operating the submarine tours in 1994. Voyager personnel have heard that a coal carrier vessel grounded in the Ala Moana/Waikiki area in 1910, and that therefore this anchor might be from that ship. However, this theory has not been researched, documented or verified.

The anchor is not part of the artificial reef project, and will not be affected by the proposed project. Voyager Submarines, however, will follow up on the historic significance of the anchor by researching possible origins of the anchor and presenting the results to the Historic Preservation Division of DLNR.

Thank you for your input into this project. Please contact me if you have any questions or need additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIIKE
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P O BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to

December 1, 1997 97-143B/epo

TO: The Honorable Michael Wilson, Chairperson
Department of Land and Natural Resources

FROM: Lawrence Miike
Director of Health

SUBJECT: CONSERVATION DISTRICT USE PERMIT APPLICATION

Applicant: Voyager Submarines Hawaii
File No: OA-2866
Request: To place artificial reefs and install mooring bouys on submerged lands
Location: Offshore of Ala Moana Beach
Honolulu, Oahu, Hawaii
TMK: (1) 2-3-37

Thank you for allowing us to review and comment on the subject application. We do not have any comments to offer at this time, however, we had commented previously on the Draft Environmental Impact Statement in our letter of October 31, 1997 to Mr. Tom Eisen, Land Division, Deparment of Land and Natural Resources.

RECEIVED
97 DEC 3 P3:25
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

RECEIVED
97 DEC 3 P4:46
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIIKE
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P O BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to

October 31, 1997 97-143A/epo

Mr. Tom Eisen
Land Division
Department of Land and Natural Resources
P.O. Box 621
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Eisen:

Subject: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
Project: Voyager Submarines Hawaii Artificial Reef Installation
Location: Ala Moana Beach Park
Honolulu, Oahu, Hawaii
Tax Map Key: Offshore of (1) 2-3-37

Thank you for allowing us to review and comment on the subject project. We have the following comments to offer:

Clean Water Branch

A Section 401 Water Quality Certification (WQC) for the subject project has been issued to the applicant by the Clean Water Branch.

Should you have any questions regarding this matter, please contact Ms. Hong Chen of the Clean Water Branch at 586-4309.

Sincerely,

BRUCE S. ANDERSON, Ph.D.
Deputy Director for Environmental Health

c: OEQC
Voyager Submarines Hawaii
Sea Engineering, Inc.✓
Clean Water Branch, DOH

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Flr., Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

BENJAMIN J. CAYETANO
GOVERNOR
SELNA F. HAYA
DIRECTOR
BRADLEY J. MOSSMAN
DEPUTY DIRECTOR
RICK EGGED
DIRECTOR, OFFICE OF PLANNING

Tel.: (808) 587-2845
Fax: (808) 587-2824

Ref. No. P-7051

November 6, 1997

MEMORANDUM

TO: Michael D. Wilson, Chairperson
Department of Land and Natural Resources

ATTN: Tom Eisen
Land Division

FROM: Rick Egged
Director, Office of Planning

SUBJECT: Draft Environmental Impact Statement for Voyager Submarines Hawaii Artificial Reef Installation

We have reviewed the subject document and offer the following.

We have formally reviewed the project for Federal consistency with Hawaii's Coastal Zone Management (CZM) Program and issued our certification on August 25, 1997. Our approval was based on the condition that the following mitigation measures that were proposed in the environmental assessment and submitted as part of the CZM consistency determination be implemented.

1. Prior to sinking, the derelict ships shall be cleaned to U.S. Coast Guard, Environmental Protection Agency and State Department of Health standards. All petroleum products, toxic materials and floatable debris shall be removed.
2. The project shall be in compliance with State water quality standards and requirements of the Department of Health.
3. Concrete ballast, as opposed to gravel or unconsolidated material, shall be used to ensure that ballast material is contained within the vessels.
4. The vessels shall be oriented perpendicular to the shoreline to minimize wave forces and the potential for the vessels to be moved during storms.
5. The mooring buoys installed on each vessel will be dedicated for public access by other site users.
6. In addition, any changes to the proposal or proposed mitigation measures require CZM approval.

Thank you for the opportunity to comment on this project. If there are any questions, please contact Howard Fujimoto of the Coastal Zone Management Program at 587-2898.

cc: OEQC
Voyager Submarines, Hawaii
Sea Engineering, Inc.

(P)1723.7

NOV 20 1997

Department of Land and
Natural Resources
Land Division
State of Hawaii
Honolulu, Hawaii 96813

Attention: Mr. Tom Eisen

Gentlemen:

Subject: Voyager Submarines Hawaii Artificial
Reef Installation, Honolulu, Oahu
Draft Environmental Impact Statement

Thank you for the opportunity to review the subject document.
We have no comments to offer.

If there are any questions, please have your staff contact
Mr. Ronald Ching of the Planning Branch at 586-0490.

Sincerely,

GORDON MATSUOKA
Public Works Administrator

RC:jy
c: Voyager Submarines Hawaii
Sea Engineering, Inc.

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

October 20, 1997

Marc Ericksen
Sea Engineering Inc.
Makai Research Pier
41-202 Kalaniana'ole Hwy, Suite 8
Waimanalo, Hawai'i 96795-1820

LOG NO: 20327
DOC NO: 9710EJ07

Dear Mr. Ericksen:

SUBJECT: Historic Preservation Review--Voyager Submarines Hawaii Artificial Reef
Honolulu, Kona, O'ahu
Offshore

Thank you for the opportunity to review this project which proposes to sink two ships to serve as artificial reefs in waters approximately 3/4 mile offshore of Ala Moana Beach Park. We have no historic preservation concerns for the proposed use of this offshore location.

Aloha,

Don Hibbard, Administrator
Historic Preservation Division

EJ:jk

BENJAMIN J. CAYETANO
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

PHONE (808) 733-4300
FAX (808) 733-4287

November 26, 1997

TO: Land Division
Department of Land and Natural Resources
State of Hawaii

ATTENTION: Mr. Tom Eisen

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense

SUBJECT: Draft Environmental Impact Statement (DEIS), Voyager Submarines Hawaii Artificial Reef Installation, Island of Oahu, Hawaii

Thank you for the opportunity to comment on the subject document for the Voyager Submarines Hawaii Artificial Reef Installation Project offshore of Ala Moana Beach Park, TMK: 2-3-37.

State Civil Defense respectfully declines making any comments on this DEIS.

If you have any questions, please call Mr. Norman Ogasawara of my staff at 733-4300.

c: Oahu Civil Defense Agency

Mr. J. C. Merrill
Voyager Submarines Hawaii
680 Iwilei Road, Suite 720
Honolulu, Hawaii 96817

Mr. Mark Ericksen
Sea Engineering, Inc.
Makai Research Pier
41-202 Kalanianaole Hwy, Suite 8
Waimanalo, Hawaii 96795-1820

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

IN REPLY REFER TO

October 28, 1997

Mr. Tom Eisen
Department of Land and Natural Resources
Land Division
P.O. Box 621
1151 Punchbowl St.
Honolulu, Hawaii 96813

Dear Mr. Eisen:

Subject: Draft Environmental Impact Statement (DEIS)
Voyager Submarines Hawaii
Artificial Reef Installation

The staff of the U.S. Geological Survey, Water Resources Division, Hawaii District, has reviewed the Draft Environmental Impact Statement, and we have no comments to offer at this time.

Thank you for allowing us to review the DEIS. We are returning the report for your future use.

Sincerely,

SG Small

for William Meyer
District Chief

cc: Gary Gill, Office of Environmental Quality Control
J.C. Merrill, Voyager Submarines Hawaii
Marc Ericksen, Sea Engineering, Inc.

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS ECOREGION
300 ALA MOANA BOULEVARD, ROOM 3108
BOX 50088
HONOLULU, HAWAII 96850
PHONE: (808) 541-3441 FAX: (808) 541-3470

NOV 17 1997

Mr. Tom Eisen
Land Division, Department of Land and Natural Resources
P.O. Box 621
1151 Punchbowl Street
Honolulu, Hawaii 96813

Re: *Draft Environmental Impact Statement for Voyager Submarines Hawaii Artificial Reef Installation, Oahu, Hawaii*

Dear Mr. Eisen:

The U.S. Fish and Wildlife Service (Service) has reviewed the October 1997 *Draft Environmental Impact Statement (DEIS) for the Voyager Submarines Artificial Reef Installation*. The project entails sinking two ships in 90 to 110 feet of water, approximately 3/4 mile offshore of Ala Moana Beach Park, to serve as artificial reefs along the Voyager submarine tour route. The project also includes installing six submerged mooring buoys to facilitate site access. The vessels will be cleaned and prepared according to State and Federal regulations, will be placed on sandy bottom areas approved by reviewing agencies, and will be ballasted with concrete to prevent movement during severe storms. The public will be allowed access to the site and two of the six submerged mooring buoys will be exclusively for public use.

Because all of our previous comments on the project have been incorporated into the DEIS, we have no further comments. The Service appreciates the opportunity to provide comments on the DEIS. If you have questions, please contact Chris Swenson, of my staff, at 541-3441.

Sincerely,

Donald Palawski

for Brooks Harper
Field Supervisor
Ecological Services

cc: J.C. Merrill
Marc Ericksen
Office of Environmental Quality Control

UNITED STATES L ARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

December 1, 1997 F/SWO23:JJN

Mr. Dean Y. Uchida
Administrator Land Division
Department of Land & Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Dec 4 12 58 PM '97

Dear Mr. Uchida:

The National Marine Fisheries Service (NMFS) has reviewed the Draft Environmental Impact Statement (DEIS) and Conservation District Use Application (CDUA) for Voyager Submarines Hawaii Artificial Reef Installation, offshore Waikiki, Oahu, Hawaii. The following comments are offered for your consideration.

The applicant proposes to sink two derelict vessels at their existing tour submarine dive site off Waikiki. The sunken vessels would serve as artificial reefs to provide habitat for reef fish and invertebrates. Several submerged mooring buoys would also be placed on and adjacent to each vessel. It is our understanding that each vessel will be cleaned to State and Federal standards and ballasted prior to sinking.

NMFS has worked closely with the applicant and their consultant during the planning phase of the artificial reef project. This included an underwater site survey, on 2 April 1997, of three potential artificial reef sites selected by the applicant. We have also worked closely with and monitored the artificial reef project for Atlantis Submarine, a competing tour submarine company operating approximately 9,000 feet southeast of the proposed site. Results of studies at the existing Atlantis artificial reef, which includes two sunken vessels, has revealed a substantial increase in reef fish biomass with no apparent adverse impacts to the marine environment or ecology of the area. Corals have also colonized many portions of both sunken vessels.

NMFS is supportive of properly designed, constructed, and placed artificial reefs, and has published the National Artificial Reef Plan (NOAA Technical Memorandum NMFS OF-6, November 1985). The proposed artificial reef appears to be in compliance with the Plan.

The majority of the Mitigation Measures outlined in Section 9.0 of the DEIS were developed with input from NMFS. This was done during our coordination with the U. S. Army Corps of Engineers for the Army permit, pursuant to the Fish and Wildlife Coordination Act. NMFS particularly recommends that we be notified when the precise artificial reef site has been selected, as specified in Mitigation Measure #2 in the DEIS. In addition, we request to be included in the review of the proposed biological monitoring program (Mitigation Measure #7) prior to its implementation.

NMFS appreciates the opportunity to review the DEIS and CDUA for the proposed artificial reef project. Should you have any questions, please contact me (973-2940) at the Pacific Islands Area Office.

Sincerely,

John J. Naughton
Pacific Islands
Environmental Coordinator

cc: F/SWX-1
F/SWO2
FWS, Honolulu
EPA, Region 9 (E-4)
Hawaii, DAR
Hawaii, CZM
Hawaii, DOH

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

November 26, 1997

Planning and Operations Division

Mr. Dean Y. Uchida, Administrator
State of Hawaii
Department of Land and Natural Resources
Land Division
PO Box 621
Honolulu, Hawaii 96809

Dear Mr. Uchida:

Thank you for the opportunity to review and comment on the Conservation District Use Application for the Voyager Submarine Project, Offshore Ala Moana, Oahu. The following comments are provided in accordance with Corps of Engineers authorities to provide flood hazard information and to issue Department of the Army (DA) permits.

The applicant has submitted and received a provisional individual DA permit for the subject project. The Hawaii State Department of Health issued a Water Quality Certification (No. 376) on October 13, 1997. Following the receipt of signed permit documents from Voyager Submarines, the Corps is prepared to issue a valid DA permit authorizing the reef installation to proceed. Please contact our Regulatory Section at 438-9258 for further information and refer to file number 970000134.

Sincerely,

Paul Mizue, P.E.
Acting Chief, Planning
and Operations Division

PLANNING DEPARTMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 8TH FLOOR • HONOLULU, HAWAII 96813-3017
PHONE: (808) 523-4711 • FAX: (808) 523-4950

JEREMY HARRIS
MAYOR

PATRICK T. ONISHI
CHIEF PLANNING OFFICER

DONA L. HANAIKE
DEPUTY CHIEF PLANNING OFFICER

RR 10/97-2092

November 13, 1997

Mr. Tom Eisen
Land Division
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Eisen:

Draft Environmental Impact Statement (DEIS)
Voyager Submarines Hawaii Artificial Reef Installation
Offshore of Tax Map Key (TMK) 2-3-37

We have reviewed the above DEIS in response to your department's request on behalf of Voyager Submarines Hawaii to install artificial reefs and reef access buoys approximately three quarters of a mile offshore of Ala Moana Beach Park.

The project does not raise any specific General Plan Objectives or Policies concerns; nor does the project directly affect the Development Plan for the Primary Urban Center and its special provisions for the area.

Should you have any questions please contact Rob Reed of our staff at 523-4402

Yours very truly,

~~PATRICK~~ T. ONISHI
Chief Planning Officer

PTO:ft

c: Voyager Submarines Hawaii
Sea Engineering, Inc.
OEQC

ALA MOANA/KAKAAKO NEIGHBORHOOD BOARD NO. 11
c/o NEIGHBORHOOD COMMISSION • CITY HALL, ROOM 400 • HONOLULU, HAWAII 96813

December 19, 1997

Marc Ericksen
Sea Engineering, Inc.
Makai Research Pier
Waimanalo, HI 96795

Dear Mr. Ericksen:

Thank you for sending a copy of the Draft Environmental Impact Statement for the Voyager Submarines Hawaii Artificial Reef Installation to the Ala Moana/Kakaako Neighborhood Board for information. We were not able to put this issue on our agenda so we can not comment on the Draft. We would like to be kept informed about this project and would welcome someone giving a brief presentation to our Board and the community in the future.

We appreciate being kept informed on this project and we look forward to offering an opportunity to you or someone from the project to give a presentation at a future Board meeting.

Sincerely,

John A. Breinich
Chair

15.0 PREVIOUS COMMENTS AND RESPONSES

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS ECOREGION
300 ALA MOANA BOULEVARD, ROOM 3108
BOX 50088
HONOLULU, HAWAII 96850
PHONE: (808) 541-3441 FAX: (808) 541-3470

SEP 10 1997

Mr. Marc Ericksen
Sea Engineering, Inc.
Makai Research Pier
41-202 Kalanianaole Highway, Suite 8
Waimanalo, Hawaii 96795-1820

Re: *Preparation of Draft Environmental Impact Statement for Voyager Submarines Hawaii Artificial Reef Installation, Oahu, Hawaii*

Dear Mr. Ericksen:

The U.S. Fish and Wildlife Service (Service) has reviewed your summary of the Voyager Submarines Artificial Reef Installation Project, dated August 28, 1997. Your letter states that you are preparing a Draft Environmental Impact Statement (DEIS) for the project. The project entails sinking two ships in 60 to 110 feet of water, approximately 3/4 mile offshore of Ala Moana Beach Park, to serve as artificial reefs along the Voyager submarine tour route. The project also includes installing six submerged mooring buoys to facilitate site access. The vessels will be cleaned and prepared according to State and Federal regulations, will be placed on sandy bottom areas approved by reviewing agencies, and will be ballasted with concrete to prevent movement during severe storms. The public will be allowed access to the site and two of the six submerged mooring buoys will be exclusively for public use.

The Service recommends that the DEIS describe project-related impacts to fish and wildlife resources and habitats within the project area. The DEIS should include current maps detailing the distribution of any native flora, fauna, coral reefs, and other habitat types in and around the project area, including federally listed threatened and endangered species. It should also describe potential environmental impacts or habitat losses caused by the project and provide details on proposed measures to avoid, minimize, or mitigate any negative ecological impacts.

The DEIS should also provide detailed answers to the following questions:

- ***Vessel cleaning and preparation:*** What specific procedures will be carried out to prepare the vessels for sinking? How will they be cleaned? Will this entail removing all rigging, lines, and other structures that might entangle or entrap sea turtles?
- ***Vessel stabilization and deployment:*** How will the vessels be stabilized and deployed, and will monitoring be required to insure that they do not shift off-site during storms?
- ***Site selection:*** How will the specific sites for sinking the vessels be chosen and how will the agencies be involved in this process to minimize potential environmental effects?

The Service appreciates the opportunity to provide comments on the proposed project, and we look forward to reviewing the DEIS. If you have questions regarding these comments, please contact Chris Swenson, of my staff, at (808) 541-3441.

Sincerely,

Brooks Harper

Brooks Harper
Field Supervisor
Ecological Services

cc: John Naughton (NMFS, Honolulu)

Sea Engineering, Inc.
Makai Research Pier 41-202 Kalanianaole Hwy, Suite 8, Waimanalo, Hawaii 96795 (808) 259-7966/FAX (808) 259-8143

October 7, 1997

Mr. Brooks Harper
Fish and Wildlife Service
Pacific Islands Ecoregion
300 Ala Moana Boulevard, Room 3108
Box 50088
Honolulu, Hawai'i 96850

Subject: Voyager Submarines Artificial Reef Installation

Dear Mr. Brooks:

Thank you for your comments on the Voyager Submarines Artificial Reef Installation Project. We have incorporated these comments into the Draft Environmental Impact Statement (DEIS). Responses to your comments are provided below.

1) The DEIS includes an assessment of water quality and marine community structure in the vicinity of the Voyager dive site. This study is included in the text of the DEIS, and is also attached as an appendix. The study includes a vicinity map showing bottom features and station locations that were surveyed for biotic community structure. The DEIS also discusses threatened and endangered species, habitat loss, potential environmental impacts and mitigative measures.

2) Vessel cleaning and preparation - The vessels will be thoroughly cleaned to U.S. Coast Guard, EPA and State DOH standards. Cleaning methods will include the following: pumping out all fuel, fluids and sludge; pressure steam cleaning and hot water blasting to clean all residual fuel, material and debris; removal of all floatable material; disposal of all hazardous material by a firm specializing in hazardous waste treatment and disposal. In addition, the vessel will be prepared by cutting holes at least 4 feet by 4 feet into compartments and decks; removing all doors and hatches; sealing off hazardous compartments; and removing entanglement hazards from cables, lines and wires. These vessels will be inspected by all interested agencies prior to deployment. This is discussed in Section 2.2.2 of the DEIS.

3) Vessel stabilization and deployment - Conservative design waves incorporating data from Hurricanes 'Iwa and 'Iniki will be used to determine wave forces at the site and vessel weight required for stability. The ballasting will be accomplished by pouring concrete into the ship hulls until the weight required for stability is reached. To the maximum extent possible, concrete will be emplaced dockside and the pre-weighted vessel will be towed out to the deployment site. The deployment will be tightly controlled using a three point mooring system. A multi-year biological monitoring program will be conducted following deployment. This monitoring will be able to record any movement of the ships during storms. This is discussed in Section 2.2.4.

4) Site selection - Possible sites have been selected in barren, unproductive sand at least 100 feet seaward of the limestone ledge. A site visit with all the interested agencies was conducted in the submarine at the onset of the project to view the general project area and possible specific sites for sinking the vessels. A representative of Fish and Wildlife Service attended that visit. Prior to vessel deployment, the final sites will be approved by interested agencies. This is discussed in Section 2.2.3 of the DEIS.

Thank you for your input into the project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

GARY GILL
DIRECTOR

September 15, 1997

Mr. Michael Wilson, Chair
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Wilson:

Subject: EISPN for Voyager Submarines Hawaii Artificial Reef Installation, Oahu

Thank you for the opportunity to review and comment on the subject document. We have the following comments and questions.

1. Please describe whether baseline and periodic monitoring of species, coral and water quality in the area will be conducted. If so, please describe the scope of the monitoring program.

2. Please describe the potential of placing alternative artificial reefs such as open-modular structures to enhance the biological productivity of the site.

3. Please disclose the results of any known study of the relationship between artificial reefs and shark attraction.

4. Please fully discuss how the project may impact any surf sites.

5. Please evaluate whether traditional practices and beliefs of native Hawaiians or other groups will be impacted by the project. The discussion should include, but be not limited to, fishing activities and legends associated with the site.

6. The list of significant criteria discussed in section 8 of the EISPN does not include the two new points and other changes made to the EIS rules in August of 1996. Please refer to §11-200-8 of the new EIS rules and make the appropriate changes.

Should you have any questions, please call Jayan Thirugnanam at 586-4185.

Sincerely,

Gary Gill
Director

c: Sea Engineering Inc.

Sea Engineering, Inc.
Makai Research Pier, 41-202 Kalanianaole Hwy, Suite 8, Waimanalo, Hawaii 96795 (808) 259-7966/FAX (808) 259-8143

October 7, 1997

Mr. Gary Gill
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813

Subject: EISPN for Voyager Submarines Hawaii Artificial Reef Installation, O'ahu

Dear Mr. Gill:

We have received a copy of your letter dated September 15, 1997 to the Department of Land and Natural Resources concerning the Voyager Submarines Artificial Reef Installation. Thank you for your comments. They have been incorporated into the draft EIS. Our responses to your comments are provided below.

1) The project will include a comprehensive, multi-year biological monitoring program. This will be a requirement of the Department of the Army Permit for the project. Following reef deployment, the biological monitoring will be conducted every 3 to 4 days during the first two weeks, once per week during the next two weeks, once every 10 to 14 days during the next two months, once per month the remainder of the first year, and once every 4 to 6 weeks during the next two years.

2) Alternative reef structures were considered for this project. Both specially designed alternative reef structures, and properly prepared steel ships have been shown to be effective artificial reefs. There are no studies directly comparing this effectiveness. Sunken ships, however, are uniquely appealing to viewing passengers, while reef modules are generally not regarded as visually attractive. Given that alternative structures and ships are both effective as artificial reefs, Voyager has elected to utilize ships that are also visually appealing. This is discussed in Section 10.0 of the DEIS.

3) There are no definitive studies concerning the attraction of sharks to artificial reefs. Extensive observations and data collected in Hawaii, however, indicate that artificial reefs in Hawaii are not particularly attractive to potentially dangerous sharks. A DLNR study completed in 1994 addressing this question could not show a relationship between sharks and artificial reefs. In fact, the DLNR study did not observe any sharks at the Atlantis site, but did observe sharks at a nearby natural reef. Similarly, Brock (1995) states that in 500 manhours observing the Moanalua and Atlantis artificial reefs, only one small whitetip reef shark was sited. From 1779 through 1995 there have been 112 documented encounters with sharks in Hawaii; none have occurred on any of the Hawaiian artificial reefs. The most comprehensive data set has been compiled by the Atlantis submarine pilots. Beginning in 1993, they have compiled 20,200 hours observing and logging unusual marine sitings, including sharks. Only 8 large potentially dangerous sharks have been sited. Only 27 potentially aggressive sharks have been sited. Thus, despite numerous hours of observation, there is no data to suggest that artificial reefs attract sharks. Rather, the data indicates that artificial reefs are not particularly attractive to sharks. This is discussed in Section 5.2.1 of the DEIS.

4) Possible impacts of this project on surfing waves can be best assessed by evaluating similar existing situations. Eight vessels have been sunk in nearshore waters around O'ahu to serve as artificial reefs. Each of these is located offshore of surf breaks. At least 18 surf breaks exist inshore of the Atlantis sunken vessels, including famous breaks such as Rice Bowls, Castles, Old Mans, Publics, Canoes, and Queens. Approximately 7 breaks are located inshore of the Mahi sunken vessel in Ma'ili. A 110 foot long barge is also located in the general vicinity of the Mahi. In addition, four barges have been sunk in nearshore waters in Maunalua Bay. There have been no reported impacts of any of these vessels on surfing waves. This incorporates 8 years of surfing at some of the most popular surf sites in Waikīkī, probably some of the most heavily surfed spots in the world, and 15 years of surfing in Ma'ili. The Voyager sunken vessels will be placed in relatively deep water and will be oriented perpendicular to the shoreline to present minimal surface area to approaching waves. These ships should therefore also have no impact on surfing waves inshore of the site. This is discussed in Section 5.2.4 of the DEIS.

5) A comprehensive ocean activities survey has been conducted for this project and is presented in Section 3.4 of the DEIS. This survey included native Hawaiian practices such as fishing, squidding, surfboard fishing, netting, gathering and paddling. The survey found that in the project area, only one commercial trap fisherman operates. However, this is not a native practice, but a contemporary commercial fishing activity. There have been no conflicts between him and the submarine operation. There are no legends associated with the specific project site. Legends in the general vicinity are associated with the name Kewalo of Kewalo Basin, and Māmala of Māmala Bay. This project should have no impacts on traditional practices and beliefs.

6) The two new points in the list of significant criteria have been added to Section 5.3 of the DEIS.

Thank you for your input into this project. Please contact me if you have any questions or need additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

Nautilus

August 27, 1997

AR

Mike Wilson, Chairman
Department of Land and Natural Resources
1151 Punchbowl Street
Honolulu, Hawaii 96813

Re: Voyager Submarine's Request for an Artificial Reef

Dear Mr. Wilson,

I would like to state my concern on the recent permit request by the Voyager Submarines company to place an artificial reef at their present dive site off Ala Moana. In the State's list of requisites when contemplating an approval of this enviromental magnitude, do you require the applicant to be financially responsible so that in the event a disaster mandates a clean up or removal, can the applicant independently take care of this?

I hope Voyager's explanation that the placement of these vessels, which is first for the restocking of marine life, and then, as an additional dive site for all divers, including his submarines, is not deceptive. Voyager's contention that there is no life there presently and that there is nothing to see, is not enough for such an impact, and, is totally incorrect.

I do not agree with the placement of any discarded metal in the open ocean. Unlike other artificial reef dive sites in protected locations (inside of barrier reefs, lakes, bays, etc.) the open ocean will sooner or later destroy these metal junks and redistribute them all over the ocean floor. If proponents would like to encourage more marine life in desolate areas, then research will tell them there are other more suitable structures for this.

My company uses the same area, and has been for the past 5 years. We have no complaints. Our guests are extremely satisfied with the types and numbers of marine life seen on our tour. The natural conditions have a lot of merit and attraction for our tours and it maintains a balance. I would encourage you and your staff to join me on one of our tours.

I hope someone is not trying to "pad" the value of their product at the expense of the state so that they may capitalize later in the event of a sale or additional investor solicitation?

Can someone respond to my letter from your office. I may be reached at 591-9199.

Sincerely,
Ted Bush

SEP 3 1997

Sea Engineering, Inc.

Makai Research Pier, 41-202 Kalanianaole Hwy, Suite 8, Waimanalo, Hawaii 96795 (808) 259-7966/FAX (808) 259-8143

October 7, 1997

Mr. Ted Bush
Nautilus
849 Halekauwila Street
Honolulu, Hawai'i 96813

Subject: Voyager Submarines Hawaii Artificial Reef Installation, O'ahu

Dear Mr. Bush:

We have received a copy of your letter dated August 27, 1997 to the Department of Land and Natural Resources concerning the Voyager Submarines Artificial Reef Installation and DLNR's response dated September 10, 1997. Our responses to your comments are provided below.

1) Voyager has not stated that "there is no life there presently and that there is nothing to see". The submarine tour currently follows the edge of a limestone shelf and ledge that harbors moderate coral and fish populations. The artificial reef sites, however, have been carefully located on barren, unproductive sand seaward of this ledge. Biological surveys of the area indicate that macrobiota and fish occurrence in this biotope are very limited. These sites therefore represent ideal locations for artificial reefs; the reefs will have little impact, and offer the possibility to significantly enhance the available fish habitat. These sites are located in 90 to 100 feet of water, and are significantly different in marine community structure than the shallower water where Nautilus operates. Large numbers and types of marine life may be seen in the shallow water where Nautilus operates, while the sandy bottom areas in deeper water targeted for the artificial reef are characterized by very limited marine life.

2) Properly prepared steel ships have been found to be excellent artificial reefs. They are durable, provide high relief, are open to water circulation, have large amounts of surface area per unit volume, and offer complex internal spaces — all important criteria for reef effectiveness. In addition, concrete ballast and very conservative design wave analyses will be used to ensure that the ships remain stable on the seafloor, even during severe storms and hurricanes.

Voyager Submarines depends on a healthy marine environment. Voyager is therefore committed to long term conservation and enhancement of the marine environment. We believe this project provides substantial public and environmental benefits, in addition to enhancing the Voyager submarine tours. Thank you for your comments. Please contact me if you have any questions or require additional information.

Sincerely,
Marc Ericksen
Sea Engineering, Inc.
cc: DLNR, Land Division

BENJAMIN J. CAYETANO
Governor of Hawaii

MICHAEL D. WILSON
Chairperson
Board of Land and Natural Resources

Deputy Director
GILBERT S. COLOMA-AGARAN

Aquatic Resources
Boating and Ocean Recreation
Conservation and Environmental Affairs
Conservation and Resources Enforcement
Forestry and Wildlife
Historic Preservation
Land Management
State Parks
Water and Land Development

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

September 10, 1997

RECEIVED
DIVISION OF
LAND MANAGEMENT
SEP 11 3 53 PM '97

Mr. Ted Bush
849 Halekauwila Street
Honolulu, HI 96813

Dear Mr. Bush:

Thank you for your letter of August 27, 1997, regarding Voyager Submarine's request for an artificial reef. Your letter and concerns will be forwarded to our Land Division's Planning and Technical Services Branch which reviews proposals involving use of State lands.

Your question about the applicant being required to be financially responsible in case any clean-up is necessary in the event of a disaster may have merit. It is very likely that if this subject application is approved, a condition similar to that placed on Atlantis Submarines where it states, "The applicant is responsible for any clean-up or other restoration which may be necessary as a result of movement of project (artificial reef or "wreck") materials, even if by accident or natural forces," would be imposed.

The applicant's contention about "no life" and "nothing to see" may be an exaggeration, although staff inspecting the potential sites for the vessels described them as barren, sandy areas.

The placement of discarded metal in the ocean is a valid concern. The State dumped several thousand derelict cars between 1961 and 1972. One of the reasons dumping was discontinued is that the cars corroded rapidly and diminished the once excellent fish habitat. However, a barge scuttled in 1970 still remains intact and is a bountiful fish shelter. Therefore, we continue to utilize heavy gauge derelicts and have scuttled a dozen vessels since the early eighties. A recent survey of an old rusty derelict barge sunk in 1985 found it literally covered with a number of coral species which may be helping to keep the barge from falling apart.

Thank you for the invitation to join you on one of your tours. I would love to see your operation and may take up your offer one day.

We also hope the applicant is not just trying to "pad" the value of their product, but is sincerely trying to upgrade their operation for the benefit of our valuable tourist industry.

Mr. Ted Bush
Page 2
September 10, 1997

Again, thank you for your letter and concern about the subject request.

Aloha,

for MICHAEL D. WILSON

cc: Land Division

Suspense Date:07/18/97

State of Hawaii
Department of Land and Natural Resources
Division of Aquatic Resources

Date: 07/17/97

TO: William Devick, Acting Administrator
THROUGH: Richard Sixberry
FROM: Brian Kanenaka, Aquatic Biologist
SUBJECT: Comments on Final EA/EIS Prep Notice, Final No.: OA-2866

Comment Requested by:		Date of Request:	Date Rec'd:
D. Uchida, Land Division		06/26	06/27

Summary of Proposed Project

Title: Sink Two Vessels as Artificial Reefs

Project by: Voyager Submarines Hawaii

Location: Offshore of Ala Moana Beach, Honolulu, Hawaii

Brief Description:

The applicant proposes to sink two derelict vessels 3/4 miles offshore from Ala Moana Beach Park in 80-100 foot depths over sandy barren bottom. The vessels being considered are between 100-180 feet in length. Adhering to State and Federal regulations the vessels will be cleaned of pollutants, prepared for safe entry/exit by divers, and ballasted with concrete. Also six submerged mooring buoys are proposed to be installed at the site. In addition, it is stated on page 4-10 of the text that "Voyager will not have exclusive use of the area . . . and will not limit private access to the area."

Comments:

The Division has no objection to the proposed project provided the site selected would not be displacing fishermen from traditional fishing grounds. Installation of two vessels as artificial reefs would impact sedentary organism, but the additional habitat would most likely increase the overall productivity of marine life in the adjacent area. In addition, access to and appreciation for underwater resources would improve for people who do not dive or fish.

Preparing the vessels for sinking should be done carefully to minimize the potential for accidential release of pollutants and other debris into the ocean. Although the "wrecks" are to be properly ballasted and installed to withstand waves and currents, responsibility for any clean-up or other restoration which may be necessary as a result of movement and deterioration, even if by accident or natural forces, should be the responsibility of the applicant by condition.

We continue to be concerned about the placement of artificial reef structures at 100 foot depths, especially an attraction like a sunken vessel which may attract and encourage SCUBA divers at a depth where diving is limited without decompression. The State generally deploys artificial reef material at depths between 60-70 feet which would allow about 50 mimutes of diving without requiring decompression. We suggest the applicant fill with concrete or block the access to the lower levels of the vessel precluding divers from going deep into the bowels of the ship thereby lessening the chance of entrapment and keeping them at a safer depth. Nevertheless, the State should be protected from liability for any injury to persons diving on the vessels. Finally, any liability from the use or moorings, especially since they could break free, should be the responsibility of the applicant.

Sea Engineering, Inc.
Makai Research Pier, 41-202 Kalanianaole Hwy, Suite 8, Waimanalo, Hawaii 96795 (808) 259-7966/FAX (808) 259-8143

October 8, 1997

Mr. Brian Kanenaka
Division of Aquatic Resources
Department of Land and Natural Resources
1151 Punchbowl Street, Room 330
Honolulu, HI 96813

Subject: Voyager Submarines Hawaii Artificial Reef Installation, O'ahu

Dear Mr. Kanenaka:

We have received a copy of your letter dated July 17, 1997 regarding the Voyager Submarines Artificial Reef Installation. Thank you for your comments. They have been incorporated into the draft EIS. Our responses to your comments are provided below.

1) A comprehensive ocean activities survey has been conducted for this project and is presented in Section 3.4 of the DEIS. This survey included native Hawaiian practices such as fishing, squidding, surfboard fishing, netting, gathering and paddling. The survey found that in the project area, only one commercial trap fisherman operates. However, this is not a native practice, but a contemporary commercial fishing activity. There have been no conflicts between him and the submarine operation.

2) The vessels will be thoroughly cleaned to U.S. Coast Guard, EPA and State DOH standards. Cleaning methods will include the following: pumping out all fuel, fluids and sludge; pressure steam cleaning and hot water blasting to clean all residual fuel, material and debris; removal of all floatable material; disposal of all hazardous material by a firm specializing in hazardous waste treatment and disposal. The vessels will be inspected by all interested agencies prior to deployment. This is discussed in Section 2.2.2 of the DEIS.

3) We recognize the diving safety concerns of placing an artificial reef in relatively deep water. There are, however, additional constraints that must be considered when selecting

the artificial reef site. These include locating a suitable substrate, minimizing possible storm wave impacts, and not creating a navigational hazard. In the project vicinity, barren sandy substrate ideal for reef placement is located at depths of 80 to 100 feet; inshore of this are potentially sensitive coral areas. Shallow waters are also subject to greater wave forces during storms. Coast Guard regulations typically require that no part of the reef extend to within 40 feet of the water surface. This usually restricts vessel placement to water deeper than approximately 80 feet. For these reasons, a restriction of the Department of the Army Permit for this project is that minimum water depths for the selected reef site should be at least 90 feet. On the other hand, water depths greater than 100 feet are generally regarded as hazardous for diving. These limitations restrict Voyager Submarines to the narrow depth range of approximately 90 to 100 feet for vessel placement. Site selection is discussed in Section 2.2.3 of the DEIS.

4) To minimize possible safety hazards, the vessels will be carefully prepared prior to deployment. This includes cutting openings at least 4 feet by 4 feet in all holds and decks, removing all doors and hatches, sealing off hazardous compartments, and removing entanglement hazards by lines, cables and wires. In addition, the vessel will be ballasted with concrete placed in the lower levels of the ship. The vessels will be thoroughly inspected by interested agencies prior to deployment. This is discussed in Section 2.2.2 of the DEIS.

Thank you for your input into the project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

CONSERVATION COUNCIL for HAWAII

A CITIZENS' ORGANIZATION PROMOTING ENVIRONMENTAL HEALTH AND EDUCATION, CONSERVATION AND MANAGEMENT OF HAWAII'S NATURAL RESOURCES.
HAWAII AFFILIATE OF THE NATIONAL WILDLIFE FEDERATION
P.O. BOX 2923, HONOLULU, HAWAII 96802.

September 13, 1997

Mr. Ed Boot, Sr. VP
Voyager Submarines
1085 AlaMoana Blvd
Honolulu, HI 96814

RECEIVED
SEP 17 12 16PM '97
DIVISION OF
LAND MANAGEMENT

RE: EIS, Voyager Sub 8/23/97 - 14

The Conservation Council for Hawaii is a state wide, 2000 member, citizens organization devoted to environmental conservation and the management of our natural resources.

Because of concerns expressed related to the possable environmental damage which could be caused as a result of storm surf effect on the submerged ships, we asked our members who have marine expertise to review the proposal.

We can find no adverse environmental effects and believe the project will provide quality habitat for marine life.

Our people have recommended several safety considerations. Plans are to sink the craft at approximately 100 foot depths. The ships may be considered an attractive nuisance. The company must protect the state from any liability. Three atmospheres requires divers to decompress during accent and bottom time is severly limited. Still, divers will be attracted to the ships. If the ships are sunk at 60-70 feet, anyone diving on the ships will be at much safer depths. We recommend that the sides of the ships be opened in such a way that divers who enter the ships cannot be trapped. We would not want a diver to be able to enter the ship, dive deep into the interior and not be able to get out.

Also, it is a state policy to encourage sustainable industries. We don't know if it is practical, but we would like to see this opperation move to renewable energy sources wherever possible.

CCH is pleased to be able to support this project.

Sincerely,

William H. Sager
Chair

cc: DLNR

Sea Engineering, Inc.

Makai Research Pier, 41-202 Kalanianaole Hwy, Suite 8, Waimanalo, Hawaii 96795 (808) 259-7966 (FAX (808) 259-8143

October 7, 1997

Mr. William H. Sager
Conservation Council for Hawaii
P.O. Box 2923
Honolulu, Hawai'i 96802

Subject: Voyager Submarines Hawaii Artificial Reef Installation, O'ahu

Dear Mr. Sager:

We have been provided a copy of your letter dated September 13, 1997 to Mr. Ed Boot concerning the Voyager Submarines Artificial Reef Installation. Thank you for your comments.

We recognize the diving safety concerns of placing an artificial reef in relatively deep water. There are, however, additional constraints that must be considered when selecting the artificial reef site. These include locating a suitable substrate, minimizing possible storm wave impacts, and not creating a navigational hazard. In the project vicinity, barren sandy substrate ideal for reef placement is located at depths of 80 to 100 feet; inshore of this are potentially sensitive coral areas. Shallower waters are also subject to greater wave forces during storms. Coast Guard regulations typically require that no part of the reef extend to within 40 feet of the water surface. This usually restricts vessel placement to water deeper than approximately 80 feet. For these reasons, a restriction of the Department of the Army Permit for this project is that minimum water depths for the selected reef site should be 90 feet. On the other hand, water depths greater than 100 feet are generally regarded as hazardous for diving. These limitations restrict Voyager Submarines to the narrow depth range of approximately 90 to 100 feet for vessel placement.

The vessels will be properly prepared prior to deployment. This includes cutting openings at least 4 feet by 4 feet in all holds and decks, removing all doors and hatches, sealing off hazardous compartments, and removing entanglement hazards by lines, cables and wires. The vessels will be thoroughly inspected by interested agencies prior to deployment.

Thank you for your input into the project. Please contact me if you have any questions or require additional information.

Sincerely,

Marc Ericksen
Sea Engineering, Inc.

cc: DLNR, Land Division

BENJAMIN J CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF BOATING AND OCEAN RECREATION
333 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813

MICHAEL D. WILSON
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY DIRECTOR
GILBERT S. COLOMA-AGARAN

July 24, 1997 BOR-A 0080.98

MEMORANDUM

TO: Dean Y. Uchida, Administrator
Land Division

FROM: David E. Parsons, Administrator

SUBJECT: File No.: OA-2866
Request for Authorization from the Department to Process a Conservation District Use Application Located on State-owned Lands

Our comments on the request follow:

1. This will impact on boating operations, but in a positive manner, by providing an alternative site for these types of operations, thus possibly relieving additional congestion at the Atlantis dive site;

2. It could also provide an alternative location for possible disposal of derelict vessels; and

3. Other specific comments will be reserved for the CDUA review process, if it is accepted.

Recommend that Chairperson sign as landowner so that this CDUA may be processed.

We request permission to retain the application for future reference.

JUL 21 3 37 PM '97

BENJAMIN J CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

July 8, 1997

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
Gilbert Coloma-Agaran

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

MEMORANDUM

LOG NO: 19748
DOC NO: 9707EJ02

TO: Dean Uchida, Administrator
Land Division

FROM: Don Hibbard, Administrator
Historic Preservation Division

SUBJECT: Historic Preservation Review -- Conservation District Use Application:
Voyager Submarines Hawaii (File No. OA-2866)
Honolulu, Kona, O'ahu
Offshore

We have no historic preservation concerns for the proposed use of this offshore location.

EJ:jk

JUL 8 2 35 PM '97

U.S. Department of Transportation
United States Coast Guard

Commanding Officer
U.S. Coast Guard
Marine Safety Office
Fax: (808)522-8270

433 Ala Moana Blvd.
Honolulu, HI 96813-4909
Port Operations Department
Tel: (808)522-8260

16703
SEP 22 [illegible]

Department of Land and Natural Resources
Land Division
Attn: Mr. Tom Eisen
1151 Punchbowl Street
Honolulu, Hawaii 96813

Gentlemen:

This is in response to Voyager Submarines' Artificial Reef proposal, published in the August 23, 1997, Office of Environmental Quality Control bulletin.

Marine Safety Office Honolulu strongly supports the establishment of a second artificial reef offshore of Waikiki.

Presently, the artificial reef established off the Hawaiian Hilton Village has proved to be a very popular commercial and recreational dive site. The area is frequently overcrowded with several vessels jockeying for positions above the reef. As a result, the Coast Guard has responded to several unsafe conditions involving both divers and boats. The installation of a second dive site off of Ala Moana Beach Park will help to alleviate crowding, thereby improving diver and vessel safety.

If we can provide further information on marine safety as it relates to this project, please contact me or Lieutenant Craig Petersen of my staff at 522-8260.

Sincerely,

F. L. WHIPPLE
Captain, U. S. Coast Guard
Captain of the Port

Copy: Voyager Submarines Hawaii
Sea Engineering, Inc.
USACOE, Kathleen Dadey

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

September 24, 1997

Operations Branch

Mr. Edward Boot
Senior Vice President
Voyager Submarines Hawaii
680 Iwilei Road, Suite 720
Honolulu, Hawaii 96817

Dear Mr. Boot:

We have completed our review of your permit application for work in navigable waters of the U.S., including the discharge of dredged or fill material, associated with installation of two derelict vessels and associated moorings on Voyager's submarine tour site for the purpose of creating an artificial reef.

Enclosed is a "PROVISIONAL PERMIT." The provisional permit is NOT VALID and does not authorize you to do your proposed work. The provisional permit describes the work that will be authorized, and includes the General and Special Conditions which will be placed on your final Department of Army (DA) permit, if the State of Hawaii Section 401 Water Quality Certification requirements are satisfied as described below. No work is to be performed in the water until you have received a validated copy of the DA permit.

Pursuant to Section 404 of the Clean Water Act, no DA permit can be issued until a State Section 401 Water Quality Certification has been issued or has been waived. As of this date, the State Department of Health has not issued a Section 401 Water Quality Certification for the proposed work. If the State Department of Health fails or refuses to act by six months from the date of this letter, the Section 401 Water Quality Certification requirement will be automatically deemed waived.

Conditions of the State Coastal Zone Management consistency determination are incorporated in and made part of the DA permit. Moreover, conditions of the Section 401 Water Quality Certification, or waiver thereof, will become conditions of the final DA permit. Should the State's action on the required certification preclude validation of the provisional permit in its current form, a modification to the provisional permit will be evaluated and you will be notified as appropriate.

Substantial changes may require a new permit evaluation process, including issuing a new public notice.

Once the State has issued (or waived) the required Section 401 Water Quality Certification or the aforementioned date has passed without the State acting, and you agree to the terms and conditions of the provisional permit, you should sign both copies of the permit and return them to our office. Your DA permit will not be valid until we have returned a copy to you bearing both your signature and the signature of an authorized Corps employee. If the State denies the required Section 401 Water Quality Certification, then the DA permit is denied without prejudice.

If you have questions regarding your State Section 401 Water Quality Certification, please contact Mr. Edward Chen at 586-4309.

If you have any other questions concerning your application, please feel free to contact Ms. Kathleen Dadey of my staff at 438-9258, extension 15. Please refer to File Number 970000134 in future correspondence regarding this project.

Sincerely,

Linda M. Hihara-Endo, Ph.D., P.E.
Acting Chief, Operations Branch

Enclosures

Copies Furnished (w/o enclosures):
U.S. Environmental Protection Agency, San Francisco, CA
U.S. Fish and Wildlife Service, Honolulu, HI
National Marine Fisheries Service, Honolulu, HI
U.S. Coast Guard (oan), Honolulu, HI
U.S. Coast Guard, Marine Safety Office, Honolulu, HI
Department of Health, Clean Water Branch, Honolulu, HI
Office of Planning, Honolulu, HI
State Department of Land and Natural Resources, Historic Preservation Division, Honolulu, HI
State Department of Land and Natural Resources, Division of Aquatic Resources, Honolulu, HI
State Department of Land and Natural Resources, Division of Boating and Ocean Recreation, Honolulu, HI
State Department of Transportation, Harbors Division, Honolulu, HI
Conservation Council for Hawaii, Honolulu, HI
Sea Engineering, Makai Research Pier, Waimanalo, HI

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Flr., Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

BENJAMIN J. CAYETANO
GOVERNOR
SELJI F. NAYA
DIRECTOR
BRADLEY J. MCGRAHAN
DEPUTY DIRECTOR
RICK EGGED
DIRECTOR OFFICE OF PLANNING

Tel.: (808) 587-2846
Fax: (808) 587-2824

Ref. No. P-6901

August 25, 1997

Mr. Edward Boot
Senior Vice President
Voyager Submarines Hawaii
680 Iwilei Road, Suite 720
Honolulu, Hawaii 96817

Dear Mr. Boot:

Subject: Hawaii Coastal Zone Management (CZM) Program Federal Consistency for the Voyager Submarines Artificial Reef Installation, Offshore of Ala Moana Beach, Oahu; Department of the Army Permit File No. 970000134

Your proposal to sink two derelict vessels to serve as artificial reefs and install six submerged mooring buoys 3/4 of a mile offshore of Ala Moana Beach Park at a depth of 80-100 feet, has been reviewed for consistency with Hawaii's CZM Program. We concur that the activity is consistent based on the condition that the following mitigation measures proposed in the environmental assessment and submitted as part of your CZM consistency determination be implemented.

1. Prior to sinking, the derelict ships shall be cleaned to U.S. Coast Guard, Environmental Protection Agency and State Department of Health standards. All petroleum products, toxic materials and floatable debris shall be removed.

2. The project shall be in compliance with State water quality standards and requirements of the Department of Health.

3. Concrete ballast, as opposed to gravel or unconsolidated material, shall be used to ensure that ballast material is contained within the vessels.

4. The vessels shall be oriented perpendicular to the shoreline to minimize wave forces and the potential for the vessels to be moved during storms.

5. The mooring buoys installed on each vessel will be dedicated for public access by other site users.

6. In addition, any changes to the proposal or proposed mitigation measures require CZM approval.

CZM consistency approval is not an endorsement of the project nor does it convey approval with any other regulations administered by any State or County agency. Thank you for your cooperation in complying with Hawaii's CZM Program. If you have any questions, please call John Nakagawa of our CZM Program at 587-2878.

Sincerely,

Rick Egged
Director
Office of Planning

cc: U.S. Army Corps of Engineers, Operations Branch
U.S. National Marine Fisheries Service, Pacific Area Office
U.S. Fish and Wildlife Service, Pacific Islands Ecoregion
Department of Health, Clean Water Branch
Department of Land & Natural Resources,
Planning & Technical Services Branch
Department of Land Utilization, City & County of Honolulu
James H. Barry, Sea Engineering, Inc.

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT
WATER RESOURCE MANAGEMENT

REF:PB:THE

FILE NO.: OA-2866
Acceptance Date: Aug. 5, 1997
180-Day Exp. Date: Feb.1, 1998

AUG 12 1997

Mark Ericksen
Sea Engineering, Inc.
Makai Research Pier
41-202 Kalanianaole Hwy., Suite 8
Waimanalo, Hawaii 96795

Dear Mr. Ericksen:

NOTICE OF ACCEPTANCE AND PRELIMINARY ENVIRONMENTAL DETERMINATION
Conservation District Use Application (CDUA) #OA-2866
(Board Permit)

This letter acknowledges the acceptance for processing of your client's CDUA to place artificial reefs and to install mooring bouys on submerged lands offshore of Ala Moana Beach, Oahu.

According to your information, the applicant (Voyager Submarines Hawaii) proposes to sink two derelict vessels approximately 3/4 mile offshore of Ala Moana Beach Park, in water depths of 60 to 110 feet. Because of the barren nature of the sandy sea floor in this area, the vessels are intended to serve as artificial reefs to enhance the habitat and promote fish and coral growth. The vessels will be cleaned of pollutants and prepared according to State and Federal regulations, and ballasted with concrete to prevent movement during storm conditions.

Additionally, six submerged mooring bouys are proposed to be installed at the site; one attached to each sunken vessel, and four others attached to the sea floor in the immediate vicinity of the vessels. The two bouys attached to the vessels will be dedicated for public access by other site users. Two other bouys will be used to moor surface support vessels for Voyager's passenger submarine tour operation, and the remaining two will be shared by Voyager and other site users. Pursuant to Coast Guard requirements, surface mooring bouys will be attached to all the submerged bouys daily by Voyager personnel. The surface bouys will alert divers and boaters of the position of the artificial reefs, and will provide them with an easy and safe alternative to anchoring, which is destructive to coral and the sea floor and can endanger divers and the submarines below.

After reviewing the application, we find that:

1. The proposed uses are identified land uses (R-2, Artificial Reefs: D1; and R-6, Marine Construction [installation of the mooring bouy anchors/anchor pins]: D-1) within the Resource subzone of the Conservation District, according to Section 13-5-24, Hawaii Administrative Rules (HAR). Please be advised, however, that this finding does not constitute Board approval of the proposal;

2. Pursuant to Section 13-5-40, HAR, a public hearing will be required, since the project is for a commercial purpose;

3. Based on the description of the proposed actions, there may be a significant effect as defined by Title 11, Chapter 200, HAR, (the environmental impact statement [EIS] rules). As a consequence, we require that a EIS be submitted in accordance with those rules and Chapter 343, Hawaii Revised Statutes (HRS); and

4. The proposed project is located outside the Special Management Area (SMA), so no SMA Use Permit will be required.

Through experience, we have learned that compliance with the EIS requirements for acceptance by the appropriate authority, which in this case is the Board of Land and Natural Resources (Board) can be a lengthy process. Pursuant to Section 183C-6, HRS, when an EIS is required, the 180-day expiration deadline may be extended an additional 90 days at the request of the applicant. Any request for additional extensions are subject to the approval of the Board.

Please keep us informed as the progress on the required EIS. Subsequent to the acceptance of your final EIS, we will notify you of the scheduling of both the public hearing and the submittal of your application to the Board. Should you have any questions, please contact Tom Eisen of our Land Division's planning staff at 587-0386.

Aloha,

MICHAEL D. WILSON

Attachment (receipt)

c: Oahu Board Member
Oahu Land Agent
DOH/OEQC/OHA/OP
UH Environmental Center
US ACE/FWS/NMFS

bc: DAR/DOBOR/HPD

DRAFT
August 21, 1997

C0808HCb

Mr. Edward Boot
Vice President
Voyager Submarines Hawaii
Dole Office Building
680 Iwilei Road, Suite 720
Honolulu, HI 96817

Dear Mr. Boot:

Subject: Section 401 Water Quality Certification (WQC) for Voyager Submarines Hawaii, Artificial Reef
WQC No. WQC 376/ Army File No.970000134

In accordance with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251 et seq.; the "Act"), and 40 Code of Federal Regulations Part 121, and Chapter 11-54 of the Hawaii Administrative Rules (HAR), the State Department of Health (the Department) has reviewed your Section 401 WQC application and appurtenant data relevant to water quality considerations for the subject project. This certification is based upon the evaluation of the information contained in the application dated July 7, 1997 and the revised Section 401 WQC application dated August 12, 1997.

The Section 401 WQC is required for the U.S. Army Corps of Engineers (COE) Section 404 Permit Program of the Clean Water Act of 1977 Under Army File No 970000134.

The Director of Health attests to the following statements based on the Section 401 WQC application and other information submitted by the applicant and its authorized agent:

Applicant:	Voyager Submarines Hawaii 680 Iwilei Road, Suite 720 Honolulu, Hawaii 96817
Contact Person: Telephone No.:	JC Merrill (808) 592-7858

DRAFT
August 21, 1997

Agent:	Sea Engineering, Inc. Makai Research Pier Waimanalo, Hawaii 96795-1820
Contact Person: Telephone No.:	Marc Ericksen (808)259-7966

1. The Director has either:

   a. examined the application made by the applicant and bases its certification upon an evaluation of the information contained in such application which is relevant to water quality considerations; or

   b. examined other information furnished by the applicant sufficient to permit the statement described in Item No. 2. below.

2. There is a reasonable assurance that the activity will be conducted in a manner which will not violate the Basic Water Quality Criteria applicable to all waters and the Specific Water Quality Criteria applicable to the class of receiving water where the proposed discharge would take place.

3. The following conditions are deemed necessary or desirable to be imposed with respect to the project activity:

   a. The granting of this Section 401 WQC shall be limited to the discharge of the following materials into the receiving water at approximately 3/4 mile offshore of Ala Moana Beach Park of Pacific Ocean:

      (1) Sinking two ships, between 90 and 190 feet in length at the Voyager dive site in approximately 100-feet of water and approximately 600-1000 cubic yards of concrete ballast; and

      (2) Installing six (6) submerged mooring buoys at the site;

   b. By applying for and accepting this Section 401 WQC, the applicant shall agree that the Department conducts routine inspection of the construction site in accordance with Section 342D of the Hawaii Revised Statutes;

   c. The applicant shall invite the Department of Health staff to inspect the ships after the ships are cleaned and before deployed into the water; and

d. The applicant shall insure that:

(1) project activities associated with the "discharge(s)" be conducted in such a manner that will not cause the receiving water quality to exceed the State water quality standards; and

(2) all temporarily constructed structures shall be removed immediately after the completion of the proposed construction work.

e. The applicant shall also insure that:

(1) project activities associated with the "discharge(s)" be conducted according to the Best Management Practices (BMPs) and Monitoring Plans submitted together with the Section 401 WQC application dated July 7, 1997 which will ensure the compliance of the applicable State Water Quality Standards. The effectiveness and adequacy of the implemented BMPs and Monitoring Plans shall be reviewed and updated, as often as needed. Any changes to the BMPs and Monitoring Plans or correction to information already on file with the Department shall be submitted to the Clean Water Branch for review and approval as such changes or corrections arise;

(2) construction debris and any other deleterious material(s) be constrained and prevented from entering State waters;

(3) all material(s) to be placed in the State water be free of waste metal products, organic materials, debris and any pollutants at toxic or potentially hazardous concentrations to aquatic life, as identified in Section 11-54-04, Hawaii Administrative Rules; and

(4) any spills or other contamination(s) that occurs at the project site be immediately reported to the Department;

f. The applicant shall conduct water quality monitoring in accordance with the proposed Monitoring Plan submitted; and

g. The following information shall be submitted to the State of Hawaii, Department of Health, Clean Water Branch:

(1) A commencement of work notification letter no later than two (2) weeks prior to the commencement date of the project activity. Such notification shall include:

(a) the location, commencement date and termination date of the project activity;

(b) an updated project construction schedule.

(2) One (1) copy of photographs and video taken before, during and after the deployment of the ships as soon as and/or no later than two (2) weeks after they become available;

This Section 401 WQC shall remain valid for two (2) years from the date of this letter or until the applicable State Water Quality Standards is revised or modified or the applicable Department of the Army permit expires or is revised or modified, whichever is earliest. If the applicable State Water Quality Standards is revised or modified during the two (2) year period and such that the activity complies with the revisions or modifications, this certification shall continue to be valid for the remainder of the two (2) year period.

The Department may, on a case-by-case basis and upon the applicant's written request, administratively extend the expiration date of this Section 401 WQC for the subject project, if the Department determines that there are no significant change(s) to the project scope and the change(s) will not, either individually or accumulatively, cause adverse impacts to the receiving water quality.

Should you have any questions regarding this matter, please contact Ms. Hong Chen, Engineering Section, Clean Water Branch, at (808)586-4309.

Sincerely,

THOMAS E. ARIZUMI, P.E., CHIEF
Environmental Management Division

HC/cr

Enclosure: Solid Waste Disclosure Form for Construction Sites

c: U.S. Army COE, Honolulu District (w/o encl.)
Marc Bricksen, Sea Engineering, Inc. (w/o encl.)

REFERENCES

Atlantic States Marine Fisheries Commission and Coastal Fisheries Institute. 1991. Hawai'i, Artificial Reef Programs and Projects. Proceedings of a Special Session on State Artificial Reef Programs in the United States. Prep. for Artificial Habitats for Fisheries, Fifth International Conference on Aquatic Habitat Enhancement. November 1991. 29-42 pp.

Bailey-Brock, Julie, R. Brock and A. Kam. 1994. Abstract: Coral Growth on a Sunken Vessel Servicing as an Artificial Reef in Hawaii. Bulletin of Marine Science 1: Vol. 55, No. 2-3.

Berger, Tina, J. McGurrin and R. Stone. 1994. Abstract: An Assessment of Coastal Artificial Reef Development and Management in the United States. Bulletin of Marine Science, Vol. 55, No. 2-3.

Brock, Richard. 1995. Assessment of Biological Attributes of the Atlantis Artificial Reef, Waikiki, Oahu, Continuing Studies, Atlantis Submarines of Hawaii.

———. 1994. Beyond Fisheries Enhancement: Artificial Reefs and Ecotourism. Bulletin of Marine Science, Vol. 55(2-3): 1181-1188.

———. 1987. Biological Assessment of a Site Proposed for Habitat Enhancement Offshore of Waikiki, Oahu. Section 1. Introductory Information. Appeared as APPENDIX B in AECOS, Inc., Draft Environmental Impact Statement. The operation of submersibles as a public attraction in the waters off Waikiki, Oahu, Hawaii.

Brock, Richard E. and Buckely, Raymond M. 1984. A Proposed Fisheries Enhancement Program Based on Artificial Reefs for Nearshore Hawaiian Waters. Sea Grant Quarterly. Volume 6, No. 1. University of Hawaii Sea Grant College Program.

Dean, Robert G. and Dalrymple, Robert A. 1984. Water Wave Mechanics for Engineers and Scientists. Prentice-Hall, Englewood Cliffs, New Jersey.

Department of Land and Natural Resources. Hawaii Administrative Rules Title 13, DLNR Subtitle 1 Administration Chapter 5 Conservation District. Pages 5-1 thru 5-42.

Fitzhardinge, R.C. and J.H. Bailey-Brock. 1989. Abstract: Colonization of Artificial Reef Materials by Corals and Other Sessile Organisms. Bulletin of Marine Science. Pages 567-577.

Fletcher, Charles H. and Sherman, C. 1995. Submerged shorelines on Oahu, Hawai'i: Archive of episodic transgression during the deglaciation? Journal of Coastal Research, Special Issue 17 Holocene Cycles: Climate, Sea Level, and Sedimentation, p. 141-152.

Kanenaka, Brian K. 1994. Abstract: Hawaii's Artificial Reef Program: Past, Present and Future. Bulletin of Marine Science, Vol. 55, No. 2-3.

National Marine Fisheries Service (NMFS). 1985. National artificial reef plan. NOAA Technical Memorandum NMFS OF-6.

Sea Engineering, Inc. 1994. Engineering Report for the Inspection of the Barbers Point Ocean Outfall. Prep. for City & County of Honolulu, Department of Wastewater Management. March 1994.

Seaman, William Jr. 1995. Artificial Habitats for Fish. In Encyclopedia of Environmental Biology, Vol. 1. Copy from Florida Sea Grant College Program M/PM-11.

Sorensen, Robert M. 1993. Basic Wave Mechanics for Coastal and Ocean Engineers. John Wiley and Sons, Inc. New York.

State of Hawaii, Department of Land and Natural Resources. 1994. Final Report on the Relationship Between Fish Feeding, Artificial Reefs and the Risk From Sharks on Inshore Recreational Users at Waikiki Beach, Oahu. In response to House Concurrent Resolution No. 180 House Draft 1 Seventeenth Legislature, 1993 Regular Session. December 1994.

Stone, R.B., J.M. McGurrin, et. al. 1991. Artificial habitats of the world: synopsis and major trends. 31-60 pp. in W. Seaman, Jr. and L.M. Sprague, eds. Artificial habitats for marine and freshwater fisheries. Academic Press, Inc. San Diego, California.

Tabata, Raymond S. 1992. Hawaii's Recreational Dive Industry and Use of Nearshore Dive Sites. UNIHI-SEAGRANT-ME-92-02, UH Sea Grant College Program, Honolulu, Hawaii.

Tabata, Raymond S. and E. Reynolds. 1995. Hawaii's Recreational Dive Industry: Results and Recommendations of a 1990 Study. Sea Grant Marine Economics Report, June 1995. Studies on Marine Economics. University of Hawai'i Sea Grant College Program and Ocean Resources Branch, DBED&T, State of Hawai'i.

APPENDIX A

ASSESSMENT OF WATER QUALITY AND MARINE COMMUNITY STRUCTURE IN THE VICINITY OF THE VOYAGER SUBMARINES HAWAII DIVE SITE, HONOLULU, HAWAI'I

ASSESSMENT OF WATER QUALITY AND MARINE COMMUNITY STRUCTURE IN THE VICINITY OF THE VOYAGER SUBMARINES HAWAII DIVE SITE, HONOLULU, HAWAII

Prepared for:

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April 30, 1997

I. INTRODUCTION

Voyager Submarines is a submarine tour company operating out of Kewalo Basin, Honolulu, Hawaii with two 48-passenger submarines. One of two such underwater tour companies in Hawaii, Voyager conducts 16 dives daily, diving approximately ½ mile offshore of Ala Moana Beach Park to depths of 60 to 120 feet (20-40 meters {m}). The dive site that is presently utilized consists of an area of fossil reef with areas of moderate vertical relief. In order to enhance the biotic habitat at the dive site, Voyager is proposing to place one or two environmentally acceptable derelict vessels on the ocean floor within the depth range of 20-40 m. By providing suitable substratum, the vessels will likely enhance the biotic community structure in an area that is presently relatively barren of macrobiota. In order to deploy the derelict vessels on the Voyager dive site, granting of an artificial reef designation status is required.

As part of the environmental documentation required to support the request for artificial reef status, studies were conducted to assess the marine ecosystems in the vicinity of the Voyager dive site, as well as on sunken vessels located at another tour submersible dive site. These studies included descriptions of the physical, chemical (water chemistry), and marine biotic community structure at the proposed deployment site. In addition, surveys conducted on other sunken vessels allowed evaluations on the potential effects of the proposed activities, especially in terms of expected changes to biotic composition in the area. Presented below are the methods, results and discussion of the assessment of the marine environment in the vicinity of Voyager Submarines dive site.

II. METHODS

A. Physical Structure and Biotic Communities

In situ investigations of the Voyager dive site were conducted using the submarine as well as SCUBA gear. Assessment of physical structure and biotic composition of the area utilizing the submarine was accomplished by holding the vessel stationary over the bottom at seven representative sites throughout the dive area (Figure 1). At each of

the sites, investigators looking through viewing ports recorded quantitative estimates of dominant visible biota, primarily reef fish and coral cover. Because of the restricted ability to get close to the bottom, a follow up SCUBA dive was made on the site.

B. Water Chemistry

One consideration of the proposed activity is potential alteration of existing water chemistry caused by placement of the derelict vessels. In order to determine if such alterations occur, a baseline of present water chemistry composition at the dive site was established. Water samples were collected at the surface, at mid-water, and near the bottom at 6 stations in the vicinity of the dive site. Station locations were determined using GPS coordinates, and triangulation with shoreline markers. Figure 2 is a diagram of the Voyager dive area showing the locations of the 6 water sampling stations. Water sampling was conducted on April 7, 1997. Sea conditions during the sampling consisted of light and variable winds and calm conditions. Sampling was done using a small boat. Water samples were collected from the boat using a 1.8 liter Niskin-type oceanographic sampling bottle. The bottle was lowered to the desired sampling depth with endcaps cocked in an open position so that water flowed freely through the bottle. At the desired depth a weighted messenger released from the surface tripped the endcaps closed, isolating a volume of water from the desired sampling depth. Surface samples were collected within 25 centimeters (cm) of the air-sea interface, deep samples were collected within 50 cm of the ocean floor.

Water quality constituents that were evaluated include the 10 specific criteria designated for inland waters in Chapter 11-54, Section 05 (Pearl Harbor waters) of the Water Quality Standards, Department of Health, State of Hawaii. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-), ammonium (NH_4^+), total phosphorus (TP), chlorophyll a (Chl a), turbidity, salinity, pH and temperature. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) are also reported. This suite of constituents will provide the basis for the initial phases of any water quality monitoring programs that might be required for regulatory compliance by State or Federal agencies.

Subsamples for nutrient analyses were immediately passed through sub-micron filters (GF-F) into 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to the laboratory. Analyses for NH_4^+, PO_4^{3-}, NO_3^-, and Si were performed using a Technicon autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following oxidative digestion. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated as the difference between TN and dissolved inorganic N, and TP and dissolved inorganic P, respectively. The level of detection for the dissolved nutrients is 0.2 µM for TDN and Si, 0.02 µM for TDP, and 0.01 µM for PO_4^{3-}, NO_3^- and NH_4^+.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with $HgCl_2$ to terminate biological activity. Fixed samples were kept refrigerated until turbidity was measured on a Monitek Model 21 90-degree nephelometer, and reported in nephelometric turbidity units (ntu) (level of detection 0.01 ntu). Chl a was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5° C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 µg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003‰. pH was determined using a field meter with a combination electrode with precision of 0.01 pH units.

Nutrient, turbidity, Chl a and salinity analyses were conducted by Marine Analytical Specialists (Laboratory Certification NO: HI-0009) of Honolulu, HI.

II. RESULTS

A. Physical Structure of the Dive Site and Proposed Vessel Deployment Sites

The physical configuration of the area off of Ala Moana Beach Park that comprises the Voyager dive site can be described as a exposed fossil coral reef roughly semi-circular in shape with distance across of diagonal of approximately 415 m (Figure 1). The semi-circular feature is defined by relatively steep relief that is likely the remnant of an old

shoreline cut during a previous stand of sea level. In some areas, the vertical relief consists of cliff faces with a maximum height on the order of 2-3 m. Sections of the cliff contain undercuts and small ledges which serve as desirable shelter areas for fish. The top of the reef feature was covered with a veneer of coarse calcareous sand and rubble fragments. Most of the rubble fragments were identified as pieces of reef corals that had likely been broken from the living colonies by storm waves. The depth of sand on the top of the reef feature was very thin; one sweep of a hand cleared the sand away to reveal solid limestone substratum.

The proposed sites for deployment of the derelict vessels lie generally seaward of the fossil reef structure (see Figure 1). These sites all presently consist of relatively barren sand flats. The character of the sand surface at Site 1 was somewhat different than at Sites 2 and 3. Site 1 is the shallowest site and lies just to the immediate west of the fossil reef edge. The sand surface in this region consisted of only a very thin layer, and was easily brushed away to reveal a solid limestone platform. At Sites 2 and 3, the sand surface was substantially thicker and digging by hand revealed a depth of a least several inches. It was beyond the scope of the present study to determine the actual depth of the sand plain.

During the underwater surveys of the ship deployment areas, the sand plains did not contain ripples, indicative of wave or current motion. Rather, the sand surfaces were covered with a thin green veneer that likely consisted of benthic diatoms or benthic algae. The presence of this green film is indicative of quiet water conditions with water velocities insufficient to create sediment resuspension.

B. Water Chemistry Analyses

Table 1 show results of all water chemistry analyses for samples collected in the vicinity of the Voyager Dive site. Table 2 shows the concentrations of State of Hawaii Department of Health water quality criteria for open coastal waters under both wet and dry conditions. Inspection of Table 1 indicates little evidence of vertical stratification of the water column at any of the sample locations. In addition there is little indication of variation between sample sites.

Comparison of the values measured at the Voyager site and State of Hawaii water quality standards (Table 2) reveals that none of the measured values exceed the "not to exceed the given value more than 10% or 2% of the time" criteria for either wet or dry conditions. Based on these comparisons, it appears that at present water quality in the dive site area is well within DOH standards, and does not appear to be affected by any factors associated with the current activities in the area.

C. Biotic Community Assessment

1. Macrobenthos

Figure 1 shows the locations of 7 stations that were surveyed for biotic community composition. These areas appeared to provide a comprehensive description of the overall dive site. Below is a description of the communities that occupy each of the survey stations.

Station 1: Upper surface of the fossil reef consisting of a flat sand-covered shelf. The predominant biota were heads of the stony coral *Pocillopora meandrina*. This coral grows as separate hemispherical colonies with short blunt branches. Other corals were small flat encrustations of *Porites lobata* and *Montipora verrucosa*. Coral cover in the area was estimated at less than 5%. Other conspicuous macrofauna included the sea urchins *Echinothrix diadema*, *Echinometra matheai* and *E.chinostrephus aciculatus*. *Echinothrix diadema* are long-spined urchins commonly called wana. Throughout the dive site, numerous *E. diadema* were observed on the reef surface, often occurring in large aggregations of up to 50-100 individuals. *Echinometra matheai* and *Echinostrephus aciculatus* are smaller, shorter spined urchins that burrow into the limestone surface of the reef. *E. matheai* and *E. aciculatus* were not as abundant as *E. diadema* at Station 1 with only several individuals present.

Filamentous benthic algae were not abundant at any area of the dive site. Algae that were noted included *Lyngbya majuscula*, *Halimeda opuntia*, and *Enteromorpha spp.* Encrusting calcareous algae including *Peyssonellia rubra* and *Porolithon spp.* were common covering rubble fragments and parts of the exposed limestone reef structure.

Station 2: This is the proposed location of one of the sunken derelict ships. The site is seaward of the edge of the fossil reef slope on a flat sand-covered plain. As discussed above, the thickness of the sand in this area is very thin, and barely covers a solid limestone platform. Biota in the area consists of widely scattered heads of *P. meandrina*, and small encrustations of *P. lobata*. Few sea urchins or other macrobiota were observed.

Station 3: This area consists of a relatively steep vertical relief with an undercut ledge approximately 2 m in height. The area is known as "urchin hill" by the Voyager personnel owing the large aggregations of *E. diadema*. It appears that the high numbers of urchins occurring in the area are relatively consistent as opposed to periodic spawning aggregations. Large heads of *P. meandrina* occurred on the edge of the reef ledge.

Station 4: This area is the another of the proposed locations for deployment of the sunken derelict vessel. Bottom composition in this region consisted of a flat sand surface covered with a patina of green benthic algae. Few macrobiota or burrows were observed on the sand surface.

Station 5: This area, known to the Voyager personnel as "Buccaneer Bay" consists of a semi-circular shaped reef ledge with steep vertical walls. The top of the reef contained the highest percentage cover of the hemispherical coral colonies of the species *Pocillopora meandrina* and *P. eydouxi* growing on hard flat bottom. Compared to most other areas of the dive site, these corals were abundant, covering up to approximately 40% of the bottom along the crest of the reef ledge.

Station 6: Located at the northeastern end of the dive site reef, this area is somewhat atypical in that the top of the reef ledge is covered with large colonies of *Porites lobata*. *P. lobata* is the most common coral throughout the Hawaiian Islands, and assumes a variety of growth forms. On the ledge at the Voyager site, most of the large colonies appear as flattened hemispherical lobes up to a meter in dimension. As at the other locations along the reef ledge, *P. meandrina* was also abundant. The combination of these two species resulted in peak coral cover of approximately 50-70% along sections of the reef top.

Station 7: The third prospective site for sunken ship deployment consists of a sand flat with interspersed rubble fragments. No macrobiota were observed during the survey.

2. Fish Communities

Table 3 lists the abundance of reef fish observed at the same seven stations investigated for macrobenthos (Figure 1). Number of species ranged from 3 to 17, while number of individuals ranged from 4 to 133 at the seven stations. In general, fish were more abundant and the assemblages more diverse in areas with higher vertical relief, while abundance was lowest on the flat sand areas. There was also a distinct association between location on the reef and the feeding guilds of fishes. The dominant fishes upcurrent of the reef ledge were midwater plankton feeders including the butterflyfishes *Chaetodon miliaris* and *Hemitaurichthys polylepis*, and the surgeonfish *Naso lituratus*. Along the ledge, the most dominant species were benthic feeders, including goat fishes (e.g. *Parupeneus multifasciatus*), wrasses (e.g. *Thalossoma duperrey*) and parrotfishes (*Scarus spp.*) Trigger fishes (Family Balistidae) were common wherever holes or depressions occurred on the hardpan surface of the reef.

While not accounted in the quantitative survey, a large school of opelu (*Decapterus macarellus*) was observed in the water column and appeared to follow the submarine throughout the dive. Several large kahala (*Seriola dumerili*) also appeared to be attracted to the submarine. A blacktip shark (*Carcharhinus limbatus*) was sighted on several occasions traversing the dive site.

3. Endangered and Protected Species

Three species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly in the nearshore areas of Hawaii, and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from Hawaiian waters.

The major nesting site in Hawaiian Islands for the green turtle is French Frigate Shoal (Balazs 1980). Sporadic rare nesting events have occurred in the main islands (J.

Naughton, personal communication). One turtle were observed on the bottom during the course of the submarine survey dive. The turtle sighted had multiple tumors on its head and front appendages. Voyager personnel report such sightings of what appears to be two individuals, including the turtle with tumors, on a regular basis.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) are known to winter in the Hawaiian Islands from December to April. The Hawaiian Monk Seal (*Monachus schauinslandi*) also has been observed sporadically in the main Hawaiian Islands.

III. DISCUSSION

Evaluating the potential environmental effects of the proposed actions by Voyager Submarines is greatly enhanced by the ability to examine the resulting conditions following sinking of derelict vessels for the same purpose (enhancement of biotic composition) by Atlantis Submarines of Hawaii at their dive site off of Waikiki. In July 1989, a 53 m surplus yard oiler was sunk at the interface between an exposed fossil reef platform and seaward sand flats in water from 29 to 32 m in depth and with an orientation into the prevailing seas. Prior to sinking, the ship was cleared of toxic materials (oil, grease, etc.) and more than 25 large holes were cut through the hull to enhance utilization of shelter space, circulation, light penetration and movement of fishes through the vessel. At the time of deployment more than 2,000 mt of basalt gravel was added to the ship to provide additional stability. In addition the sunken ships, concrete terrace reefs, and two surplus aircraft were placed in the area. A second vessel has since been sunk at the dive site.

Brock (1994) has monitored the effects of the sunken vessel in terms of an enhanced habitat for fish and attached benthos. The standing crop of fishes on the deployed vessel showed tremendous oscillations through the first years of monitoring. Compared to the standing stock of the natural bottom, estimated at 44 g m^{-2}, the average standing crop on the vessel was estimated at 1,165 g m^{-2}, an increase of approximately two orders of magnitude. Much of the fluctuation of the fish stocks on the vessel were a result of the activities of fishermen. The sunken ship serves as a locus for a variety of fishing activities (trolling, drift bait, spear, net) and downward fluctuations in the results

of fish census appeared to occur when surveys were conducted shortly after fishermen were on the site.

Brock (1994) estimates that the daily fishing catch on the ship is approximately 31 kg, which suggests that the fishermen are removing in one day what should be taken from the natural coral reef system in the area over an annual period. This high catch from around the deployed vessel is probably far in excess of in situ production, suggesting that much of what is being caught are fishes that have aggregated around the artificial reef (i.e. sunken ship) rather than as a result of enhanced productivity resulting from the reef structure. Brock calculates that annual gross proceeds from consumptive use of the reef (fishing) are 4% of the annual net profit derived from using the site solely as a dive tour destination. Thus, the value of the site as part of a well-planned tour attraction may far outweigh the value of enhanced consumptive use, both in terms of education and economic value.

In addition to fish stocks, recruitment and growth of corals on the sunken vessel were assessed. Five hundred and nine days after deployment, upper surfaces of the wreck were colonized with approximately 250 colonies of *Pocillopora meandrina* and *Porites lobata*. Another coral that was observed on natural substratum near the wreck (*Montipora verrucosa*) did not appear on the wreck (Brock et al.) Inspection of the wreck in April 1997 as part of the present report revealed high densities of corals colonizing the horizontal decks of the sunken ship. Colonizing corals were primarily *Pocillopora meandrina* and *P. eydouxi* , with an estimated density of 3 colonies per square meter. The only other coral noted to colonize the ship were small (less than 10 cm in diameter) colonies of *Porites lobata*. Corals were also observed on the vertical surfaces of the ships hull, and in the interior spaces. However, only a few such corals were noted, and the occurrence of corals on these surfaces was very rare compared to abundance on the horizontal decks. Similarly, corals on the natural substratum surrounding the ship were rare, in part because basalt gravel used to anchor the hull had spilled out of the ship and covered the surrounding bottom.

Artificial reefs are usually deployed directly for human benefit in the form of improved fisheries yield and secondarily for the enhancement and conservation of the resource (Brock 1994). However, in recent years, biologists have questioned the value of

artificial reefs reef development in response to declining fisheries (Bohnsack 1989). Concern has bee raised over the ability of artificial reefs to locally aggregate formerly dispersed fishes, increasing their susceptibility to be caught. The production-aggregation issue remains unresolved and the full ecological impact of artificial reef development in declining fisheries is not fully understood (Bohnsack 1989).

IV. CONCLUSIONS AND RECOMMENDATIONS

The primary attraction of the Voyager Submarine operation is to provide a first hand viewing experience of deep water Hawaiian reef communities. While the present dive site contains relatively high levels of biota for the depth range (~20-30 m) owing to vertical relief created by an fossil reef, the proposed plan to deploy several sunken vessels is aimed at further enhancing the biotic habitat. Such enhancement will include increasing the biotic communities (primarily fish) as a result of the providing increased shelter space provided by the ship structures. In this sense, the sunken ships will serve as "artificial reefs."

Time course monitoring data collected from a similar project off Waikiki (Atlantis Submarines) indicates that sunken ships do indeed cause local increases in fish populations in areas that were previously nearly featureless and devoid of substantial biotic community structure. While it appears unequivocal that the increases in physical complexity provided by artificial reefs increase fish biomass in a certain area, there is still disagreement within the scientific community whether the increased biomass represents increased productivity of an area, or simply serves as a focal point for aggregations of fish moving to the new habitat from surrounding barren areas.

The horizontal decks of the sunken ships also appear to be highly suitable substratum for settlement of reef corals. On the decks of the ships at the Atlantis site, coral abundance is substantially higher than on the surrounding natural substratum. Similar high rates of coral recolonization of the exposed horizontal surfaces of the Voyager ships would be expected. Other than increasing resting space for green turtles (which are often observed in sunken vessels), the proposed action appears to have no effect on endangered or threatened species.

Several potential impacts are important to consider with respect to deployment of sunken vessels: 1) Coverage of the existing substratum and associated communities; 2) Possible leaching of toxic materials from the sunken vessels; 3) The potential for damage from storm induced movement of the sunken vessels.

1) While the present overall dive site is located on a bottom feature that offers relatively high biotic diversity owing to vertical relief, the specific sites proposed for vessel deployment are on adjacent areas of the sand-covered flat limestone platform. Macrobiota and fish occurrence in this biotope is very limited, and are far more depauperate than the nearby areas of physical habitat complexity. It appears that deployment of ships on the flat areas will have a net effect of increasing biotic composition of the area that is presently barren. During the actual ship sinking, fish in the area will likely be able to avoid harm by fleeing the area. The few sessile benthos that may be at the locations of the ship placement should be a very minor component of the community. It was beyond the scope of this report to evaluate the composition of infauna inhabiting the sediment at the sites of potential ship deployment. However, it is highly unlikely that the infaunal sediment communities at the Voyager site are substantially different than the rest of the nearly continuous sand flat that extends across Mamala Bay at depths of approximately 30-40 m. Hence, coverage of the small area that the ships will occupy will represent a loss of a very small portion of a vast habitat.

While the intended sites for the ship deployments are sand flats, they are in close proximity to reefs with relatively high biotic community composition. It is important that the operation of sinking the vessels is precise enough to ensure that the vessels come to rest on the sand flat and not the fossil reef.

2) Prior to placement, ships should be cleared of all possible sources of environmental contamination including fuel, oil and hydraulic fluid. Removal of such materials should eliminate the potential for any pollution of the water column. The evaluation of water quality included as part of this report provides a background data base to compare any potential pollutant effects from the proposed activity. In addition, holes cut through the hull should increase the access for marine life, and increase the safety factors for divers entering the vessels.

3) The potential impact of storm waves on sunken ships is obviously dependent on the magnitude and orientation of each storm. Observations of sunken ships at depths of 25-35 m off the south shore of Oahu following Hurricanes Iwa (1982) and Iniki (1992) revealed substantial movement, and in some cases hull breakage. Ships and aircraft sunk at the Atlantis site appeared to have moved and have lost much of the gravel ballast as a result of Hurricane Iniki. While the gravel covering the natural bottom may serve as settling sites for benthos, it is also possible that movement of the gravel by future storm energy may result in damage to surrounding benthos. The Voyager deployment sites are located just seaward of a fossil reef with substantial biotic assemblages. To avoid impacts associated with storm energy, it is important to engineer the ship deployment to minimize or eliminate the potential for inshore movement during hurricane-level storms. Orientation of the ships perpendicular to direction of wave travel, and proper ballast to keep the ship stationary are important considerations for the project to maintain the environmental integrity of the area. In addition, if possible design criteria should focus on maintaining the ballast material within the hull, avoiding spread over the natural bottom.

In summary, the most important environmental considerations with respect to the proposed action of sinking several derelict vessels at the Voyager Submarine dive site appear to be the actual placement of the vessels to avoid areas of living reef, and engineering considerations to ensure to the maximum extent possible that the ships (and the ballast) remain in place during episodic storm events. Should these factors be addressed, it is likely that the proposed activity will have no effect on the environmental integrity of the existing natural reef at the dive site.

Based on observations of other sunken ships, it appears that the habitat suitability of the ships for colonization by benthic invertebrates (primarily corals) will be substantially enhanced over the natural substratum of the area. These benthic components of the marine community may serve as forage or forage sites for other organisms resulting in locally enhanced food webs. Once in place, the ships should serve as a locus for the production and recruitment of larvae and/or adult fish. The increases in localized aggregations of fish may also result in increased fishery take in the area compared to the present.

REFERENCES CITED

Bohnsack, J. A. 1989. Are high densities of fishes at artificial reefs the result of habitat limitation or behavioral preference? Bull. Mar. Sci. 44:631-645.

Brock R. E. 1994. Beyond fisheries enhancement: artificial reefs and ecotourism. Bull. Mar. Sci. 55:1181-1188.

Grasshoff, K. 1983. Methods of seawater analysis. Verlag Chemie, Weinheim, 419 pp.

Strickland J. D. H. and T. R. Parsons. 1968. A practical handbook of sea-water analysis. Fisheries Research Bd. of Canada, Bull. 167. 311 p.

TABLE 1. Results of water chemistry measurements from samples collected in the vicinity of the Voyager Submarine Dive Site. "S" indicates surface samples; "M" indicates mid-water sample; and "B" indicates bottom samples. For sampling locations, see Figure 2.

SAMPLE STATION	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	DOP (µg/L)	DON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (ntu)	SALT (o/oo)	pH (rel)	Chl-a (µg/L)
1-S	4.96	0.28	1.40	65.52	11.78	111.86	16.74	113.54	0.22	34.757	8.14	0.211
1-M	4.96	0.14	1.40	64.40	11.78	107.24	16.74	108.78	0.14	34.751	8.16	0.223
1-B	4.65	0.42	1.12	65.24	10.85	112.28	15.50	113.82	0.20	34.768	8.17	0.235
2-S	4.34	0.42	0.42	61.32	11.47	121.52	15.81	122.36	0.14	34.773	8.17	0.230
2-M	4.03	0.42	0.84	61.32	9.92	82.18	13.95	83.44	0.11	34.757	8.17	0.216
2-B	4.03	0.42	0.84	61.32	11.47	106.82	15.50	108.08	0.19	34.760	8.17	0.238
3-S	4.03	0.28	0.84	63.00	11.16	89.74	15.19	90.86	0.11	34.758	8.17	0.240
3-M	3.72	0.28	0.84	59.08	11.16	96.88	14.88	98.00	0.09	34.771	8.17	0.233
3-B	4.34	0.14	1.26	57.96	9.61	83.58	13.95	84.98	0.11	34.761	8.16	0.238
4-S	3.72	0.28	0.56	76.44	10.54	106.82	14.26	107.66	0.11	34.698	8.17	0.218
4-M	3.72	0.28	0.84	70.00	10.23	86.38	13.95	87.50	0.11	34.723	8.17	0.233
4-B	3.72	0.14	1.54	66.36	11.47	100.66	15.19	102.34	0.11	34.725	8.17	0.211
5-S	3.72	0.42	0.56	60.76	10.54	114.38	14.26	115.36	0.11	34.758	8.17	0.225
5-M	3.72	0.56	1.54	58.80	10.85	103.60	14.57	105.70	0.10	34.751	8.17	0.228
5-B	3.72	0.84	0.70	56.56	10.85	123.76	14.57	125.30	0.20	34.744	8.17	0.228
6-S	3.72	0.84	0.56	61.32	10.23	118.02	13.95	119.42	0.12	34.726	8.17	0.208
6-M	3.72	0.70	1.96	61.88	10.23	117.60	13.95	120.26	0.11	34.757	8.17	0.235
6-B	4.03	0.98	1.26	60.20	12.40	186.20	16.43	188.44	0.11	34.741	8.17	0.235

TABLE 2. Specific Criteria for Open Coastal Waters based on Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards which apply to Receiving Water Limitations.

Parameter	Geometric mean not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Total Nitrogen (µg N/L)	150.00* 110.00**	250.00* 180.00**	350.00* 250.00**
Ammonia Nitrogen (µg NH4-N/L)	3.50* 2.00**	8.50* 5.00**	15.00* 0.90**
Nitrate+Nitrite Nitrogen (µg [NO3+NO2]-N/L).	5.00* 3.50**	14.00* 10.00**	25.00* 20.00**
Total Phosphorus (µg P/L)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Chlorophyll a (µg/L)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Turbidity (NTU)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**

pH units - shall not deviate more than 0.5 units from a value of 8.1.

Temperature - shall no vary more than 1 deg.C from "ambient conditions".

Salinity - shall not vary more than 10% from natural or seasonal changes considering input and oceanographic factors.

Dissolved oxygen - not less than 75% saturation.

* "wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile.
** "dry" criteria apply when open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.

TABLE 3. Abundance of reef fish at representative locations at the Voyager Submarine Dive Site. For station locations, see Figure 1.

FAMILY	Survey Station						
Genus species	1	2	3	4	5	6	7
MULLIDAE							
Mulloidichthys pflugrei		1					
Parupeneus multifasciatus	7		7	6	5	5	9
P. pleurostigma			2		9		2
P. bifasciatus					12		
CARANGIDAE							
Caranx melamphygus	1						
CHAETODONTIDAE							
Chaetodon miliaris	14		3	4	30	3	24
C. kleinii						3	
Heniochus diphreutes							2
Hemitaurichthys polylepis			20				
POMACENTRIDAE							
Dascyllus albisella	29					27	12
LABRIDAE							
Novaculichthys taeniourus				1			
Coris gaimard	2						
Thalassoma duperrey	7						
SCARIDAE							
Scarus sordidus			1				
S. perspicillatus	1			1			
S. rubroviolaceus			1				
juvenile Scarus	10		3			8	
ACANTHURIDAE							
Acanthurus achilles			3				
A. triostegus	3						
A. olivaceus	3			4	3	3	8
A. nigrofuscus	12		7	5		8	3
Naso lituratus	30		50		50	15	20
N. unicornis	5	2	1		6	3	3
ZANCLIDAE							
Zanclus cornutus	2					1	1
MONOCANTHIDAE							
Aluterа scripta	2		1		2		
BALISTIDAE							
Rhinecanthus rectangulus				2			
Sufflamen bursa	2	1	2	3	2		
Melichthys vidua	3		2			3	2
NUMBER SPECIES	17	3	14	8	9	11	11
NUMBER INDIVIDUALS	133	4	103	26	119	79	88
SPECIES DIVERSITY	2.33	1.04	1.75	1.93	1.65	2.00	1.98

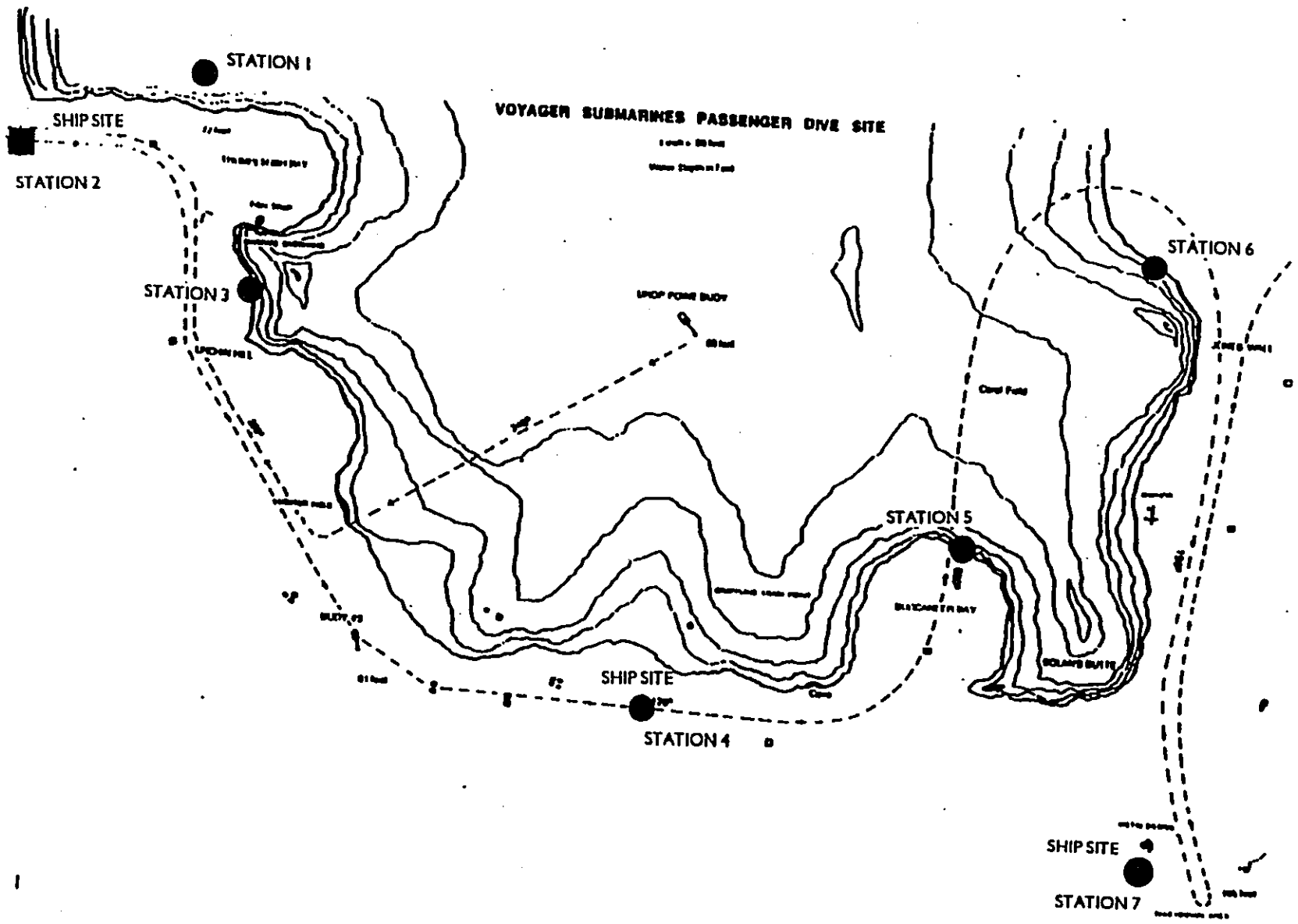

FIGURE 1. Map of Voyager Submarines Hawaii dive site showing locations of three proposed areas for deployment of sunken ships (Ship Site), as well as locations of seven stations surveyed for biotic community structure. Dashed line is route of submarine tour.

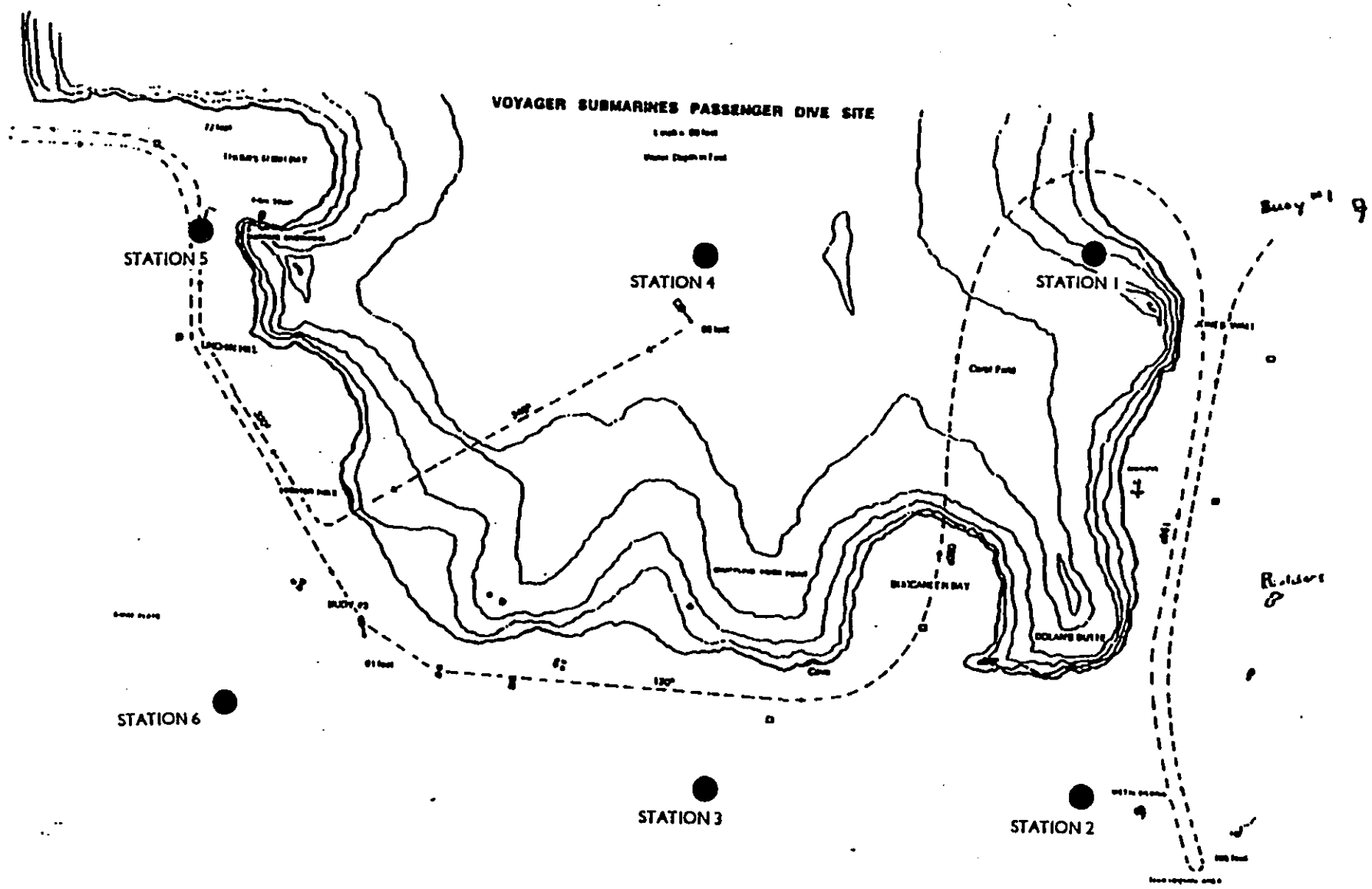

FIGURE 2. Map os Voyager Submarines Hawaii dive site showing locations of water sampling stations.

APPENDIX B

OCEAN ACTIVITIES SURVEY

OCEAN ACTIVITIES SURVEY

for the

Voyager Submarines Hawaii
Artificial Reef Installation

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1.0 OCEAN ACTIVITIES SURVEY.

1.1 Purpose.

This ocean activities survey was undertaken to provide background information for an environmental assessment (EA) for the Voyager Submarines Hawaii Artificial Reef Site project. The information is intended to assist Sea Engineering, Inc., in addressing environmental and social concerns regarding the construction of an artificial reef on the sea floor approximately 3/4 mile offshore of Ala Moana Beach park in depths of 60 to 120 feet.

1.2 Scope.

The scope of work included;

1. Observing and identifying the ocean activities in the project site, the waters where Voyager Submarines Hawaii is presently operating, and in the survey area, the waters between Ala Wai Boat Harbor Channel and the Honolulu Harbor Main Channel.

2. Interviewing members of user groups who use the waters in the survey area, including businesses, yacht clubs and groups engaged in consumptive and non-consumptive activities.

3. Identifying the potential impacts of the project on the user groups in the survey area.

4. Assisting other consultants with environmental and social concerns related to the ocean activities in the survey area.

1.3 Survey Methodology.

Information for this survey was gathered from a visits to the project site and the survey area, from interviews with people familiar with the waters and activities in the survey area, and from personal observations. Site visits and interviews were conducted during March and April, 1997. Additional information was gathered from the references that are listed in the References section.

2.0 PHYSICAL CONDITIONS.

2.1 Survey Area.

The survey area includes the nearshore waters between the Ala Wai Boat Harbor Channel and the Honolulu Harbor Main Channel and extends from shore to approximately 3/4 mile offshore. The project site is located within the survey area and is approximately 3/4 mile from the west food concession in Ala Moana Beach Park.

The survey area lies within East Māmala Bay which is defined as the shoreline from the Reef runway to Diamond Head. This shoreline is primarily artificial, the result of extensive dredging of reef area, the construction of artificial structures, and the filling of former mudflats, fishponds and shallow reefs. In spite of the alterations and artificial structures, the shoreline of the survey area still provides many opportunities for ocean activities, especially swimming, surfing, kayaking, outrigger canoe paddling, fishing and boating. It also adjoins the major shipping lanes for commercial boating traffic moving in and out of Honolulu to and from all ports east of O'ahu.

2.2 Harbors and Parks. The survey area includes one boat harbor, Kewalo Basin, and is bordered by Honolulu Harbor and Ala Wai Boat Harbor. Most of the shoreline of the survey area consists of beach parks: Ala Moana Beach Park, the City and County of Honolulu's most important urban beach park, is immediately inshore of the project site and comprises the majority of the survey area shoreline; and two state parks, Kewalo Basin Park and Kaka'ako Waterfront Park, are located to the west of Ala Moana Beach Park.

2.3 Ala Moana Reef. Ala Moana Reef is the largest single, unaltered section of consolidated coral reef that remains on the shoreline of urban Honolulu. Approximately 1/2 mile long and 200 yards wide, it extends from Magic Island to Kewalo Channel. A small portion of the reef is also found on the West side of Kewalo Channel fronting Kaka'ako Waterfront Park.

2.4 Surfing Sites. No surf breaks in the project area because of its depth, but several surfing sites are located 2,000 to 3,000 feet inshore of it along the seaward edge of the Ala Moana Reef. These sites are among the most popular and heavily used on the south shore of O'ahu. These are at least 11 primary surfing sites, and several secondary ones. They are used by surfers, bodyboarders, and bodysurfers.

Surf on the south shore is normally biggest and best for surfing during the summer months from May to August when high surf of 6 feet or greater strikes the south shores of all Hawaiian islands. However, small trade wind-generated surf of 1-3 feet breaks consistently throughout the year at all of the sites in survey area, and occasionally, high winter surf from the west or northwest will wrap into the south shore.

2.5 Regional Winds. In Hawaiian waters strong, gusty trade winds blow from a northeasterly direction and prevail throughout most of the year. During the summer months from June through August, the trade winds prevail over 90 percent of the time.

Interruption of the normal trade winds often results in southerly or Kona winds that are usually light and variable. Kona winds are more common during the winter months but may occur at any time of year. They blow directly onshore in the survey area and produce rough, choppy ocean conditions.

3.0 OCEAN ACTIVITIES.

The entire survey area is heavily used for both commercial and non-commercial ocean activities. Most of the commercial activities take place in the open ocean offshore Ala Moana Reef, while most of the non-commercial activities take place at the edge of, on or inshore of Ala Moana Reef.

3.1 Specific Activities.

3.10 Fishing.

Fishing is a popular activity that takes many forms in the survey area, including fishing from boats, from shore, from the edge of Ala Moana Reef, and especially along the edges of the harbor channels. A number of free swimming and schooling species are found nearshore and in the boat channels and the swimming channel at Ala Moana Beach park, including pāpio, mullet, and halalū, when they are in season. Many common reef species are found offshore of Ala Moana Reef.

- Squidding. Squidding is a local term for fishing for octopus which are commonly called "squid" by local fishermen. Squidding usually consists of wading across a shallow reef flat with a glass-bottomed look-box and spearing octopus hiding in the rocks. The number of users depends on the day of the week and the level of the tide. The most popular days are Saturdays, Sundays and holidays during daylight hours when the tide is at its lowest. The number of users averages approximately 2 per day on weekdays and 5 per day on weekends and holidays.

- Surfboard Fishing. Surfboard fishing is a form of boat fishing in which a motorized surfboard is substituted for a small boat. The boards are 13 feet long, 40 inches wide and weight about 60 pounds. They are powered by a 5 horsepower outboard engine. The fishermen motor along at a slow speed and scout for fish by hanging over the edge of the board while wearing a mask and snorkel. When they spot a fish, they use a rod and reel to lower a hook to tempt the fish.

The surfboard fishermen in the survey area do not fish for fish. They fish exclusively for octopus or "tako" as they call them, the Japanese word for octopus, using a star hook instead of a regular fishing hook. They launch their surfboards at the Ala Wai Boat Harbor ramp and search for productive octopus grounds in waters from 30 to 120 feet deep anywhere from Waikīkī to Sand Island. They note that the ocean bottom in the survey area is generally regarded as marginally productive for reef fish, but that it provides good habitats

for octopus. They consider the entire survey area to be a good octopus grounds, but in the area of the project site, they usually fish in the shallower waters closer to shore and not where the submarines are operating. The number of surfboard fishermen averages 1 per day on the weekdays, and 2 per day on the weekends and holidays.

- Netting. Very little subsistence gill net fishing and thrownet fishing occur in the survey area. Both types of net fishing are normally practiced on at the west end of Kaka'ako Waterfront Park. The number of thrownet fishermen averages approximately 1 per day on weekdays, and 2 per day on weekends and holidays.

Commercial surround net fishing operations to catch migrating schooling fish such as akule is an infrequent activity in the survey area.

Commercial underwater surround net fishing is an infrequent activity in the survey area. Instead of using surround nets on the surface, the fishermen use scuba gear to set up surround nets underwater into which they herd schooling reef fish such as weke, mū, kūmū and ta'ape. These commercial operations occur in waters from 40-100 feet.

Crab netting inshore for crabs such as Samoan crabs or offshore for deep water crabs such as Kona crabs is an infrequent activity. In addition, the boulder seawalls in the survey area are populated with a'ama crabs, a popular luau food, but the populations are not large enough to encourage large scale gathering.

- Pole Fishing. A number of free swimming and reef species are found nearshore and in the boat channels and the swimming channel at Ala Moana Beach Park, including pāpio, mullet, and halalū when they are in season. Pole fishing, especially whipping, occurs along the boulder seawalls, the harbor channels, the Ala Moana Beach Park swimming channel and along the edges of Ala Moana Reef, especially at low tide. Other pole fishermen such as shore casters fishing for ulua are found at Kaka'ako Waterfront Park. Some pole fishing for 'oama occurs in Ala Moana Beach Park during the summer months when these juvenile goat fish school in shallow, sandy areas around the island. The number of pole fishermen averages approximately 5 per day on weekdays and 10 per day on weekends and holidays.

Some pole fishing occurs from boats offshore. These are primarily small boats less than 20 feet long which are allowed to drift with the wind while fishing with a rod and reel. This type of drift fishing normally occurs seaward of the survey area.

Some catamaran sailors and kayak paddlers attach fishing poles or handlines to their crafts and troll for pāpio and other species as they transit the area.

- Spear fishing. Spear fishing primarily by subsistence fishermen occurs at the edge of Ala Moana Reef and offshore Kaka'ako Waterfront Park. The spear fishermen accessing the area offshore Ala Moana Reef are usually from boats while at Kaka'ako Waterfront Park, they are usually swimming out from shore. Spear fishing also occurs on the University of Hawaii Look Laboratory's artificial reef which is in 40 feet of water on the west side of Kewalo Basin Channel. Some spearing for fish and octopus by commercial fishermen also occurs but this is on infrequent activity. The number of spear fishermen averages approximately 10 per day on weekdays and 20 per day on weekends and holidays.

Torch fishing is an infrequent activity on Ala Moana Reef. It normally occurs on dark, moonless nights, for night octopus and reef fish such as weke and kūmū.

- Trapping. The only trapping in the survey area is done by one commercial trap fisherman. He is a Hawaiian who, with his family and friends, has been trapping for fish there for over 30 years. One of his trap sites is located along the present submarine tour route. He notes that this is the only place in the area that is productive for fish. Other trap fishermen are located to the west of him. They all have a gentlemen's agreement to stay out of each other's areas. His area is from Waikīkī to the Reef Runway.

- Tropical fish collecting. Tropical fish collecting is an infrequent activity in the survey area. The number of tropical fish collectors averages approximately 1 per day on weekdays, weekends and holidays.

- Commercial Cruise Boat Fishing. Approximately two years ago, one of the cruise boats from Kewalo Basin started offering nearshore night fishing charters. Catering almost exclusively to Japanese tourists, the tour goes into the survey area seaward of Ala Moana Reef in 50 feet of water and lets their passengers fish for reef fish such as ta'ape and menpachi with rods and reels. Now there are approximately four cruise boats who offer similar night fishing cruises in the same location. These cruises usually run for several hours in the early evening just after the sun sets.

- Commercial Charter Boat Fishing. Commercial charter boat fishing is an infrequent activity in the survey area. Most commercial charter fishing boats only pass through the survey area when they enter or exit Kewalo Basin. They normally do not fish near shore and may range as far as 20 miles offshore the island.

3.11 Gathering. Certain sections of the survey area's shoreline are artificial and consist of massive boulder seawalls. In other areas similar boulder structures provide habitats for 'opihi and other gathered shellfish, but few are found in the survey area. In addition, the extensive reef flat of Ala Moana Reef provides a habitat for various species of seaweed, but the two most popular species for consumption, manauea and ogo, are so scarce that seaweed gathering is regarded as an infrequent activity for the survey area.

3.12 Outrigger Canoe Paddling. Outrigger canoe paddling is Hawaii's official ocean team sport, and annually attracts approximately 10,000 participants statewide. The short course regatta season begins in the spring and ends with the state championships in August. Then the long distance racing season begins and ends with the Moloka'i-to-O'ahu race in October.

Approximately 12 of O'ahu's canoe clubs train in the survey area. The majority of them are headquartered along the Ala Wai Canal and use the canal for training until August. After August they begin their long distance training and leave the canal to paddle in the open ocean. A popular training course is from the outside harbor markers at the Ala Wai to the outer markers at Kewalo Basin. Training runs on this course can be easily timed, and several clubs are frequently present at once. Since this is a clean water area, it is also used to practice crew changes. Changes occur during long distance races when one paddler replaces another. An escort boat will drop one paddler (or more) into the ocean ahead of the canoe. When the canoe comes abreast of the paddler(s) in the water, the paddler(s) in the boat who are being replaced jump out and their alternates climb in. The escort boat then retrieves the paddler(s) in the water. Most practices occur after 5 PM in the evening, and the course runs inshore of the proposed wreck site.

Outrigger canoes also transit the waters of the survey area during the races. During the long distance season approximately 10 races are held, some of which transit the survey area.

3.13 Kayaking. The waters in the survey area are a transit area for kayakers who have launched their crafts from other areas. During the spring and summer months long distance kayak races are held on O'ahu; one formerly used course finished at Kewalo Basin Park and the course passed through the survey area.

3.14 Recreational Power Boats. Recreational power boats are common throughout the survey area. The majority of them are owned by fishermen and are launched from either Ala Wai Boat Harbor or Ke'ehi Boat Harbor.

3.15 Parasailing. Parasailing, towing someone in a parachute with a high speed power boat, is a commercial activity that occurs seaward of the survey area. The Hawaii Administrative Rules, Part III, Ocean Waters Navigable Streams and Beaches (effective Feb. 24, 1994) by the State Division of Boating and Ocean Recreation regulates the activity and confines it to specific areas around the island. Paragraph 13-256-92 South Shore Parasail Area states the following for the area seaward of the survey area:

1. The boundaries of the South Shore Parasail Area are from the buoy R-2 of Kalihi Channel entrance; then by straight line to buoy G-1 of the Ala Wai Channel; then by straight line to buoy R-2 off Diamond Head. All operating parasail vessels shall operate seaward of the boundary line.
2. No person shall operate a parasail aloft within 1000 feet of any channel entrance buoys.
3. No more than 4 commercial operating area use permits shall be authorized in this area.
4. No permittee shall operate more than one vessel with a parasail aloft at any one time.
5. This area shall be closed to parasail operations from January 6 to May 15 of each year.
6. The boundaries of the South Shore Alternate parasail Area are from the buoy R-2 of Kalihi Channel entrance; then by straight line to buoy R-2 off Diamond Head. All operating parasail vessels shall operate seaward of the boundary line.
7. The South Shore Alternate Parasail Area is designated for parasail operations from January 6 to May 15 of each year. (The same restrictions listed above for the South Shore parasail Area apply to the alternate area.)

3.16 Reef Walking.

Reef walking is an infrequent low tide activity on Ala Moana Reef. Some individuals and families go on their own, but most of the reef walks are organized and conducted by an experienced leader, usually a school teacher. The reef flat is recognized by the Department of Education as an educational reef walking site and is listed in its manual A Compendium of Coastal Field Sites as "Kewalo Basin". The site is accessed from Kewalo Basin Park and is considered to be a good area for viewing fish, seaweed and invertebrate organisms such as sea anemones, shells, sea urchins, and brittle stars.

3.17 Scuba Diving.

Introductory scuba diving for visitors, primarily Japanese visitors, is the most common scuba diving activity in the survey area. Introductory classes are held in the Ala Wai Channel at

the east end of Magic Island in Ala Moana Beach Park. The channel offers one of the few scuba diving sites near Waikīkī that is easily accessible by land. Introductory classes are offered by the following companies: Sunshine Scuba, Hawaii Pro Dive, Breeze Hawaii, Ocean Concepts, Fantasea and Island Divers. Aaron's Dive Shops, other diver shops and independent dive instructors offer introductory and advanced classes to visitors and residents, especially during the winter months when high surf precludes the use of west and North Shore dive sites. Some dive shops also offer boat dives in the survey area, but this is a less frequent activity than the introductory shore dives.

Other survey area users who scuba dive include spear fishermen, underwater surround net fishermen and members of the Honolulu Fire Department's rescue squads conducting training. HFD has two heavy rescue squads. Rescue 1 and Rescue 2, and their members periodically do training dives seaward of Ala Moana Reef.

3.18 Sailing. Both the Hawaii Yacht Club and the Waikīkī Yacht Club are headquartered in the Ala Wai Boat Harbor, and their members regularly transit the survey area. In addition to general sailing traffic, every Friday night at 5:30 pm, Waikīkī Yacht Club members hold their Friday Night Race. The race course goes from the outside buoy of Ala Wai Channel to the outside buoy of the Honolulu Harbor Main Channel and back. The course of this race, however, usually keeps their boats outside the survey area. Some night sailing occurs in the survey area by boats from the yacht clubs.

Competitive sailing in Honolulu takes three forms: local yacht club races, large scale professional competitive race series based out of Honolulu such as the Kenwood Cup and races in which Honolulu is the final destination such as the Transpac. The Transpac and the Kenwood Cup occur on alternate years. Competitive sailing yachts transit the water offshore the survey area during certain legs of their races.

3.19 Research Activities. For the past 15 years the Look Laboratory of Oceanographic Engineering, University of Hawaii has had an in-water Test Range in approximately 40 feet of water on the west side of Kewalo Basin Channel . The range includes two artificial reefs, one constructed of automobile tires and one constructed of concrete blocks, and two flat 8' x 8' platforms constructed out of fiberglass I-beams and PVC decking that are used for mounting instruments. This site and other nearby sites within the general area have been used by members of the Look Laboratory staff to conduct a variety of ocean engineering tests, including instrumentation tests, drogue and dye studies, and sampling water for turbidity, salinity and temperature. Many of these activities are conducted each summer by students who are taking ocean engineering classes.

Prior to the commencement of Voyager's submarine tours, some research activities were conducted on the east side of the Kewalo Channel, in the immediate vicinity of the present submarine operations. Look Lab's activities in this area consist of attaching taut line moorings and instrument strings to concrete blocks on the ocean bottom and monitoring the wave and current measurement instruments.

3.20 Sunbathing and Swimming.

Sunbathing and swimming are the two most popular activities in the survey area. Sunbathers and swimmers are concentrated primarily at Ala Moana Beach Park, including the Magic Island lagoon at the east end of the park. The City and County of Honolulu's Water Safety Division normally staffs all five of its lifeguard towers daily to watch the large numbers of swimmers. The beach is especially attractive to families with children.

- Open Ocean Swimming. Ala Moana Beach Park is fronted by a 1000 meter long channel that was originally dredged as a boat channel between Ala Wai Boat Harbor and Kewalo Basin. The portion of the channel fronting the park was isolated by the construction of landfills at either end. The former channel offers an excellent venue for protected open ocean swimming and is used daily by members of the Waikīkī Swim Club, Hawaii Swim Club Masters, and other swim clubs and by many independent swimmers who swim for fitness. However, all of the ocean swimming in the survey area is confined to the channel,and no open ocean swimming occurs outside Ala Moana Reef. An annual five mile, long distance swim starts at Kaimana Beach at Diamond Head and turns around at the Ala Wai Channel buoy at eastern edge of the survey area, but the swim does not enter the survey area.

3.21 Surfing.

At least 11 primary surfing sites are located along the seaward edge of Ala Moan Reef, and they are as follow from east to west: Islands, Americas, Bombora, Baby Hale'iwa, Big Lefts, Courts, Concessions, Big Rights, Shallows, In Betweens, and Kewalos. Each of these sites may attract from 20-40 surfers and bodyboarders, so during periods of high surf there may be over 400 surfers in the water offshore Ala Moana Beach Park. Surfing contests are occasionally held at Courts and Kewalos.

One primary surfing site, Point Panic, is found to the west of Kewalo Channel fronting Kaka'ako Waterfront Park. It is reserved exclusively for bodysurfing and is the site of an annual bodysurfing championship put on by the Honolulu Bodysurfing Club. The Hawaii Administrative Rules, Part III, Ocean Waters, Navigable Streams and Beaches (effective Feb. 24, 1997) by the State Division of Boating and Ocean Recreation regulates the

activities there. Paragraph 13-254-13 contains the rules governing the Point Panic Ocean Waters which includes the following: a. No person shall operate a surfboard in the restricted area of the Point Panic Ocean Waters, and b. Point Panic Ocean Waters are primarily reserved for bathing, swimming, bodysurfing and paipo board riding.

3.22 Tour Boats.

The O'ahu tour boat industry operates between Hawaii Kai and Pearl Harbor. The vessels range from tourist catamarans to 100 foot cruise vessels that offer tourists dinner cruises and various excursions. Some of the largest vessels are berthed in Honolulu Harbor, but the majority of them are kept in the survey area in Kewalo Basin.

Kewalo Basin is a 126-slip boat harbor that is used exclusively to berth commercial boats. The balance of the slips are filled by commercial fishing boats that do not offer cruises or charters. In general, the majority of the boats in Kewalo Basin pass through the survey area only when the enter or exit the harbor through Kewalo Basin Channel. The charter fishing boats may fish out to 20 miles offshore the island, and the cruise boats usually tour seaward of the survey area. However, there are several exceptions, one of which was noted previously in the Fishing Section. Several cruise boats now offer night fishing tours immediately seaward of Ala Moana Reef. In addition, some of the cruise boats that conduct evening dinner and nightclub cruises also come closer to shore at night and transit the same area. Other exceptions during the day include those boats that offer glass bottomed boat tours. They tour immediately seaward of Ala Moana Reef, but inshore of the project site.

4.0 Impacts on Ocean Activities.

The project site will be the area offshore Ala Moana Beach Park where Voyager Submarines Hawaii is presently conducting submarine tours. Voyager intends to place two environmentally acceptable derelict vessels on the ocean floor in approximately 100 feet of water. The sunken vessels will be marked with two submerged mooring buoys. In addition, four additional submerged mooring buoys will be installed with anchor pins at the site to facilitate public access. All mooring buoys will be approximately 30 to 40 feet below the ocean surface. Construction of this site should have minimal short and long term impacts on the other activities that take place around it.

4.1 Short Term Impacts.

Short term impacts would occur during placement of the two derelict vessels and would include temporarily securing the project site as a safety measure to protect all other area users. The major operation, the ship sinkings, should take one day per ship. Installation of the mooring anchors and buoys would be done from a small boat with minimal intrusiveness. Overall short term impacts on the present area users who are primarily fishermen, sailors, canoe paddlers, and so on, who are only transiting the area in their respective boats, would be minimal. They normally pass either seaward or shoreward of the Voyager support boats anyway, the boats that are always on site while the submarines are operating.

4.2 Long Term Impacts.

Existing Site Users. At present there are only two users who conduct activities on the ocean bottom in the immediate area of the project site: the ocean engineering students and staff of the University of Hawaii's Look Laboratory, and a commercial trap fisherman.

The Look Lab staff has already resolved any potential conflict by simply abandoning the sites along Voyager's route and has re-established them elsewhere behind Ala Moana Reef where submarines are not operating. The placement of the two derelict vessels will have no further impact on the Look Lab operations.

The second area user who conducts activities on the ocean bottom in the immediate area of the project site is a Hawaiian commercial trap fisherman, one of three who operate between Waikīkī and Barbers Point. His area, by a gentlemen's agreement with the other two fishermen, is from Waikīkī to the Reef Runway. One of his traps is set at the base of a ledge along the submarine tour route, a site that he has been using for over 30 years. He notes that this particular site is the only productive one in this area. There have been

REFERENCES.

Bathen, Karl. Circulation Atlas for Oahu, Hawaii. Honolulu: University of Hawaii, Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-78-05, 1978.

Clark, John. The Beaches of Oahu. Honolulu: University of Hawaii Press, 1977.

Haraguchi, Paul. Weather in Hawaiian Waters. Honolulu: Hawaii Reprographics, 1979.

Hawaii State. A Compendium: Coastal Field Sites in the State of Hawaii. Honolulu: Department of Education RS 83-4146, 1983.

Hawaii State, Department of Land and Natural Resources, Division of Boating and Ocean Recreation. Hawaii Administrative Rules, Part III Ocean Waters, Navigable Streams and Beaches. Honolulu: DLNR, 1994.

Hawaii State. Hawaii Regional Inventory of the National Shoreline Study. *Prepared by U.S.* Army Engineer Division, Pacific Ocean, Corps of Engineers. Honolulu: 1971.

Moberly, Ralph and Chamberlain, Theodore. Hawaiian Beach Systems. Honolulu: Hawaii Institute of Geophysics, University of Hawaii, 1964.

Tabat, Raymond. Hawaii's Recreational Dive Industry and Use of Nearshore Dive Sites. University of Hawaii Sea Grant College Program and Ocean Resources Branch, Department of Business, Economic Development and Tourism, State of Hawaii, Honolulu: 1992.

Canoe Paddling. The site is seaward of the most commonly used training runs between Ala Moana and Kewalo Harbors. In addition, most canoe training takes place either before or after normal working hours. Impacts should therefore be minimal. Some paddlers, and others as well, expressed concern that the increased biomass on the artificial reef will include more sharks and, therefore, increase their chances of being attacked while they are in the water practicing their long distance changes.

Surfing and Swimming. Ala Moana Beach Park, including Magic Island, and Ala Moana Reef are two of the most heavily used shoreline recreational sites in the survey area and in the city of Honolulu. The project site, however, is located more than 3/4 mile seaward from the park and 1/2 mile seaward from the nearest surfing site. Placement of the sunken ships should not produce any negative long term effects on any on the activities on the reef or shoreward of it. If anything, the artificial reef may contribute to the overall biomass in the area and provide more nearshore consumptive possibilities, especially for fishermen. Some surfers, however, have expressed a concern that the sunken ships may change the contour of the ocean bottom and, therefore, negatively change the characteristics of the surfing waves at the edge of the Ala Moana reef.

no conflicts between his activities and the Voyager operations. When he comes to check his trap, the Voyager support vessels notify the submarines below. The placement of the ships should enhance his catch by increasing the biomass in the area.

Future Site Users. The situation with the trap fisherman's activities and the Voyager operations is representative of a larger situation which may occur after the artificial reef is established: the potential conflict between consumptive and non-consumptive activities. Voyager Submarines is establishing the artificial reef to enhance the growth of coral, fish and invertebrate species in an area that is presently barren and unproductive. The reef in turn will provide a unique viewing opportunity for Voyager's passengers, but at the same time it will attract consumptive users such as underwater spear, net and trap fishermen. Voyager will not have exclusive use of the area in which it operates and will not limit private access to the area. It also will not discriminate against consumptive use of the site. The mooring buoys available to the general public will also be available to consumptive users in the hope of encouraging environmentally benign anchoring.

The artificial reef may also attract surface fishermen who presently pole or bottom fish from boats either seaward or shoreward of the project site. One of the night fishing cruise boats has already expressed interest in fishing on the site after dark. This should not present a problem, since Voyager does not operate after dark. Experience with the intermittently closed or "kapu" areas off Waikīkī has shown that pole fishing has a relatively low impact on the biomass at a site.

Diving on shipwrecks is a major attraction for scuba divers. Wreck diving is also an important option for scuba tour operators to offer their customers. The artificial reef with its two derelict vessels will be a focal point for resident recreational divers and for commercial scuba tours. It will be easily accessible by boat with its close proximity to the two major public boat ramps in Honolulu, the Ala Wai Boat Harbor and the Ke'ehi Boat Harbor ramps. The reef's depth at 100 feet will preclude introductory divers, but will be accessible to divers of intermediate and greater ability.

Day-use mooring buoys will be attached to the submerged buoys daily by Voyager personnel prior to the start of their operations. The surface buoys will alert divers and fishermen to the position of the wrecks and provide them with an opportunity to tie up rather than anchor which might endanger the submarines and other divers below. In anticipation of large numbers of boats and divers on the wrecks, a user plan should be worked out between Voyager and all other commercial dive shops and recreational dive clubs.

APPENDIX C

SUBMERSIBLE OPERATING AREA
BOAT TRAFFIC SURVEY

SUBMERSIBLE OPERATING AREA
BOAT TRAFFIC SURVEY

DATE: 5/1/97
WEATHER CONDITIONS: Clear skies, wind: light N.E. tradewinds 8- 10 knots,

TIME	CRAFT TYPE	LENGTH (est. ft)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (feet)
0830	P	17	Boston Whaler	C	Fishing	fishes almost every day at site	0
0834	P	35	Catamaran "Kahala Kai"	C	Dive Charter	transit Ewa-Waikiki, i.b.	300
0834	P	25	Sportfisher "Enzo"	C	Dive Charter	transit Ewa-Waik, i.b.	300
0836	S	25	Catamaran "Mana Kai"	C	Beach Catamaran	transit Ewa-Waik, i.b.	400
0836	P	35	Sportfisher	P	Fishing, in transit	Waik-Ewa o.b.	1000
0840	P	232	"Star of Honolulu"	C	Sea Trials	transit Ewa-Waik i.b.	200
0840	S	45	Catamaran "Kepoikai II"	C	Beach Catamaran	transit Ewa- Waik i.b.	800
0846	P	17	Sportfisher	P	Pleasure	transit Ewa-Waik o.b.	1500
0847	S	35	Catamaran "Nahoku II"	C		transit Ewa-Waik i.b.	300
0858	P	18	Pontoon Boat	C	Jet Ski Support	transit Ewa-Waik i.b.	600
0912	P	18	Sampan "Miss Ha__"	P	Pleasure	transit Ewa-Waik i.b.	400
0916	P	14	Speedboat	P	Pleasure	transit Ewa-Waik i.b.	1000
0925	-	8	Kayak	P	Pleasure	transit Waik-Ewa i.b.	200

TIME	CRAFT TYPE	LENGTH	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA
0936	-	8	Kayak	P	Pleasure	Ewa-Waik i.b.	300
0950	P	35	Catamaran "Kahala Kai"	C	Dive Charter	anchored 1000' to NE	1000
0953	P	80	Aikane-type Catamaran "Hoku Nani"	C	Pleasure	transit Ewa-Waik i.b.	200
0953	P	80	Junk "Lin Wa II"	C	Pleasure	transit Ewa-Waik i.b.	200
1008	P	40	Sportfish-type	C	Dive Charter	transit Ewa-Waik o.b.	1500
1015	P	40	Mele-Kai	C	Dive Charter	made delivery to Voyager, then anchored 1000 ft to NE	0
1020	P	80	Nautilus Semi-Submersible	C	Pleasure	stationary outside of Kewalo Basin Entrance Channel	1000
1038	P	35	"Enzo"	C	Dive Charter	transit Waik-Ewa i.b.	300
1050	P	100	"Starlet II"	C	Pleasure	transit Ewa-Waik, i.b.	200
1100	P	35	Catamaran "Kahala Kai"	C	Dive Charater	transit Waikiki to Kewalo Basin, i.b.	200
1107	P	80	Aikani-type Catamaran "Hoku Nani"	C	Pleasure	transit Waik to Kewalo Basin, i.b.	150
1113	P	80	American Dream	C	Pleasure (barefoot charter)	transit Kewalo-Waik, i.b.	300
1114	P	80	Nautilus Semi-Submersible	C	Pleasure	stationary outside of Kewalo Basin entrance channel	1000
1114	P	80	Fireboat "Moku Ahi"	C	in transit	transit Ewa-Waik o.b.	800
1135	P	17	Boston Whaler	P	Fishing	same as 0830	0
1140	P	25	Seamoor	P	Pleasure		800

TIME	CRAFT TYPE	LENGTH	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA
1149	P	28	Aloha Parasail Speedboat	C	Pleasure	transit south from Kewalo Basin	800
1204	P	40	Catamaran "Mele Kai"	C	Dive Charter	transit Kewalo Basin - Waikiki o.b.	800
1210	P	40	"Iwalani"	C	Fishing	in transit from Kewalo Basin	800
1217	S	45	Ketch	P	Pleasure	transit Waik-Ewa o.b.	1000
1222	P	70	Fishing Vessel "Nightwind"	C	Fishing	transit Waik-Kewalo o.b.	1500
1244	P	80	Fireboat "Moku Ahi"	C		transit Waik-Ewa i.b.	1500
1246	P	80	Junk "Lin Wa II"	C	Pleasure	tranist Waik-Ewa i.b.	150
1320	P	80	Nautilus Semi-Submersible	C	Pleasure	Stationary, outside Kewalo Entrance Channel	1000
1323	P	40	Catamaran "Mele Kai"	C	Dive Charter	anchored to NE	1000
1324	P	100	"Starlet II"	C	Pleasure	transit Waik-Kewalo i.b.	300
1330	S	30	-	P	Pleasure		1500
1412	P	100	Crew Boat	C		tranist Ewa-Waik o.b.	1500
1417	P	80	"American Dream"	C	Pleasure	transit Waik-Kewalo Basin, i.b.	300
1419	S	20	Cal-20 "Whatevah"	P	Pleasure	transit Waik-Ewa, o.b.	1000
1426	P	14	Whaler	P	Pleasure	transit Waik-Ewa, i.b.	200
1426	P	18	Sampan, same as 0912	P	Pleasure	transit Waik-Ewa, o.b.	1000
1441	S	35	"Native"	P	Pleasure	transit Waik-Ewa, o.b.	500
1445	P	17	Boston Whaler, same as 0830	P	Fishing		20
1448	S	50	Schooner	P	Pleasure	transit Wak-Ewa, o.b.	1500

TIME	CRAFT TYPE	LENGTH	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA
1454	P	40	Sampan "Waipouli"	P		transit Waik-Ewa i.b., stopped briefly near Voyager, then continued	200
1458	P	14	Whaler	P	Pleasure	transit Waik-Ewa, i.b.	500
1515	S	45	Sailing Catamaran "Holo Holo Kai"	C	Pleasure	anchored off Kewalo surf break	1000
1521	S	20	Cal-20 "Whatevah"	P	Pleasure	transit Ewa-Waik, o.b.	800
1533	S	45	Sailing Catamaran "Holo Holo Kai"	C	Pleasure	transit Ewa-Waik, i.b.	400
1546	S	20	Cal-20 "Whatevah"	P	Pleasure	transit Waik-Ewa o.b.	1500
1549	S	45	Sailing Catamaran "Holo Holo Kai"	C	Pleasure	transit Waik-Kewalo Basin, i.b.	150
1555	P	45/80	Tug and tow: Atlantis Submersible	C		transit Waikiki- Honolulu Harbor	1500

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1138	P	25	Mele Kai	C	Dive	heading Diamond Head	500
1153	P	20	Aloha Parasail	C	Transit to Kewalo	500 yards off shore	1500
1233	P	25	Mele Kai	C	Transit to Kewalo	dive boat	300
1242	P	20	Enzo	C	Transit to Kewalo	dive boat	300
1305	P	60	Starlet	C	Transit to Kewalo	-	150
1310	P	20	Aloha Parasail	C	Parasailing	reeling in parachute going to Kewalo	200
1325	P	10	-	C	Dive boat	-	300
1326	P	15	-	C	Dive boat	-	30
1334	P	14	-	P	Fishing	bottom fishing	1500
1341	P	26	Aloha Parasail	C	Parasailing	offshore from Kewalo	1500
1342	P	32	-	C	-	outbound from Kewalo	1500
1342	P	35	Fishing	C	Transit to Kewalo	inbound	1500
1345	C	32	Rena	C	Transit from Sand Island to dive	Diamond Head bound	400
1349	P	38	Catamaran	C	Diving	outbound from Kewalo basin,	1500
1351	N/A	14	Paddleboard	P	Paddling	600' off Ala Moana Park	800
1351	N/A	14	Paddleboard	P	Paddling	600' off Ala Moana	800
1354	P	35/40	Tug/Fishing	C	Towing	into Kewalo from Honolulu Harbor	1500

SUBMERSIBLE OPERATING AREA
BOAT TRAFFIC SURVEY

DATE: 12/16/97
WEATHER CONDITIONS: Partly cloudy; wind: ENE; 10-20 mph; surf, 0-1'

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
0800	P	10	Sportfisher	P	Fishing	stationary	12
0800	P	12	Sportfisher	P	Fishing	stationary	100
0808	P	15	Sportfisher	P	Fishing	stationary	400
0850	P/S	20	Manokai	C	Sail, Pleasure	picking up gear	0
0945	P	40	Good Fortune	?	Fishing	passing through	100
1035	P	32	Power	P	Pleasure	passing through	400
1038	P	60	Starlet	C	Pleasure	transit Waikiki	500
1038	P	30	-	C	Dive	transit Waikiki	500
1041	P	15	-	P	Diving	-	400
1046	P	30	Aloha Parasail	C	Para Sailing	transit to Kewalo Basin	60
1055	P	31	No Name	P	Pleasure Vessel	Passing through	100
1110	P	32	Angle Fish	P	Fishing	transit Ewa to Waikiki through	100
1125	?	40	Explorer	C	Dive	transit to Kewalo	300

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1405	P	80	American Dream	C	Pleasure	return to Kewalo	150
1435	P	15	Skiff	P	-	passing through dive site	500
1443	P	20	Parasail	C	-	from Kewalo outbound	700
1448	P	40	Kahuna-Kai	C	Fishing Charter	transit Waikiki to Kewalo	200
1452	P	80	Neptune tug	C	Tugboat	over dive sit transit Waikiki to Ewa	500

SUBMERSIBLE OPERATING AREA
BOAT TRAFFIC SURVEY

DATE: 12/17/97
WEATHER CONDITIONS: Overcast in the morning; wind: ENE 10-20 mph; surf: 1-2'

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
0705	P	12	HA65043	P	Fishing	drifting - fishing white hull, red upper	120
0714	P	1	HA6316B	P	Fishing	drifting fishing white hull, blue bimini	130
0736	P	80	American Dream	C	Tour Pearl Harbor	leaving Kewalo	1500
0800	P	40	Catamaran	P	Cruise	left Kewalo going Diamond Head	1000
0830	P	40	Pontoon	C	Jet Ski	everyday	1000
0900	P	50	No Hoku II Catamaran	C	Snorkel Cruise (?)	everyday	1000
0910	P	50	Catamaran	C	Blue/White Snorkel	everyday	1000
0915	P	45	Deep Sea Fishing Boat	-	Private Fish Charter Boat	off-shore going Diamond Head	1400
0924	P	45	Aloha Parasail	C	Para sail	going to Kewalo parasail down	200
0952	P	40	White Fishing Boat	P	-	transit across dive site	500
1018	P	15	White Fishing Boat	P	Fishing	-	200
1028	P	80	American Dream	C	Tour Boat	-	500
1028	P	50	Nautilus	C	Semi-submersible	-	1200

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1030	P	50	Fish Boat	C	fishing boat out of Kewalo basin	-	600
1030	P	45	Aloha Parasail	C	Parasailing	-	300
1032	P	35	Capt Bayan's	C	Dive boat	transit to dive site	300
1050	P	50	Kahala Kai	C	Sail	passing through inshore side	300
1205	P	70	sail boat	P	Sail	cross by	600
1205	P	40	fishing boat	C	Fishing	cross by	600
1255	P	40	Mele Kai	C	Dive boat	cross by	200
1413	P	80	American Dream	C	Tour boat	transit from Diamond Head to Kewalo	300
1413	P	45	Parasail	C	Parasailing	to Kewalo	300
1416	P	45	Aloha Parasail	C	Parasailing	to Kewalo	300

SUBMERSIBLE OPERATING AREA
BOAT TRAFFIC SURVEY

DATE: 12/17/97
WEATHER CONDITIONS: Overcast in the morining; wind: ENE 10-20 mph; surf: 1-2'

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
0705	P	12	HA65043	P	Fishing	drifting - fishing white hull, red upper	120
0714	P	1	HA6316B	P	Fishing	drifting fishing white hull, blue bimini	130
0736	P	80	American Dream	C	Tour Pearl Harbor	leaving Kewalo	1500
0800	P	40	Catamaran	P	Cruise	left Kewalo going Diamond Head	1000
0830	P	40	Pontoon	C	Jet Ski	everyday	1000
0900	P	50	No Hoku II Catamaran	C	Snorkel Cruise (?)	everyday	1000
0910	P	50	Catamaran	C	Blue/White Snorkel	everyday	1000
0915	P	45	Deep Sea Fishing Boat	-	Private Fish Charter Boat	off-shore going Diamond Head	1400
0924	P	45	Aloha Parasail	C	Para sail	going to Kewalo parasail down	200
0952	P	40	White Fishing Boat	P	-	transit across dive site	500
1018	P	15	White Fishing Boat	P	Fishing	-	200
1028	P	80	American Dream	C	Tour Boat	-	500
1028	P	50	Nautilus	C	Semi-submersible	-	1200

SUBMERSIBLE OPERATING AREA
BOAT TRAFFIC SURVEY

DATE: 12/21/97
WEATHER CONDITIONS: Clear, partly cloudy; wind: calm; seas: 2-4; surf: < 2'

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
0927	P	35	Enzo	C	Dive Charter	in transit at 15 knots	300
0930	P	8	-	P	Fishing	jet ski	1000
0936	P	60	Nautilus	C	Glass Bottom	-	1500
0938	P	45	Rena	C	Dive Charter	in transit	1000
0938	P	20	-	P	Fishing	in transit	500
0940	-		-		Canoes, paddling together	4 canoes (3/1man; 1/6man)	500
0946	P	15	HA9100E	P	Fishing	drifting	300
0950	P	15	HA9100E (Sand T II)	P	Fishing	drifting	50
1001	P	30	Mele Kai	C	Dive Charter	in transit	500
1009	P	100	American Dream	C	Barefoot Charter	in transit	1500
1015	P	60	Nautilus	C	Glass Bottom	-	1000
1024	S	12	Sabot	P	Pleasure	-	300
1029	P	65	Explorer II	C	Dive Charter	in transit	300
1030	P/S	45	Kahala Kai	C	Dive Charter	in transit	300
1034	P	70	-	P	Pleasure	in transit	1000
1040	P	100	Starlet II	C	Barefoot Charter	in transit	500
1043	S	25	-	P	Pleasure Sail	in transit	1500

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1029	P	65	Explorer II	C	Dive Charter	in transit	300
1030	P/S	45	Kahala Kai	C	Dive Charter	in transit	300
1034	P	70	-	P	Pleasure	in transit	1000
1040	P	100	Starlet II	C	Barefoot Charter	in transit	500
1043	S	25	-	P	Pleasure Sail	in transit	1500
1047	P	18	-	P	Fishing	in transit	1500
1052	S	30	-	P	Pleasure	in transit	1000
1101	P	35	Zodiac	C?	-	in transit	1000
1105	P	18	Whaler	P	Dive	1500 SE	1500
1111	P	18	Whaler	P	Dive	-	0
1115	P	60	Nautilus	C	Glass Bottom	-	1500
1119	P	100	American Dream	C	Barefoot	in transit	400
1118	P	30	Mele Kai	C	Dive Charter	in transit (W)	600
1120	P	130	Royal Princess	C	-	in transit	100
1123	P	18	-	P	Pleasure/dive	in transit through dive site	0
1130	P	25	Aloha Parasail	C	Parasail	-	1000
1139	P	25	Aloha Parasail	C	Parasail	-	1000
1139	P	25	Aloha Parasail	C	Parasail	different boat - in transit	500
1142	P	25	-	P	Pleasure	(runabout)	1000
1144	P	18	-	P	Pleasure	(runabout)	1000
1149	P	50	Chis Charter type	P	Pleasure	in transit	1500
1150	P	15	-	P	Fishing	drifting/trolling over site	0

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1156	P	35	Enzo	C	Dive Charter	in transit W	500
1200	P	45	Kahala Kai	C	Dive Charter	in transit E	400
1204	S	30	-	P	Pleasure	-	1500
1209	P	15	Runabout	P	Pleasure	in transit E	500
1212	S/P	45	Catamaran Enzo	-	Dive Charter	in transit W	1500
1213	P	19	Runabout	P	Pleasure	in transit	1000
1224	P	180	Navatec I	C	Whale watch?	in transit	1500
1225	P	65	Explorer II	C	Dive Charter	in transit W	500
1227	P	60	Na Alii Kai	C	Fishing	in transit E	1500
1234	S	35	Ketch	P	Pleasure	in transit W	1500
1234	S	45	Trimaran	P	Pleasure	in transit W	1500
1236	P	35	Enzo?	C	Dive Charter	in transit W	1500
1258	S	40	Sloop	P	Pleasure	in transit (sailing) E	1500
1301	P	10	Zodiac	P	Pleasure/dive	in transit W	400
1310	P	130	Royal Princess	P	Pleasure (?)	in transit W	1500 - 2000
1316	P	20	Runabout	P	Pleasure	in transit W	1000
1320	P	60	Nautilus	C	Glass Bottom	-	1000
1321	P	65	Stalet II	C	Barefoot	in transit W	500
1330	P	25	Aloha Parasail	C	Parasail	in transit W	300
1340	S/P	35	Kahala Kai	C	Dive Charter	in transit W	700

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1346	P	170	Navatek	C	Whale Watch	in transit W	1500-2000
1348	P	30/80	Atlantis	C	Tug & Tow	tug in transit W with submarine in tow	1500
1408	P	40	Sportfish	P	-	in transit E	1500
1410	S	24	sloop	P	Pleasure	-	1000
1416	P	65	American Dream	C	Barefoot	in transit W	500
1430	P	15	-	P	Pleasure	in transit W	1000
1432	P	25	Sportfish	P	Pleasure	in transit W	750
1438	P	10	Zodiac	P	Pleasure/dive	in transit E	400
1439	P	15	Runabout	P	Fishing	in transit E	600
1440	S	45	Kalani	P	Pleasure/Sail	in transit W	0
1441	P	15	Runabout	P	Pleasure	-	0
1444	P	10	Zodiac	P	Pleasure	in transit E	500
1445	P	18	Runabout	P	Pleasure	in transit W	400
1446	P	65	Explorer	C	Dive Charter	in transit E	600
1448	S	29	Fairwind sloop	P	Pleasure	sailing W	0
1455	P	20	small catamaran hull	P	Pleasure	in transit E	750
1459	P	30	sport fishing	P	Pleasure	in transit W	1000
1501	P	10	Zodiac	C	Explorer operation	in transit W	700
1501	P	6	Zodiac	C	Explorer operation	in transit W	700

TIME	CRAFT TYPE P = Power S = Sail	LGTH (est. ft.)	VESSEL MAKE/NAME	COMM/ PRIV	ACTIVITY	NOTES	CPA (ft)
1504	P	6	Zodiac	C	Explorer operation	in transit W	700
1504	P	18	Runabout	P	Explorer operation	in transit E	0
1508	P	65	Golden Eagle	C	Fishing Charter	in transit to Kewalo Basin	700
1510	P	25	Aloha Parasail	C	Parasail	in transit to Kewalo	500
1520	P	25	Aloha Parasail	C	Parasail	parasail	1500
1525	P	65	American Dream	C	Barefoot/Sunset Cruise?	transit E from Kewalo Basin	1000
	P	45	Sampan Rutledge	C	Fish?	in transit to Kewalo Basin	400
1536	P	45	Sampan Aukaka	C	Fishing	transit to Kewalo Basin	0
1537	P	18	Runabout	P	Fish	drifting/fishing	1000
1544	P	15	speedboat Runabout	P	-	transit E	500
1545	P	65	Explorer	C	Dive/Barefoot	transit W	500
1545	P	25	Spotfish	P	-	transit E	750
1550	P	30/85	Atlantis	C	Tug & Towtug	towing Atlantis Submarine	1500
1552	P	20	Runabout	P	Pleasure	transit E	500
1553	P	45	Grand Banks Taru	P	Pleasure	transit W	750
1559	P	45	Spotfish Maze Tor	P	Fish	transit W	0
1609	P	65	American Dream	P	Barefoot	transit W	400