FINAL

SUPPLEMENTAL ENVIRONMENTAL REPORT FOR MODIFICATIONS IN THE DESIGN, INFRASTRUCTURE, AND INSTALLATION OF THE COASTAL-SCALE NODES, REGIONAL-SCALE NODES, AND GLOBAL-SCALE NODES OF THE OCEAN OBSERVATORIES INITIATIVE (OOI)

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Acronyms and Abbreviations

ACM	acoustic current meter
ADCP	acoustic Doppler current profiler
ADV	Acoustic Doppler Velocimeter
approx.	approximately
AUV	autonomous underwater vehicle
BARF	Benthic Anchor Recovery Frame
CFR	Code of Federal Regulations
CFRF	Commercial Fisheries Research Foundation
CSN	Coastal-Scale Nodes
DAS	days at sea
EFH	Essential Fish Habitat
EM	electrical-mechanical
EO	electro-optical
EOM	electrical-optical-mechanical
ESA	Endangered Species Act
FHL	Friday Harbor Laboratories
fm	fathom(s)
FONSI	Finding of No Significant Impact
ft	foot/feet
GSN	Global-Scale Nodes
lbs	pounds
LNM	Local Notice to Mariners
LVN	Low-Voltage Node
m	meter(s)
m^2	square meter(s)
MARS	Monterey Accelerated Research System
MFN	multi-function node
mm	millimeters
NEPA	National Environmental Policy Act
NEPTUNE	North-East Pacific Time-Series Underwater Networked Experiments
nm	nautical mile(s)
nm^2	square nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOTMAR	Notice to Mariners
NSF	National Science Foundation
O&M	Operations and Maintenance
OFCC	Oregon Fishermen’s Cable Committee
OOI	Ocean Observatories Initiative
OSU	Oregon State University
PATON	Private Aid to Navigation
PEA	Programmatic Environmental Assessment
ROV	remotely operated vehicle
RSN	Regional-Scale Nodes
R/V	research vessel
SER	Supplemental Environmental Report
SOP	Special Operating Procedure
SSEA	Site-Specific Environmental Assessment
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
UW	University of Washington
Vdc	volts direct current
VENUS	Victoria Experimental Network Under the Sea
WDFW	Washington Department of Fish and Wildlife
WHOI	Woods Hole Oceanographic Institute

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1.0 PURPOSE AND NEED

This Supplemental Environmental Report (SER) has been prepared to assess the potential impacts on the human and natural environment associated with proposed modifications in the design, installation, and operation and maintenance (O&M) of components of the Coastal-Scale Nodes (CSN) Endurance Array, CSN Pioneer Array, Regional-Scale Nodes (RSN), and the Global-Scale Nodes (GSN) of the Ocean Observatories Initiative (OOI) that were previously assessed in a Site-Specific Environmental Assessment (SSEA) (National Science Foundation [NSF] 2011a, b). The SSEA was prepared by NSF to assess the potential impacts on the human and natural environment associated with proposed site-specific requirements in the design, installation, and operation of the OOI that were previously assessed in a Programmatic Environmental Assessment (PEA) (NSF 2008, 2009a) and a 2009 SER (NSF 2009b). The SSEA analysis concluded that installation and O&M of the proposed OOI as presented in the 2011 Final SSEA would not have a significant impact on the environment and a Finding of No Significant Impact (FONSI) was signed on January 31, 2011 (NSF 2011b) (Appendix A).

The purpose of this SER is to determine if the proposed OOI design modifications would result in significant impacts to the environment not previously assessed in the SSEA, including cumulative impacts. If the proposed modifications would result in potentially significant impacts or impacts that were not addressed in the SSEA and further analysis were deemed necessary, then in accordance with the National Environmental Policy Act (NEPA) (42 U.S. Code §4321 *et seq.*) and the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] §§1500-1508), a Supplemental Environmental Assessment or an Environmental Impact Statement would need to be prepared and distributed for review and comment.

1.1 BACKGROUND

The following is a brief summary and background based upon the information provided in the 2011 SSEA. For a detailed description of the purpose, goals, and design of the OOI, please refer to the 2008 PEA, 2009 SER, and 2011 SSEA (NSF 2008, 2009b, 2011a).

1.1.1 OOI Coastal, Regional, and Global Scales

To provide the U.S. ocean sciences research community with the basic sensors and infrastructure required to make sustained, long-term, and adaptive measurements in the oceans, the NSF's Ocean Sciences Division developed the OOI from community-wide, national, and international scientific planning efforts. OOI builds upon recent technological advances, experience with existing ocean observatories, and lessons learned from several successful pilot and test bed projects. The OOI would be an interactive, globally distributed and integrated network of cutting-edge technological capabilities for ocean observatories. This network of sensors would enable the next generation of complex ocean studies at the coastal, regional, and global scale.

The OOI infrastructure includes cables, buoys, deployment platforms, moorings, junction boxes, electric power generation (solar, wind, fuel cells, and undersea cabled power supplies), mobile assets (i.e., autonomous underwater vehicles [AUVs] and gliders), and two-way communications systems. This large-scale infrastructure would support sensors located at the sea surface, in the water column, and at or beneath the seafloor.

As described in detail in the PEA, the OOI design is based upon three main physical infrastructure elements across global, regional, and coastal scales. At the global and coastal scales, mooring observatories would provide locally generated power to seafloor and platform-mounted instruments and sensors and use satellite or other wireless technologies to link to shore stations and the Internet. Up to four GSN or buoy sites for ocean sensing would be installed in the Eastern Pacific and Atlantic oceans. The RSN off the coast of Oregon would consist of seafloor and mooring observatories with various physical, chemical, biological, and geological sensors linked with submarine cables to shore that provide power and Internet connectivity. The CSN would be represented by the Endurance Array off the coast of Washington and Oregon and the Pioneer Array off the southern coast of Massachusetts. In addition, there would be an integration of mobile assets such as AUVs and gliders with the GSN and CSN observatories.

1.2 SCOPE OF THIS SER

This SER addresses the proposed:

- revised siting of the Pioneer Array moorings;
- modifications to a mooring component for RSN and CSN (Pioneer and Endurance arrays);
- revised siting of the Endurance Array moorings;
- testing of RSN mooring designs in Puget Sound; and
- changes in the subsurface hybrid profiler moorings and spacing of subsurface flanking moorings of the GSN.

All other components and installation and O&M activities of the OOI would remain unchanged from the description and analysis presented in the 2011 SSEA. Section 2.0 describes in detail the proposed changes to the Pioneer and Endurance arrays of the CSN, RSN, and GSN being addressed in this SER.

2.0 DESCRIPTION OF PREVIOUSLY ASSESSED OOI COMPONENTS AND PROPOSED MODIFICATIONS

2.1 COASTAL SCALE NODES (CSN)

2.1.1 Pioneer Array

The Mid-Atlantic Bight of eastern North America is characterized by a relatively broad shelf, a persistent equator-ward current originating from the north, a well-defined shelfbreak front separating shelf and slope waters, distributed buoyancy inputs from rivers, variable wind forcing, and intermittent offshore forcing by Gulf Stream rings and meanders. The Pioneer Array would be designed to resolve transport processes and ecosystem dynamics within the shelf-slope front, which is a region of complex oceanographic dynamics, intense mesoscale variability, and enhanced biological productivity. It would collect high-resolution, multidisciplinary, synoptic measurements spanning the shelf break on horizontal scales from a few kilometers to several hundred kilometers.

The Pioneer mooring array would extend approximately (approx.) 25 nautical miles (nm) across the continental shelf, centered at the shelf-break front (Figure 1). The array would employ surface moorings, subsurface profiler moorings, gliders, and AUVs to sample on multiple horizontal scales from the air-sea interface to the seafloor. The surface moorings would be equipped to measure surface meteorology and air-sea fluxes, fitted with power generation capability, and moored with electrical-mechanical (EM) cable to the seafloor, allowing incorporation of a benthic node for science user instrumentation.

2.1.1.1 Pioneer Array Components Previously Assessed in the SSEA

The Pioneer mooring array, as described in the 2011 SSEA, would consist of 2 lines of moorings running approx. north-south across the continental shelf (refer to Section 2.2.1.2 of the SSEA). The western (downstream) line would consist of surface moorings, wire-following profiler moorings with a small surface expression, and surface-piercing profiler moorings with intermittent surface expression. The eastern (upstream) line would consist of wire-following profiler moorings with a smaller surface expression. Gliders and AUVs would run missions in the vicinity of the moored array (Figure 2). As assessed in the SSEA, the Pioneer Array would contain (Figures 2, 3, and 4; Table 1):

- 3 electrical-optical-mechanical (EOM) surface moorings with local power generation, satellite communications capabilities, and multi-function nodes (MFNs). The MFN footprint would be 4 square meters (m^2).
- 2 EOM moorings would be adjacent to surface-piercing profiler moorings, and 1 would be adjacent to a wire-following profiler mooring.
- 4 stand-alone wire-following profiler moorings that would be internally powered with satellite communication capabilities.
- 3 AUVs with 2 docking stations electrically connected to 2 EOM surface moorings (Offshore and Inshore) for power transfer and communications.
- An AUV mission box of approx. 2,489 square nautical miles (nm^2).
- 6 gliders operating within a glider mission box of approx. 5,697 nm^2.

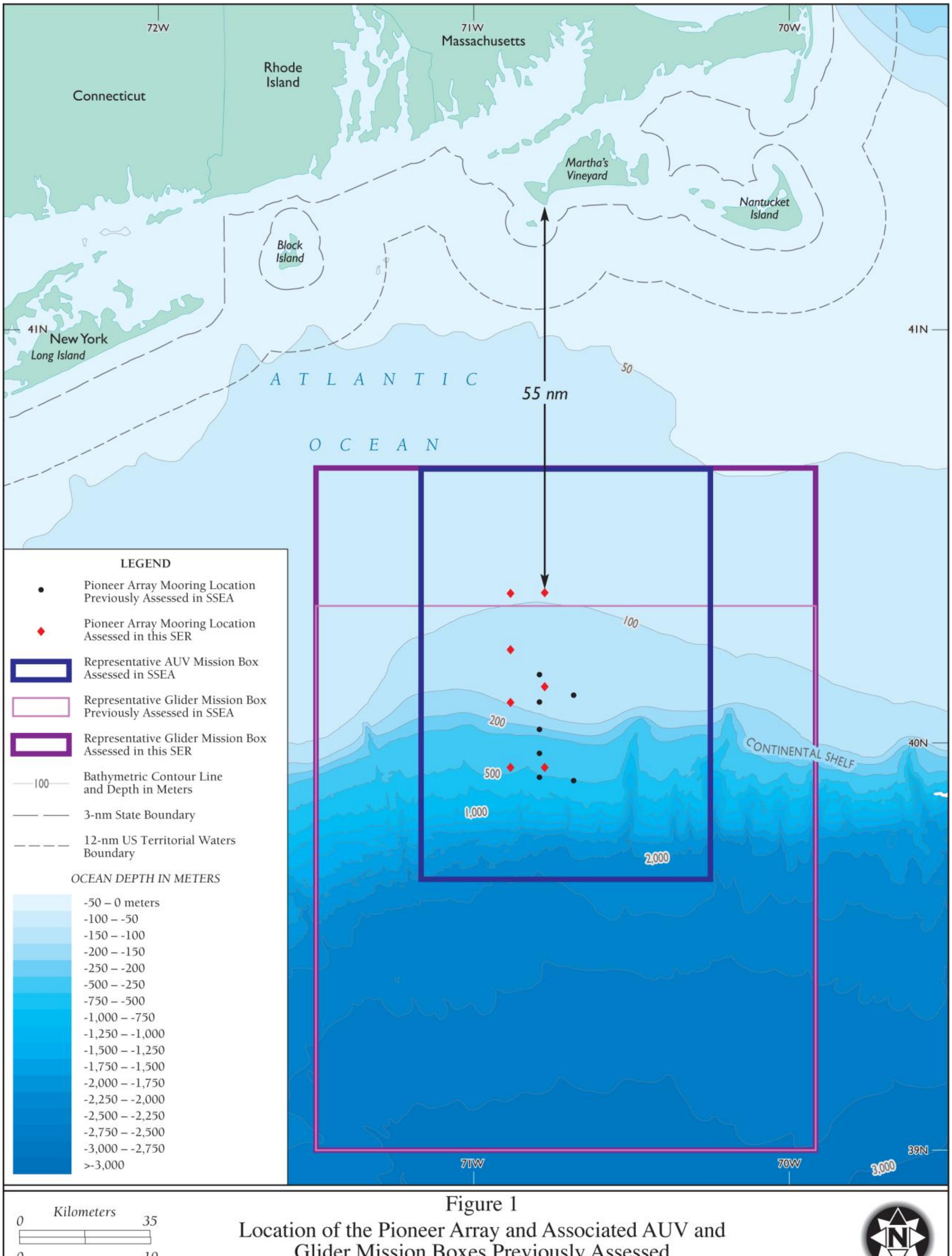


Figure 1
Location of the Pioneer Array and Associated AUV and Glider Mission Boxes Previously Assessed in the 2011 SSEA and Assessed in this SER

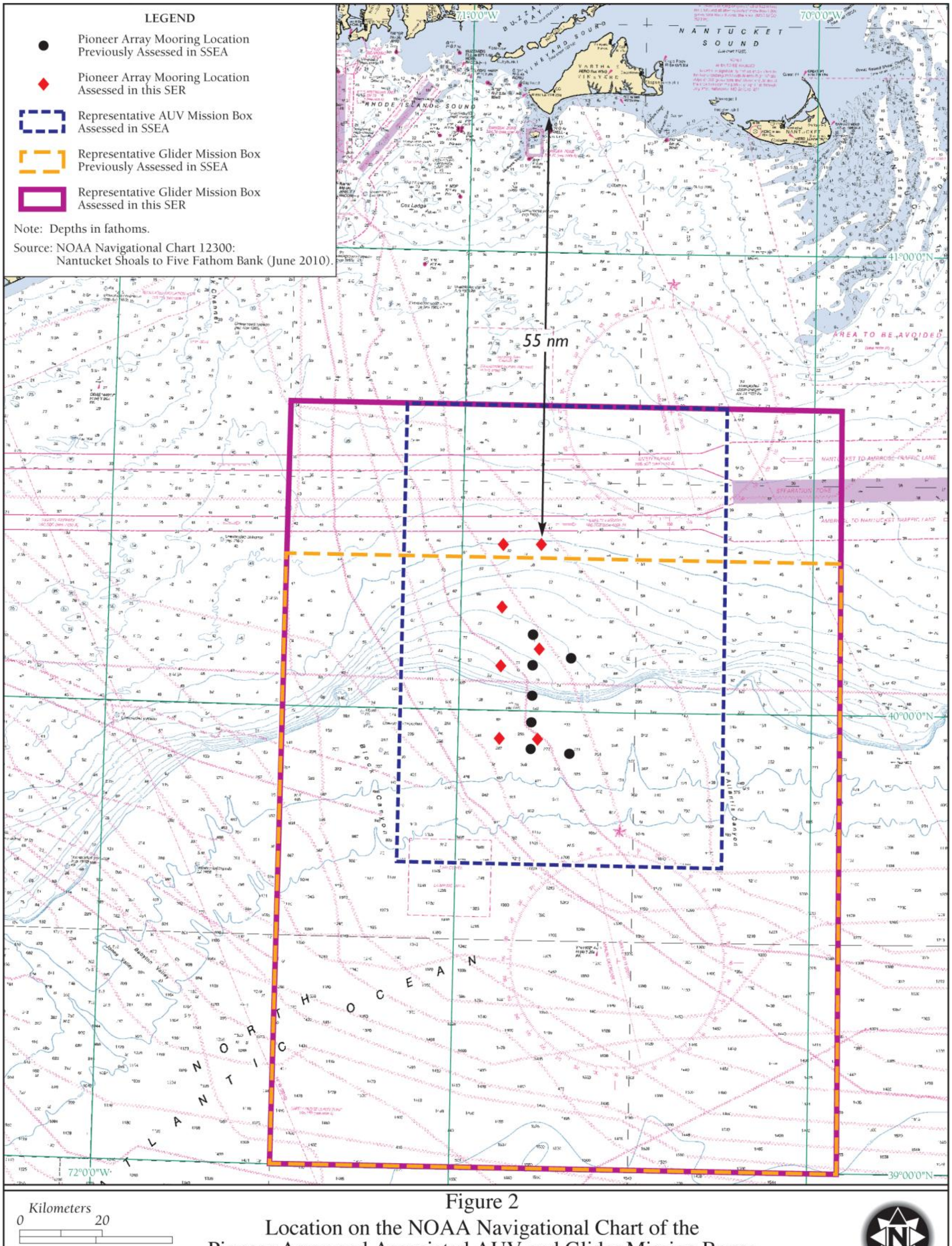


Figure 2

Location on the NOAA Navigational Chart of the Pioneer Array and Associated AUV and Glider Mission Boxes Previously Assessed in the 2011 SSEA and Assessed in this SER

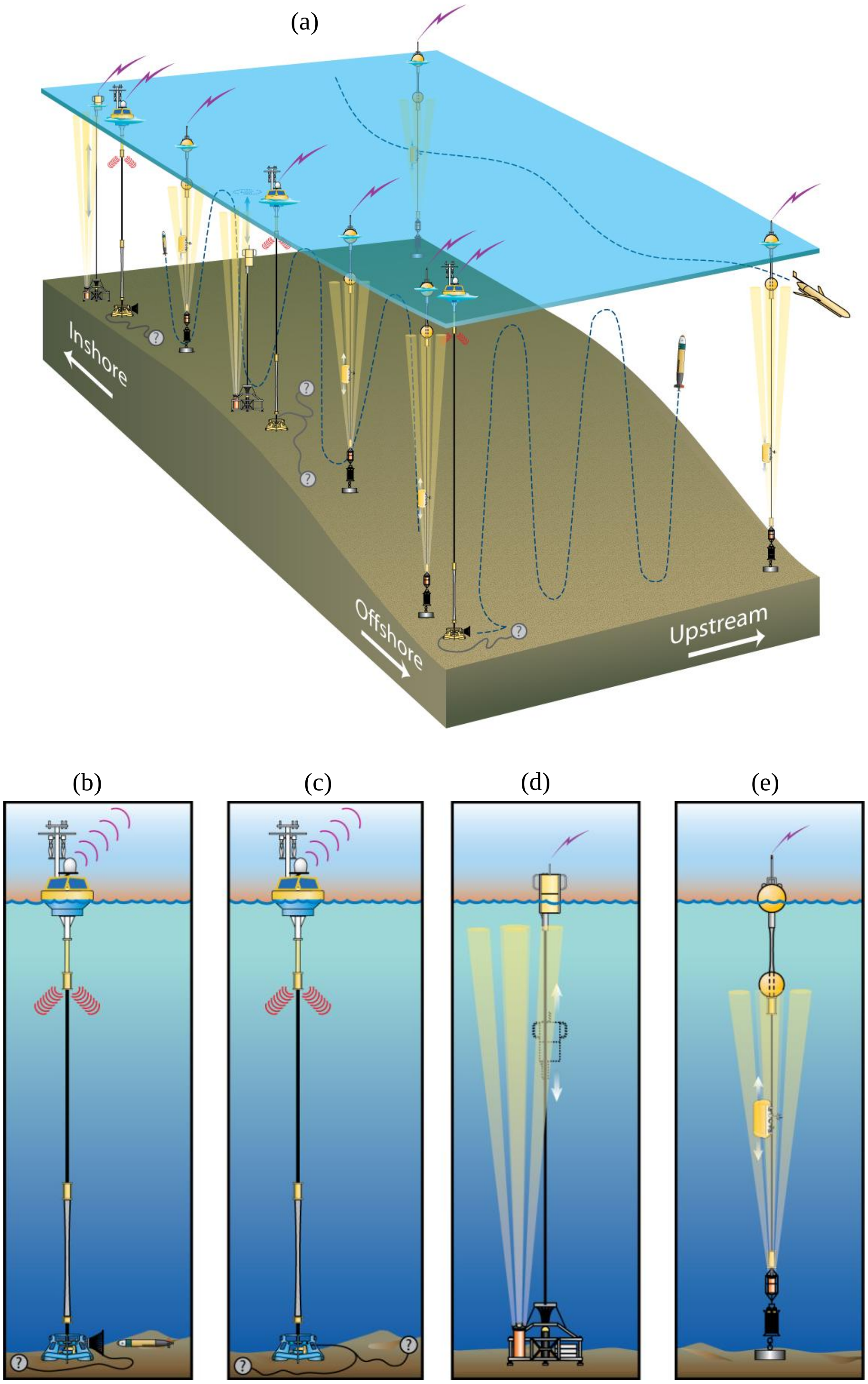
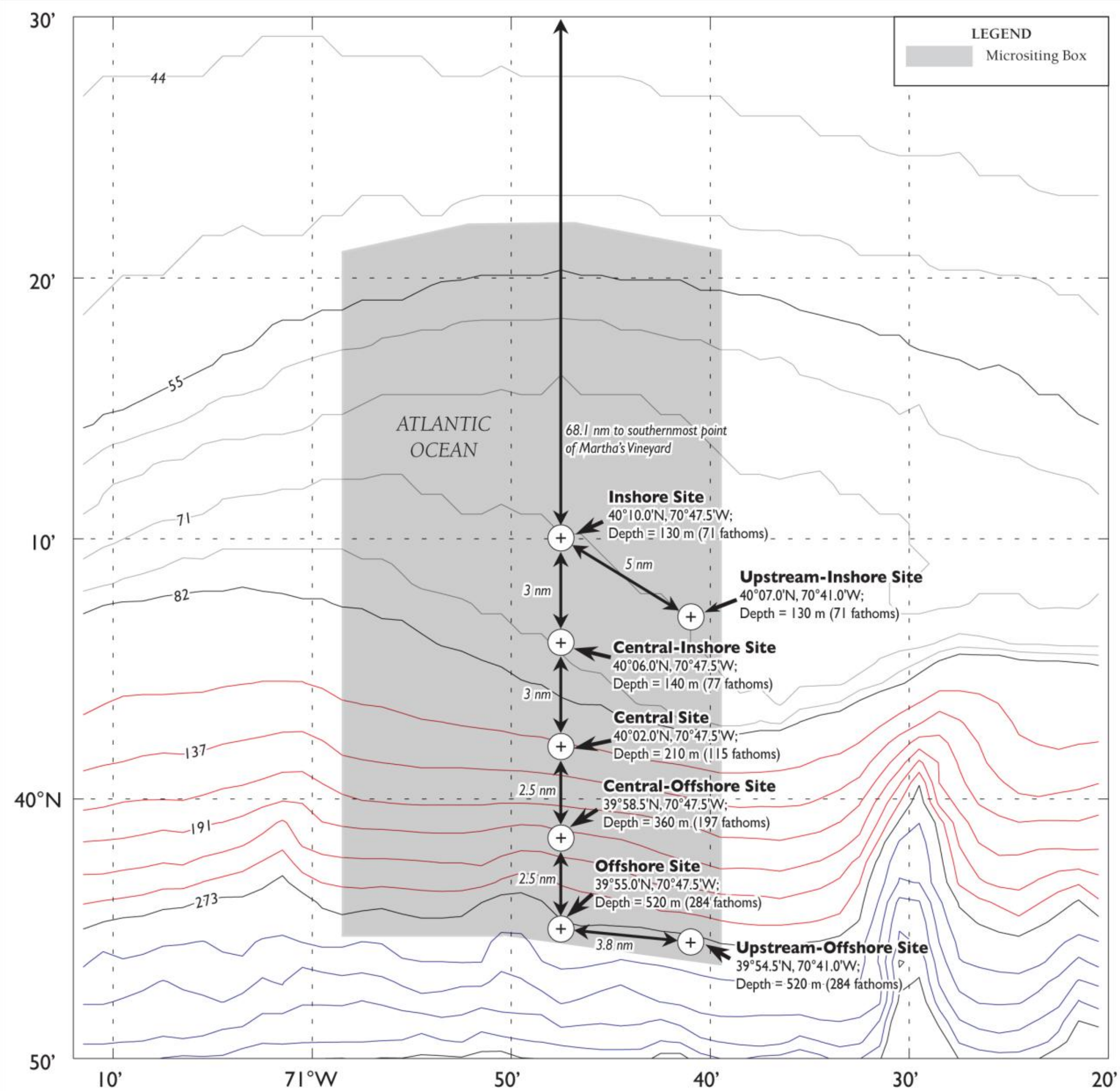


Figure 3. Schematic Diagram of the Pioneer Array (a) and Moorings (b-e) as Assessed in the 2011 SSEA

(b) EOM surface moorings with MFNs supporting AUV docks will be at the Inshore and Offshore mooring sites.
(c) An EOM surface mooring with MFN supporting science user instrumentation will be at the Central Mooring Site.
(d) Surface-piercing profiler moorings with acoustic Doppler current profilers (ADCPs) at their base will be at the Inshore and Central mooring sites.
(e) Wire-following profiler moorings with ADCPs will be at the intermediate sites along the inshore/offshore line, and at the upstream corners.



Black contours are at 100 m, 150 m, 500 m and 1000 m. Gray, red and blue contours are at 10-m, 50-m and 100-m intervals, respectively. Selected contours are labeled in fathoms. Mooring site centers are marked by black "+" and encircled by approximate 0.5-nm radius buffer zones. Distances between buffer zones are shown between arrows.

Figure 4
Pioneer Array Mooring Configuration
as Previously Assessed in the 2011 SSEA

Table 1. Summary of Previously Assessed (PEA and SSEA) and Proposed Modifications (SER) to Pioneer Array Infrastructure

Item	*PEA and SSEA*	*SER**
Moorings	• 3 EOM surface moorings with MFN footprint of 4 m^2. • 2 surface-piercing profiler moorings. • 5 wire-following profiler moorings. • Active & non-active acoustic sensors on moorings.	• 3 EM surface moorings with MFN **footprint of 8 m^2**. • 2 surface-piercing profiler moorings. • 5 wire-following profiler moorings. • Active & non-active acoustic sensors on moorings. • **Addition of 2 guard buoys to mark the location of the surface piercing profilers at the Inshore and Central mooring sites (Figure 6).** • **AUV docking stations mechanically separated from the Inshore and Offshore moorings and connected by cable to the mooring base. Each docking station would have a footprint of 12.25 m^2.** • **Repositioning of all mooring sites to the west and north of the locations originally proposed in the SSEA, with greater separation between moorings (Figures 1 and 6).**
AUVs & Gliders	• 3 AUVs and 6 gliders. • AUV mission box = 2,489 nm^2. • Glider mission box = 5,697 nm^2.	• 3 AUVs and 6 gliders. • AUV mission box = 2,489 nm^2. • **Glider mission box = 7,145 nm^2.**

Note: ***Bolded** entries are proposed modifications to the Pioneer Array assessed in this SER.
Sources: NSF 2011a; Consortium for Ocean Leadership 2012.

In summary, a total of 10 moorings would be installed on the seafloor under the SSEA. In addition, 3 AUVs and 6 gliders would be used to provide monitoring abilities across the entire shelf break.

2.1.1.2 Proposed Pioneer Array Design Modifications

The location of the proposed revisions to the Pioneer Array, inclusive of the glider mission box, is still within the area previously assessed in the SSEA. As assessed in this SER as the Proposed Action (Figures 1, 5, and 6, and Table 1), the proposed changes in the Pioneer Array configuration would include:

- The two parallel linear mooring lines would be shifted approx. 3.5 nm to the west, would extend further north, and there would be greater spacing between moorings than proposed in the SSEA (Figures 1, 4, and 6).
- Addition of 2 guard buoys to mark the location of the surface piercing profilers at the Inshore and Central mooring sites (Figure 6).
- EOM moorings have been eliminated from the design; all CGN moorings would be EM moorings.
- Increase in MFN footprint from 4 m^2 to 8 m^2 for the 3 EM surface moorings.
- The AUV docking stations would not be incorporated into the base/anchor of the 2 EM surface moorings at the Inshore and Offshore mooring sites as originally proposed in the SSEA and depicted in Figure 3b. Instead, the 2 AUV docking stations would be separate units connected to the base of the surface moorings via submarine cable up to 500 m in length (Figure 7). The Inshore and Offshore EM moorings would now resemble the mooring depicted in Figure 5b. The footprint of each AUV docking station would be 12.25 m^2.
- Increase the glider mission box by 1,448 nm^2 from 5,697 nm^2 to approx. 7,145 nm^2.

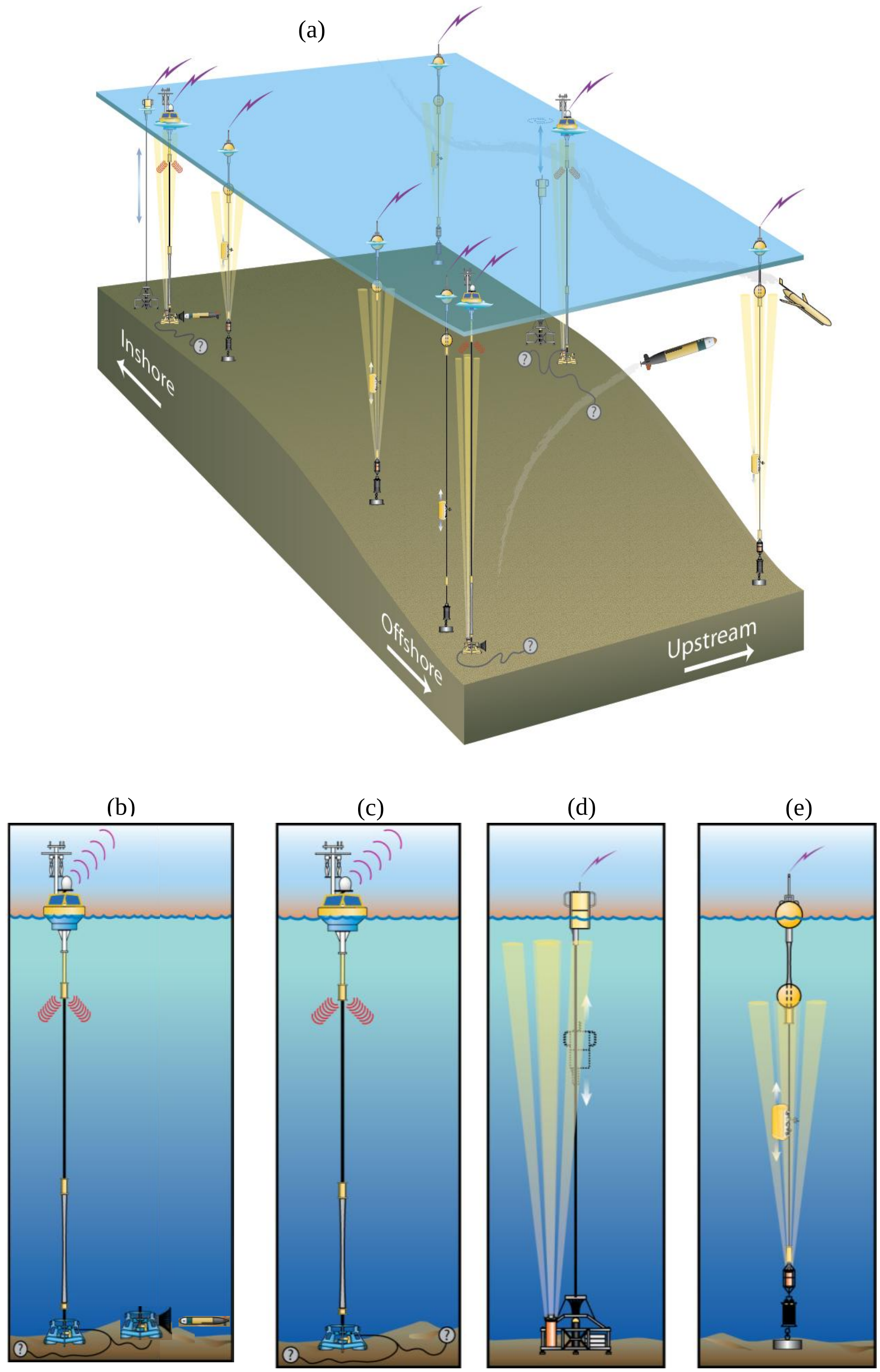


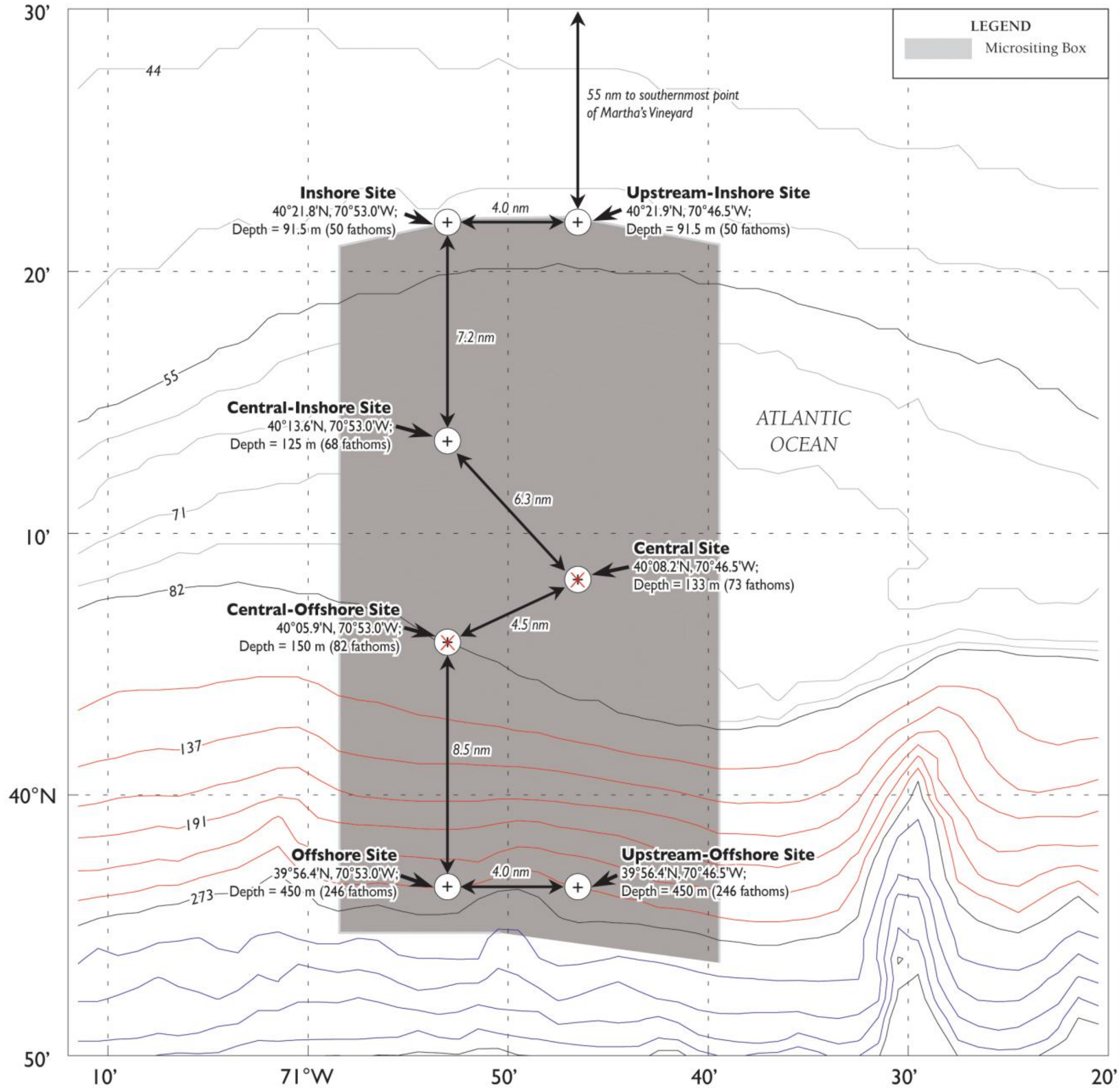
Figure 5. Schematic Diagram of the Pioneer Array (a) and Moorings (b-e) as Proposed in this SER

(b) EM surface moorings with MFN and cabled AUV dock. MFNs supporting AUV docks will be at the Inshore and Offshore mooring sites.

(c) An EM surface mooring with MFN supporting science user instrumentation will be at the Central Mooring Site.

(d) Surface-piercing profiler moorings with ADCPs at their base will be at the Inshore and Central mooring sites.

(e) Wire-following profiler moorings with ADCPs will be at the intermediate sites along the inshore/offshore line, and at the upstream corners.



Black contours are at 100 m, 150 m, 500 m and 1000 m. Gray, red and blue contours are at 10-m, 50-m and 100-m intervals, respectively. Selected contours are labeled in fathoms. Red "X" symbols denote locations of known "hangs" avoided by mobile-gear fishermen. Mooring site centers are marked by black "+" and encircled by approximate 0.5-nm radius buffer zones. Distances between buffer zones are shown between arrows.

Figure 6
Revised Pioneer Array Mooring Configuration
as Assessed in this SER

Pioneer Array Siting Process after Completion of 2011 SSEA

The following section provides a summary of the Pioneer Array siting process implemented during the preparation of the Final SSEA and after the Final SSEA was completed.

In response to written and oral comments on the Draft SSEA regarding the potential placement of the proposed OOI Pioneer Array moorings, NSF initiated a process whereby marine stakeholders and the public, in particular the fishing community, could provide input to the site selection process, or micro-siting, for final mooring placement within the Pioneer Array study area analyzed in the SSEA. The micro-siting process was developed as a way for the marine user communities and general public to continue providing input on the specific placement of the uncabled moorings in their affected areas after the Final SSEA was completed. Stakeholder input to the micro-siting process for the Pioneer Array occurred via public meetings, small workshops with fishing industry representatives, and/or e-mail. The initial determination of candidate sites where the moorings could be placed was made by scientists (supported by NSF) to meet the science/operational requirements. Coordinating with the public, including local marine users, regarding the micro-siting of each mooring within the study area analyzed in the SSEA assisted in addressing regional fishing interests.

The micro-siting of moorings within the identified study area for the Pioneer Array was informed through a public process during which input from the public, including representatives of marine user stakeholders, was both sought and encouraged. Representatives of marine user stakeholders include, but are not limited to:

American Alliance of Fishermen and their Communities
Atlantic Offshore Lobstermen's Association
Broadbill Fishing, Inc.
Cape Cod Commercial Hook Fishermen's Association
Colbert Seafood, Inc.
Commercial Fisheries Center of Rhode Island
Commercial Fisheries Research Foundation
Eastern New England Scallop Association
Garden State Seafood Association
Long Island Commercial Fishing Association
Manomet Seafood, Inc.
Massachusetts Fishermen's Partnership
Mataronas Lobster Company, Inc.
Mid-Atlantic Fishery Management Council
New England Fishery Management Council
Ocean State Lobster
Rhode Island Fisherman's Alliance
Rhode Island Lobstermen's Association
Rhode Island Shellfishermen's Association
Sakonnet Lobster Company
Trebloc Seafood, Inc.

Discussions also included the establishment of voluntary (i.e., non-regulatory) "areas to avoid" or buffer zones around the Pioneer Array mooring sites. Mooring sites have pre-defined, fixed centers and an associated buffer zone. Individual moorings are placed within the buffer zone at a given site; individual moorings themselves do not have their own buffer zones around them. A 0.5-nm radius buffer zone is planned for each of the Pioneer Array mooring sites. The site locations and individual mooring locations at each site would be published in the Notice to Mariners (NOTMAR) and Local Notice to Mariners (LNM), clearly charted on National Oceanographic and Atmospheric Administration (NOAA) electronic navigation charts, and identified through direct contact with user communities. Surface buoys would have required U.S. Coast Guard (USCG) lighting and markings and, as appropriate, active radar transponders.

Commercial Fisheries Research Foundation (CFRF) Report. In addition to the above items, during public micro-siting meetings held in the New England region during 2010, it was suggested by members of the commercial fishing community that continuing the dialog regarding micro-siting and navigational safety concerns through smaller, informal meetings would better address issues and concerns associated with the installation and operation of the Pioneer Array. The Consortium for Ocean Leadership provided funding to the CFRF to facilitate a series of 4 meetings between representatives from the regional fishing community and regional OOI scientists during the fall of 2011. The meetings were summarized in a 2012 report *Pioneer Array Workshops – Exploration of Issues and Concerns Connected with the Planned OOI Pioneer Array Project* (CFRF 2012). The recommendations that resulted from these meetings informed the configuration of the Pioneer Array that is assessed in this SER. Those recommendations relevant to micro-siting that are within the scope of the environmental analysis contained in this SER are summarized below.

1) *Recommendations dealing with array and mooring locations:*
    a) Fishermen and scientists recommend that the mooring configuration be rearranged by shifting the whole array to the west, then shifting the Central Site (74-fathom [fm] mooring) to the northeast, and northern most moorings (Inshore Site [52 fm] and Upstream Inshore Site [52 fm]) to the north (to 50 fm). In addition, the Central Offshore Site Mooring (82 fm) and Central Mooring (74-fm mooring moved east to 73 fm) be placed on existing shipwrecks.
    b) In sites where there are to be two moorings, fishermen recommend that they be placed as close together as possible. This distance, as confirmed by scientist representatives, is 0.5 nm.
    c) In sites where moorings could be placed near shipwrecks or existing "hangs" (obstacles), fishermen recommend that they be placed as close as possible to these existing hangs.

    Implementation of these recommendations is acceptable to the extent practicable and within the limitations of the laws and policies protecting submerged cultural resources. OOI would site infrastructure as near the recommended existing shipwreck or "hang" locations as practicable to avoid adverse impacts to those wrecks. OOI's deployment plan is to avoid placing infrastructure directly on any known cultural resources (including shipwrecks and sunken military craft). Note that the site plan will also be reviewed by the U.S. Army Corps of Engineers as part of the permit application review for the Pioneer Array.

    Consultation among OOI scientists and engineers, as well as experience with the OOI test moorings deployed in September 2011, indicates that the closest practical spacing is approximately twice the water depth at the deployment site. Thus, at the deepest site with paired moorings (Offshore, 250 fm) the surface mooring and profiler mooring would be separated by approximately 0.5 nm. At the shallowest site (Inshore, 50 fm) the spacing could be as little as 0.1 nm. These distances are the operational objectives and may not be achieved for a given mooring deployment due to shipboard operating constraints, environmental conditions, engineering design, or other factors. Minimum mooring separation distances would also apply to the separation between moorings and shipwrecks or hangs.

2) *Recommendation regarding communication between the fishing community and the OOI:*
    a) Fishermen requested that the exact locations (coordinates) of all mooring site centers and radius of the buffer zones circle surrounding each center, and information on the type of individual moorings and anchor locations within a mooring site be communicated to all fishermen using the study area.

    The Consortium for Ocean Leadership will provide exact mooring locations of all sites through the USCG LNM upon deployment. The LNM will serve as the primary source of this information. Mooring locations, mooring types, site centers, and buffer zone distances will be displayed on an OOI web page and updated as appropriate.

These extensive coordination activities and discussions with the marine user communities that utilize the Pioneer Array study area occurred during the preparation of the Final SSEA and continued after issuance of the Final SSEA until site-specific mooring site location was achieved that considered the regional fishing interests yet continued to meet the science/operational requirements. Discussions resulted in the current configuration and placement of the Pioneer Array mooring sites as presented below. Discussions with the fishing community and other marine users will continue as necessary to address potential concerns during the installation and operation of the Pioneer Array.

Pioneer Array Mooring Placement Assessed in this SER

Based on coordination with regional fishing groups and other marine users, the two parallel linear mooring lines would be shifted approx. 3.5 nm to the west, would extend further north, and there would be greater spacing between mooring sites than proposed in the SSEA (Figures 1, 4, and 6). The increased spacing between all mooring sites would allow greater flexibility in movement by fishing vessels and their gear within the Pioneer Array study area to minimize the potential for gear entanglement. For example, the spacing between the Inshore Site and the Central-Inshore Site in the 2011 SSEA was 3 nm (Figure 4); under the proposed revised configuration, the spacing would be 7.2 nm (Figure 6). In addition, 2 of the revised mooring locations would be within the vicinity of known ‘hangs’ or areas already avoided by fishers. Recent project-specific multibeam bathymetric surveys have not identified any significant objects or formations within the vicinity of the revised Pioneer mooring sites.

Guard Buoys at the Inshore and Central Mooring Sites

Under the revised Pioneer Array design, 2 guard buoys could potentially be installed to mark the surface location of surface piercing profilers (which do not have a permanent surface expression) at the Inshore and Central sites (Figure 6). The guard buoys would be located within the 0.5-nm buffer zone for each mooring site. The anchor and surface expression for a guard buoy would be similar in design and size to a moored profiler (Figure 5d) but without the profiler and scientific instruments. The installation of the additional guard buoys is expected to take an additional 1 day per buoy. Guard buoys would be serviced once per year in the fall while the other Pioneer Array buoys are serviced in spring and fall. This would not change the number of O&M cruises or the type of ship, only the activity taking place during the O&M cruises.

MFN Modifications

As described in the 2008 PEA, an MFN rests on the seafloor and provides the necessary anchoring weight for a mooring as well as the potential for integration of or cable connections to benthic scientific instruments. The weight is provided by a releasable cast steel anchor fitted with a secondary anchor recovery line pack. The MFN has a metal frame with an approximate 8 m^2 footprint, is 1 m high, and houses a rechargeable battery pack to provide power for intermittent seafloor needs. The MFN would provide data and power ports for benthic instrumentation. Batteries and electronics are housed in one or more aluminum pressure-tolerant housings. MFNs are proposed for use on the 3 EM surface moorings of the Pioneer Array. The additional area covered on the seafloor due to the increase in the MFN footprint from 4 m^2 to 8 m^2 would equal an additional 4 m^2 for each MFN, for a total of 12 m^2.

AUV Docking Stations

As assessed in the 2011 SSEA, 2 AUV docks were to be incorporated into the surface mooring MFNs at the Inshore and Offshore mooring sites (refer to Figure 3a). Under the proposed Pioneer Array design modifications, the AUV docks would be mechanically separated and set away from the surface mooring anchor frames (Figures 5b and 7), slightly increasing benthic coverage. The AUV dock would cover an area on the seafloor of approx. 12.25 m^2 and have a wet weight of 4,000 pounds (lbs) and an air weight of 7,000 lbs. The AUV dock would rest on the seafloor adjacent to a surface mooring at a depth of 100-500 meters (m) (55-273 fm). It would be connected to the anchor frame of the surface mooring via a 0.7-1.2 inch diameter fluid-filled submarine cable which may be up to 500 m in length and would provide power and communications. However, the AUV docks and associated cable would still be within the 0.5-nm radius buffer zone of each mooring site. The area covered on the seafloor due to the additional infrastructure not previously assessed in the 2011 SSEA would equal 27.25 m^2 for each AUV dock and associated 500-m cable for a total of approx. 55 m^2.

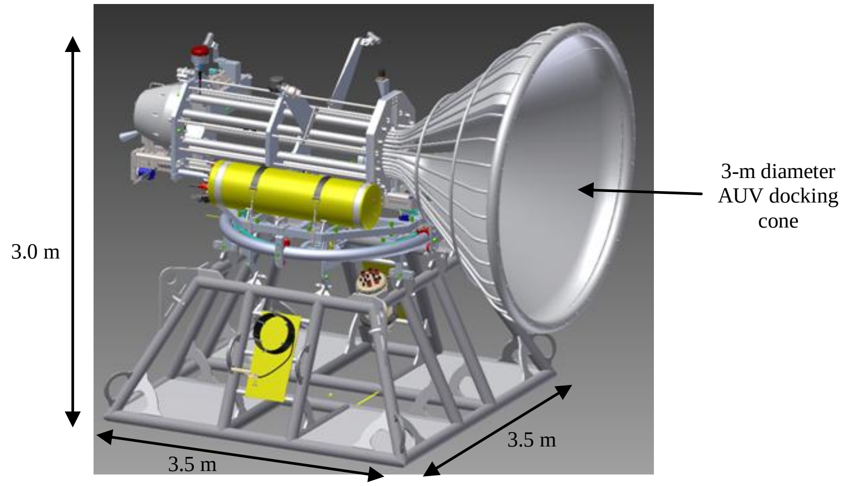


Figure 7. Proposed Cabled AUV Docking Station

The AUV docks would be deployed and retrieved using the ship's winch and a remotely operated vehicle (ROV). The ROV would ensure that the dock is in its desired orientation, attach the seafloor cable to the dock and to the surface mooring anchor frame, and detach the winch's lowering line from the dock. For recovery, the ROV would detach and retrieve the seafloor cable and attach a winch lifting line to the AUV dock. The AUV dock would then be hauled in by the ship's winch. It is expected that a 66 to 100-foot (ft) long coastal scientific research vessel would support ROV operations and annual O&M activities. AUV dock servicing would occur twice a year and take 4 days to complete.

Glider Mission Box

The glider mission box would be extended approx. 20 nm to the north (Figures 1 and 2), making the northern boundary of the AUV and glider mission boxes contiguous. The original glider box extended only to the 100-m isobath (Figure 1), offshore of the revised mooring locations and well offshore of the anticipated excursions of the foot of the shelfbreak front. Since glider missions were intended be able to span the array and the revised northern extent of the mooring array was shifted north, and since mobile platforms would be needed to identify the foot of the shelfbreak front if it was inshore of the moorings, it was recommended that the inshore boundary of the glider box be moved inshore to match that of the AUV box (Figures 1 and 2). The total glider mission area would increase by 1,448 nm^2 to approx. 7,145 nm^2. However, the number of gliders would remain the same as that assessed in the SSEA.

2.1.1.3 Installation and O&M of Pioneer Array

The methods for the installation of infrastructure of the Pioneer Array and conducting routine O&M activities that were described in the 2011 SSEA (refer to Section 2.2.6 of the PEA) would be used for the proposed design modifications assessed in this SER. Installation and O&M activities use standard methods and procedures currently used by the ocean observing community, such as NOAA's National Data Buoy Center and programs funded by the NOAA Integrated Ocean Observing System. With the addition of the proposed design modifications in this SER, the initial installation of the Pioneer Array components is expected to take an additional 4 days at sea (DAS) over that assessed in the Final SSEA for a total of 28 DAS per year and involve a global or intermediate class vessel. For regularly scheduled maintenance and replacements of AUV docks and AUVs/gliders, there would be an additional 28 DAS using a coastal class vessel for a total of 40 DAS per year (Table 2).

Table 2. Estimated DAS for Installation and Annual O&M of Proposed Modifications to the Pioneer Array

Infrastructure	*Vessel Class (size)*	*Total Annual O&M DAS**
O&M: moorings, gliders, AUVs	Global (235-280 ft) or Intermediate (170-200 ft)	24 + **4** = 28
AUV dock turns, glider/AUV turns	Coastal (66-100 ft)	12 + **28** = 40

Notes: *DAS includes transit time to and from the Pioneer Array and proposed activities at the moorings. Proposed DAS are a potential maximum and actual DAS may be less depending on actual O&M requirements after the Pioneer Array is operational.
Bold = change from previously assessed in SSEA (see Table 2-11 of the SSEA) based on proposed design modifications.
Source: Woods Hole Oceanographic Institute (WHOI) 2012.

2.1.1.4 Pioneer Array Installation Schedule

The installation schedule for the Pioneer Array has changed since the SSEA. The installations are now proposed as phased deployments to be accomplished during 2013 and 2014 (Table 3). This means that some, but not all, elements of the Pioneer Array would be installed in late 2013 with installation of the full array to be completed during 2014; the Pioneer Array would be fully operational by 2015.

Table 3. Proposed Installation Schedule for Pioneer Array Components

Infrastructure/Component	Deployments(1) 2013	2014	Fully Operational by 2015
Inshore Site	CPM	CSM(2) CSPPM AUV dock	CSM CSPPM AUV dock
Central-Inshore Site	CPM		CPM
Central Site	CSM	CSPPM	CSM CSPPM
Central-Offshore Site	CPM		CPM
Offshore Site	CPM	CSM AUV dock	CSM CPM AUV dock
Upstream-Inshore Site		CPM(2)	CPM
Upstream-Offshore Site	CPM		CPM
Gliders	6		6
AUVs		3	3

Notes: (1)CSPPM = coastal surface-piercing profiler mooring (refer to Figure 5d).
CSM = coastal surface mooring (refer to Figures 5b and c).
CPM = coastal wire-following profiler mooring (refer to Figure 5e)
AUV dock = AUV docking station (refer to Figure 5b).
(2)CPM installed in 2013 at the Central-Inshore Site would be moved to the Upstream-Inshore Site.

The first phase of Pioneer Array installation is planned to occur in Fall 2013 with deployments of 5 coastal wire-following profiler moorings, one EM surface mooring, and 6 gliders (Table 3). To best address OOI science requirements in the first phase of deployment, a coastal wire-following profiler mooring may be deployed temporarily at the Inshore Site in 2013. This short-term deployment would provide a cross-shelf line of instrumented moored profilers to characterize the properties around the shelf break front (the interface between water masses), a critical science topic to addressed by the Pioneer Array. In 2014, this wire-following profiler mooring would be moved from the Inshore Site to the Upstream-Inshore Site. A coastal surface mooring and a surface-piercing profiler mooring would be installed at the Inshore Site. Installations of the other Pioneer Array infrastructure would be continued in 2014, consistent with the design as described in the SSEA.

2.1.1.5 Special Operating Procedures (SOPs) for Installation and O&M of the Proposed Modifications to the Pioneer Array

The proposed modifications to the Pioneer Array do not require any changes or additions to the SOPs that were presented in the SSEA (Section 2.2.10, Table 2-13). The SOPs presented in Table 4 would be implemented as part of the proposed design modifications to avoid and minimize any potential impact to commercial fishing activities.

Table 4. SOPs to be Implemented under the Proposed Modifications to the Pioneer Array

1. All Pioneer Array moorings would be permitted as Private Aids to Navigation (PATONs) through the USCG. Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NOTMAR and LNM. Surface buoys would be marked with contact information, which will be included in the NM and LNM with suggested buffer zones around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As Pioneer Array moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NOTMAR and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
2. Locations for all moorings and associated components of the Pioneer Array would be published on NOAA charts once moorings are listed in the USCG NOTMAR and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
3. The coordinates for Pioneer Array AUV and glider mission boxes would be published on NOAA Charts and through a NOTMAR. Gliders and AUVs would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.

Source: Table 2-13 from NSF (2011a).

2.1.2 Endurance Array

The coastal ocean off Oregon and Washington is characterized by a relatively narrow shelf, an energetic eastern boundary current, persistent wind-driven upwelling, a large buoyancy source (fresh water from the Columbia River), a number of distinct biogeographical regimes, mesoscale variability forced by bathymetry and fluid instabilities, and interannual variability forced by fluctuations in the tropical Pacific (e.g., El Niño Southern Oscillation), as well as variations in the large-scale circulation of the North Pacific (e.g., Pacific Decadal Oscillation). Over this shelf, water properties and biological community size and composition vary most strongly in the cross-shelf direction. A well-instrumented array spanning the continental shelf is key to sorting out ecosystem responses across this strong gradient. The proposed Endurance Array would be comprised of two lines of moorings, one located off the coast of central Oregon (Oregon Line), and a second off the coast of central Washington (Washington Line). Both lines would consist of surface and subsurface moorings and would employ gliders.

2.1.2.1 Endurance Array Components Previously Assessed in the SSEA

The Endurance Array would be comprised of the Oregon Line and the Washington Line of moorings (refer to Section 2.2.1.1 of the 2008 PEA and Section 2.2.1.1 of the 2011 SSEA). Both lines would consist of surface and subsurface moorings and would employ gliders. The 80-m Shelf and 500-m Offshore moorings on the Oregon Line would be cabled and connected to the backbone cable of the RSN.

As assessed in the 2011 SSEA (Section 2.2.1.1), the Oregon and Washington lines would include those items listed in Table 5 and depicted in Figure 8.

Table 5. Summary of Previously Assessed (SSEA) and Proposed Modifications (SER) to Endurance Array Infrastructure

Item	*SSEA**	*SER**
OR Line (see Figure 8)	• Active and non-active acoustic sensors on moorings & benthic nodes.	• Active and non-active acoustic sensors on moorings & benthic nodes.
	• 1 paired surface/subsurface mooring at approx. 25 m with MFN footprints of 4 m^2 each.	• 1 paired surface/subsurface mooring at approx. 25 m with **MFN footprints of 8 m^2**.
	• 1 surface mooring at approx. 80 m with an MFN footprint of 4 m^2.	• 1 surface mooring at approx. 80 m with a **BARF footprint of 8 m^2.**
	• 1 BEP at approx. 80 m cabled to RSN PN1D with a footprint of 4 m^2.	• 1 BEP at approx. 80 m cabled to RSN PN1D with **a footprint of 8 m^2.**
	• 1 subsurface, cabled profiler mooring at approx. 80 m with an MFN footprint of 4 m^2.	• 1 subsurface, cabled profiler mooring at approx. 80 m with an **MFN footprint of 8 m^2**.
	• 1 BEP at with a footprint of 4 m^2 at approx. 500 m cabled to RSN PN1C.	• 1 BEP with a **footprint of 8 m^2** at approx. 500 m cabled to RSN PN1C.
	• 1 mooring with deep and shallow profilers at approx. 500 m cabled to RSN PN1C with an MFN footprint of 4 m^2.	• 1 deep profiler mooring at approx. 600 m cabled to RSN PN1C **with one anchor with a footprint of 0.8 m^2 each**. • 1 shallow profiler mooring at approx. 600 m with **two anchors with a footprint of 1.1 m^2 each**.
	• 1 surface mooring at approx. 500 m with an MFN footprint of 4 m^2.	• 1 surface mooring at approx. **600 m with an anchor footprint of 0.8 m^2**.
WA Line	• 3 paired surface/subsurface moorings at approx. 25, 80, and 500 m with MFN footprints of 4 m^2. • Active and non-active acoustic sensors on moorings and benthic nodes.	• 3 paired surface/subsurface moorings at approx. 25, 80, and **600 m with MFN footprints of 8 m^2.** • Active and non-active acoustic sensors on moorings and benthic nodes.
Gliders	• Mission box to 128° W. • N-S glider track along 126° W. • 5 east-west glider tracks from coast to 128° W; new east-west line north of Pacific City (SSEA Figure 2-1b). • 6 gliders.	• No change.

Notes: *BEP = Benthic Experiment Package; BARF = Benthic Anchor Recovery Frame; PN = Primary Node.
Bolded entries are proposed modifications to the Endurance Array assessed in this SER.
Sources: NSF 2011a; Consortium for Ocean Leadership 2012.

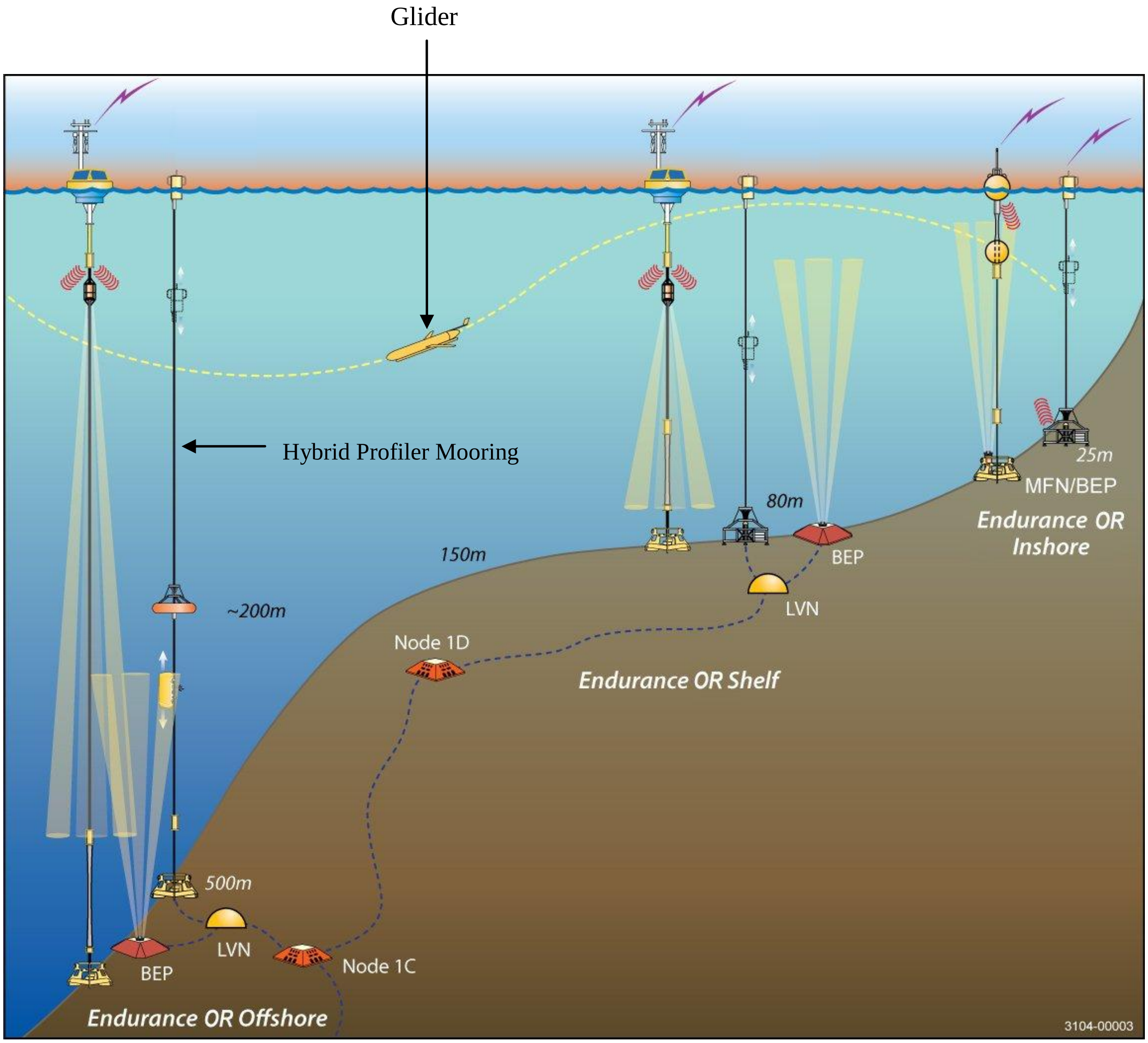


Figure 8. Conceptual Representation of the 25-m (Inshore), 80-m (Shelf), and 500-m (Offshore) Moorings of the Proposed Endurance Array (Oregon Line) as Assessed in the SSEA

Notes: Not to scale. LVN = Low-Voltage Node; MFN/BEP = Multi-Function Node/Benthic Experiment Package; OR = Oregon. For a detailed discussion of the various components of the moorings such as sensors, gliders, etc., refer to the 2008 PEA.

2.1.2.2 Micro-Siting of Endurance Array Mooring Sites

Site locations within the Endurance Array have been selected via an iterative process. The PEA and SSEA describe the science goals and operational siting requirements that helped determine the initial approximate location of each site as well as the types of platforms and instruments needed for addressing these goals. These mooring site locations have been revised based on site-specific bathymetric surveys, sediment analyses, and oceanographic and environmental constraints. The geographic location of RSN cabled infrastructure, which provides power and communication capabilities to the Shelf and Offshore Oregon sites, was determined in collaboration with RSN's operational requirements. In addition, mooring sites are located so as to minimize gear conflicts with other marine users as described in the SSEA. The following sections describe the additional site-specific activities and coordination with other marine users that were conducted after the completion of the Final SSEA as part of an on-going micro-siting process to ensure the selection of the best mooring site locations that meet the science goals of OOI as well as avoiding and minimizing conflicts with other marine users in the region.

Oregon Line Mooring Sites

Oregon Inshore (44.6583°N, 124.0957°W; 24.3 m depth). This site meets the science and siting requirements presented in Table 2-2 of the SSEA and is shown in Figure 9. Further input to site selection was collected at two public meetings in Newport, Oregon as well as a presentation to the Lincoln County Fishermen Involved in Natural Energy (FINE) committee and the Oregon Dungeness Crab Commission. Two test buoys were also deployed, one directly off Yaquina Head and one at the selected site. OOI project scientists have also coordinated with the Northwest National Marine Renewable Energy Center (NNMREC) Wave Energy Mobile Test Bed project to reduce potential conflicts and cumulative impacts. The NNMREC final experiment site is located to the northeast of Yaquina Head such that the proposed Oregon Inshore site is as far away from that site as possible. OOI received a request from a representative of the recreational fishery (Coastal Conservation Association) to move the Oregon Inshore site nearer to Yaquina Head to avoid the recreational crab pot fishery south of Yaquina Head, but an Endurance Array test mooring failure near Yaquina Head and other potential conflicts at that site lead to the selection of the final site depicted in Figure 9. Due to the close proximity of the revised mooring site to the site previously assessed in the SSEA, this revised Oregon Inshore mooring site location does not require further environmental analysis.

Oregon Shelf (44.6328°N, 124.3035°W; 80 m depth). This site meets the science and siting requirements presented in Table 2-2 of the SSEA and is shown in Figure 9. It has been approved by the RSN as accessible by cable and acceptable to the Oregon Fishermen's Cable Committee (OFCC). This site is near the location of NOAA's NH-10 buoy (http://www.ndbc.noaa.gov/station_page.php?station=46094) and will replace that well known buoy as the OOI is deployed. Due to the close proximity of the revised mooring site to the site previously assessed in the SSEA, this revised Oregon Shelf mooring site location does not require further environmental analysis.

Oregon Offshore (44.3691°N, 124.9541°W; 588 m depth). The decision to locate the mooring at the approx. 600-m depth was made based on the science/operational siting requirements presented in Table 2-2 of the SSEA as well as RSN cable burial requirements. Site identification was challenging due to the requirement that there be an acceptable path for RSN cable burial between the Hydrate Ridge site and the Oregon Line Offshore Mooring site. The site was also selected to minimize impacts on a very active trawl fishery in the area. Sites known to regional fishers as Poggy's Point, Halibut Bank, Walter's Bump, The Bowtie and Gary's Bad Hang were all considered. Gary's Bad Hang was selected as the best compromise that still met the science requirements. This site is traditionally avoided by regional fishers because trawling at this location frequently results in hangup and loss of gear. Based on the 2010 RSN cable survey, an initial site was chosen and assessed in the 2011 SSEA (Figure 9). Once the RSN cable route survey was completed, the proposed 600-m mooring site was selected approx. 1 nm south of the mooring site location initially assessed in the SSEA (Figures 9 and 10).

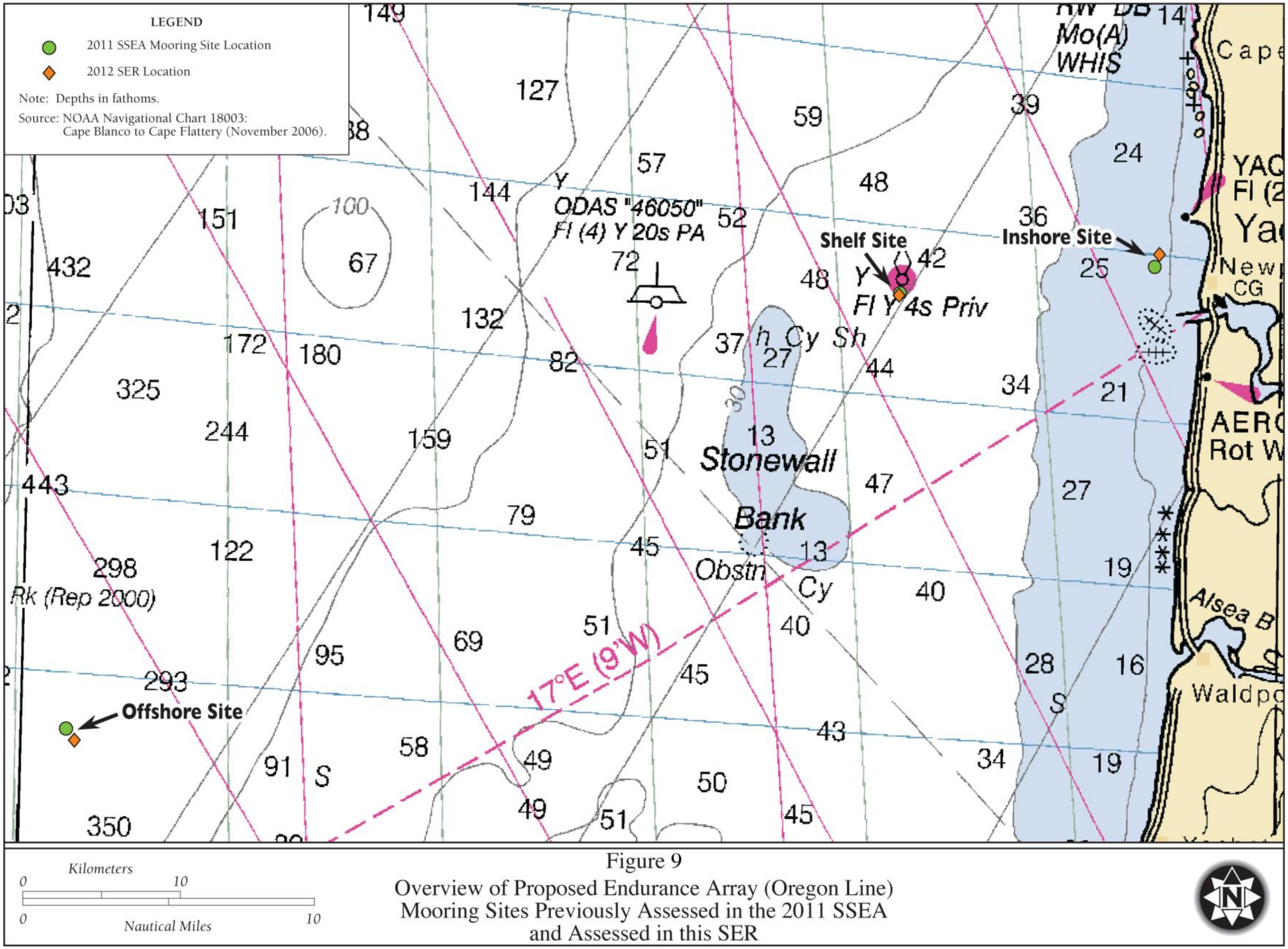


Figure 9
Overview of Proposed Endurance Array (Oregon Line) Mooring Sites Previously Assessed in the 2011 SSEA and Assessed in this SER

Considerable additional site-specific survey time was invested to determine the best placement of the Oregon Line Offshore mooring. In addition to the initial 2010 cable survey, a site-specific survey was conducted in 2011 on-board the research vessel (R/V) *Thompson* which included a multibeam survey to assess bottom topography and sediment type as well as ROV and AUV surveys to ground truth the multibeam data. The proposed approx. 600-m site has been determined to meet the science/operational siting requirements of the Endurance Array and furthermore, it meets the following additional requirements:

- acceptable path for RSN cable burial,
- bottom has a slope of <10 degrees,
- outside of published barge towing lanes,
- outside of designated shipping lanes, and
- minimizes potential impacts to regional fisheries.

In addition to the revised mooring site location, the mooring design at the Oregon Line Offshore site has been revised and details are presented below in Section 2.2.3.2.

<u>Washington Line Mooring Sites</u>

Washington Inshore (47.1333°N, 124.2716°W; 29 m depth). This site meets the siting requirements presented in the SSEA (SSEA Table 2-2), but has been moved approx. 9 nm north of the mooring site location previously assessed in the SSEA (Figure 11). The November 17, 2010 micro-siting meeting in Westport, Washington with local fishermen and other marine users arrived at a suggestion to locate the site along 47.1333 °N which would minimize gear conflict between the Quinault primary Special Management Area (State of Washington, crab fishery) and the crab fisheries to the south. Working with the Quinault Indian Nation, confirmation of the selected site was agreed to on June 1, 2012 by Joe Schumacker, Marine Resources Scientist, Quinault Department of Fisheries. OOI project scientists accepted an overall array line that ran from the northeast towards the southwest as a satisfactory compromise with potential gear conflicts and impacts on crab and recreational fisheries.

In addition, the revised Inshore mooring site location would be located within the boundary of the Olympic Coast National Marine Sanctuary (OCNMS) (Figure 11). NSF and Oregon State University (OSU) have had on-going discussions with OCNMS personnel regarding permit requirements for siting scientific instruments within a National Marine Sanctuary.

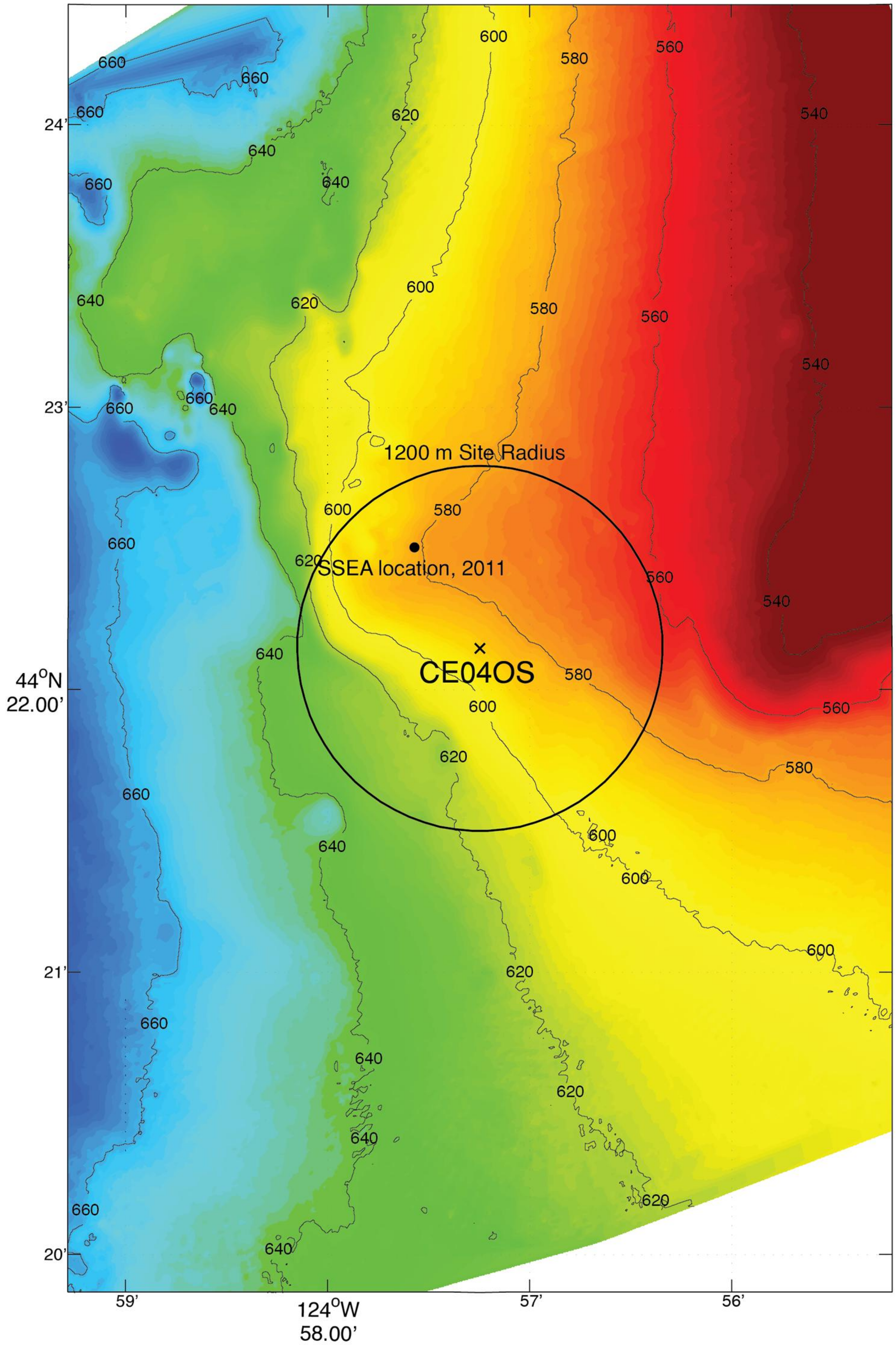


Figure 10. Proposed Endurance Array, Oregon Line Offshore Mooring Location (x) Assessed in this SER Compared to Previous Location Assessed in 2011 SSEA

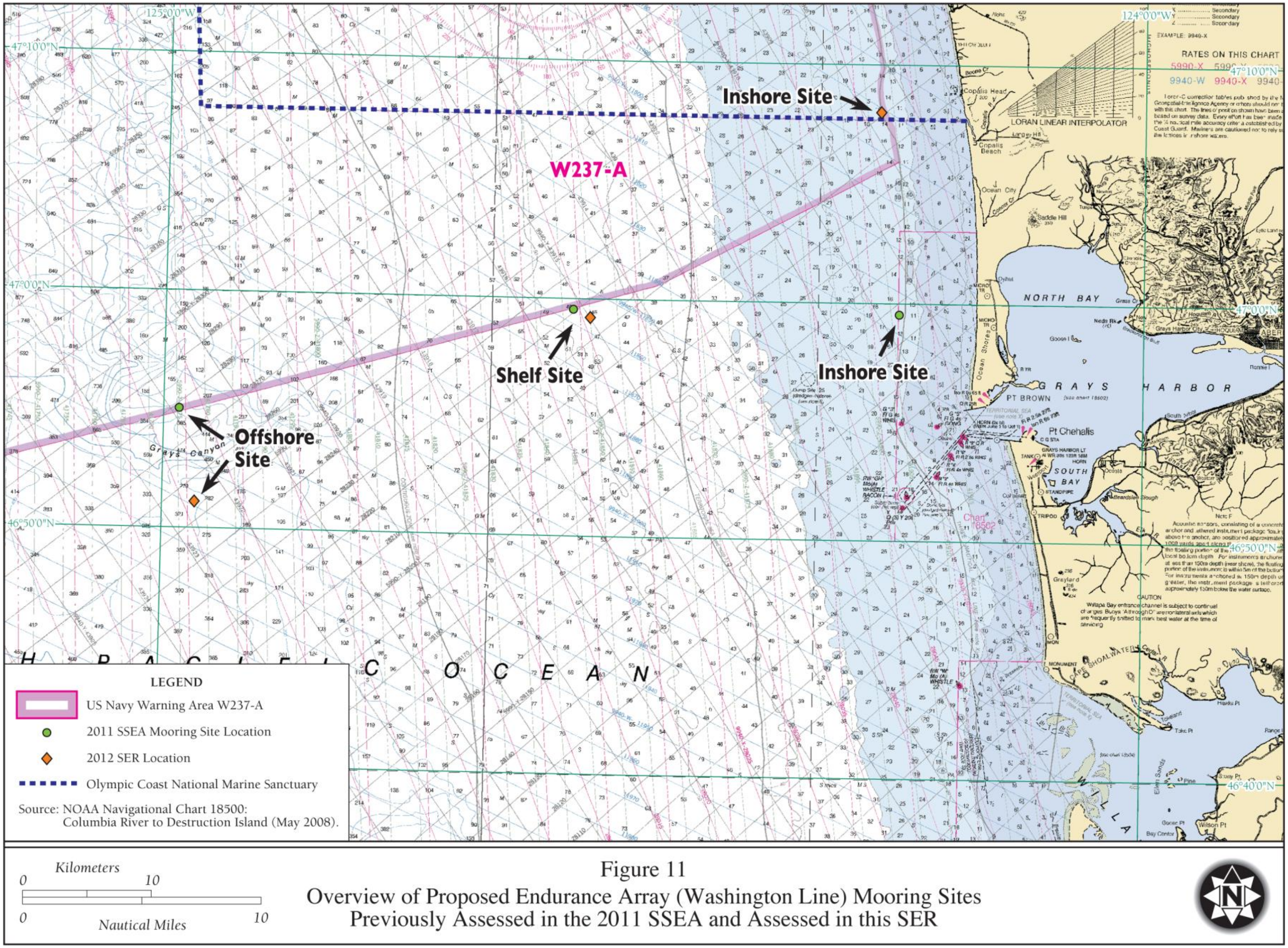


Figure 11
Overview of Proposed Endurance Array (Washington Line) Mooring Sites
Previously Assessed in the 2011 SSEA and Assessed in this SER

Washington Shelf (46.9862°N, 124.5662°W; 87 m depth). This site meets the siting requirements presented in the SSEA (Table 2-2), but has been moved approx. 1 nm southeast of the mooring site location previously assessed in the SSEA (Figure 11). The November 17, 2010 micrositing meeting in Westport, Washington arrived at a suggestion for another candidate site that would avoid conflict with a rocky reef targeted by charter and recreational fisheries and minimize conflict with the shrimp trawl and salmon fisheries to the west. Discussions with fishers identified a depth swath between 45 and 48 fm that met the OOI/Endurance Array science requirements. Due to the close proximity of the revised mooring site to the site previously assessed in the SSEA, this revised Washington Shelf mooring site location does not require further environmental analysis.

Washington Offshore (46.8516°N, 124.9666°W; 542 m depth). The original siting requirements for this site placed it to the north side of Grays Canyon (Figure 11). Based on site-specific bathymetric surveys, it was determined that no site was available within the originally proposed area with bottom slopes less than 10 degrees necessary to avoid mooring anchor movement. An additional candidate mooring site location was suggested during a Westport, Washington public comment hearing that would decrease conflict with longline fisheries (as represented by the Fishing Vessel Owners Association, Inc.). It was requested that the site be located on the south side of Grays Canyon. The proposed revised mooring site location has been sited approx. 4 nm south of the site originally assessed in the SSEA, on the south side of the canyon (Figure 11). This site avoids a fault line to the east and also falls on the Grays Canyon Bottom Trawl Contact closure line (Essential Fish Habitat [EFH]) and would therefore eliminate any possible conflict with trawl fisheries. The Pacific Fishery Management Council was also coordinated with regarding the Washington Offshore site. Due to the close proximity of the revised mooring site to the site previously assessed in the SSEA, this revised Washington Offshore mooring site location does not require further environmental analysis.

2.1.2.3 Proposed Endurance Array Modifications

As assessed in this SER as the Proposed Action (Table 4), the proposed change in the Endurance Array would include:

- Revised siting of the Washington Line Inshore mooring site based on micro-siting and coordination with regional fishing interests.
- Siting of the Oregon Line Offshore mooring at a water depth of approx. 600 m.
- Instead of a single mooring with deep and shallow profilers at the Oregon Line Offshore site, the mooring design would now consist of 2 moorings: a shallow profiler mooring and a deep profiler mooring. Whereas in the SSEA the single hybrid profiler mooring would have an anchor with a footprint of 4 m^2 (an MFN), under this SER there would be 2 moorings with 3 anchors: deep profiler mooring with an anchor footprint of 0.8 m^2 and the shallow profiler mooring with 2 anchors with an anchor footprint of 1.1 m^2 for each anchor for a total anchor footprint of 3 m^2. Therefore, the total anchor footprint would decrease from 4 m^2 as assessed in the SSEA to 3 m^2 as assessed in this SER.
- An increase in the size of the MFN footprint from 4 m^2 to 8 m^2 for the 3 Washington Line surface moorings and the Oregon Line Inshore mooring.
- Changing of the anchor for the Oregon Line Shelf mooring from an MFN to a Benthic Anchor Recovery Frame (BARF) which, like the MFN, would have a footprint of 8 m^2.
- Changing of the anchor for the Oregon Line Offshore mooring from an MFN to anchors with a footprint of 0.8 m^2 each.

Revised Siting of Washington Line Inshore Mooring

As stated earlier in Section 2.1.2.2, the proposed location of the Inshore Mooring of the Washington Line has been revised from the original siting as assessed in the SSEA. Based on discussions with regional fishers, the Quinault Indian Nation, and the OCNMS, the proposed Inshore Mooring site assessed in this SER would be located approx. 8 miles north of the location assessed in the SSEA (Figure 11). The paired surface/subsurface moorings would be deployed in 25 m water depth and would include a surface buoy and a vertical profiling mooring (Figure 12). The mooring anchor would be placed upon sandy bottom, in an area devoid of nearby hardbottom, kelp bed, or seagrass resources. The anchor footprint on the bottom would 0.8 m^2. It is unlikely the anchor, as designed, would drag and move during storms.

Although the Inshore Mooring site proposed under this SER is approx. 8 miles north of the location previously assessed in the SSEA, the oceanographic and environmental conditions are very similar so as to still meet the science goals and operational siting requirements of the Washington Line Inshore Mooring. Due to the close proximity of the revised mooring site to the site previously assessed in the SSEA and similarity of the affected environments across both locations, this revised Washington Inshore mooring site location does not require further environmental analysis.

Deep and Shallow Profiler Moorings at the Oregon Line Offshore (600-m) Site

Moored platforms provide the ability to deploy sensors at fixed depths between the sea floor and the sea surface and to deploy packages that profile vertically at one location by moving up and down along the mooring line or by winching themselves up and down from their point of attachment to the mooring. The combination of a wire-following and shallow profiler on one subsurface mooring is called a hybrid profiler mooring. A mooring of this type provides the capability to sample the water column from near the seafloor to the sea surface. As proposed in the Final SSEA, the hybrid profiler mooring consists of 4 components: 1) mooring line; 2) deep profiler and instrument package; 3) subsurface buoyant platform that includes an instrument package, winch, and shallow profiler, and 4) MFN (refer to SSEA Figure 2-3).

Under the Proposed Action as assessed in this SER, the proposed hybrid profiler mooring at the Offshore (500-m) site as assessed in the SSEA has been redesigned and would now include separate deep and shallow profiler moorings instead of a single hybrid-profiler mooring. Both the deep and shallow profiler moorings would be cabled to RSN Primary Node 1C (PN1C) (Figure 12)

- The *deep profiler mooring* would consist of: 1) mooring line, 2) deep profiler and instrument package, 3) subsurface buoy, and 4) a single anchor with a footprint of 0.8 m^2 (Figure 12). The subsurface buoy would be at approx. 175 m below the ocean surface. The deep profiler would sample the water column from the ocean bottom to the subsurface buoy. The deep profiler instrument package is approx. 2 m high and weighs 220 lbs (Figure 13).
- The *shallow profiler mooring* would consist of: 1) 2 mooring lines, 2) shallow profiler and instrument package, 3) subsurface platform, and 4) 2 anchors (Figures 12 and 14). The subsurface platform would be at approx. 200 m below the ocean surface. The shallow profiler would sample the water column from approx. 200 m depth to approx. 5 m below the ocean surface. Each cylindrical anchor would measure 1.2 m in diameter x 1.2 m high with a bottom footprint of 1.1 m^2. The distance between the anchors at the Oregon Line Offshore site would be approx. 1,000 m.

The horizontal distance between the deep profiler mooring and the shallow profiler mooring at the Oregon Line Offshore site would be approx. 720 m.

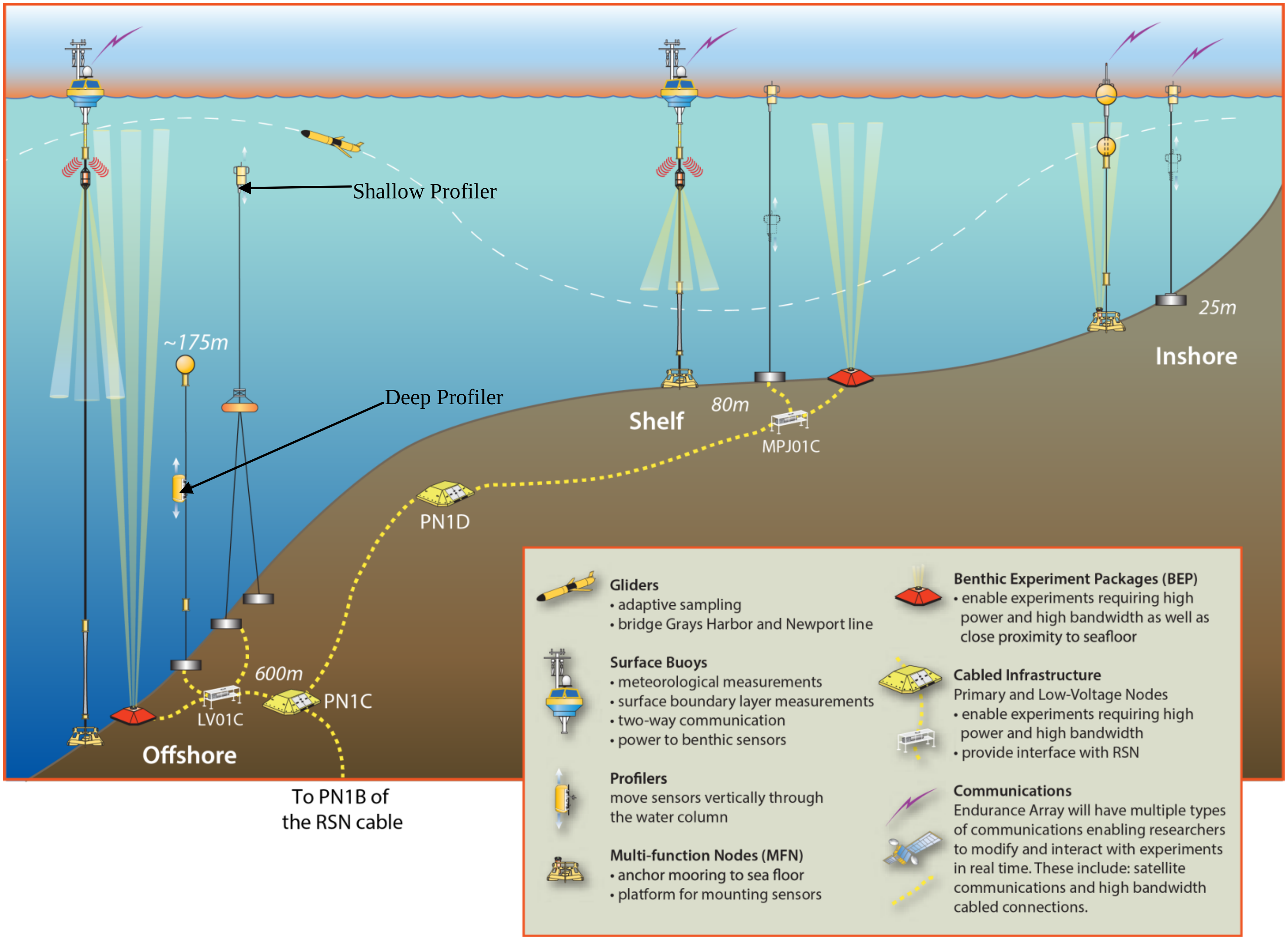


Figure 12. Conceptual Representation of the 25-m (Inshore), 80-m (Shelf), and 600-m (Offshore) Moorings of the Proposed Endurance Array (Oregon Line) as Assessed in this SER

Note: Not to scale.

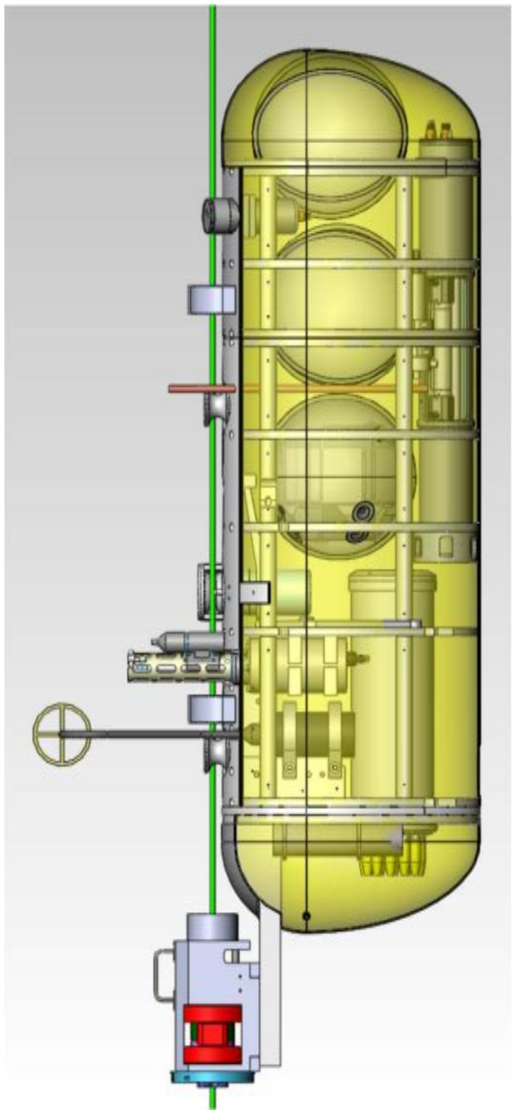
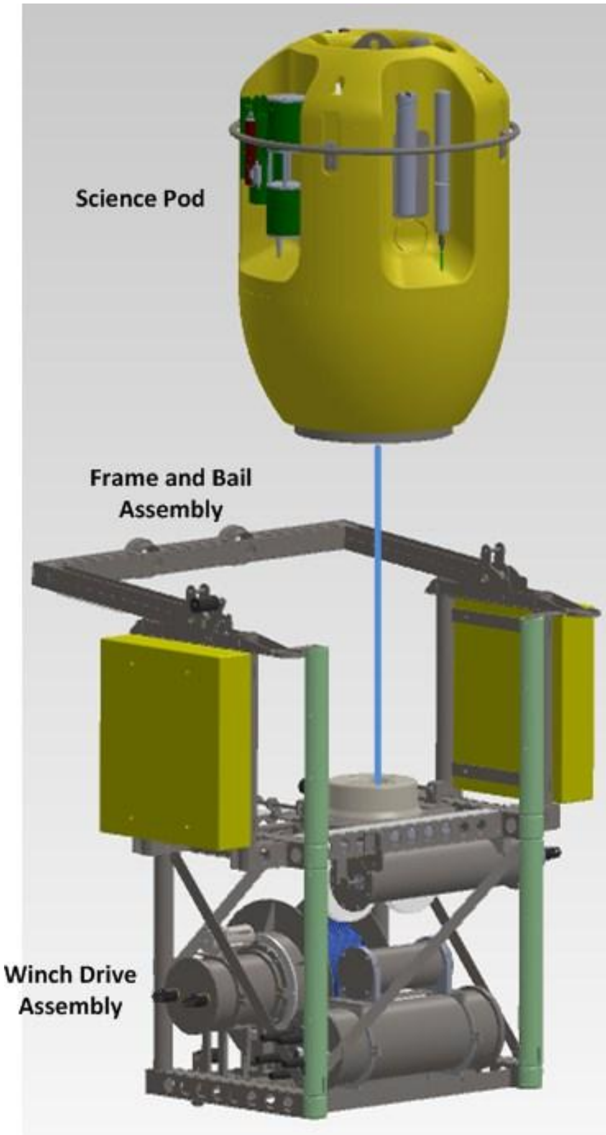


Figure 13. Representative Deep Profiler Vehicle
Dimensions: 0.3 m wide x 0.5 m deep x 2 m high (220 lbs in air)

(a)



(b)

Figure 14. (a) Shallow Profiler and Mooring Platform Assembly; (b) Shallow Profiler Extended from the Platform

MFN/BARF Modifications

As described in the 2008 PEA, an MFN rests on the seafloor and terminates the bottom of a mooring and would provide the necessary anchoring weight and would also provide data and power ports for benthic instrumentation. The weight is provided by a releasable cast steel anchor fitted with a secondary anchor recovery line pack. The originally assessed MFN had a footprint of 4 m^2. The proposed revised MFN would have a footprint of 8 m^2. Batteries and electronics are housed in one or more aluminum pressure-tolerant housings. MFNs are proposed for use on the Washington Line Shelf and Offshore moorings and Inshore moorings on both the Oregon and Washington lines.

The bottom anchors at the Oregon Line Shelf and Offshore moorings would use a BARF and not an MFN. A BARF, like the MFN, provides the necessary anchor weight for a mooring. Although the BARF is the same size/footprint (8 m^2) and weight as an MFN, a BARF does not include any scientific instrumentation. That is, a BARF is the anchor frame and an MFN is a BARF that supports instrumentation. The Oregon Line Shelf and Offshore moorings are cabled to the RSN infrastructure and therefore do not require MFNs for instrument power and/or communication.

2.1.2.4 Installation and O&M of Endurance Array

The methods for the installation of infrastructure of the Endurance Array and conducting routine O&M activities that were described in the 2011 SSEA (refer to Section 2.2.8.2) would be used for the proposed Endurance Array modifications assessed in this SER. Installation and O&M activities use standard methods and procedures currently used by the ocean observing community, such as NOAA's National Data Buoy Center and programs funded by the NOAA Integrated Ocean Observing System. There are no changes in the Intermediate Class Vessel DAS required for the uncabled moorings. The Oregon Line 600-m cabled hybrid profiler system would not be installed in 2013 so only 3 days of the Global Ship/ROV are required that year. The complexity of the new cabled hybrid mooring system is expected to require 3 additional DAS to install and service. A total of 8 days would be needed each year from 2014 to 2017.

With the addition of the proposed modifications in this SER, the installation of the Endurance Array Oregon Offshore mooring at the 600-m site, as well as the increase in size of the MFNs/BARFs, is expected to require 2 less DAS than that assessed in the SSEA (SSEA Table 2-11). Under the Proposed Action in this SER, the total annual O&M would increase by 3 DAS for each year from 2014 through 2017 (Table 6). Therefore, the total proposed DAS proposed under this SER is 35, or 10 DAS more than that assessed in the SSEA.

Table 6. Estimated DAS for Installation and Annual O&M of Proposed Modifications to the Cabled Infrastructure of the Endurance Array

Infrastructure	*Vessel Class (size)*	*Total Install DAS* (2013)*	*Total Annual O&M DAS (2014-2017)*	*Total DAS (2013-2017)*
Moorings, cable, MFNs, BARFs	Global (235-280 ft) or Intermediate (170-200 ft)			
Assessed in SSEA		5	20	25
Proposed in this SER		3	32	35

Notes: *DAS includes transit time to and from the Endurance Array and proposed activities at the moorings. Proposed O&M DAS are a potential maximum and actual DAS may be less depending on actual O&M requirements after the Endurance Array is operational.

Sources: NSF 2011a; OSU 2012.

2.1.2.5 SOPs for Installation and O&M of the Proposed Modifications to the Endurance Array

The proposed modifications to the Endurance Array do not require any change or additions to the SOPs that were presented in the SSEA (Section 2.2.10, Table 2-13). The SOPs presented in Table 7 would be implemented as part of the proposed design modifications to avoid and minimize any potential impact to commercial fishing activities.

Table 7. SOPs to be Implemented under the Proposed Modifications to the Endurance Array

1. The OFCC has been notified regarding the proposed cabled moorings and sensors of the Oregon Line. In accordance with Oregon State law, the Consortium for Ocean Leadership entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and OOI activities.
2. All Endurance Array moorings would be permitted as PATONs through the USCG. Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NM and LNM. Proposed surface buoys would be marked with contact information, which will be forwarded to the USCG for inclusion in the NM and LNM with suggested buffer zones around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As OOI moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NOTMAR and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
3. Locations for all moorings and associated components of the proposed Endurance Array would be published on NOAA Charts once the moorings are listed on the NOTMAR and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
4. The coordinates for proposed Endurance Array glider tracks would be published on NOAA Charts and through the NOTMAR and LNM. Gliders would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.

Source: Table 2-13 from NSF (2011a).

2.2 REGIONAL-SCALE NODES (RSN)

The proposed RSN would enable oceanic plate-scale studies of water column, seafloor, and sub-seafloor processes using high-powered, high-bandwidth instrument arrays cabled to shore. The cabled RSN would provide the ocean sciences community with virtually unlimited bandwidth and considerable electrical power that would enable collection of decadal-scale time-series measurements over a tectonic plate, a major coastal upwelling system, a highly variable divergence zone between two North Pacific gyres, one of the most productive fishing areas in the world's oceans, boundary currents on the west coast, and hundreds of kilometers of volcanically and seismically active plate boundaries.

2.2.1 RSN Components Previously Assessed in the SSEA

The RSN is comprised of 3 components: shore station, primary infrastructure, and secondary infrastructure. Under the Proposed Action assessed in this SER, there would be no change in the shore station and RSN primary infrastructure. Only a change in the hybrid profiler moorings of the secondary infrastructure is assessed in this SER.

As previously assessed in the 2008 PEA (Section 2.2.2.2) and 2011 SSEA (Section 2.2.2), subsurface profiler moorings would be a component of RSN. Subsurface profilers would be located at the base of Hydrate Ridge (connected to PN1A) and Axial Seamount (connected to PN3A) (Table 8). Detailed descriptions for each of these locations are provided in the PEA (Section 2.2.2.2) and SSEA (Section 2.2.2.2 and Figure 2-22). In addition, a hybrid profiler mooring would connect the Endurance Array Oregon Line Offshore mooring to the RSN at PN1C. However, this mooring has been previously discussed in this SER in Section 2.2.3. and is not discussed further in this section on RSN.

Table 8. Summary of Previously Assessed (SSEA) and Proposed Modifications and Additions (SER) to RSN Infrastructure

Item	*SSEA*	*SER*
Hydrate Ridge (PN1A)	• 1 subsurface hybrid profiler mooring with deep and shallow profilers with an anchor footprint of 4 m^2.	• 1 deep profiler mooring cabled to PN1A with anchor footprint of 0.8 m^2. • 1 shallow profiler mooring with two anchors with a footprint of 1.1 m^2 each.
Axial Seamount (PN3A)	• 1 subsurface hybrid profiler mooring with deep and shallow profilers with an anchor footprint of 4 m^2.	• 1 deep profiler mooring cabled to PN3A with anchor footprint of 0.8 m^2. • 1 shallow profiler mooring with two anchors with a footprint of 1.1 m^2 each.

Sources: NSF 2011a; Consortium for Ocean Leadership 2012.

2.2.2 Proposed RSN Secondary Infrastructure Modifications

Under the Proposed Action as assessed in this SER, the proposed hybrid profiler moorings associated with Hydrate Ridge (PN1A) and Axial Seamount (PN3A) as assessed in the SSEA have been redesigned and would now include separate deep and shallow profiler moorings instead of a single hybrid-profiler mooring (Figure 15). Both the deep and shallow profiler moorings would be cabled to RSN primary nodes.

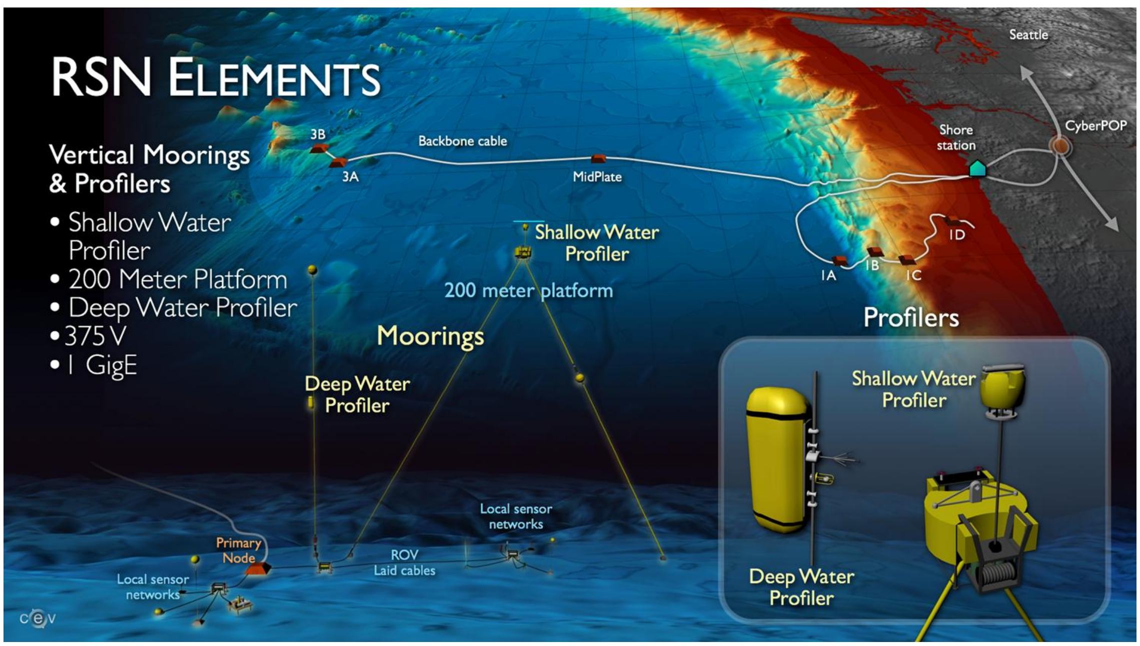


Figure 15. Conceptual Depiction of Proposed RSN Deep and Shallow Profiler Moorings at PN1A (Hydrate Ridge) and PN3A (Axial Seamount)

- The *deep profiler mooring* cabled to PN1A would consist of: 1) mooring line, 2) deep profiler and instrument package, 3) subsurface buoy, and 4) a single anchor with a footprint of 0.8 m^2 (Figure 15). The subsurface buoy would be at approx. 175 m below the ocean surface. The deep profiler would sample the water column from the ocean bottom to the subsurface buoy. The deep profiler is approx. 2 m high and weighs 220 lbs (Figure 13).
- The *shallow profiler mooring* would consist of: 1) 2 mooring lines, 2) shallow profiler and instrument package, 3) subsurface platform, and 4) 2 anchors (Figures 14 and 15). The subsurface

platform would be at approx. 200 m below the ocean surface. The shallow profiler would sample the water column from approx. 200 m depth to approx. 5 m below the ocean surface. Each cylindrical anchor would measure 1.2 m in diameter x 1.2 m high with a bottom footprint of 1.1 m^2 (Figure 12). The distance between the shallow profiler mooring anchors at the Axial Seamount and Hydrate Ridge primary nodes would be approx. the same as the depth, or 3,000 m.

The horizontal distance between moorings at Hydrate Ridge and Axial Seamount would be approx. 770 m and 750 m, respectively.

2.2.3 Installation and O&M

Based on the proposed action to increase the number of subsurface moorings from 1 hybrid profiler to paired subsurface moorings, additional DAS are required for RSN installation and fewer days are required for O&M activities (Table 9).

Table 9. Estimated DAS for Installation and Annual O&M of Proposed Modifications to the RSN Infrastructure

Infrastructure	*Vessel Class*	*Total Install DAS* (2012)*	*Total Annual O&M DAS (2013-2017)*	*Total DAS (2013-2017)*
Moorings, cable, anchors	Global (235-280 ft)			
Assessed in SSEA		14	361	375
Proposed in this SER		20	249	269
Change		6	-112	-106

Notes: *DAS includes transit time to and from the RSN components and proposed activities at the moorings and cables. Proposed DAS are a potential maximum and actual DAS may be less depending on actual O&M requirements after the RSN is operational. DAS also do not reflect ship time donated by the University of Washington (UW).
Source: UW 2012a.

2.2.4 Special Operating Procedures (SOPs)

The proposed modifications to the RSN component do not require any changes or additions to the SOPs that were presented in the SSEA (Section 2.2.10, Table 2-13). The SOPs presented in Table 10 would be implemented as part of the proposed design modifications to avoid and minimize any potential impact to commercial fishing activities.

Table 10. SOPs to be Implemented under the Proposed Action

1. Cable and equipment locations for all RSN components of the proposed OOI would be published on NOAA Charts and through a NOTMAR and LNM, and accurate locational information would be made available to fishers to assist their avoidance of the instruments. A 24-hr contact phone number would be established where trawlers can report possible entanglements.
2. The OFCC has been notified regarding the proposed RSN submarine cable route and associated sensors. In accordance with Oregon State law, Ocean Leadership has entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and operation of the RSN submarine cable.
3. Site-specific surveys have been completed and discussions with the OFCC are ongoing to finalize the extent of buffer zones around the RSN secondary infrastructure.

Source: Table 2-13 from NSF (2011a).

2.2.5 Pre-Installation Testing of RSN Components

2.2.5.1 Pre-Installation Test Sites Previously Assessed in the SSEA

As detailed in the 2011 SSEA, testing of RSN infrastructure components would occur prior to deployment off the coast of Oregon. In Section 2.2.7.2 of the SSEA, 2 preferred test sites were identified in Puget Sound in Shilshole Bay, Seattle (Figure 16). The Puget Sound sites are directly accessible from UW research facilities. As originally proposed, each component test would last less than 24 hours and a maximum of 5 tests would occur each year, starting in the spring of 2011 (*Note*: no tests have been conducted at these sites as of August 2012). UW anticipated 2 types of testing:

1) *Shallow-water* (approx. 20 m in depth) – testing of components of the RSN secondary infrastructure (e.g., Low-Voltage Nodes [LVNs] and junction boxes).
2) *Deep-water* (approx. 60-120 m in depth) – testing of components of the RSN vertical moorings.

Located in Seattle, Washington, UW is a public research university located close to Puget Sound, a complex estuarine system of interconnected marine waterways and basins offering a convenient test bed for RSN components. Test activities in Puget Sound would occur at a shallow-water site at depths around 20 m, and at a deep-water site at depths of 60-120 m. For RSN components that require deeper waters, they would be tested at either the Monterey Accelerated Research System (MARS) Ocean Observatory, Monterey Bay, California; or the Victoria Experimental Network Under the Sea (VENUS) facility, British Columbia, Canada.

Test Site A – Shallow Water Site. The shallow-water test deployment site (Site A) would be located in Shilshole Bay, in the eastern portion of central Puget Sound (Figure 16). This would be the preferred test location for all components of the RSN secondary infrastructure such as LVNs and junction boxes (Table 2-5 and refer to Sections 2.2.2.3 and 2.2.2.4 of the PEA for details on LVNs and junction boxes). Testing would be conducted over the side of a vessel with the equipment deployed to the bottom. Testing at this site would occur around 20 m water depth. Testing of some components would involve use of about 100 watts of power.

Test Site B – Deep Water Site. The deep-water test deployment site (Site B) would be located approx. 3.5 nautical miles north of Site A, also in the eastern portion of central Puget Sound (Figure 16). Site B would be the preferred test location for of all components of RSN vertical moorings. Tests would be performed over the side of a vessel at depths of approx. 60 to 120 m. Due to the excess buoyancy of the mooring platform, the equipment would need to be anchored to the seabed with 4 stacked railroad wheels, which would be recovered at the end of the test operations. Railroad wheels are approx. 1 m in diameter and weigh 500 kg each. Testing of some components of the vertical mooring would involve use of up to 2 kilowatts of power. All active acoustics that would potentially be used during test operations were previously described and assessed in the PEA and SSEA.

Testing at all Puget Sound sites would be conducted from the UW Applied Physics Laboratory's R/V *Henderson* or R/V *Robertson*. The proximity of the sites to Applied Physics Laboratory facilities would also ensure quick access and efficient testing turn around.

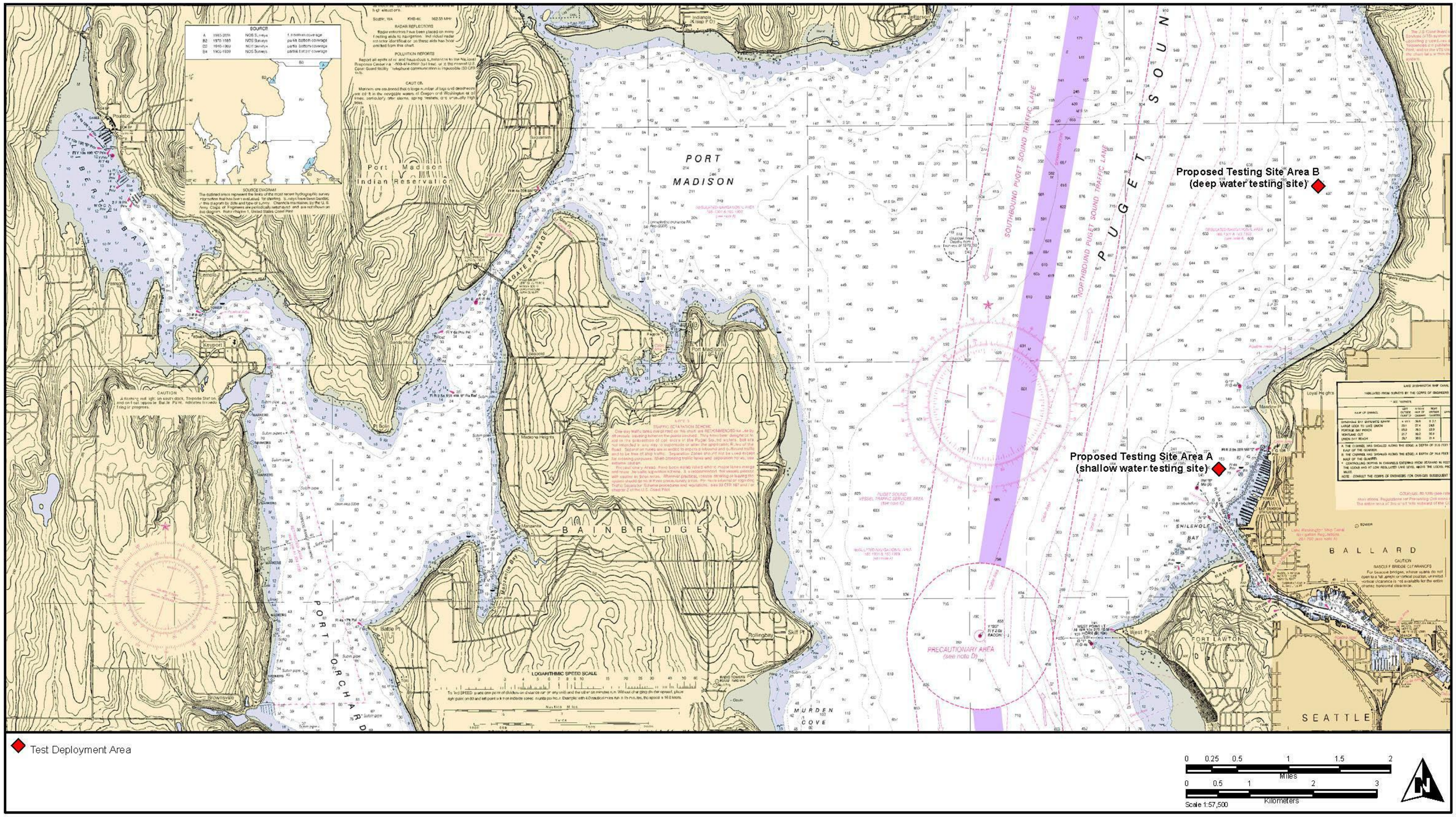


Figure 16. Proposed Puget Sound Testing Locations for RSN Components as Assessed in the SSEA

2.2.5.2 Proposed New Pre-Installation Test Sites of RSN Components

Since the preparation of the SSEA and the assessment of the 2 test sites in Shilshole Bay, there have been substantial design modifications to the RSN infrastructure, particularly the shallow and deep profilers. The design changes now necessitate 4-6 months of operational test time and test sites must be diver serviceable (i.e., <40 m depth) (Table 11). After the initial 4-6 month test period, additional testing of OOI cabled assets or components listed in this SER may be conducted within the next 4 years. In addition, proposed testing requires higher power requirements than that initially proposed in the SSEA.

Table 11. Summary of RSN Pre-Installation Test Site Requirements as Described in the SSEA and Proposed Changes under this SER

SSEA	*SER*
1. Maximum of 5 days of in-water testing per year. 2. Maximum test length = 24 hrs. 3. No permanent infrastructure on seabed; all infrastructure removed after each test day. 4. Power supply/communications via surface vessel 5. Vessel-based testing. 6. Moderate boat traffic in area 7. Test depths of Sites A and B are 20 m and 60-120 m, respectively.	1. 4-6 months of in-water test days necessary. 2. Testing would be continuous 24/7. 3. Infrastructure would be cabled on the seafloor to Friday Harbor Laboratories (FHL). 4. Power supply/communications via submarine cable 5. No vessel-based testing. 6. Low boat traffic in area 7. Diver accessible (i.e., <40 m).

Source: UW 2012b.

2.2.5.3 Assessment of Alternative RSN Pre-Installation Test Sites for this SER

Six sites were initially considered as alternative test sites for RSN infrastructure. Three of the sites were outside the State of Washington (MARS, VENUS, and North-East Pacific Time-Series Underwater Networked Experiments [NEPTUNE] Canada) and three were within Puget Sound (Point Wells, Sunset Bay Resort, and FHL) (UW 2012c, d).

MARS. Although the MARS observatory offers adequate support services and a cabled testing infrastructure, it is located over 800 miles from Seattle in Monterey Bay, California. A full evaluation of the potential for MARS to meet the RSN testing requirements resulted in the following (UW 2012d):

- Science node is located at a depth of 891 m, beyond the diver-serviceable depth of <40 m and too deep to test the RSN shallow profiler (500-m design depth).
- Science node depth necessitates use of ROV and a surface vessel, significantly increasing the operational costs.
- Platform mooring would not be available before July-August 2013.
- The MARS copper 100 megabyte Ethernet system is incompatible with the RSN Fiber gigabit Ethernet.
- Requires transporting all the infrastructure for testing to California, which is over 13 hours travel time by car and increases the costs.

Based upon the above deficiencies, the MARS site did not meet the minimum siting criteria for the RSN test site and was dismissed from further consideration.

<u>VENUS</u>

Located in Victoria, British Columbia, Canada, the VENUS observatory is closer to UW but across the international border. The 3 cabled nodes are at depths of 100, 170, and 300 m, all greater than the diver-serviceable depth of <40 m. In addition, VENUS does not have fiber gigabit Ethernet. Based upon these deficiencies, the VENUS site did not meet the minimum siting criteria for the RSN test site and was dismissed from further consideration.

NEPTUNE Canada

Also located in British Columbia, Canada, the shallowest node at the NEPTUNE Canada site is 100 m, beyond the diver-serviceable depth of <40 m. Based upon this deficiency, the NEPTUNE Canada site did not meet the minimum siting criteria for the RSN test site and was dismissed from further consideration.

Point Wells

First developed in 1909, Point Wells is a brownfield site immediately south of Edmonds, Washington. Between 1909 and 2006 it was owned by three different petrochemical companies for product storage and sales. Point Wells is now owned by BSRE Point Wells, LP who intend to redevelop it as a residential/mixed use community.

The mean low water depth at the on-site pier is 10 m, increasing to 40 m approx. 200 m to the west. Testing of the RSN profilers at this site would involve acquiring and setting up a shore station trailer on the pier or operating from a vessel alongside the test site for the duration of the 3-6 month tests. The Point Wells location is not practical due to the large amount of infrastructure that would have to be acquired and deployed for RSN instrument testing. Therefore this site was eliminated from further consideration as a test site for RSN infrastructure.

Sunset Bay Resort

The privately owned Sunset Bay Resort is located in a bay with low vessel traffic 4 miles northeast of the Edmonds, Washington ferry terminal. The facility has a good dock with a rail ‘elevator’ for moving heavy equipment in and out of the water and 220VAC/200A service. Adjacent to the dock is an office with a fiber optic network connection and space for test support equipment. The water depth is 40 m approx. 200 m to the west of the dock.

One of the major drawbacks to Sunset Bay was the existence of the Alaska United fiber optic cable that lands immediately to the north of the resort. It was anticipated that installing another cable at Sunset Bay would not meet the recommendations of the International Cable Protection Committee in terms of separation between systems. Therefore this site was eliminated from further consideration as a test site for RSN infrastructure.

Friday Harbor Laboratories (FHL)

FHL is an existing UW research facility located on San Juan Island, approx. 70 miles north of Seattle, Washington within a marine preserve (Figure 17). The Friday Harbor Marine Preserve is one of five San Juan Marine Preserves created by the Washington Department of Fish and Wildlife (WDFW) in 1990 in conjunction with FHL. WDWF created these partial-take reserves after FHL requested that the intertidal and subtidal waters adjacent to their upland biological preserves be protected from harvesting pressure for bottomfish and invertebrates (WDFW 2012).

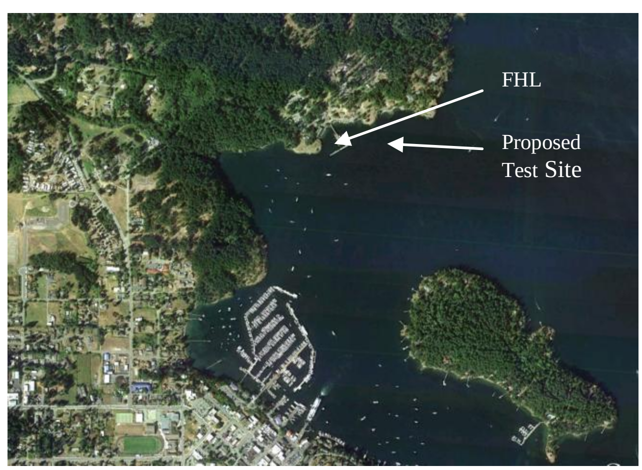


Figure 17. Location of Friday Harbor and FHL

The FHL site has been determined to be the most suitable option for RSN component testing. The FHL would provide RSN with a test location that could support testing of the RSN shallow and deep profilers in 2013 prior to their deployment. Deployment depths of <40 m at the FHL location meet the requirement that the site be serviceable by divers.

Detailed high resolution, multibeam bathymetry and backscatter surveys were conducted at FHL and the most suitable cable route location for the deep and shallow profiler testing along the 37-m bathymetric contour has been identified (Figure 18). The data suggest that the seafloor at the proposed site location is relatively flat and consists of sand with no known obstructions, cultural resources or other obstacles in the proposed project area. There are remains of old intake lines close to shore immediately north of the pump house but there are no existing cables in the area of the proposed test site. Prior to any infrastructure testing, ROV and diver visual and photographic surveys would be conducted at the proposed test location to verify bottom type and site suitability.

FHL has existing power and communications on site and the shore station provides a 375 Volts direct current (Vdc) power supply; fiber network; computer control for seafloor instrument monitoring and control of the power supply; and continuous seafloor video recording. FHL's underwater infrastructure includes 2 electro-optical (EO) cables approx. 180 m long, one of which can be connected to the RSN infrastructure (Figures 18 and 19). Since shore-side power and cabled infrastructure will already be in place, RSN would not be required to have a research vessel on-site for the duration of the test period in order to provide power to deployed instruments. Additionally, UW, in support of the expansion of capabilities for the FHL, has acquired or is in the process of acquiring all necessary federal and state permits required for their facilities expansion. As necessary and appropriate, RSN will work with UW to provide necessary additional compliance documentation relative to any OOI equipment proposed for future testing at FHL not assessed in this SER.

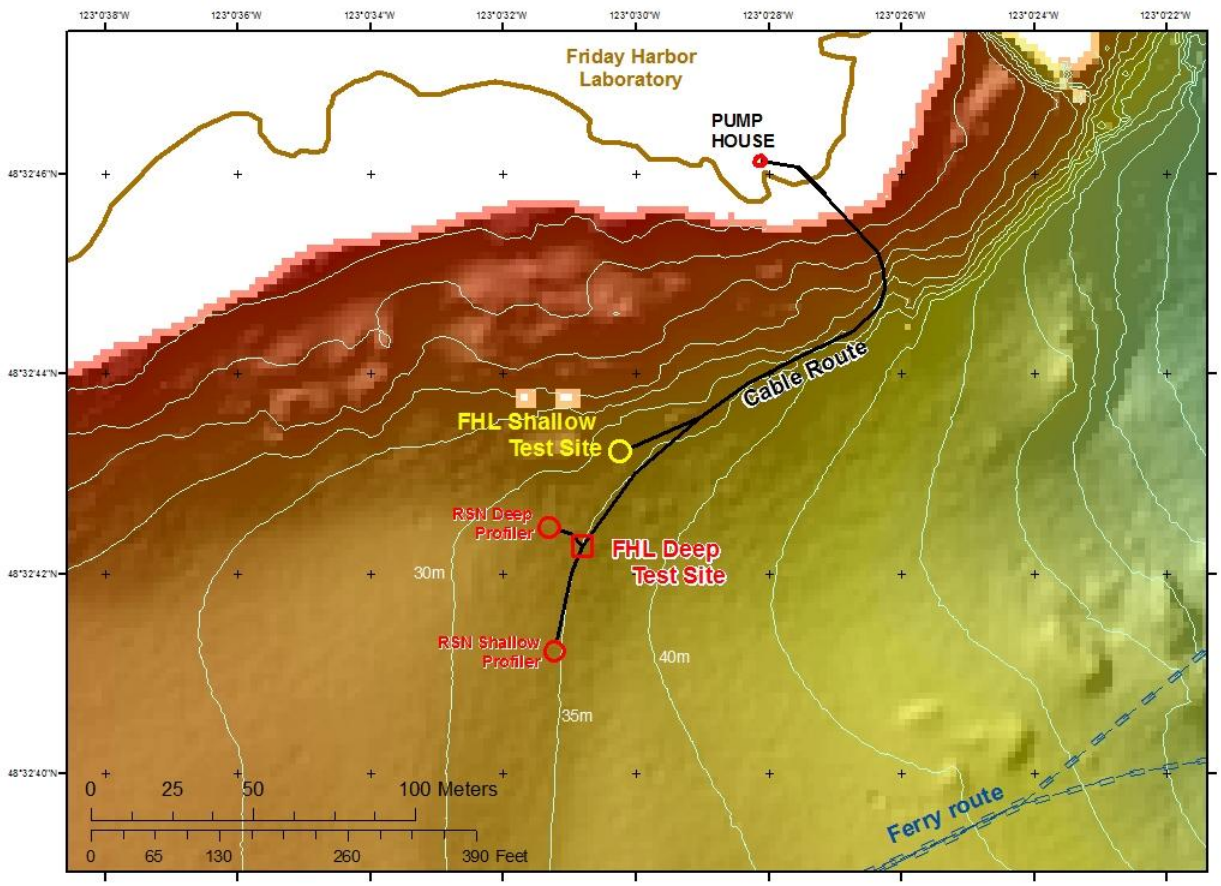


Figure 18. Bathymetry within the Vicinity of the Proposed FHL Test Site

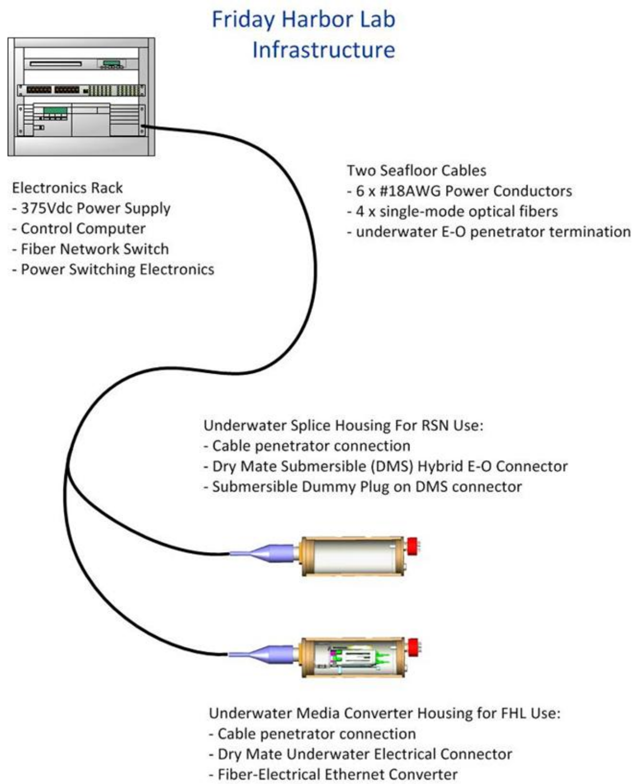


Figure 19. FHL Cabled Infrastructure

2.2.5.4 Pre-Installation Testing of RSN Infrastructure at FHL

As assessed in this SER as the Proposed Action, the proposed changes in the RSN testing locations would include:

- Addition of a new test site at FHL, San Jan Island, Washington.
- Testing of deep profiler, shallow profiler and other associated infrastructure at the FHL test site.

Under the revised RSN testing plan, the FHL location would be the primary location for infrastructure testing of RSN shallow- and deep-profiler moorings.

Infrastructure testing requirements have evolved since the 2011 SSEA due to the fact there are no commercial off-the-shelf (COTS) shallow and deep water profilers that meet RSN requirements; therefore, project engineers have designed new solutions. RSN requires extensive testing of the deep and shallow profiler mooring designs and associated support infrastructure due to the substantial design modifications to the systems.

The deep profiler is a modified version of an COTS design. The modifications include a new hull, increased battery payload, inductive charging and docking mechanisms, increased communications capacity, and an increased instrument payload. The deep profiler mooring would consist of an anchor, a fixed mooring cable, an instrumented profiler, and a static spherical float at a depth of 5 m below the surface at mean lower low tide (Figure 20).

The shallow profiler has been designed and would be built by the UW Advanced Physics Laboratory. The shallow profiler mooring would be installed on the seabed, with a frame-mounted winch assembly that will raise and lower an instrumented platform (or science pod) between the seafloor and 5 m below the sea surface. The base assembly (support frame) has not yet been designed, but will be up to 3 m x 3 m planar L-beam (steel) structure with railroad wheels for ballast.

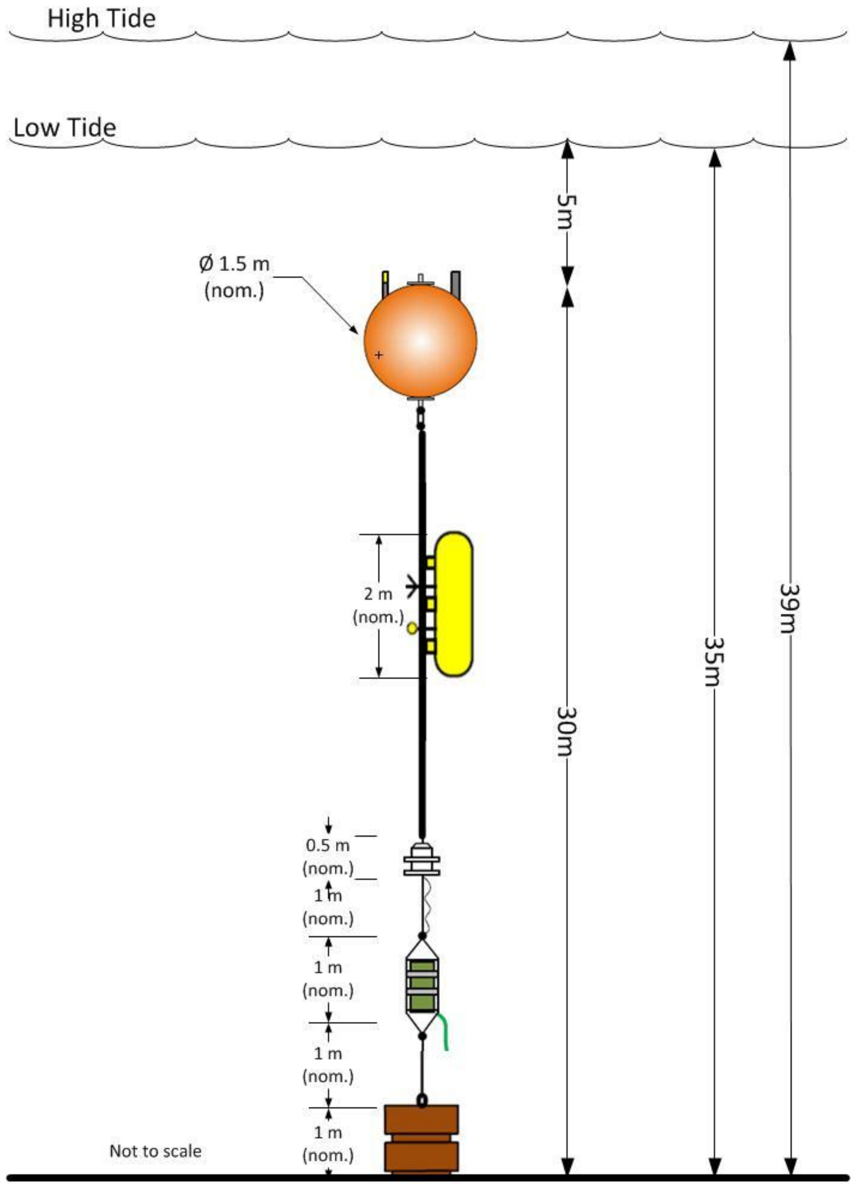


Figure 20. Deep Profiler Mooring Configuration
(water depth relative to mean sea level)

An LVN would be supplied with 375 Vdc from FHL and would transfer approx. 2,000 Watts (W) of power to the 2 profilers (Figures 21 and 22). Connectors between the LVN and the profilers would be ROV/diver wet-mateable hybrid EO connectors. The connector from the backbone (FHL) cable and LVN would also be wet mateable. The cable to the shallow profiler would be an electrical cable approx. 50 m in length, while the cable to the deep profiler will be an EO cable approx. 10 m in length. Both the electrical and EO cables will be in oil-filled hoses with a diameter of 25 millimeters (mm). A preliminary plan view of the deployment layout is provided in Figure 23.

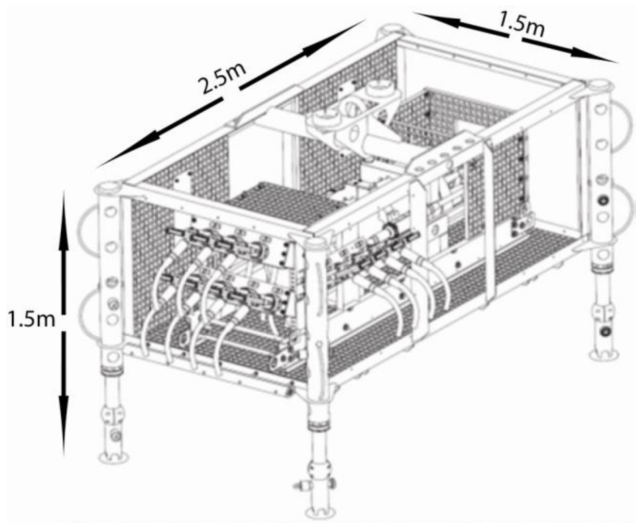


Figure 21. Representative Drawing of an LVN Frame

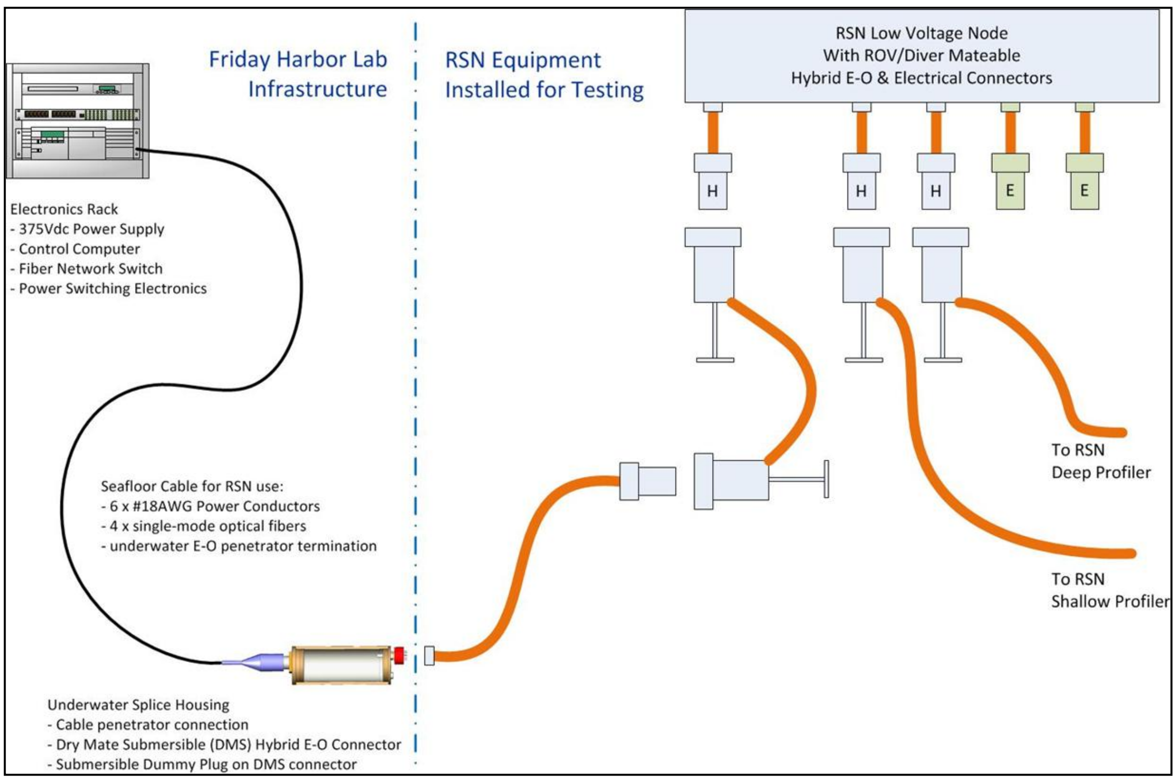


Figure 22. Proposed UW and OOI Assets for RSN Testing at FHL

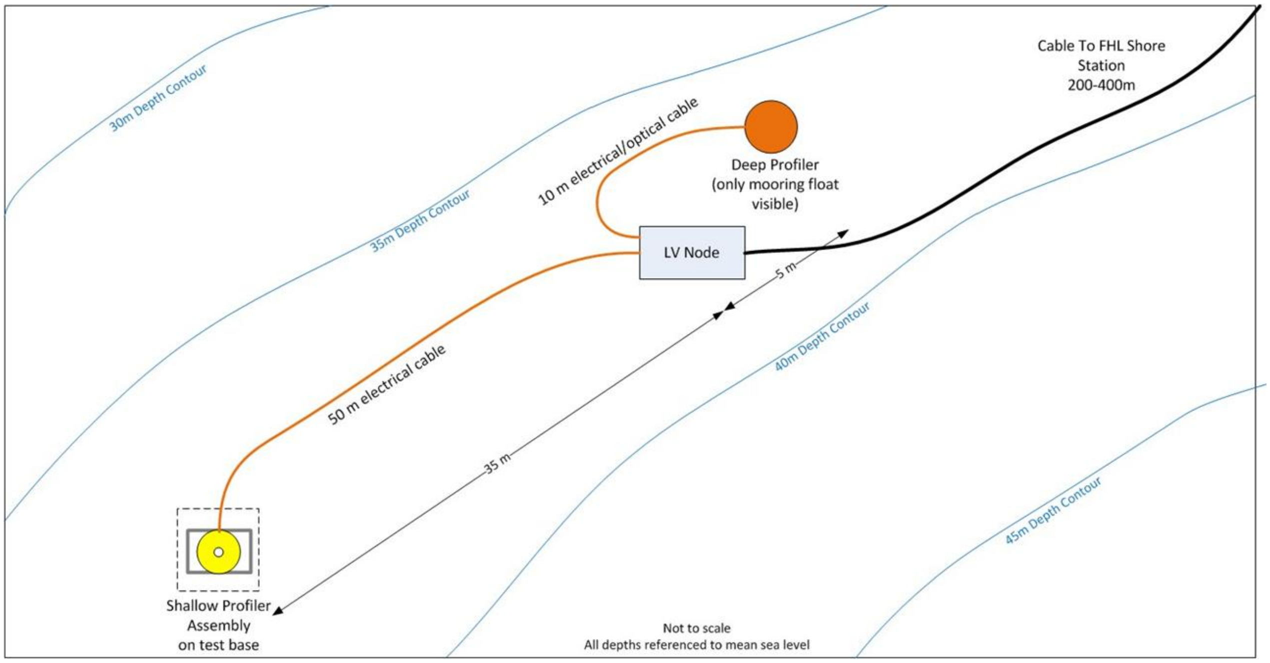


Figure 23. Conceptual Plan View of Proposed FHL Test Site for Deep and Shallow Profiler Moorings
(water depth relative to mean sea level)

Table 12 presents a summary of the infrastructure that would be needed to support RSN testing at FHL.

Table 12. Representative Infrastructure for RSN Testing at FHL

Infrastructure	*Size*	*Weight on Land (lbs)*	*Figure*
LVN	1.5 m wide x 2.5 m long x 1.5 m high	2,500	21, 22, 23
Electrical and EO cable	~60 m long, 25 mm diameter		22, 23
Deep Profiler Mooring Base (anchor)	1.2 m wide x 1.2 long x 1 m high	2,800	20
Deep Profiler Vehicle	0.3 m wide x 0.5 m deep x 2 m high	220	13, 15, 20
Shallow Profiler Assembly (including Base)	1.3 m wide x 2 m deep x 2.5 m high	4,000	14, 15

2.2.5.5 Active Acoustics

In addition to the active acoustic instruments assessed in the 2011 SSEA (SSEA Table 2-7), an acoustic current meter (ACM) and an acoustic Doppler velocimeter (ADV) would also be used on the proposed deep and shallow profilers. The ACM and ADV parameters are similar to the acoustic sources already evaluated for the OOI (Table 13).

Table 13. Representative Active Acoustic Sensors Proposed for Use in the OOI

Acoustic Source	*Frequency*	*Source Level (re 1µPa @ 1 m)*	*Pulse Length*	*Purpose/Platform(s)*
PROPOSED FOR USE UNDER THIS SER				
ACM	2-4 MHz	<170 dB	17µs	Current velocity/Mooring, benthic
ADV	1-6 MHz	220 dB	600 µs	Current velocity/Mooring, benthic
PREVIOUSLY ASSESSED IN SSEA				
ADCP	75-1,200 kHz	220 dB	0.4-25 ms	Current velocity across the water column/Mooring profilers, gliders, AUVs, benthic sensors
BAPs	38-460 kHz	213 dB	150-350 µs	Presence and location of biological parameters (e.g., zooplankton)/Mooring profilers
Altimeters	170 kHz	206 dB	4 ms	Height above seafloor/AUVs, gliders
MBES	100 kHz	225 dB		Bottom mapping/AUVs
Acoustic modems	20-30 kHz	180 dB	1-2,000 ms	Communication/Moorings, AUVs, gliders, mooring profilers
Tracking pingers	10-30 kHz	180-186 dB	7 ms	Location/AUVs, gliders, moorings
HPIES	12 kHz	172, 177, 182 dB (depending on depth)	6 ms	Water column velocity, pressure, temperature/Mooring, benthic sensors
SBP	2-7 kHz	203 dB	*	Bottom mapping/AUVs

Notes: BAP = bio-acoustic profiler; dB = decibels; HPIES = horizontal electrometer-pressure-inverted echosounder; kHz = kilohertz; MBES = multibeam echosounder; MHz = megahertz; re 1µPa @ 1 m = reference 1 micropascal at 1 m; ms = millisecond; SBP = sub-bottom profiler; µs = microsecond.
Source: NSF 2011a.

2.3 GLOBAL SCALE NODES (GSN)

The GSN would support air-sea, water-column, and seafloor sensors operating in remote, scientifically important locations and provide data and near-real time interaction to diverse communities of scientific and educational users. The scientific goals are to provide sustained atmospheric, physical, biogeochemical, ecological, and seafloor observations at high latitudes. These observations are required to understand critical influences on the global ocean-atmosphere system such as air-sea interactions and gas exchange; the global carbon cycle; ocean acidification; and global geodynamics.

Moored buoy, open-ocean observatories are well suited to address these requirements, especially in remote areas where cabled observatories are unavailable or prohibitively expensive to install. Thus, moored buoy observatories are an important complement other components of the global ocean observing system that include satellite remote sensing, cabled ocean observatories, coastal arrays, gliders and AUVs, and research vessels.

2.3.1 GSN Mooring Array Design and Placement Previously Assessed in the PEA and 2009 SER

The design for the GSN moored arrays proposed for the high-latitude sites was described and assessed in the PEA (NSF 2008) and tiered SER (NSF 2009a). The four sites proposed for implementation by 2015 are:

- Station Papa in the southern Gulf of Alaska – 50° N, 145° W; depth = 2,324 fm (4,250 m)
- Southern Ocean off Chile – 55° S, 90° W; depth = 2,625 fm (4,800 m)
- Irminger Sea southeast of Greenland – 60° N, 39° W; depth = 1,531 fm (2,800 m)
- Argentine Basin – 42° S, 42° W; depth = 2,843 fm (5,200 m)

These high-latitude arrays consist of an acoustically linked surface discus buoy (except Station Papa), 1 subsurface hybrid profiler mooring, 2 flanking subsurface moorings, and 3 gliders.

The GSN surface mooring design is a discus buoy consisting of a welded aluminum core structure and a closed-cell polyethylene foam buoyancy module in the shape of a cylinder about 2 m high and 3 m in diameter. The buoy has a welded aluminum tower structure that supports meteorological sensors, antennas for communications, solar panels, and wind turbine(s). The top of the buoy tower is ~5 m above the sea surface and the draft is 3 m. Surface moorings are anchored to the seafloor using 11-mm diameter steel and synthetic mooring line with 10 m of EOM urethane-molded chain directly below the buoy.

The subsurface hybrid profiler mooring is located close to the surface mooring at the array central site. The subsurface hybrid profiler mooring would have two profilers. An upper profiler would operate from ~150 m to the surface, providing a platform for high vertical-resolution sampling up to and including at the sea surface. A lower profiler would sample down to the seafloor. Communication within the subsurface mooring and the upper part of the surface mooring would be inductive, while acoustic modems would be used for communication between the subsurface mooring and the surface buoy and to sensors deeper in the water column or on the seafloor. The upper profiler would penetrate the surface, allowing satellite data telemetry.

The two flanking subsurface moorings may be deployed to form a triangular array with the central site (~100 km on a side). These flanking moorings are subsurface moorings and have no surface expression or satellite telemetry. They are supported by a syntactic foam subsurface float ~2 m in diameter, below which is a mechanical wire rope mooring to releases at the bottom and a deadweight cast steel anchor.

2.3.2 GSN Mooring Array Design and Placement Assessed in this SER

The GSN array design remains essentially as described in the PEA, 2009 SER, and SSEA (NSF 2008, 2009b, 2011a). With maturation of the design, minor changes to the GSN design include 10 m of EOM molded chain replaced with 5 m of EM molded chain, 3 of 4 GSN arrays would have subsurface profiler moorings with 2 lower profilers instead of 1 lower profiler, and the spacing between flanking subsurface moorings would range from ~20 and ~100 km, specific to each array location (Table 14).

Table 14. Summary of Previously Assessed (PEA) and Proposed Modifications (SER) to GSN Array Infrastructure

Item	*PEA*	*SER**
Surface Moorings	• Surface buoy anchoring system using 11-mm diameter steel and synthetic mooring line with 10 m of EOM molded chain directly below the surface buoy.	• Surface buoy anchoring system using 11-mm diameter steel and synthetic mooring line with **5 m of EM molded chain** directly below the buoy.
Subsurface Profiler Moorings	• Subsurface hybrid profiler moorings would have an upper surface-penetrating profiler and a lower profiler to sample down to the seafloor.	• Subsurface hybrid profiler moorings at Station Papa, Southern Ocean, and Argentine Basin sites would have an upper surface-penetrating profiler and **two lower profilers to sample within 200-250 m of the seafloor**. • The subsurface hybrid profiler mooring at the Irminger Sea site would have an upper surface-penetrating profiler and **one lower profiler to sample within 200-250 m of the seafloor.**
Flanking Moorings	• The two flanking subsurface moorings may be deployed to form a triangular array with the central site (~100 km on a side).	• The two flanking subsurface moorings may be deployed to form a triangular array with the central site **(~20 to ~100 km on a side**).
Array Location	• Argentine Basin is located at 42° S, 42° W • Irminger Sea is located at 60° N, 39° W	• Argentine Basin would be located at **43° S**, 42° W • **Irminger Sea location may be revised to a site ~70 km south**.

Note: ***Bolded** entries are proposed modifications to the Global Arrays assessed in this SER.
Sources: NSF 2008, 2009a; Consortium for Ocean Leadership 2012.

There is the potential for the location of the Irminger Sea Array to be revised in order to complement observing infrastructure of existing and planned ocean observing programs supported by other U.S. and international research institutions. The proposed location would shift the Irminger Array approximately 70 km to the south of the location assessed in the PEA and 2009 SER (NSF 2008, 2009b). The revised location is still within Greenland's Exclusive Economic Zone (EEZ). This decision is pending scientific analysis and approval by NSF.

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3.0 POTENTIAL IMPACTS WITH IMPLEMENTATION OF PROPOSED MODIFICATIONS

3.1 PIONEER ARRAY

The affected environment would not change under the proposed modifications to the Pioneer Array addressed in this SER. That is, the marine environment for all resource areas is the same as that previously discussed and assessed in the 2008 PEA and 2011 SSEA, only changes in the placement or types of infrastructure are proposed. Those proposed changes are the scope of the analysis in this SER.

3.1.1 Installation and O&M Activities

Marine Biological Resources. The installation of additional infrastructure associated with the proposed Pioneer Array design modifications (i.e., larger footprint of MFNs, addition of AUV docks and associated cabling) would impact an estimated 79 m^2 of additional EFH above the 30 m^2 previously assessed in the 2008 PEA. This would not result in adverse impacts to EFH. The installation of 2 additional guard buoys and 2 segments of cable on the seafloor up to 500 m long would not significantly increase the potential for entanglement by marine mammals. No new species have been listed or proposed for listing under the Endangered Species Act (ESA) that may occur within the Pioneer Array project area. Therefore, with implementation of the proposed Pioneer Array design modifications there would be no additional impacts to marine biological resources above those previously assessed in the 2011 SSEA.

Water Quality. With implementation of the proposed changes to the MFN footprint and the location of the Pioneer Array moorings, there would not be any change in impacts to water quality beyond what was assessed in the 2008 PEA and 2011 SSEA. Therefore, there would be no significant impacts to water quality with implementation of the proposed Pioneer Array design modifications.

Geological Resources. The change in dimensions of the MFN from a 4-m^2 footprint to an 8-m^2 footprint would impact an estimated 24 m^2 of bottom sediment above the 12 m^2 assessed in the 2008 PEA. In addition, the installation of the proposed AUV docking stations and associated cabling would impact approx. 55 m^2 of bottom sediment. Impacts due to the deployment of the MFNs, AUV docking stations, and associated cabling would include short-term disturbance of soft sediments and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Socioeconomics (Fishing). The installation of additional infrastructure associated with the proposed Pioneer Array design modifications would not significantly impact regional socioeconomic resources (fishing). Discussions with the regional fishing community resulted in the proposed configuration and placement of the Pioneer Array moorings, including relocating 2 moorings to areas already avoided by fishers and the addition of guard buoys. The AUV docks with connecting cable and the proposed guard buoys would be within the previously established 0.5-nm radius buffer zone for the associated mooring. Therefore, there would be no significant impacts with the implementation of the proposed Pioneer Array design modifications.

Cultural Resources. The best available data does not list any known cultural resources at the proposed revised Pioneer Array mooring locations (Wreck Hunter 2010; MassGIS 2012; NOAA 2012; TechnoOcean 2012). Recent project-specific multibeam bathymetric surveys have not identified any significant objects or formations within the vicinity of the revised Pioneer Array mooring sites. It is OOI's deployment plan to avoid placing infrastructure directly on any known cultural resources (including shipwrecks and sunken military craft). Therefore, there would be no impacts to cultural resources with implementation of the proposed Pioneer Array design modifications.

3.1.2 Gliders

Under the proposed Pioneer Array design modifications, there would be an increase in the area of the glider mission box from 5,697 nm^2 to 7,145 nm^2 (Figures 1 and 2) but no change in the number or use of gliders associated with the Pioneer Array nor the overall location. Under the proposed action assessed in this SER, the northern boundary of the glider mission box would be extended to the north to be contiguous with the already assessed AUV mission box and the glider mission box would still be completely contained within the AUV mission box that was previously assessed in the 2010 SSEA. Therefore there would be no additional impacts with the proposed change in the glider mission box.

3.1.3 Active Acoustic Sources

There are no proposed changes in the use or types of active acoustic sources associated with the Pioneer Array that were previously assessed in SSEA.

3.1.4 Summary

Due to the nature and extent of the proposed modifications to the Pioneer Array infrastructure, potential impacts to marine biological resources, water quality, geological resources, socioeconomics (fishing), and cultural resources would be discountable. In addition, the proposed modifications to the Pioneer Array would not change the cumulative effects analysis as presented in the 2011 SSEA since no additional regional cumulative projects have been proposed since the completion of the SSEA and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed Pioneer Array design modifications, the FONSI for the 2011 SSEA is still warranted (NSF 2011b), and additional NEPA documentation is not necessary.

3.2 ENDURANCE ARRAY

The affected environment would not change under the proposed modifications to the Endurance Array addressed in this SER. Therefore, the affected environment for all resource areas is the same as that previously discussed in the 2008 PEA and 2011 SSEA.

3.2.1 Installation and O&M Activities

Marine Biological Resources. The installation of additional infrastructure associated with the proposed Endurance Array design modifications (i.e., larger footprint of MFNs/BARFs, addition of mooring anchors for shallow profiler mooring) would impact an estimated 32 m^2 of additional EFH above the 26 m^2 previously assessed in the 2008 PEA and 2011 SSEA. This would not result in adverse effects to EFH. The proposed change in the location of the Oregon Line Offshore mooring from approx. 500 to 600 m would not result in a change in impacts to marine biological resources since the revised location is within the area previously assessed in the 2011 SSEA. The addition of the shallow profiler mooring with 2 mooring lines is not expected to result in significant impacts to marine mammals or sea turtles. Entanglement of marine species with mooring cables in the water column is considered highly unlikely because of the rigidity of the mooring cables and the ability of marine species to detect and avoid the mooring lines. Since the preparation of the Final SSEA, no new species have been listed or proposed for listing under the ESA that may occur within the Endurance Array project area.

Water Quality. Impacts to water quality based on the proposed changes to the MFN/BARF, mooring anchors, and the change in location for the Oregon Line Offshore mooring, from approx. 500 to 600 m, would not increase beyond that assessed in the 2008 PEA and 2011 SSEA.

Geological Resources. The change in dimensions of the MFN/BARF from a 4-m^2 footprint to an 8-m^2 footprint would impact an estimated 32 m^2 of bottom sediments above that assessed in the 2008 PEA and 2011 SSEA. Impacts due to the deployment of the MFNs/BARFs, additional anchors associated with the proposed shallow profiler mooring lines and associated cabling would include short-term disturbance of soft sediments and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Socioeconomics (Fishing). The change in dimension of the MFN/BARF and the change in location for the Oregon Line Offshore mooring, from approx. 500 to 600 m would not impact regional socioeconomic resources (fishing). Discussions with the regional fishing community resulted in the current placement of the Oregon Line Offshore mooring. Additionally, the MFNs/BARFs and shallow and deep profiler mooring anchors would be within the buffer zones for the Endurance Array moorings that were previously assessed in the SSEA.

Cultural Resources. Under the Proposed Action, it is anticipated that there would be no impacts to archeological, historic, or cultural resources with the proposed modifications to the Endurance Array. Site-specific surveys have been conducted to determine if any undiscovered resources are within the immediate vicinity of the proposed Endurance Array moorings. Based on these surveys, neither archeological resources, nor historic resources (e.g., historic shipwrecks, aircraft wrecks) are within the vicinity of the proposed Endurance Array moorings. Therefore, there would be negligible impacts to archaeological and historic resources with implementation of the modifications to the Endurance Array components.

3.2.2 Active Acoustic Sources

There are no proposed changes in the use or types of active acoustic sources associated with the Endurance Array that were previously assessed in SSEA.

3.2.3 Summary

Due to the nature and extent of the proposed modifications to the Endurance Array infrastructure, potential impacts to marine biological resources, water quality, geological resources, socioeconomics (fishing), and cultural resources would be discountable. In addition, the proposed modifications to the Endurance Array would not change the cumulative effects analysis as presented in the 2011 SSEA since no additional regional cumulative projects have been proposed since the completion of the SSEA and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed Endurance Array design modifications, the FONSI for the 2011 SSEA is still warranted (NSF 2011b), and additional NEPA documentation is not necessary.

3.3 REGIONAL-SCALE NODES (RSN)

The affected environment would not change under the proposed modifications to the RSN infrastructure addressed in this SER. Therefore, the affected environment for all resource areas is the same as that previously discussed in the 2008 PEA and 2011 SSEA. However, the proposed FHL test site is new and a summary of the affected environment is presented below under the section addressing FHL.

3.3.1 Installation and O&M Activities

Marine Biological Resources. The installation of additional infrastructure associated with the proposed RSN design modifications (i.e., addition of mooring anchors for shallow profiler mooring and associated cabling) would impact an estimated 2 m^2 less EFH than the 63 ha previously assessed in the 2011 SSEA. This reduction in impacts to EFH would not result in adverse effects to EFH. The addition of the 2 mooring lines at the shallow profiler mooring sites is not expected to result in significant impacts to marine mammals or sea turtles. Entanglement of marine species with mooring cables in the water column is considered highly unlikely because of the rigidity of the mooring cables and the ability of marine species to detect and avoid the mooring lines. No new species have been listed or proposed for listing under the ESA that may occur within the RSN project area. As the potentially effected ESA-listed and marine mammal species occurring within the affected environment of the RSN components previously assessed in the PEA and SSEA would be the same as those occurring within FHL marine waters, the Letters of Concurrence (LOCs) from the National Marine Fisheries Service (NMFS) regarding potential impacts to ESA-listed species and marine mammals assessed in the PEA and SSEA (NMFS 2008a, 2008b 2010, 2011) would still be applicable for the proposed testing at FHL. Therefore, there would be no adverse effects to ESA- or Marine Mammal Protection Act (MMPA)-listed species with implementation of the proposed testing of RSN components at FHL.

Water Quality. Impacts to water quality based on the proposed changes to the anchor footprints and the addition of the shallow profiler moorings and associated cabling would not increase beyond what was assessed in the 2008 PEA and 2011 SSEA.

Geological Resources. The installation of additional infrastructure associated with the proposed RSN design modifications (i.e., additional mooring anchors for shallow profiler moorings and associated cabling) would impact an estimated 2 m^2 less bottom sediments than the 63 ha previously assessed in the 2008 PEA and 2011 SSEA. Impacts due to the deployment of the additional anchors associated with the proposed shallow profiler mooring and associated cabling would include short-term disturbance of soft sediments and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Socioeconomics (Fishing). The addition of the shallow profiler mooring and associated cabling would not impact regional socioeconomic resources (fishing). Discussions with the regional fishing community resulted in the current placement of the RSN infrastructure including the revised components.

Cultural Resources. Under the Proposed Action, it is anticipated that there would be no impacts to archeological, historic, or cultural resources with the proposed modifications to the RSN infrastructure. Site-specific surveys have been conducted to determine if any undiscovered resources are within the immediate vicinity of the proposed RSN moorings. Based on these surveys, neither archeological resources, nor historic resources (e.g., historic shipwrecks, aircraft wrecks) are within the vicinity of the proposed RSN moorings. Therefore, there would be negligible impacts to archaeological and historic resources with implementation of the modifications to the RSN components.

3.3.2 Pre-Installation Testing of RSN Components at FHL

3.3.2.1 Affected Environment

Since the FHL site is a new site that has not been previously addressed in the PEA and SSEA, the following is a description of the affected environment.

Marine Biological Resources

EFH. Within Puget Sound, which includes the FHL test site, EFH has been designated for 45 groundfish species, 4 Coastal Pelagic Species (anchovy, Pacific sardine, market squid, and Pacific chub mackerel), and 3 salmon species (coho, Chinook, and pink) (Pacific Fisheries Management Council 1998; 2006).

ESA-Listed Species and Critical Habitat. Five ESA-listed species potentially occur within the proposed FHL test site: 1 Evolutionarily Significant Unit (ESU) and 3 Distinct Population Segments (DPSs) of anadromous fish species, with 1 DPS and 1 ESU having designated critical habitat, and 1 marine mammal (Table 15).

Table 15. ESA-listed Marine Species Potentially Occurring within the Vicinity of the Proposed FHL Test Site

Species	*ESA Status**
Southern Resident killer whale (*Orcinus orca*)	E, CH
Puget Sound Chinook salmon ESU (*Oncorhynchus tshawytscha*)	T, CH
Puget Sound Steelhead DPS (*Oncorhynchus mykiss*)	T
Green sturgeon Southern DPS (*Acipenser medirostris*)	T, CH
Pacific eulachon Southern DPS (*Thalichthys pacificus*)	T

Notes: *CH = critical habitat, E = endangered, T = threatened.
Sources: NMFS 2012; U.S. Fish and Wildlife Service (USFWS) 2012.

Given the location of the FHL test site within the nearshore environment in proximity to a relatively busy harbor (including a Washington State ferries terminal approx. 1.2 miles to the south), it is considered highly unlikely that a Southern Resident killer whale would occur within the proposed FHL test site. Although the fish species are considered potentially present within the FHL test site, the possibility that proposed RSN test activities or associated materials could harm (through physical contact) individuals or their habitat, including critical habitat, or significantly interfere with their behavior in the marine environment is considered discountable and there would be no effect to ESA-listed fish species and designated critical habitat. Since the Proposed Action would not impact ESA-listed species or their critical habitat, they are not considered further in this SER.

Marine Mammals. The only known pinniped haulout sites within the vicinity of Friday Harbor are harbor seal haulouts. The closest is over 3 miles southeast of the proposed FHL test site (Jeffries et al. 2000). California sea lions are very rare around San Juan Island. Given the location of the FHL test site within the vicinity of a relatively active harbor, it is unlikely that harbor seals would frequent the proposed test site area on a regular basis, although they may occasionally visit the area to forage or while passing through to other areas along the coast of San Juan Island.

Water Quality

Water quality in the vicinity of Friday Harbor is considered good (UW 2005).

Geological Resources

Based on recent bathymetric surveys, the seabed at the proposed FHL test site is sandy and flat (UW 2012c).

Socioeconomics (Fishing)

The marine waters of FHL are a biological preserve and fishing and other activities unrelated to the laboratory are prohibited (UW 2005).

Cultural Resources

Based on detailed, high-resolution, multibeam bathymetry and backscatter surveys, there are no known cultural resources or other obstructions within the proposed FHL test site area (UW 2012c).

3.3.2.2 Environmental Consequences

Marine Biological Resources

The installation of infrastructure associated with the proposed testing of RSN infrastructure at the FHL test site (i.e., LVN, cabling, shallow and deep profiler mooring bases/anchors) would impact an estimated 27 m^2 of EFH. This would not result in adverse effects to EFH. Entanglement of marine mammals with mooring cables in the water column is considered highly unlikely because of the rigidity of the mooring cables, the ability of marine mammals to detect and avoid the mooring lines, and the expected infrequent occurrence of marine mammals (seals) within the FHL test area. Therefore, there would be no significant impact to marine biological resources with implementation of proposed RSN test activities at the FHL test site.

Water Quality

The installation of infrastructure associated with the proposed testing of RSN infrastructure at the FHL test site (i.e., LVN, cabling, shallow and deep profiler mooring bases/anchors) would impact an estimated 27 m^2 seafloor resulting in short-term suspension of bottom sediments. These impacts are considered minor and would result in short-term insignificant impacts to water quality.

Geological Resources

The installation of infrastructure associated with the proposed testing of RSN infrastructure at the FHL test site (i.e., LVN, cabling, shallow and deep profiler mooring bases/anchors) would impact an estimated 27 m^2 of bottom sediment. Impacts due to the deployment of the LVN, cabling, and profiler mooring anchors would include short-term disturbance of soft sediments and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Socioeconomics (Fishing)

The proposed FHL test site is closed to commercial fishing and there would be no impacts to socioeconomics with the implementation of proposed RSN test activities at the FHL test site.

Cultural Resources

There are no known cultural resources within the proposed FHL test site area. Therefore, there would be no impacts to cultural resources with the implementation of proposed RSN test activities at the FHL test site.

3.3.3 Active Acoustic Sources

No additional active acoustic sources are proposed for use during RSN testing that are outside the acoustic parameters previously assessed in the PEA and SSEA. The analysis of potential effects of acoustic sources on marine fauna as provided in the PEA and SSEA is still applicable to the current Proposed Action within the FHL test site. Therefore, there would be no significant impact to marine fauna with the use of active acoustic sources at the proposed FHL test site.

3.3.4 Summary

3.3.4.1 RSN Infrastructure

Due to the nature and extent of the proposed modifications to the RSN infrastructure, potential impacts to marine biological resources, water quality, geological resources, socioeconomics (fishing), and cultural resources would be discountable. In addition, the proposed modifications to the RSN would not change the cumulative effects analysis as presented in the 2011 SSEA since no additional regional cumulative projects have been proposed since the completion of the SSEA and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed RSN design modifications, the FONSI for the 2011 SSEA is still warranted (NSF 2011b), and additional NEPA documentation is not necessary.

3.3.4.2 RSN Infrastructure Testing at FHL

The installation of infrastructure associated with the proposed testing of RSN infrastructure at the FHL test site (i.e., LVN, cabling, shallow and deep profiler mooring bases/anchors) would impact an estimated 27 m^2 of seafloor. Due to the nature and extent of the proposed RSN testing activities at the FHL test site, potential impacts to marine biological resources, water quality, geological resources, socioeconomics (fishing), and cultural resources would be discountable.

3.4 GLOBAL-SCALE NODES (GSN)

The affected environment would not change under the proposed modifications to the GSN infrastructure addressed in this SER. Therefore, the affected environment for all resource areas is the same as that previously discussed in the 2008 PEA and 2009 SER.

3.4.1 Installation and O&M Activities

Marine Biological Resources. The change in location or spacing of GSN moorings would not significantly increase the potential for entanglement by marine mammals. No new species have been listed or proposed for listing under the ESA that may occur within the GSN project areas. Therefore, with implementation of the proposed GSN design modifications there would be no additional impacts to marine biological resources above those previously assessed in the 2008 PEA and 2009 SER.

Water Quality and Geological Resources. With implementation of the proposed changes to the GSN moorings, there would not be any change in impacts to water quality and geological resources beyond what was assessed in the 2008 PEA and 2009 SER. Therefore, there would be no significant impacts to water quality and geological resources with implementation of the proposed GSN design modifications.

3.4.2 Active Acoustic Sources

There are no proposed changes in the use or types of active acoustic sources associated with the GSN that were previously assessed in 2008 PEA and 2009 SER.

3.4.3 Summary

Due to the nature and extent of the proposed modifications to the GSN infrastructure, potential impacts to marine biological resources, water quality, and geological resources would be discountable. In addition, the proposed modifications to the GSN would not change the cumulative effects analysis as presented in the 2008 PEA and 2009 SER since no additional regional cumulative projects have been proposed since the completion of the PEA and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed GSN design modifications, the FONSI for the 2008 PEA is still warranted (NSF 2009a), and additional NEPA documentation is not necessary.

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5.0 LIST OF PREPARERS

This SER was prepared by Cardno TEC, Inc. and was managed by the Consortium for Ocean Leadership with contributions from Oregon State University (OSU), the University of Washington (UW), and Woods Hole Oceanographic Institute (WHOI).

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APPENDIX A:
FONSI for OOI Site-Specific EA
(January 2011)

FINDING OF NO SIGNIFICANT IMPACT/DECISION DOCUMENT
SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT
OCEAN OBSERVATORIES INITIATIVE

Pursuant to Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] 1500-1508) implementing procedural provisions of the National Environmental Policy Act (NEPA) (Public Law 91-190, 42 U.S. Code [USC] 4321 et seq.), the National Science Foundation (NSF) gives notice that an environmental assessment (EA) has been prepared and an environmental impact statement (EIS) is not required for the proposed site-specific installation and operation and maintenance (O&M) of the Ocean Observatories Initiative (OOI) in the Gulf of Alaska; north and south Atlantic Ocean; southeastern Pacific Ocean; and off the coasts of Washington, Oregon, and Massachusetts.

A Site-specific Environmental Assessment (SSEA) was prepared to assess the potential impacts on the human and natural environment associated with proposed site-specific design, installation, and operation of the OOI previously assessed in a Programmatic Environmental Assessment (PEA) and a Supplemental Environmental Report (SER). This SSEA was prepared on behalf of NSF in compliance with NEPA (42 USC 4321 *et seq*.), and the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), and NSF's NEPA implementing regulations at 45 CFR Part 640. The NEPA process ensures that environmental impacts of proposed major federal actions are considered in the decision-making process.

1.0 PREVIOUS ENVIRONMENTAL COMPLIANCE DOCUMENTATION – PEA AND SER

Because the OOI action would occur over several different locations across the Atlantic and Pacific oceans and would be phased in over time, it was determined that an initial programmatic approach would be the most efficient in terms of overall analysis and, hence, a PEA was prepared in 2008. A programmatic analysis at a conceptual level of detail provided early identification and analysis of potential impacts, methods to mitigate anticipated impacts, and a strategy to address issue areas at a tiered level if necessary.

Preparing the PEA served several purposes. First, it provided a format for a comprehensive impact analysis of the planned OOI activities as a whole. This was accomplished by assembling and analyzing the broadest range of potential direct, indirect, and cumulative impacts associated with all proposed OOI activities in the Region of Influence (ROI). The PEA also set up a framework for addressing the time- and location-specific aspects of the proposed OOI, as well as more detailed technical information (when it becomes available) through site-specific tiered EAs (e.g., this SSEA) or other environmental documentation (e.g., the SER). Tiering of environmental documents in this manner makes subsequent documents of greater use and meaning to the public as the OOI and associated research develops, without duplicating paperwork and analysis from a previous assessment.

The PEA analysis concluded that installation and operation of the proposed OOI as presented in the 2008 Final PEA would not have a significant impact on the environment and a Finding of No Significant Impact (FONSI) was signed on February 4, 2009. The SER was prepared in April 2009 to assess the potential impacts on the environment associated with proposed modifications in the design, installation, and operation of the OOI since the completion of the PEA. The SER analysis concluded that the proposed changes in the design, installation, and operation of the OOI as presented in the 2008 Final PEA would not result in additional impacts to the environment.

2.0 PROPOSED ACTION

To provide the U.S. ocean sciences research community with the basic sensors and infrastructure required to make sustained, long-term, and adaptive measurements in the oceans, the NSF's Ocean Sciences

Division developed the OOI from community-wide, national, and international scientific planning efforts. OOI builds upon recent technological advances, experience with existing ocean observatories, and lessons learned from several successful pilot and test-bed projects. The proposed OOI would be an interactive, globally distributed and integrated network of cutting-edge technological capabilities for ocean observatories.

The OOI infrastructure would include cables, buoys, deployment platforms, moorings, junction boxes, and mobile assets (i.e., autonomous underwater vehicles [AUVs] and gliders). The infrastructure would be powered by solar, wind, fuel cells, and undersea cabled power supplies. This large-scale infrastructure would support sensors located at the sea surface, in the water column, and at or beneath the seafloor.

The OOI design is based upon three main technical elements across global, regional, and coastal scales. At the global and coastal scales, mooring observatories would provide locally generated power to seafloor and platform instruments and sensors and use a satellite link to shore and the Internet. Up to four Global-scale Nodes (GSN) or buoy sites are proposed for ocean sensing in the Eastern Pacific and Atlantic oceans. The Regional-scale Nodes (RSN) off the coast of Washington and Oregon would consist of seafloor observatories with various chemical, physical, biological, and geological sensors linked with submarine cables to shore that provide power and Internet connectivity. Coastal-scale Nodes (CSN) would be represented by the Endurance Array off the coast of Washington and Oregon and the Pioneer Array off the coast of Massachusetts. In addition, there would be an integration of mobile assets such as AUVs and gliders with the GSN, RSN, and CSN observatories. Under the Proposed Action, the CSN, RSN, and GSN would consist of the following elements:

- CSN – the Endurance Array (Newport and Grays Harbor lines) off the coasts of Washington and Oregon and the Pioneer Array in the mid-Atlantic Bight south of Massachusetts;
- RSN – a configuration with 7 Primary Nodes located off the coast of Oregon and 1 shore station at Pacific City, Oregon; and
- GSN – four sites: Station Papa in the southern Gulf of Alaska; Southern Ocean off of Chile in the southeastern Pacific; Irminger Sea southeast of Greenland in the north Atlantic; and Argentine Basin in the south Atlantic..

2.1 COASTAL-SCALE NODES (CSN)

2.1.1 Endurance Array

The Endurance Array would be comprised of two lines of moorings, one located off the coast of central Oregon (Newport Line), and a second at a contrasting site in central Washington (Grays Harbor Line). The array would employ surface moorings, subsurface profiler moorings, gliders, and AUVs to sample on multiple horizontal scales from the air-sea interface to the seafloor.

2.1.2 CSN (Pioneer Array)

The Pioneer Array would extend ~40 kilometers (km) across the continental shelf ~ 75 nautical miles (nm) south of Massachusetts. The array would employ surface moorings, subsurface profiler moorings, gliders, and AUVs to sample on multiple horizontal scales from the air-sea interface to the seafloor. In contrast to the Endurance Array, the Pioneer Array would be able to be moved to a new location approximately every 3-5 years to compare and contrast different shelf-break systems. The SSEA only addressed the proposed initial location of the Pioneer Array in the Mid-Atlantic Bight. The removal and installation of the Pioneer Array to a new location would be covered by subsequent environmental documentation.

2.2 REGIONAL-SCALE NODES (RSN)

The proposed RSN would enable oceanic plate-scale studies of water column, seafloor, and sub-seafloor processes using high-powered, high-bandwidth instrument arrays cabled to shore. Seven Primary Nodes were chosen based on their proximity to diverse tectonic features and water column settings. These nodes would be installed in the North East Pacific Ocean off the coast of Oregon at locations spatially coincident with the Juan de Fuca Plate and a suite of mesoscale oceanographic processes that operate in a 300–400-km wide swath that extends from south of Vancouver Island to southern Oregon. Under the Proposed Action, the RSN would be comprised of three components:

1. *Shore Station* – The shore station is the cable-landing site that would house the Power Feed Equipment and Network Termination Equipment for the submarine telecommunications backbone cable. The shore station provides power to the RSN and would provide network gateways between the Primary Nodes and the terrestrial data center. An existing submarine telecommunications shore station at Pacific City, Oregon has been identified for use as the RSN cable landing site.
2. *Wet Plant or Primary Infrastructure* – From the shore stations, main branches of the backbone cable span long distances to the Primary Nodes, which are located in areas of high scientific interest on the Juan de Fuca Plate. The Primary Nodes convert the high voltage from the shore stations to a lower, useable voltage for distribution to the Secondary Infrastructure. The Primary Nodes and backbone cable make up the Primary Infrastructure. The backbone infrastructure of the RSN would initially comprise 903 km of up to four types of standard submarine telecommunications electrical-optical cable; 309 km would be buried and 594 km would be on the surface of the seafloor. Each node would be enclosed in a trawl-resistant frame (TRF), which protects the electronic equipment of each node from fishing activities.
3. *Secondary Infrastructure* – The Primary Nodes distribute low voltage and data at a lower rate to Low-voltage Nodes (LVNs) positioned geographically around the Primary Nodes. The secondary infrastructure would include ~35 km of 25-millimeter (mm) diameter cable. The LVNs and the cables that connect them to the Primary Nodes make up the Secondary Infrastructure. The LVNs are connected to either a Medium-Power Junction Box (MPJbox) or a Low-Power Junction Box (LPJbox). The Jboxes then provide the correct power and data interface to small groups of scientific instruments or sensors. The tertiary infrastructure would include ~13 Jboxes.

2.3 GLOBAL-SCALE NODES (GSN)

The GSN would include moored buoy, open-ocean observatories to support air-sea, water-column, and seafloor sensors operating in remote, scientifically important locations and provide data and near-real time interaction to diverse communities of scientific and educational users. The OOI's design process has identified four strategic high-latitude sites as comprising the initial GSN under the Proposed Action:

1. Station Papa in the southern Gulf of Alaska; depth = 4,250 meters (m)
2. Southern Ocean off Chile; depth = 4,800 m
3. Irminger Sea southeast of Greenland; depth = 2,800 m
4. Argentine Basin; depth = 5,200 m

All stations, with the exception of Station Papa, would all have an acoustically linked surface buoy, 1 subsurface and 2 flanking subsurface moorings, and 3 gliders. Station Papa would have a non-acoustically linked buoy.

2.4 SENSORS

To measure changes and variability in the chemical, biological, and geological processes in the ocean, the proposed OOI would be equipped with a complex suite of sensors. These sensors would be deployed from a number of platforms including water column moorings and on the seafloor. It is important to note that the actual sensors to be deployed as part of the OOI program would be determined based on scientific objectives, costs, and the on-going discussions between engineers and investigators. It is expected that additional sensors would be added as the OOI program proceeds and the scientific objectives change based on researcher needs and priorities. Although these sensors would be largely commercial off-the-shelf sensors, some would require some modification for extended deployment and a small number would require further development to meet the scientific objectives and requirements of the proposed OOI. This would maximize the utility of the proposed OOI to the broader ocean research community. As additional sensors are proposed, they would be examined for potential environmental impacts, either during their installation or operation, and additional environmental documentation would be prepared, if necessary, that would be tiered off of the Programmatic EA.

2.4.1 Active Acoustic Sensors

The active acoustic sources proposed for use in the OOI include:

- Acoustic Doppler Velocimeter (ADV). ADVs are active sensors with an operating frequency of 1-6 megahertz (MHz), a source level of approximately 220 dB reference 1 micropascal at 1 m (re 1µPa @ 1 m), and a pulse length of 600 microseconds (µs). They would be placed on moorings or on the seafloor to investigate turbulence, boundary layers, directional waves, and sediment transport.
- ADCP. An ADCP can calculate the speed of the water current, direction of the current, and the depth in the water column of the current. This instrument can be placed on the seafloor, attached to a buoy or mooring cable, or mounted on an AUV or glider. The ADCP measures water currents with sound, using a principle of sound waves called the Doppler effect and works by transmitting high frequency (approximately 75-1,200 kilohertz [kHz]) very short pings (0.4-25 milliseconds [ms]) of sound into the water. The source level would be approximately 220 dB re 1µPa @ 1 m.
- Bio-acoustic Profilers (BAPs). BAPs monitor the presence and location of zooplankton within the water column by transmitting short (approximately 300 µs) narrow-beam (10°) signals at 38-460 kHz, which measure acoustic backscatter returns. The source level is 213 dB re 1µPa @ 1 m. Other targets detected include fish and suspended sediments. Much like a downward looking fish-finder, this tool measures the vertical distribution of plankton and fish.
- Altimeters. Altimeters would be used to assist AUVs and gliders with determining their altitude above the sea floor. They generally use generally high frequency (170 kHz) sources that emit a narrow (<5°), downward directed beam with a source level of 206 dB re 1µPa @ 1 m.
- Multibeam Echosounder (MBES). During research activities, the ocean floor would be mapped with an MBES. The MBES emits brief pulses of high-frequency (100 kHz) sound in a narrow (1-2°) fan-shaped beam at a source level of 225 dB re 1µPa @ 1 m.
- Acoustic Modems. Acoustic modems would be used for communication between mooring profilers, benthic sensors, gliders, and surface and subsurface buoys. They would operate as a omni-directional 20-30 kHz signal with a pulse duration of 1-2,000 ms.

- Tracking Pingers. These pingers would enable the tracking of AUVs and gliders once they are deployed. These pingers operate at a frequency of 10-30 kHz and emit a very brief (7 ms) pulse at source levels of 180-186 dB re 1µPa @ 1 m.
- Horizontal Electrometer-Pressure-Inverted Echosounder (HPIES). The HPIES is proposed as a core sensor on the RSN located on the seafloor near the full water column moorings. This instrument package combines a bottom pressure sensor, 12-kHz inverted (i.e., upward looking) echosounder, and a horizontal electrometer. Together these sensors allow measurement of bottom pressure, seafloor to sea surface acoustic travel time, and motionally induced electric fields. These properties provide insights into the vertical structure of current fields and water properties including temperature, salinity, and specific volume anomaly, separation of sea surface height variation and temperature, and near-bottom water currents. The echosounder would operate at a source level 172, 177, 182 dB re 1µPa @ 1 m at depths of 547, 1,094, and 1,641 fm (1, 2 and 3 km), respectively. There would be 24 narrow beamed (<5°), 6-ms pings per hour.
- Sub-bottom Profiler (SBP). The SBP is normally operated to provide information about the near-surface features and bottom topography that is simultaneously being mapped by the MBES. It operates at mid-frequencies (2-7 kHz) with a source level of 203 dB re 1µPa @ 1 m.

2.5 INSTALLATION AND OPERATION & MAINTENANCE (O&M)

2.5.1 Schedule for OOI Testing, Installation, and Operation (2010-2014) and O&M

Proposed installation and O&M activities would use standard methods and procedures currently used by the undersea telecommunications industry and oceanographic research institutions. However, methods may change based upon site-specific surveys, ship schedules, and final determination of types of equipment to be installed (e.g., sensor types, models, etc.).

Under the Proposed Action, the installation of the CSN, RSN, and GSN components of the proposed OOI Network would generally occur from spring 2011 through 2014, with all OOI components operational by 2015. However, some components (e.g., portions of RSN, Newport Line, Pioneer Array, and some GSN sites) would be operational before 2015 and associated O&M activities for those components would begin before 2015. Overall, it is expected to take approximately 100-250 days at sea (DAS), depending on the year, and involve 4 classes of vessels to install the various OOI components (Table 2-11). All OOI infrastructure would be maintained from University-National Oceanographic Laboratory System (UNOLS) vessels or vessels of opportunity (VOOs) using deployment and retrieval techniques common in oceanographic research. Average annual O&M operations after the OOI Network is fully commissioned and operational (i.e., beginning in 2015) would take an estimated 286 DAS. Note that the nominal weather window for installation and O&M activities in the Northern Hemisphere is May through October and in the Southern Hemisphere is November through April.

Prior to their installation on the backbone cable off the coast of Oregon, and depending on the device requirements, RSN components could be tested at one of 4 sites: 2 sites in Puget Sound in Shilshole Bay near UW, Seattle; the Monterey Accelerated Research System (MARS) Ocean Observatory, Monterey Bay, California; and the Victoria Experimental Network Under the Sea (VENUS) facility, British Columbia, Canada. For logistical reasons, each test event would involve the testing a group of OOI devices or components. The Puget Sound sites are the preferred test sites as they are directly accessible from UW research facilities. Each test would last less than 24 hours and a maximum of 5 tests would occur each year, starting in the spring of 2011.

2.6 Special Operating Procedures (SOPs) for Installation and O&M of the Proposed OOI

Table 1 lists the SOPs that would be implemented as part of the Proposed Action to avoid and minimize any potential impact to biological resources and commercial fishing activities.

Table 1. SOPs to be Implemented under the Proposed Action

Regional Scale Nodes (RSN)	
1.	Cable and equipment locations for all RSN components of the proposed OOI would be published on NOAA Charts and through a Notice to Mariners (NM) and Local Notice to Mariners (LNM), and accurate locational information would be made available to fishers to assist their avoidance of the instruments. A contact phone number would be established where fishers can report possible entanglements.
2.	The Oregon Fishermen's Cable Committee (OFCC) has been notified regarding the proposed RSN submarine cable route and associated sensors. In accordance with Oregon State law, Ocean Leadership has entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and of submarine cable operations.
3.	Site-specific surveys have been completed and discussions with marine users (i.e., fishers) are ongoing to address final positioning of RSN secondary infrastructure as well as associated buffer zones around them.
4.	Onshore construction activities would avoid sensitive coastal dune, bluff, and wetland habitats, or scenic locations, and be sited on relatively level ground and to the maximum extent practicable on previously disturbed or developed land.
5.	For onshore construction activities, appropriate best management practices (BMPs), based on the Oregon Department of Environmental Quality's (ODEQ's) Erosion and Sediment Control Manual (ODEQ 2005), would be incorporated into a Stormwater Pollution Prevention Plan (SWPPP) and submitted to the ODEQ in partial fulfillment of the CWA Section 301 National Pollutant Discharge Elimination System (NPDES) permit.
6.	The shallow water exit points for horizontal directional drilling (HDD) have been sited in sandy bottom areas. Pre-installation cable route surveys have been conducted to identify bottom conditions, plan cable burial accordingly, and to minimize the crossing of rocky and/or geologically unstable areas.
7.	The cables would be buried approximately 1.3 m deep where substrate conditions allow, using a combination of plow and/or remotely operated vehicle (ROV). In so far as practicable, cables would be buried to a position about 1 km seaward of the 700-fm Essential Fish Habitat (EFH) boundary. In addition to complying with any permit conditions, it is expected that the cable routes would be inspected at 5-year intervals after the installation to determine whether there are exposed sections of cable that could be snagged by fishing gear, and such areas would be reburied to the extent possible.
8.	During initial installation, where it is anticipated that burial cannot be achieved, the cable would be armored and fishers notified of the location of the exposed cable.
9.	The cable-laying vessel will monitor boat speed and direction to avoid marine mammals and sea turtles during the cable burial operations. To the extent practicable, the vessel will maintain speed limits of generally less than 2 knots to avoid interactions with marine mammals and sea turtles.
10.	NSF will establish a 500-ft (152-m) safety zone along the proposed cable route to avoid marine mammals and sea turtles.
11.	To the extent practicable, NSF will schedule cable-laying and installation activities during daylight hours when visibility allows detection of marine mammals and sea turtles within the safety zone.
12.	Trained marine mammal observers (MMOs) will monitor for marine mammals and sea turtles during cable-laying activities. Any incidents will immediately be reported to the National Marine Fisheries Service (NMFS), Office of Protected Resources (OPR) by calling 301-713-2289.
13.	To the extent practicable, MMOs will have the authority to call for curtailment of operations if any marine mammal or sea turtle enters the safety zone. If a marine mammal or sea turtle is sighted, operations will be delayed until the animal moves out of the area. The operations should not resume or startup until the animal is confirmed to be out of the safety zone or 15 minutes after the last sighting of the animal within the safety zone, whichever is later.

Table 1. SOPs to be Implemented under the Proposed Action

REGIONAL SCALE NODES (RSN) (cont.)
14. The MMOs will record and document the dates, times, locations, species, number, distance from vessel, and behavior of marine mammals and sea turtles sighted during monitoring activities as well as mitigation measures implemented. After completion of submarine cable installation and at subsequent submarine cable inspection/maintenance activities, these records will be combined into a summary report to be sent to the Director, NMFS OPR, 1315 East-West Highway, Silver Spring, MD 20910.
15. The RSN cable route has been submitted to the U.S. Navy.
16. Owners of all existing systems crossed by the RSN backbone cable would be contacted to coordinate crossings, if necessary. To the extent possible, all crossings would meet the recommendations of the International Cable Protection Committee (ICPC).
17. As much as possible, cables will be laid perpendicular, rather than parallel to, steep offshore slopes. Perpendicular placement is more stable and reduces the risks of damage from underwater landslides or differential slippage of cable sections down side slopes.
18. For HDD operations, an HDD Monitoring and Spill Contingency Plan would be prepared and submitted to the U.S. Army Corps of Engineers (USACE) and ODEQ as appropriate. The plan would include, but not necessarily be limited to the following: • description of surficial and bedrock geological conditions and the proposed bore profile at each HDD location; • use a forward-reaming drilling method, as planned, for the HDD; this method would result in much smaller volumes of drilling mud and drill cutting discharges than an alternative back-reaming method;. • Flush the drilling mud and cuttings from the borehole, when technically feasible, prior to the final drill out during a forward-reaming process • assessment of the likelihood of a "frac-out" involving the release of drilling fluids from the bore hole into the overlying ocean waters; • procedures to monitor drilling fluid returns, regulate drilling pressure, and add lost circulation materials as necessary to plug fractures along the bore path and minimize the possibility of a frac-out; • to minimize the release of drilling mud when the drill punches through on the seabed, operators would switch from drilling mud to water only to lubricate the bore during the last stage of the operation before the drill reaches its exit point; • procedures for monitoring the bore path between the bore entry and the planned exit point to detect a release of drilling mud; • construct a drilling mud and cuttings containment area at the HDD drill base to receive and temporarily contain the discharged materials where they could be recovered and disposed of; • a Contingency Plan for the containment and cleanup of a discharge of drilling mud onto the shore or seabed; and • reporting procedures to document the implementation of the plan and its effectiveness.

Table 1. SOPs to be Implemented under the Proposed Action

COASTAL SCALE NODES (CSN) – ENDURANCE ARRAY
1. The OFCC has been notified regarding the proposed cabled moorings and sensors of the Newport Line. In accordance with Oregon State law, Ocean Leadership entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and OOI activities.
2. All Endurance Array moorings would be permitted as Private Aids to Navigation (PATONs) through the U.S. Coast Guard (USCG). Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NM and LNM. Proposed surface buoys would be marked with contact information, which will be forwarded to the USCG for inclusion in the NM and LNM with suggested buffer zones around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As OOI moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NM and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
3. Locations for all moorings and associated components of the proposed Endurance Array would be published on NOAA Charts once the moorings are listed on the NM and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
4. The coordinates for proposed Endurance Array glider tracks would be published on NOAA Charts and through the NM and LNM. Gliders would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.
COASTAL SCALE NODES (CSN) – PIONEER ARRAY
1. All Pioneer Array moorings would be permitted as PATONs through the USCG. Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NM and LNM. Proposed surface buoys would be marked with contact information, which will be included in the NM and LNM with suggested buffer zones around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As OOI moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NM and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
2. Locations for all moorings and associated components of the proposed Pioneer Array would be published on NOAA charts once moorings are listed in the USCG NM and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
3. The coordinates for proposed Pioneer Array AUV and glider mission boxes would be published on NOAA Charts and through a NM. Gliders and AUVs would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.

3.0 PURPOSE AND NEED

The OOI would build a network of sensors that would collect ocean and seafloor data at high sampling rates over years to decades. These sensors would be linked to shore using the latest communications technologies, enabling scientists to reconfigure them from their laboratories and use the incoming data in near-real time in their models. Scientists and educators from around the country, from large and small institutions, and from fields other than ocean science, would be able to take advantage of OOI's open data policy and emerging cyberinfrastructure capabilities in distributed processing, visualization, and integrative modeling. Researchers would make simultaneous, interdisciplinary measurements to investigate a spectrum of phenomena including episodic, short-lived events (tectonic, volcanic, biological, severe storm-related), to more subtle, longer-term changes or emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidity, ecosystem trends). Through a unifying cyberinfrastructure, researchers would control sampling strategies of experiments deployed on one part of the infrastructure in response to remote detection of events by other parts of the infrastructure. The long-term introduction of ample power and bandwidth to remote parts of the ocean by the OOI would provide the ocean science community with unprecedented access to detailed data on multiple spatial scales, studying the coastal-, regional-, and global-scale ocean, and using mobile assets (AUVs, gliders, and vertical profilers) to complement fixed-point sensors. The discoveries, insights, and the proven new technologies of the OOI effort would continuously transfer to more operationally oriented ocean-sensing systems operated by other agencies and countries. Increased ocean coverage, the growth of technical capability, development of new and more precise predictive models, and increasing public understanding of the ocean would all be tangible measures of the OOI's contribution to transforming ocean science. In this manner, OOI would play a key role in keeping the U.S. science effort at the cutting edge of ocean knowledge.

4.0 ALTERNATIVES CONSIDERED

Numerous alternative configurations were considered for the CSN, RSN, and GSN components of the proposed OOI. As a result of extensive technical and NSF review of numerous planning and technical supporting documents, no other action alternatives to the Proposed Action emerged that would satisfy the identified purpose and need and scientific objectives and siting criteria. Consequently, only the Proposed Action and the No-Action Alternative are carried forward for analysis in the SSEA.

5.0 SUMMARY OF ENVIRONMENTAL EFFECTS

5.1 CSN (Endurance Array) and RSN

5.1.1 Air Quality

The Proposed Action is located within the jurisdiction of Grays Harbor County, Washington; and Clatsop, Tillamook, and Lincoln counties, Oregon. All affected counties are in attainment of the National Ambient Air Quality Standards as well as state and regional air quality standards. Therefore, a Clean Air Act conformity determination is not required. The Proposed Action would result in minor temporary emissions from surface vessels during installation and O&M activities of the RSN and CSN. However, these vessel emissions would not represent a substantial increase above existing conditions, as only a small number would be used and for only a few weeks per year. The Proposed Action would not compromise air quality attainment status in Washington and Oregon or conflict with attainment and maintenance goals established in their State Implementation Plans. Therefore, the Proposed Action would have a negligible impact on air quality.

5.1.2 Terrestrial Biological Resources

The only terrestrial area proposed for use under the Proposed Action would be an existing shore station and beach manhole (BMH) that would be used for the landing of the RSN submarine or backbone cable at Pacific City, Oregon. Proposed HDD activities would occur in the vicinity of an existing BMH within a previously disturbed residential area with no sensitive vegetation or habitat. No sensitive terrestrial biological resources are expected to occur at or in the vicinity of the proposed HDD and BMH site. Therefore, there would be no impacts to terrestrial biological resources with implementation of the Proposed Action. The U.S. Fish and Wildlife Service (USFWS) concurs that there would be no effect to terrestrial Endangered Species Act (ESA)-listed species under their jurisdiction. The CSN does not have a terrestrial component and therefore there would be no significant impacts to terrestrial biological resources from implementation of the Grays Harbor and Newport lines of the Endurance Array.

5.1.3 Transportation

Generally only two to three vessels would be used during installation and O&M activities associated with the proposed OOI, and then only for a few weeks per year. Projected increases in vessel traffic due to implementation of the Proposed Action would constitute a negligible portion of the total existing vessel traffic in the ROI. In addition, proposed activities associated with the installation and annual O&M of the proposed OOI would not restrict or change existing vessel traffic patterns within the ROI. All mooring buoys of the Endurance Array would be marked in accordance with U.S. Coast Guard (USCG) requirements and locations of all buoys would be published in the NM, LNM, and on NOAA charts. Therefore, there would be no significant impacts to transportation within the ROI with implementation of the Proposed Action.

5.1.4 Land Use

Proposed terrestrial activities associated with the proposed cable landing Pacific City, Oregon would be sited in accordance with established land use guidelines addressing safety, functionality, and environmental protection zones where appropriate. The proposed shore station is an existing facility and no additional construction is required. With implementation of SOPs during RSN HDD activities, there would be no significant impacts to terrestrial resources. In addition, no changes to existing land use would occur with implementation of the Proposed Action.

5.1.5 Marine Biological Resources

Under the Proposed Action, there would be no significant change in the proposed CSN and RSN installation and O&M activities that were previously assessed in the PEA and SER. The installation of 1 less primary/secondary node, 510 km less of backbone cable (including the burying of 166 km less of backbone cable), 15 fewer LVNs, 7 fewer low-power junction boxes, and 8 fewer medium-power junction boxes, and associated less installation and O&M activities, would result in less potential impact to all marine species than that assessed in the PEA and SER.

The vessels and activity associated with installation of RSN cable, surface and subsurface moorings, and associated scientific sensors on the sea floor may cause marine species to temporarily avoid the immediate vicinity of the proposed CSN (Endurance Array) and RSN, but this impact would not be significant due to the small scale and temporary nature of the proposed activities. The vessel used for cable and mooring deployment would move very slowly during the activity and would not pose a collision threat to marine mammals, including ESA-listed species.

There are no documented incidents of marine mammal entanglement in a submarine cable during the past 50 years. The cables would be taut against the seafloor, without loose slack. Entanglement of marine species is not likely because the submarine cable would be buried in water depths less than 1,500 m. For water depths greater than 1,300 m, where the cable is not buried, the rigidity of the cable would cause the cable to lie extended on the sea floor and not coil thereby eliminating the potential for entanglement. Entanglement of marine species within mooring cables in the water column is considered highly unlikely because of the rigidity of the mooring cables and the ability of marine species to detect and avoid the mooring lines. Once installed on the seabed, the proposed mooring anchors and scientific sensors would be equivalent to other hard structures on the seabed, again posing no risk of adverse effect on marine organisms.

Electromagnetic fields (EMF) are produced when electricity is transmitted through cables buried in the seafloor. The concern with EMF is the sensitivity of particular groups of the marine animals to EMF, especially the potential responses (e.g., attraction, repulsion, disorientation, or other behaviors) of fish (particularly elasmobranchs [i.e., sharks, skates, and rays]), sea turtles, and marine mammals, and the effectiveness of mitigation, primarily through burying or shielding of the cable. It is expected that due to the relatively low voltage transmitted, the smaller cable size, and the armoring and burying of the OOI cables, that potential impacts from EMF on fish, sea turtles, or marine mammals, including ESA-listed species would not be significant.

The use of up to 6 gliders within a survey area of ~16,000 nm^2 around the Endurance Array is not expected to affect marine species, as the proposed gliders would move within the water column similar to a dolphin or whale. Gliders are sealed, contain no motors, fuels, or hazardous materials; and move at very slow speeds (~0.5 knot), thereby eliminating the potential for collisions with marine fauna.

The proposed active acoustic sources associated with the Endurance Array and RSN would generally operate at frequencies much higher than those frequencies considered audible by fish and marine mammals. The ADV, BAP, and the ADCP would all operate at frequencies greater than 180 kHz, with most operating at frequencies greater than 200 kHz. For the HPIES, MBES, SBP, altimeters, acoustic modems, and tracking pingers operating at frequencies between 2 and 170 kHz, fish and marine mammals would not be disturbed by any of these proposed acoustic sources given their low duty cycles, the brief period when an individual animal would potentially be within the very narrow beam of the source, and the relatively low source levels of the HPIES, pingers, and acoustic modems. Therefore, implementation of the proposed deployment of the Endurance Array and RSN is not expected to result in significant acoustic impacts to fish and marine mammals, including ESA-listed species. NMFS concurs that there would be no adverse effects to ESA-listed species and marine mammals under their jurisdiction. No additional active acoustic sources are proposed and the analysis of potential effects of acoustic sources on marine fauna as provided in the PEA is still applicable to the current Proposed Action.

The Marine Mammal Protection Act (MMPA) Letter of Concurrence (LOC) issued by NMFS for the PEA is still applicable for the activities as proposed in this SSEA; therefore, there would be no significant impacts to marine mammals with implementation of the Proposed Action. In their 2011 LOC regarding potential effects to ESA-listed species, NMFS concurred with NSF's determination that the proposed revisions to the installation and O&M of the OOI are not likely to adversely affect ESA-listed species. All conservation measures or other protective measures requested by NMFS in their LOCs have been included in the SOPs for implementation of the proposed CSN (Endurance Array) and RSN components of the OOI network.

Under the provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), federal agencies must consult with NMFS prior to undertaking any actions that may adversely affect Essential Fish Habitat (EFH). Federal agencies retain the discretion to determine what actions fall within the definition of "adverse affect." Temporary or minimal impacts, as defined by NMFS regulations and below, are not considered to "adversely affect" EFH (50 CFR Part 600). "Temporary impacts" are those that are limited in duration and that allow the particular environment to recover without measurable impact. "Minimal impacts" are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions.

In considering the potential impacts of a proposed action on EFH, all designated EFH must be considered. Impacts on EFH would entail temporary mechanical disturbance of the substrate, and long-term coverage of relatively small areas of substrate by RSN cable, TRFs, mooring anchors, LVNs, junction boxes, and cabled scientific sensors. Implementation of the Proposed Action would impact an estimated 63 ha of EFH, or 36 ha less than the 99 ha previously assessed in the SER. The PEA and SER analysis concluded that implementation of the proposed actions identified in those documents would not result in adverse effects to EFH, therefore, there would not be adverse effects to EFH with implementation of the current Proposed Action.

Testing of RSN Infrastructure. The potential use of the Shilshole Bay test sites would occur no more than 5 times over a 1-year period, with each test lasting less than 24 hours and potential bottom disturbance of less than 0.8 m^2 would result in short-term, negligible impacts to marine biological resources, including ESA-listed species. In their 2011 LOC regarding potential effects to ESA-listed species, NMFS concurred with NSF's determination that the proposed testing of RSN infrastructure in Shilshole Bay is not likely to adversely affect currently listed threatened and endangered species or currently designated critical habitat.

5.1.6 Geological Resources

Under the Proposed Action, potential impacts to geological resources from the proposed (CSN) Endurance Array (Grays Harbor and Newport lines) would only be associated with the placement of 12, 2 m^2 mooring anchors and associated sensors on the seafloor. Impacts would include temporary mechanical disturbance of soft sediments, and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Impacts to onshore geological resources from the installation of the RSN cable would include temporary soil disturbance by grading, excavation, and equipment operations to support HDD activities at Pacific City, Oregon. At each site, it is anticipated that HDD activities would temporarily disturb approximately 0.2 ha in close proximity to existing beach manholes for existing cables. The onshore drilling sites would be configured to avoid impacting sensitive coastal habitats that would be especially vulnerable to erosion. In accordance with CWA NPDES requirements, the OOI would obtain coverage under the State of Oregon's general permit for construction stormwater discharges. This would include the preparation and implementation of a SWPPP with BMPs to minimize erosion and sediment transport from construction sites, and to restore disturbed areas to a stable condition after construction. As a result, no significant impacts to onshore geologic resources would occur.

Impacts on offshore geology would entail temporary mechanical disturbance of the substrate, and long-term coverage of relatively small areas of substrate by TRFs, mooring anchors, LVNs, Jboxes, and cabled scientific sensors. As described previously, the substrate in the affected area offshore consists of sand, sand and mud, and mud. The cables, anchors, and instruments themselves would constitute ~3 ha of new hard substrate. Soft sediments would be excavated and dispersed a short distance around the bore exits, sites where equipment would be placed, and cable burial corridors. Use of the sea plow and/or ROV to install the cables would impact an approximately 2-m wide swath of substrate during installation, and a total area of 60 ha. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. If necessary, the placement of cables on rock substrate would cause minor physical abrasion (grooving) of the substrate. Repair activities and/or future removal of the proposed cable, moorings, and associated infrastructure would have impacts on seafloor geology similar to those of installation at the affected locations. These impacts on soft- and hard-bottom substrates are considered minor and not significant.

5.1.7 Water Quality

The onshore portion of the Proposed Action would not affect water quality. Project activities are expected to occur on level sites without surface water features or direct drainage to the ocean. A project-specific

SWPPP incorporating BMPs for erosion and sedimentation control would be prepared and implemented to prevent the discharge of sediment or pollutants or runoff from the sites.

The offshore cables consist of metallic and synthetic, essentially inert materials (glass fibers, plastic (polyethylene), copper, steel, waterproof nylon yarn). Based on observations of previously installed underwater cables, the cables would soon be covered with marine growth or buried by sand, and would not break down for a very long period of time. The available information, although limited, suggests that cable constituents (such as copper and zinc) are not normally leached into surrounding waters unless the cable is damaged, and that in any case, the amounts are small and unlikely to affect the organisms that grow on the cables. Ultimately, as cable components disintegrate, decompose, or corrode, the constituent elements would be dispersed into surrounding media, with no significant effect on sediment or water quality.

The HDD process would not directly or cumulatively introduce toxic or hazardous substances or chemicals, organic substances, or solid wastes into bodies of water or on land to cause the level of these substances to exceed regulatory standards. The bentonite clay used in the drilling process is a non-toxic, non-hazardous clay. It is possible that drilling mud could escape from the bore into the surrounding geologic formation. However, any material migrating to the surface would be rapidly dispersed by wave and current action and would not be expected to persist or accumulate in appreciable amounts. During the final stage of drilling, bentonite addition to the drilling fluid would be discontinued, and only water would be used, thus minimizing the release of the clay sediment when the bore exits the seabed. The drilling contractor would follow procedures established in a project-specific Drill Monitoring and Cleanup Plan to minimize the possibility of a release of drilling mud into the ocean, and to remove any accumulation of drilling mud on the seafloor.

The only hazardous substances that would be used in the proposed project are lubricants and fuel contained in marine vessels and equipment. Vessels would adhere to federal, state, and Implementing Organization (IO) requirements for the management of hazardous materials and hazardous waste. Vessels engaged in installation would adhere to all USCG requirements regarding the containment, cleanup, and reporting of spills, which would assure that the effects are minimized. Therefore, there would be no significant impacts to marine water quality with implementation of the Proposed Action.

Small-scale increases in turbidity would occur due to installation of the cables and instruments on the seafloor. Turbidity would be minor and temporary throughout the installation activities. Sediments would rapidly disperse and/or settle back to the seabed. Coarse sediments (sand or larger) would resettle within seconds in the immediate area, whereas fines (silt to clay) would tend to drift and remain in suspension for minutes to hours, depending on particle sizes and bottom currents. There would be no permanent or significant effect on marine water quality due to suspended sediments. The outer layers of submarine cables are insoluble and readily become encrusted with marine organisms and are not expected to break down for decades. Inner metallic components are sealed from the surrounding media. Any by-products of corrosion or dissolution of cable components in seawater would be rapidly dispersed and diluted in the water column and as such would have no significant effect on water quality.

Regular O&M operations would have impacts on marine water quality similar to those of installation at the affected locations.

Shilshole Bay Test Sites. Testing of the RSN infrastructure would occur no more than 5 times over a 1-year period, with each test lasting 24 hours or less. Depending on the test, some equipment may be placed on the seabed, including for instance the Secondary Nodes and or four 1,100 pound weights allowing the vertical mooring to remain stable. Deployment and retrieval of each device would create temporary resuspension of sediments and turbidity. However, turbidity or sediment suspension would not persist as the effects would be reversed by natural dispersive processes in the area within minutes of the equipment deployment or its removal. The temporary increase in suspended sediment concentrations and turbidity levels are expected to cause negligible effects to the surrounding water quality.

5.1.8 Cultural Resources

NSF has been conducting Government-to-Government consultations with Washington State Native American Indian Tribes and Nations since April 2010. The purpose of the consultations has been to present the Proposed Action and this site-specific phase. They also have served to initiate consultations under Section 106 of the NHPA and to inform the Native American Indian Tribes and Nations that compliance with Section 106 of the NHPA would be through the NEPA process. The Hoh Tribe, Makah Nation, Quileute Nation and Quinault Nation (listed in alphabetical order) were sent a letter discussing the proposed project. The letters were followed up with email correspondence and telephone calls. NSF also offered an opportunity to hold an in-person Government-to-Government consultation with each Tribe and Nation.

The Hoh Tribe's primary concern is access to data and data sharing and they requested written assurances that the data generated by this project be made available to Tribal Fisheries Managers. The Makah Nation responded to a telephone request indicating that further consultation was not needed. The Quileute Nation responded and indicated that they were reviewing the materials provided, including the Draft SSEA.

In addition, the USACE has also conducted government-to-government consultations with the Confederated Tribes of Grande Ronde and Confederated Tribes of Siletz Indians in Oregon as part of RSN's NWP process. Other tribes were consulted by the Oregon Department of State Lands as part of the removal fill permit process associated with the proposed RSN HDD activities. No Oregon tribes have responded with any comments or concerns (see Appendix F).

Under the Proposed Action, it is anticipated that there would be no impacts to archeological, historic, or cultural resources along the Endurance Array and RSN infrastructure. Site-specific surveys have been conducted to determine if any undiscovered resources are within the immediate vicinity of the proposed RSN cable and Endurance Array moorings. Based on these surveys, neither archeological resources, nor historic resources (e.g., historic shipwrecks, aircraft wrecks) are within the vicinity of the proposed RSN infrastructure and Endurance Array moorings. Therefore, there would be negligible impacts to archaeological and historic resources with implementation of the CSN (Endurance Array) and RSN components of the Proposed Action.

In the spring of 2010, communications were initiated between representatives of NSF and the potentially affected Washington State Tribes and Nations to discuss whether any cultural, archeological, or historic resources are present in the vicinity of the Grays Harbor Line of the Endurance Array. NSF representatives met with the Quinault Nation ("Nation") on July 7, 2010 to engage in a government-to-government consultation to address potential impacts to such resources. While the Nation has indicated that installation of the Grays Harbor Line within the area discussed in the SSEA is not likely to impact any cultural, archeological, or historic resources, the Nation and NSF have acknowledged that components of the Grays Harbor Line may, through the micro-siting process, ultimately be located within the Nation's U&A fishing areas, which were reserved by the Nation in the 1855 Treaty of Olympia. As such, NSF and the Nation are in the final stages of negotiating a Memorandum of Agreement to address such issues as the Nation's role in the micro-siting process; data sharing; opportunities for the Nation to submit proposals for services related to deployment, operations and maintenance of the Grays Harbor Line moorings and glider fleet; and efforts by NSF to develop and carry out educational experiences for the Nation's members. Therefore, implementation of the Proposed Action would result in negligible adverse effects to cultural resources. Because there are no known cultural resources within the vicinity of the RSN cable, there would be no impacts to cultural resources with installation and O&M of the RSN cable.

5.1.9 Socioeconomics (Fisheries)

The proposed installation and O&M activities of the CSN (Endurance Array) and RSN would have 2 potential impacts to commercial fisheries operations in the ROI: 1) presence of the cable installation vessel would preclude fishing activities within a limited area (approximately 1.6 km) for a temporary period (a few hours to several days), and 2) commercial fisheries that use equipment that contacts the bottom could potentially snag unburied portions of the cable or scientific sensors, causing damage to or loss of their fishing gear, or damage to the cable or scientific sensors on the seafloor.

Notice would be given to fishing vessels regarding the proposed CSN and RSN installation operations to reduce the potential for damage to fishing gear. No exclusions are proposed along the cable route, so interference would not occur between the cable installation vessel and commercial fisheries. Potential interference with commercial fishing activities could occur during cable and mooring installation operations, but these would be temporary and localized. As the cable vessel and installation operations progress, fishing activities would not be precluded along the entire proposed cable route or Endurance Array lines. Only small areas would not be available for fishing while the cable plow and cable-laying vessel are in a specific area.

The potential site-specific placement, or '*micro-siting*', of moorings within the identified study area for the Grays Harbor Line moorings and the Inshore Newport Line mooring is being coordinated with members of the public, including representatives of marine users and tribal nations. These include but are not limited to: Quinault Indian Nation, Coalition of Coastal Fisheries, Washington Dungeness Crab Fishermen's Association, Grays Harbor Marine Resources Committee, Oregon Dungeness Crab Commission, Oregon Trawl Commission, Oregon Albacore Commission, Oregon Salmon Commission, Midwater Trawlers Co-Op, FACT, Columbia River Crab Fishermen's Association, OFCC, FINE, Purse Seine Vessel Owners Association, Fishing Vessel Owners Association, and Pacific City Dorymen's Association. Coordinating with the public, including local marine users, regarding the micro-siting of each mooring will assist in addressing conflicts with regional fishing interests as well as ensuring that the mooring locations meet the scientific objectives of the CSN. Two micro-siting meetings were hosted by NSF and held in November 2010 (one in Westport, Washington and one in Newport, Oregon) to allow the public, including the fishing community, to provide input regarding potential impacts to access to fishing areas and the proposed buffer zones associated with the uncabled Endurance Array mooring sites. The meetings were well attended by the local fishing community. The public meetings allowed in-depth discussion between interested members of the public and OOI scientists to identify potential alternative siting locations for the proposed moorings based on bathymetry, known high-value fishing areas, and scientific objectives. The micro-siting process will continue through additional public meetings, if necessary, e-mail, and/or teleconferences.

Discussions have also been initiated regarding the establishment of buffer zones or 'watch circles' around OOI seabed sensors and moorings. Buffer zones would identify voluntary areas to be avoided by fishermen and other users to minimize the potential for gear entanglement or damage to OOI infrastructure. The buffer zones would be established in consultation with the USCG and the affected fishing communities. The size of these buffer zones would relate to water depths (larger buffer zones in deeper water). Currently, an approximate 0.2-nm radius buffer zone is under discussion for the two

Inshore Endurance Array sites off the coast of Washington and Oregon, and an approximate 0.5-nm radius buffer zone is under discussion for the Shelf and Offshore sites off the coast of Washington. The sites and associated buffer zones would be clearly charted on the electronic NOAA navigation charts, published in an NM and LNM, and through direct contact with user communities. There would be active radar transponders on surface buoys as well as required USCG markings; other markings are under consideration. Discussions are ongoing with members of the public, including the fishing community, regarding the proposed size and location of the proposed buffer zones and will continue as necessary to address further concerns. With the implementation of these on-going discussions with the fishing community to address potential impacts to area fisheries, there would be short- and long-term minor impacts to commercial fisheries with implementation of the Proposed Action.

In accordance with Oregon State law, Ocean Leadership and OFCC have entered into a formal agreement that would address concerns of the fishing industry regarding installation and operation of the RSN cable and potential impacts on fishing revenues from potential loss of gear associated with the installation and operation of the proposed RSN infrastructure off the coast of Oregon. Such agreements have been incorporated into the considerations and approvals of previous commercial fiber optic cable projects in Oregon coastal waters. They have provided a model for the preliminary discussions. With the implementation of the SOPs and the incorporation of an agreement between the OFCC and Ocean Leadership, there would be short- and long-term minor impacts to commercial fisheries with implementation of the Proposed Action.

5.2 MID-ATLANTIC BIGHT CSN (PIONEER ARRAY)

5.2.1 Geological Resources

Under the Proposed Action, potential impacts to geological resources from the proposed Pioneer Array would only be associated with the placement of 10 mooring anchors and associated sensors on the seafloor ~75 nm from shore. The placement of these anchors and sensors would result in short-term insignificant impacts to surface sediments in the immediate vicinity of the proposed Pioneer Array assets, and there would be no significant impacts to marine geological resources.

5.2.2 Air Quality

The Proposed Action is not located within the jurisdiction of any state and is also outside U.S. Territory. There are no emissions standards for vessels or activities operating beyond 12 nm of shore. Proposed activities would result in minor temporary emissions from surface vessels or surface buoys during installation and O&M activities of the Pioneer Array. However, these emissions would not represent a substantial increase above existing conditions as only a small number of vessels and surface buoys would be used. The proposed installation and O&M activities associated with the Pioneer Array would take place more than 75 nm from the shoreline of any state and therefore would not compromise air quality attainment status in New York, Rhode Island, Connecticut, and Massachusetts. Therefore, the Proposed Action would have a negligible impact on air quality within the ROI.

5.2.3 Water Quality

Proposed installation and O&M activities at the proposed Pioneer Array would not introduce any materials or substances into the marine environment that would adversely affect marine water quality. The only potential sources of hazardous materials would be unanticipated accidents or spills that resulted in a discharge of fuel, lubricants, or sensor components (e.g., batteries) from a project vessel or associated OOI equipment and sensors. Based on existing IO requirements and procedures for management of such materials on board vessels and the design of scientific equipment and sensors, such events are extremely unlikely to occur. If such a spill were to occur, it would be a localized occurrence, and adherence to standard containment, cleanup, and reporting requirements would assure that the effects are minimized. In addition, residual material would be dispersed by natural processes.

The project would not alter currents or circulation regimes. A minor and localized area for which the anchors, scientific sensors, and connecting cables would be placed would likely have some re-suspension of sediment, but these effects would be temporary. Therefore, there would be no impacts to water quality with implementation of the Pioneer Array component of the proposed OOI.

5.2.4 Cultural Resources

Under the Proposed Action, potential impacts to cultural resources from the proposed Pioneer Array would only be associated with the placement of 10 mooring anchors and associated sensors on the seafloor beyond 75 nm of shore. Prior to deployment of the proposed moorings and anchors, a site survey would be conducted within an approximate 1-km radius of each proposed anchor site to determine if any known or unknown cultural resources (e.g., shipwrecks) are within the vicinity. All obstructions and/or cultural resources would be avoided based on these surveys and after consulting the Automated Wreck and Obstruction Information System (AWOIS). Therefore, the placement of the proposed Pioneer Array would not result in significant impacts to cultural resources.

5.2.4 Marine Biological Resources

The vessels and activity associated with installation of 10 surface and subsurface moorings and associated scientific sensors on the sea floor may cause marine species to temporarily avoid the immediate vicinity of the proposed Pioneer Array, but this impact would not be significant due to the small scale and temporary nature of the proposed activities (estimated time to deploy a mooring with one vessel is 12-24 hours). The vessel used for mooring deployment would move very slowly (1-2 knots) during the activity and would not pose a collision threat to marine mammals. Entanglement of marine species is not likely because the rigidity of the mooring cables and the ability of marine species to detect and avoid the mooring lines. Once installed on the seabed, the proposed mooring anchors and scientific sensors would be equivalent to other hard structures on the seabed, again posing no risk of adverse effect on marine organisms.

Impacts from the placement of proposed mooring anchors or nodes, and cabled scientific sensors on the seafloor would include temporary mechanical disturbance of soft sediments, and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Based on the expected size and number of anchors and scientific sensors on the seafloor, ~30 m^2 of EFH would potentially be impacted during installation activities. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. The short-term and minor increases in turbidity and sedimentation would not affect the ability of EFH to support healthy fish populations and affected areas are expected to recover quickly. Therefore, the implementation of the proposed Pioneer Array would not have an adverse effect on EFH in the area.

The use of up to 6 gliders and 3 AUVs within a survey area around the Pioneer Array is not expected to affect marine species as the proposed gliders and AUVs would move within the water column similar to a dolphin or whale. Gliders are sealed, contain no motors, fuels, or hazardous materials; and move at very slow speeds (~0.5 knot), thereby eliminating the potential for collisions with marine mammals. AUVs also move at low speeds (~3.5 knots) with little potential for collisions with marine species. AUV batteries are sealed with little potential for leakage. Therefore, the use of gliders and AUVs associated with the proposed Pioneer Array would not have an adverse effect on marine species, including ESA-listed species, in the ROI.

The proposed active acoustic sources associated with the Pioneer Array would generally operate at frequencies much higher than those frequencies considered audible by fish and marine mammals. The ADV, BAP, and the ADCP would all operate at frequencies greater than 180 kHz, with most operating at frequencies greater than 200 kHz. For the HPIES, MBES, SBP, altimeters, acoustic modems, and tracking pingers operating at frequencies between 2 and 170 kHz, fish and marine mammals would not be disturbed by any of these proposed acoustic sources given their low duty cycles, the brief period when an individual animal would potentially be within the very narrow beam of the source, and the relatively low source levels of the HPIES, pingers, and acoustic modems. Therefore, implementation of the proposed deployment of the Pioneer Array is not expected to result in significant acoustic impacts to fish and marine mammals, including ESA-listed species.

The MMPA LOC issued by NMFS for the PEA is still applicable for the activities as proposed in this SSEA. Therefore, there would be no significant impacts to marine mammals with implementation of the Proposed Action. In their 2011 LOC regarding potential effects to ESA-listed species, NMFS concurred with NSF's determination that the proposed revisions to the installation and O&M of the OOI are not likely to adversely affect ESA-listed species. All conservation measures or other protective measures requested by NMFS in their Letters of Concurrence have been included in the SOPs for implementation of the proposed CSN (Pioneer Array) component of the OOI network.

5.2.5 Socioeconomics (Fisheries)

Pioneer Array Micro-Siting Process

In response to written and oral comments to the Draft SSEA regarding the potential placement of the proposed OOI Pioneer Array moorings, NSF initiated a process whereby the public, including the fishing community, could provide input to the site selection process, or micro-siting, for final mooring placement within the study areas analyzed in this SSEA. Stakeholder input to the micro-siting process for the Pioneer Array has occurred via meetings and/or e-mail. The initial determination of candidate sites where the moorings could be placed was made by scientists (supported by NSF) to meet the science/operational requirements. Coordinating with the public, including local marine users, regarding the micro-siting of each mooring, within the study area analyzed in this SSEA will assist in addressing regional fishing interests. These discussions are on-going and will continue after issuance of this Final SSEA until site-specific placements of the Pioneer Array moorings within the study area can be determined in a manner that considers the regional fishing interests and meets the science/operational requirements of the Pioneer Array.

The micro-siting of moorings within the identified study area for the Pioneer Array is being informed through a public process during which input from the public, including representatives of marine user stakeholders, is both sought and encouraged. Representatives of marine user stakeholders include, but are not limited to:

- Massachusetts Fishermen's Partnership
- Cape Cod Commercial Hook Fishermen's Association
- Commercial Fisheries Center of Rhode Island
- Ocean State Fisheries Association
- Rhode Island Lobstermen's Association
- Rhode Island Shellfishermen's Association

- Commercial Fisheries Research Foundation
- Rhode Island Fisherman's Alliance
- American Alliance of Fishermen and their Communities
- Mataronas Lobster Company, Inc.
- Sakonnet Lobster Company
- Eastern New England Scallop Association
- Trebloc Seafood, Inc.
- Colbert Seafood, Inc.
- Manomet Seafood, Inc.
- Broadbill Fishing, Inc.
- Garden State Seafood Association
- Atlantic Offshore Lobstermen's Association
- Long Island Commercial Fishing Association
- New England FMC
- Mid-Atlantic FMC

To date, NSF and Ocean Leadership have hosted 2 micro-siting meetings dedicated to the Pioneer Array moorings:

- October 5, 2010, Coastal Institute, Narragansett Bay Campus, University of Rhode Island
- November 15, 2010, Coastal Institute, Narragansett Bay Campus, University of Rhode Island

During all micro-siting meetings, OOI representatives provided an overview of the project including, but not limited to, the OOI science goals, equipment that is proposed for deployment, and subsequent data that will be available to the public. OOI representatives also outlined the science and operational requirements for mooring siting and described how the initial candidate mooring locations were determined.

Discussions have also been initiated regarding the establishment of buffer zones or 'watch circles' around the Pioneer Array moorings. Buffer zones identifying voluntary avoidance areas around the moorings would be established in consultation with the affected fishing communities. The diameters of these buffer zones relate to water depths (larger in deeper water). Currently, a 0.5-nm radius is being proposed for each of the Pioneer Array moorings. The sites would be published in the NM and LNM, clearly charted on NOAA navigation charts, and identified through direct contact with user communities. There would be active radar transponders on surface buoys as well as required USCG markings; other markings are under consideration. Discussions with the fishing community are ongoing and will continue as necessary to address further concerns (refer to Appendix G).

NSF has stated in public meetings that the agency has no interest in seeing fishing areas closed around or near proposed OOI moorings (either on the Endurance Array on the west coast or the Pioneer Array on the east coast), and will continue to emphasize this point with its USCG contacts, state officials, and the public. Specifically, NSF contacted the USCG First District, Waterways Management, Boston, Massachusetts, to get clarification on the potential for the USCG to restrict fishing around proposed Pioneer Arrays moorings. The USCG representative stated that USCG has no statutory authority to close off areas to fishing or navigation beyond the 12-nm limit.

During the October 5 and November 15 micro-siting meetings in Rhode Island, candidate locations for the Pioneer Array within the study area analyzed in the Draft SSEA were presented and the northeast fishing community requested a detailed, quantitative socioeconomic analysis. In addition, they requested assurance that the Pioneer Array region would not be closed to fishing. During the November 15 meeting, NSF made the following statement in an effort to address concerns about fisheries closures in the area of the Pioneer Array: *NSF is stating that the agency has no interest in seeing fishing areas closed by deploying OOI, and will continue to emphasize this point with its US Coast Guard contacts, state officials, and the public.* Additional micro-siting meetings are being planned for the northeast and these meetings will occur after the Final SSEA, inclusive of the SIAR, has been published. The micro-siting process will continue through additional public meetings, e-mail, and/or teleconferences as necessary.

With the implementation of these on-going discussions with the fishing community in a manner that considers potential impacts to area fisheries, there would be short- and long-term minor impacts to commercial fisheries with implementation of the Proposed Action.

Socioeconomic Impact Analysis Report (SIAR)

In accordance with the PEA (NSF 2008) regarding the need for additional detailed assessment of the proposed OOI at the site-specific stage, to support a previous qualitative analysis, and in response to public comments on the Draft SSEA, the SIAR was prepared to provide quantitative verification of the qualitative analysis of potential impacts to socioeconomics (fisheries) from the installation and O&M of the proposed Pioneer Array as set forth in the Draft SSEA. A summary of the SIAR is presented below; the full SIAR is found in Appendix I.

The SIAR estimated the benefits and costs of the proposed installation and O&M of the proposed Pioneer Array. The Pioneer Array would be comprised of a series of 10 relocatable moorings in 7 mooring locations approximately 68 nm south of Martha's Vineyard, Massachusetts. Although gliders and AUVs would run missions in the vicinity of the moored array, they are assumed to not have an impact on fisheries. Therefore, the economic analysis within the SIAR focused on the Pioneer Array moorings only and specifically on the proposed 0.5-nm radius buffer zone around each mooring.

The SIAR concluded that the Pioneer Array would produce very modest costs and likely no costs in the future as fishermen adapt to the location of the moorings and buffer zones (Table 2). While net present value (NPV) is calculated in the summary section, the result contains many uncertainties. Over the proposed 5-year life of the Pioneer Array in this proposed location, benefits to society would have to exceed $11.3 million per year after the first year to produce a slightly positive NPV over the 5-year life of the array in this location. It is likely that benefits will exceed this value, but it may take several years for them to begin to accrue. Either way, the vast majority of the project costs are in design, installation and operation and the actual avoidance costs represent a very small portion, less than 0.01% at the upper bound level of avoidance cost, of the $47.9 million cost of the Pioneer Array over 5 years. Even under the most conservative assumptions across the most conservative additional operating cost scenario, installation and operation of the Pioneer Array does not constitute a significant impact on harvesters or shoreside businesses supported by their fishing activity in the area of the proposed buffer zones. Therefore, the SIAR did provide quantitative verification of the conclusions in the Draft SSEA's qualitative analysis of socioeconomic impacts. Accordingly, there will be no significant socioeconomic impacts as a result of implementation of the Pioneer Array.

Table 2. Summary of Potential Economic Impacts of the Proposed Pioneer Array

Sector		Potential Impact Value	Potential Impact Per Vessel Per Trip
Commercial Fishing	Revenue at risk - According to the NMFS economic analysis guidelines, revenue at risk is often used when operating cost calculations cannot be made. Therefore, this estimate is an extreme upper bound	$25,386	$1,692
	Lower bound avoidance cost – This scenario assumes that only the 15 trips estimated to occur directly in the buffer zones incur any additional avoidance costs and that those additional costs involve relocating their gear set by 1 nm to avoid the buffer zone.	$162	$11
	Upper bound avoidance cost – This scenario assumes that all 666 trips in all three 10-min squares containing buffer zones will avoid the entire 10-min square containing the buffer zone and includes the cost of moving the set of their gear by the width of the 10-min square where the effort occurred.	$40,676	$61
For-Hire Recreational	No trips will be impacted by the operation and installation of the Pioneer Array.	$0	$0
Private Recreational	No trips will be impacted by the operation and installation of the Pioneer Array.	$0	$0

5.3 GLOBAL SCALE NODES (GSN)

The Proposed Action would only involve the elimination of one GSN site (Mid-Atlantic Ridge) from proposed installation by 2015, thereby reducing the potential impacts, and would not add any infrastructure or activities that were not previously assessed in the PEA and SER. As the affected environment discussion and impact analysis were regional in nature given the large area of proposed activities and lack of site-specific data for each site, the impact analysis conducted for the GSN sites under the PEA and SER is still applicable for the proposed implementation of the Proposed Action. Therefore, additional impact analysis is not necessary within this SSEA for the proposed installation and O&M of the GSN sites. In addition, the PEA, SER, and this Final SSEA meet the requirements of Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*.

5.4 CUMULATIVE IMPACTS

CEQ regulations (40 CFR 1500 – 1508) implementing the provisions of NEPA, as amended (42 USC 4321 et seq.) provide the definition of cumulative impacts. Cumulative impacts are defined as:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7)

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. A cumulative impact results from the additive effect of all projects in the same geographical area. Generally, an impact can be considered cumulative if: a) effects of several actions occur in the same locale, b) effects on a particular resource are the same in nature, and c) effects are long-term in nature. The common factor key to cumulative assessment is identifying any potential temporally and/or spatially overlapping or successive effects that may significantly affect individual or populations of marine resources occurring in the analysis areas.

5.4.1 Resource Considerations

Certain resources do not need to be considered for cumulative impacts because either a) the effects of the proposed action would be so small and localized that the potential additive effects with other actions would be negligible; or b) the effects of the proposed action would be limited sufficiently by statutory or regulatory requirements and procedures that potential additive effects would again be negligible. These include the following:

- *Air Quality*. Emissions from the Proposed Action would be minimal in comparison with other local and regional sources and would be transitory during installation and use of the proposed systems. Local air basin jurisdictions establish emissions thresholds for significance and mitigation that help ensure that individual project emissions do not individually or cumulatively have a significant impact on air quality. Emissions from the Proposed Action would be below levels of significance and do not involve permanent stationary sources. In the offshore waters, emissions from proposed activities would involve relatively small quantities of pollutants produced by project vessels; such emissions would be transient and rapidly dispersed. Therefore, no significant cumulative impacts to air quality would occur.
- *Geology and Water Quality*. Effects of the Proposed Action are sufficiently small in magnitude and limited in extent that potential additive effects are negligible. Potential water quality impacts are also limited by CWA requirements for permitting, which would be followed for onshore and in-water construction. Therefore, no significant cumulative impacts on geological resources and water quality would occur.
- *Transportation*. Marine transportation effects would be minimized by coordination with local coastal authorities and the avoidance of heavily used vessel transit corridors, the latter by design of the system. Publication of mooring, cable, and AUV/glider assets on NM and LNM would be used to minimize the potential conflicts with other vessels, during installation, and the depiction of the structures on NOAA navigation charts would minimize conflicts thereafter. Surface buoys or other structures would be marked in accordance with USCG regulations and readily avoidable. Therefore, there would be no significant cumulative impacts on transportation.
- *Hazardous Materials*. The only potential sources of hazardous materials would be unanticipated accidents or spills that resulted in a discharge of fuel, lubricants, or sensor components (e.g., batteries) from a project vessel or associated OOI equipment and sensors. Based on existing requirements and procedures for management of such materials on board vessels and the design of scientific equipment and sensors, such events are extremely unlikely to occur. If such a spill were to occur, it would be a localized occurrence, and adherence to standard containment, cleanup, and reporting requirements would assure that the effects are minimized. In addition, residual material would be dispersed by natural processes, but the potential for additive effects with other discharges of hazardous materials in the same location(s) is considered negligible. Significant cumulative impacts would not occur.
- *Cultural Resources*. Site-specific evaluations and compliance with the requirements of the National Historic Preservation Act would ensure that the Proposed Action no significant impacts on properties listed or potentially eligible-for-listing on the National Register of Historic Places would occur. There are no additional impacts on cultural resources from other past, present, or reasonably foreseeable activities within the ROI. Therefore, no significant cumulative impacts to cultural resources would occur.
- *Terrestrial Resources at Shore Stations*. Project SOPs would ensure that any new onshore construction would have minimal or no impact on sensitive natural resources. Since the proposed

shore stations are on previously developed and disturbed sites on the immediate coast, the impacts on land are essentially contained within an existing "footprint" and there is little to no potential for cumulative effects with development or other activities onshore. Implementation of BMPs in conjunction with obtaining coverage under the NPDES general permit for construction would effectively avoid potential cumulative effects on surrounding lands and waters. Finally, the permitting for the new infrastructure onshore would address consistency with zoning requirements, local land uses, and resources of the adjacent coastal areas. Therefore, no significant cumulative impacts would occur at the proposed shore station location.

- *Marine Biology*. Marine biological resources, including the species and communities of marine benthic, water column, and surface water habitats affected by the Proposed Action, are subject to potential cumulative impacts through the incremental effects of multiple actions on habitats, species' populations, or ecological processes. Cumulative effects on habitats can result from incremental degradations and losses that ultimately diminish the capacity of the habitat to support species, communities, and ecological processes. Owing to the dispersal of populations, incremental effects on species at one location can interact with effects occurring elsewhere to affect the overall distribution and abundance of the species. Based on the analyses in the PEA, SER, and SSEA, however, there are no significant impacts on marine biological resources anticipated.
- *Socioeconomics (Fisheries)*. Potential cumulative effects on Socioeconomics (Fisheries) reflect primarily the potential for structures installed on the seabed and within the water column to interfere with commercial fishing. These potential impacts would be reduced, but not eliminated, through coordination with the public, including local fishing groups, as part of the Proposed Action. Based on the additional quantitative analysis within the SIAR, however, there are no anticipated significant socioeconomic impacts.

5.4.2 Cumulative Impacts Analysis Summary

CSN (Endurance Array) and RSN. Installation and use of the Grays Harbor and Newport lines of the Endurance Array would entail relatively small, localized areas of disturbance to the seabed during installation. The extent of disturbance to the seabed associated with the RSN is of wider extent, but still affects a very small area of the seabed in any particular location. Disturbance would be predominantly in soft-sedimentary habitats, which are subject to natural disturbances (bioturbation by fishes and invertebrates) and strong sediment deposition and transport in the dynamic cross-shelf environment. These natural phenomena ensure that alterations of the soft-bottom habitat are temporary. Once in place, the permanent structures of the RSN would either remain buried or provide hard surfaces for attachment and sheltering of fishes and invertebrates, a beneficial effect. Overall, cumulative effects on marine biological resources would be insignificant.

The CSN (Endurance Array) and RSN structures could potentially interfere with commercial fishing to varying degrees, depending on gear type, and in conjunction with restrictions imposed under the Fishery Management Plans. Coordination with the local fishing community would reduce these potential impacts, and it is possible that the presence of structures may contribute to resource sustainability by providing localized refuges from fishing. Overall, however, because of the expanding, incremental loss of access to fishing grounds due to the placement of structures on the seabed and in the water column, the potential exists for the proposed action to have cumulative effects on commercial fishing. Such impacts could be mitigated by the finalization of fishing agreements with the affected parties (i.e., OFCC) to a level of insignificance.

CSN (Pioneer Array). For the same reasons discussed above for the Endurance Array, the proposed Pioneer Array would have negligible cumulative effects on marine biological resources. Potential effects would be negligible due to the extremely small "footprints" of the array components (surface and subsurface mooring buoys). The Pioneer Array is proposed as a relocatable array that may be moved to another location 3-5 years after its initial proposed deployment as covered under the Proposed Action. The movement of the Pioneer Array, including the retrieval of assets from the proposed location south of Massachusetts, would be covered under a separate NEPA document. However, it is not expected that the retrieval or redeployment of the Pioneer Array would have any cumulative effects based on the current analysis.

GSN. Use of the proposed GSN sites would impact relatively small areas of the seabed, water column, and ocean surface of relatively remote areas. With the wide dispersion of research and other activities across these areas, no significant cumulative effects are anticipated.

6.0 CONCLUSION

The attached SSEA was prepared and evaluated pursuant to NEPA and in accordance with CEQ regulations at 40 CFR 1500-1508, and NSF's NEPA implementing regulations at 45 CFR Part 640. I have concluded that, based on the analyses contained in the PEA, SER, and SSEA, the installation and O&M of the OOI as proposed would not result in any significant direct, indirect, or cumulative impacts. Nor does not it constitute a "major Federal action significantly affecting the quality of the human environment" when considered individually or cumulatively in the context of NEPA. Therefore, no further study under NEPA is required, and a Finding of No Significant Impact is thus warranted. NSF's compliance with the National Historic Preservation Act, Marine Mammal Protection Act, Endangered Species Act, and Coastal Zone Management Act has also been completed. In addition, in light of the analyses in the PEA and SER, there are no significant impacts as a result of the installation of the GSN and, therefore, no further environmental analyses under EO 12114 are required. Accordingly, I hereby approve the installation and operation of the OOI as described in the SSEA.

David Conover
Director, Ocean Sciences Division
National Science Foundation

1/31/2011
Date