VINEYARD NORTHEAST

CONSTRUCTION AND OPERATIONS PLAN
VOLUME I APPENDIX

MARCH 2024

PREPARED BY:

Epsilon
ASSOCIATES INC.

SUBMITTED BY:

VINEYARD NORTHEAST LLC

VINEYARD OFFSHORE

PUBLIC VERSION

Vineyard Northeast COP

Appendix I-F Draft Oil Spill Response Plan

Prepared by:
RPS

Prepared for:
Vineyard Northeast LLC

March 2024

Revision	Date	Description
0	July 2022	Initial submission.
1	April 2023	Updated to address Bureau of Ocean Energy Management (BOEM), Bureau of Safety and Environmental Enforcement (BSEE), and United States Coast Guard (USCG) Round 1 Comments (dated January 13, 2023) and Round 2 Comments (dated March 1, 2023) and made other minor revisions.
2	December 2023	Updated to address BOEM and BSEE Round 5 Comments (dated November 8, 2023) and made other minor revisions.
3	March 2024	Made minor revisions.

DRAFT

OIL SPILL RESPONSE PLAN

For

VINEYARD NORTHEAST LLC

OCS-A 0522

March 2024

Response Plan Cover Sheet

A Response Plan Cover Sheet, presenting basic information regarding Vineyard Northeast is provided below:

Owner/operator of facility:	**Vineyard Northeast LLC**		
Facility name:	**Vineyard Northeast**		
Facility mailing address:	**200 Clarendon Street, 18th Floor, Boston, MA 02116**		
Facility phone number:	**TBD**	Latitude:	**N 40.682**
SIC code:	**4911**	Longitude:	**W -70.228**
Dun and Bradstreet number: TBD			
Largest aboveground oil storage capacity (gals):	**215,616 for Electrical Service Platform [ESP]**	Maximum oil storage capacity (gals):	**236,754 (per ESP)**
Number of aboveground oil storage tanks:	**2 units per ESP**	Worst case oil discharge amount (gals):	**236,754 (per ESP)**

Facility distance to navigable water. Mark the appropriate line:

0-1/4 mile:		1/4-1/2 mile:		1/2-1 mile		**> 1 mile:**	**X**

Applicability of Substantial Harm Criteria:				
Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons?	**YES**	**X**	NO	
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and, within any storage area, does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation?	YES		**NO**	**X**
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments?	YES		**NO**	**X**
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance such that a discharge from the facility would shut down a public drinking water intake?	YES		**NO**	**X**
Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years?	YES		**NO**	**X**

Management Certification

This plan has been developed for Vineyard Northeast to prevent and/or control the spills of oil. Vineyard Northeast LLC herein commits the necessary resources to fully prepare and implement this plan and has obtained through contract the necessary private personnel and equipment to respond, to the maximum extent practicable, to a worst case discharge or substantial threat of such a discharge.

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and that based on my inquiry of those individuals responsible for obtaining information, I believe that the submitted information is true, accurate and complete.

Signature: ______________________________ Title: ______________________________

Name: ______________________________ Date: ______________________________

Plan Distribution

Plan Number	Plan Holder	Location
1	Qualified Individual	200 Clarendon Street, 18th floor Boston, MA 02116
2	Alternate Qualified Individual	200 Clarendon Street, 18th floor Boston, MA 02116
3	Operations Center	TBD
4	BOEM Gulf of Mexico OCS and Atlantic Activities	BOEM Atlantic OCS Region 1201 Elmwood Park Boulevard New Orleans, LA 70123-2394
5	Bureau of Safety and Environmental Enforcement (BSEE) Supervisor – Oil Spill Preparedness Division Gulf of Mexico Region OSP Section – GE 921	BSEE Oil Spill Preparedness Division Gulf of Mexico Region OSP Section – GE 921 1201 Elmwood Park Boulevard New Orleans, LA 70123-2394
6	EPA Region 1	EPA Region 1 Emergency Planning and Response Branch 5 Post Office Square Suite 100 (OSRR02-2) Boston, MA 02114-2023
7	USCG First Coast Guard District (D1)	USCG D1 408 Atlantic Avenue Boston, MA 02110
8	USCG Sector Southeastern New England	USCG Sector Southeastern New England 30 Little Harbor Road Woods Hole, MA 02543
9	USCG Sector Long Island Sound	USCG Sector Long Island Sound 120 Woodward Avenue New Haven, CT 06512
10	Massachusetts Department of Environmental Protection (MassDEP)	MassDEP 1 Winter Street Boston, MA 02108
11	Connecticut Department of Energy and Environmental Protection (DEEP)	CT DEEP 79 Elm Street Hartford, CT 06106

30 CFR 254.30(a): OSRP Review

Date	Name of Reviewer &Title	Signature

30 CFR 254.30(b): Revision Record

Revision Number	Revision Date	Pages and/or Sections Affected	Description of Revision

Table of Contents

List of Figures

List of Tables

Annex List

List of Acronyms

ACP	Area Contingency Plan
AQI	Alternate Qualified Individual
bbls	Barrels
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
COP	Construction and Operations Plan
COTP	Captain Of The Port
CFR	Code of Federal Regulations
CT	Connecticut
CT DEEP	Connecticut Department of Energy and Environmental Protection
CTV	Crew Transfer Vessels
DOI	Department of the Interior
EPA	Environmental Protection Agency
ERMA	Environmental Response Management Application
ESI	Environmental Sensitivity Index
ESP	Electrical Service Platform
FOSC	Federal On-Scene Coordinator
gals	Gallons
GRP	Geographic Response Plan
GRS	Geographic Response Strategy
ICS	Incident Command System
IMT	Incident Management Team
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MW	Megawatt
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NIMS	National Incident Management System
NOAA	National Oceanic & Atmospheric Administration
NRC	National Response Center
OCS	Outer Continental Shelf
OECC	Offshore Export Cable Corridor
O&M	Operation and Maintenance
OSHA	Occupational Safety & Health Administration
OSPD	Oil Spill Preparedness Division
OSRO	Oil Spill Removal Organization
OSRP	Oil Spill Response Plan
OSRV	Oil Spill Recovery Vessel
PDE	Project Design Envelope

POI	Point of Interconnection
PPE	Personal Protective Equipment
QI	Qualified Individual
RCP	Regional Contingency Plan
RRT	Regional Response Team
SERO	Southeast Regional Office of Massachusetts Department of Environmental Protection
SHPO	State Historical Preservation Officer
SOSC	State On Scene Coordinator
SOV	Service Operations Vessels
SPCC	Spill Prevention, Control, and Countermeasures
TBD	To Be Determined
UC	Unified Command
USCG	United States Coast Guard
Vol	Volume
WEA	Wind Energy Area
WTG	Wind Turbine Generators

1. Plan Introduction Elements

1.1 Purpose and Scope of Plan Coverage

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." Vineyard Northeast includes up to 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. Up to three of those positions will be occupied by ESPs[1] and the remaining positions will be occupied by WTGs. The WTGs and ESP(s) will be oriented in fixed east-to-west rows and north-to-south columns with one nautical mile (1.9 km) spacing between positions. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut. The Lease Area is within the Massachusetts/Rhode Island Wind Energy Area (MA/RI WEA) identified by BOEM, following a public process and environmental review, as suitable for wind energy development.

The Lease Area is approximately 46 kilometers (km) (29 miles [mi]) from Nantucket, just over 64 km (40 mi) from Martha's Vineyard, and approximately 193 km (120 mi) from Stonington, Connecticut. The closest WTG/ESP position within the Lease Area is approximately 49 km (31 miles) from Nantucket and approximately 63 km (39 miles) from Martha's Vineyard. While the final ESP locations have not yet been determined, two representative locations at the northeast and southwest corners of the Lease Area were selected for analysis. One of the representative ESP locations (ESP 1) is located approximately 66 km (41 mi) from Martha's Vineyard and 51 km (32 mi) from Nantucket, while a second representative ESP location is located approximately 87 km (54 mi) from Martha's Vineyard and 83 km (52 mi) from Nantucket. These two representative ESP locations provide an Envelope for the up to three ESPs that could be installed at any location in the Lease Area. These sites are displayed in Figure 1-1. Additionally, if high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[2] of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket.

This OSRP does not include response actions for Vineyard Northeast-related vessels operating within the Lease Area as it is anticipated that such vessels would manage a spill based on their Vessel Response Plans.

---

[1] If two or three ESPs are used, they may be located at separate positions or two of the ESPs may be co-located at the same grid position. Co-located ESPs would be smaller structures installed on monopile foundations.

[2] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

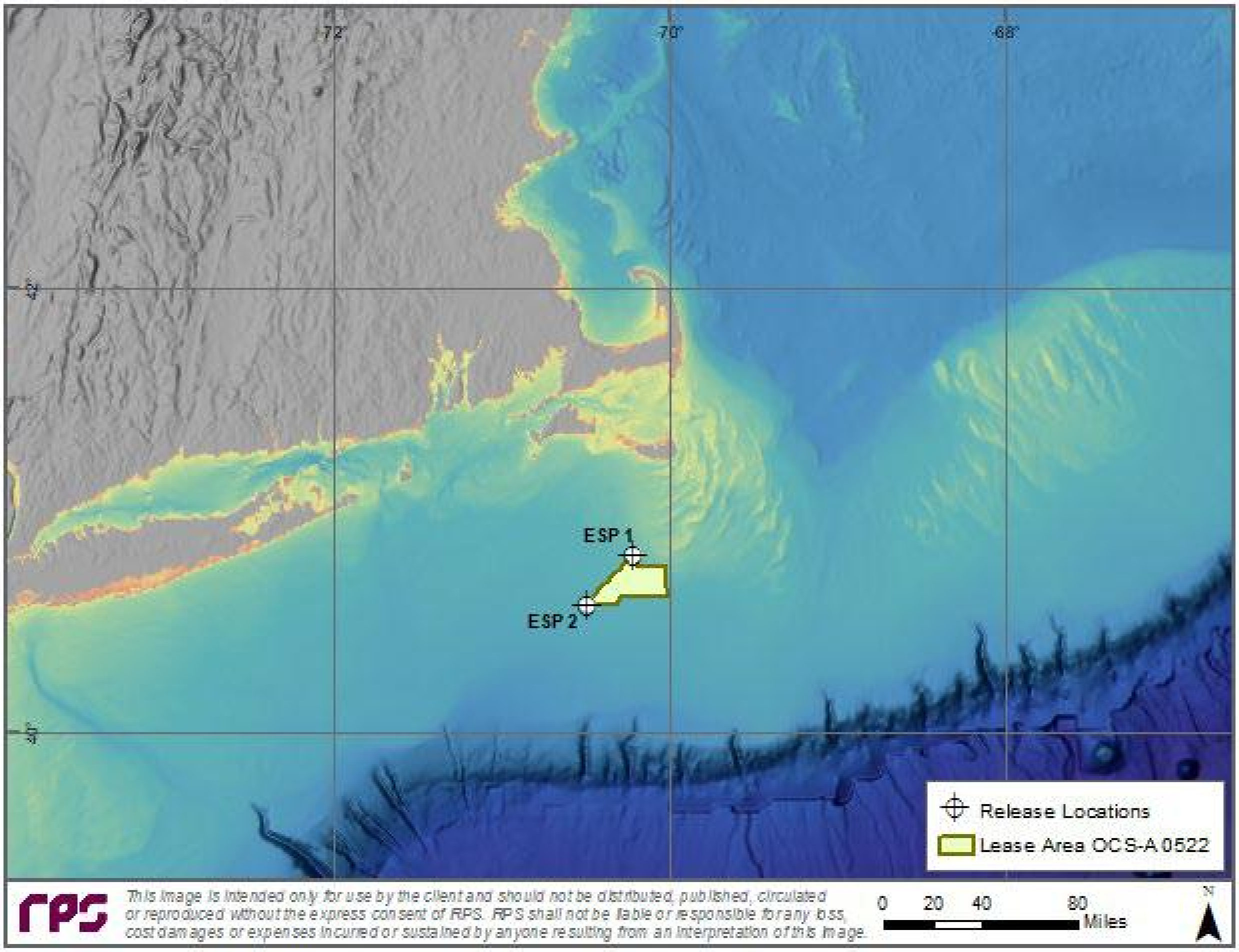


Figure 1-1. Shallow continental shelf surrounding the region of the proposed Vineyard Northeast facility. The white markers represent potential electrical service platform (ESP) locations (ESP 1 and ESP 2).

This Oil Spill Response Plan (OSRP) covers Vineyard Northeast's offshore facilities. The OSRP provides clear notification and activation procedures and identifies shore-based resources to respond to an oil spill or the substantial threat of an oil discharge from any Vineyard Northeast wind turbine generator (WTG) ESP, or booster station. This OSRP describes the oil spill response for spills from the WTGs and ESPs located in the Lease Area. This current OSRP is a draft plan. The OSRP will be finalized for Bureau of Safety and Environmental Enforcement (BSEE), an agency of the Department of the Interior (DOI), and BOEM review and approval prior to construction.

The Lease Area will occupy 536 km^2 (132,370 acres). The worst case oil discharge associated with Vineyard Northeast is conservatively assessed as a catastrophic discharge of all oil contents from the topple of an ESP located closest to shore.

The oil sources in the WTGs include transformer oil, drive train main bearing oil, hydraulic oil, and grease (which could be hydrocarbon-based), which total approximately 6,604 gallons for the largest WTG. Oil sources in the ESPs include diesel oil from the emergency generator, diesel engine, and fuel oil storage tank and naphthenic oil from the emergency generator, platform crane, power transformers, reactors, auxiliary/earthing transformers, and other general sources. The oil sources associated with one ESP total approximately 236,754 gallons (5,637 barrels [bbl]). The oil sources associated with one booster station are similar to that of an ESP and total approximately 185,978 gallons (4,428 bbl).

The Lease Area is located in the Outer Continental Shelf (OCS), as defined by 30 CFR 254.6 and Section 2 of the Submerged Lands Act (43 U.S.C. 1301). Therefore, this plan was written in accordance with the requirements of 30 CFR 254, Subpart B, Oil Spill Response Plans for Outer Continental Shelf Facilities. The OSRP demonstrates that Vineyard Northeast can respond effectively in the unlikely event that oil is discharged in the Lease Area. As required by 30 CFR 254.22(d), Table 1-1 provides a cross-reference matrix of the location in this OSRP where all of the 30 CFR 254 requirements can be found.

Table 1-1. OSRP Cross-Reference Matrix.

Oil Spill Response Plans for Outer Continental Shelf Facilities 30 CFR 254, Subpart B		Plan Reference
254.21(b)(1)	Table of Contents	Table of Contents
254.21(b)(2)	Emergency response action plan	Annex 3
254.21(b)(3)(i)	Equipment response inventory	Annex 8
254.21(b)(3)(ii)	Contractual agreements	Annex 7
254.21(b)(3)(iii)	Worst case discharge scenario	Annex 6
254.21(b)(3)(iv)	Dispersant use plan	OSRP Section 2.7
254.21(b)(3)(vi)	In situ burning plan	OSRP Section 2.8
254.21(b)(3)(vi)	Training and drills	Annex 5
254.22(a)	Facility location and type	OSRP Section 1.3
254.22(b)	Table of Contents	Table of Contents
254.22(c)	Record of changes	OSRP Page v
254.23(a)	Designation of QI	OSRP: Section 2.2, Table 2-2, Section 2.3
254.23(b)	Designation of spill management team	OSRP Section 2.2.2
254.23(c)	Spill response operating team	OSRP Section 2.2.2
254.23(d)	Spill response operation center	OSRP Section 2.2.2
254.23(e)	Oil stored, handled, or transported	Annex 6
254.23(f)	Procedures for early detection of a spill	OSRP Section 2.1 and 2.4.1
254.23(g)(1)	Spill notification procedures	OSRP Section 2.2 Annex 2
254.23(g)(2)	Methods to detect/predict spill movement	OSRP Section 2.1 and 2.4.1
254.23(g)(3)	Methods to prioritize areas of importance	OSRP Section 2.5
254.23(g)(4)	Methods to protect areas of importance	OSRP Section 2.5
254.23(g)(5)	Containment and recovery equipment deployment	OSRP Section 2.5
254.23(g)(6)	Storage of recovered oil	OSRP Section 2.6

Oil Spill Response Plans for Outer Continental Shelf Facilities 30 CFR 254, Subpart B		Plan Reference
254.23(g)(7)	Procedures to remove oil and oil debris from shallow waters	OSRP Section 2.4
254.23(g)(8)	Procedure to store, transfer, and dispose of recovered oil and oil-contaminated materials	OSRP Section 2.6
254.23(g)(9)	Methods to implement dispersant use plan and in situ burning plan	OSRP Section 2.7 and 2.8
254.24(a)	Inventory of spill response resources	Annex 8
254.24(b)	Procedures for inspecting and maintaining spill response equipment	Annex 8
254.25	Contractual agreements	Annex 7
254.26(a)	Volume of worst case discharge	Annex 6
254.26(b)	Trajectory analysis	Annex 10
254.26(c)	List of special economic and environmentally important resources	OSRP Section 2.4.2
254.26(d)(1)	Response equipment	Annex 8
254.26(d)(2)	Personnel, materials, and support vessels	OSRP Section 2.10
254.26(d)(3)	Oil storage, transfer, and disposal equipment	Annex 8
254.26(d)(4)	Estimation of time to mobilize	OSRP Section 2.10
254.26(e)	Suitability of response	OSRP Section 2.9
254.27	Dispersant use plan	OSRP Section 2.7
254.28	In situ burning plan	OSRP Section 2.8
254.29(a)	Training	Annex 5
254.29(b)	Drills	Annex 5
254.30	Revision of OSRP	OSPR Page v

The purpose of this OSRP is to provide a written procedure for directing a plan of action in the event of a discharge of oil in the Lease Area. The discharge may be the result of a spill, accident, natural disaster, or civilian threat. This OSRP adopts procedures to allow for a uniform plan of action that will assist in a systematic and orderly manner of response to any oil discharge incident. This plan of action will minimize confusion and indecision, prevent extensive damage to Vineyard Northeast or injury to personnel, and minimize exposure to personnel within or outside of the Lease Area. Routine training and exercises regarding the content of this plan will provide the confidence needed for employees to perform their assigned duties if such an event occurs. Designated Qualified Individual (QI) and Alternate Qualified Individuals (AQI) are considered Emergency Coordinators. In addition, a Spill Response Coordinator and alternate Spill Response Coordinator will be identified to lead any spill response effort. Personnel, through the use of this OSRP, will utilize all resources necessary to bring any discharge under control. In order to prepare for such control, all personnel will be well trained and knowledgeable as to their various roles during an incident.

The OSRP was prepared considering the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR §300), or NCP, the Region I Regional Response Team (RRT) Regional Contingency Plan

(RCP), the Sector Long Island Sound Area Contingency Plan (ACP), and the Rhode Island and Southeastern Massachusetts ACP. This ACP is also commonly referred to as the Southeastern New England Area Contingency Plan. Because of the location of Vineyard Northeast, either of these ACP Planning Areas could be impacted by a spill.

- The RRT1 RCP is available at: https://www.nrt.org/sites/38/files/2021%20Regional%20Contingency%20Plan.pdf
- The Rhode Island and Southeastern Massachusetts ACP is available at: https://homeport.uscg.mil/Lists/Content/Attachments/2471/2020 SEMA and RI Area Contingency Plan.pdf
- The Sector Long Island Sounds ACP is available at: https://homeport.uscg.mil/Lists/Content/Attachments/65980/SLIS_ACP_2016_2.0.pdf

The location of the Vineyard Northeast Lease Area offshore of Martha's Vineyard, Massachusetts is within the Rhode Island and Southeastern Massachusetts ACP Planning Area and under the U.S. Coast Guard (USCG) Federal On-Scene Coordinator (FOSC) at Sector Southeast New England. This location is only a short distance from the Long Island Sound ACP Planning Area which is under the USCG FOSC at Sector Long Island Sound. The Lease Area is wholly within Region 1 for the RRT and Region 1 for the Environmental Protection Agency (EPA). However, an oil spill from Vineyard Northeast could impact Long Island which is covered by Region 2 and the USCG FOSC at Sector New York. Figure 1-2 shows the relation of the Lease Area to these regulatory areas. The locations of the USCG Districts are provided in Figure 1-3.

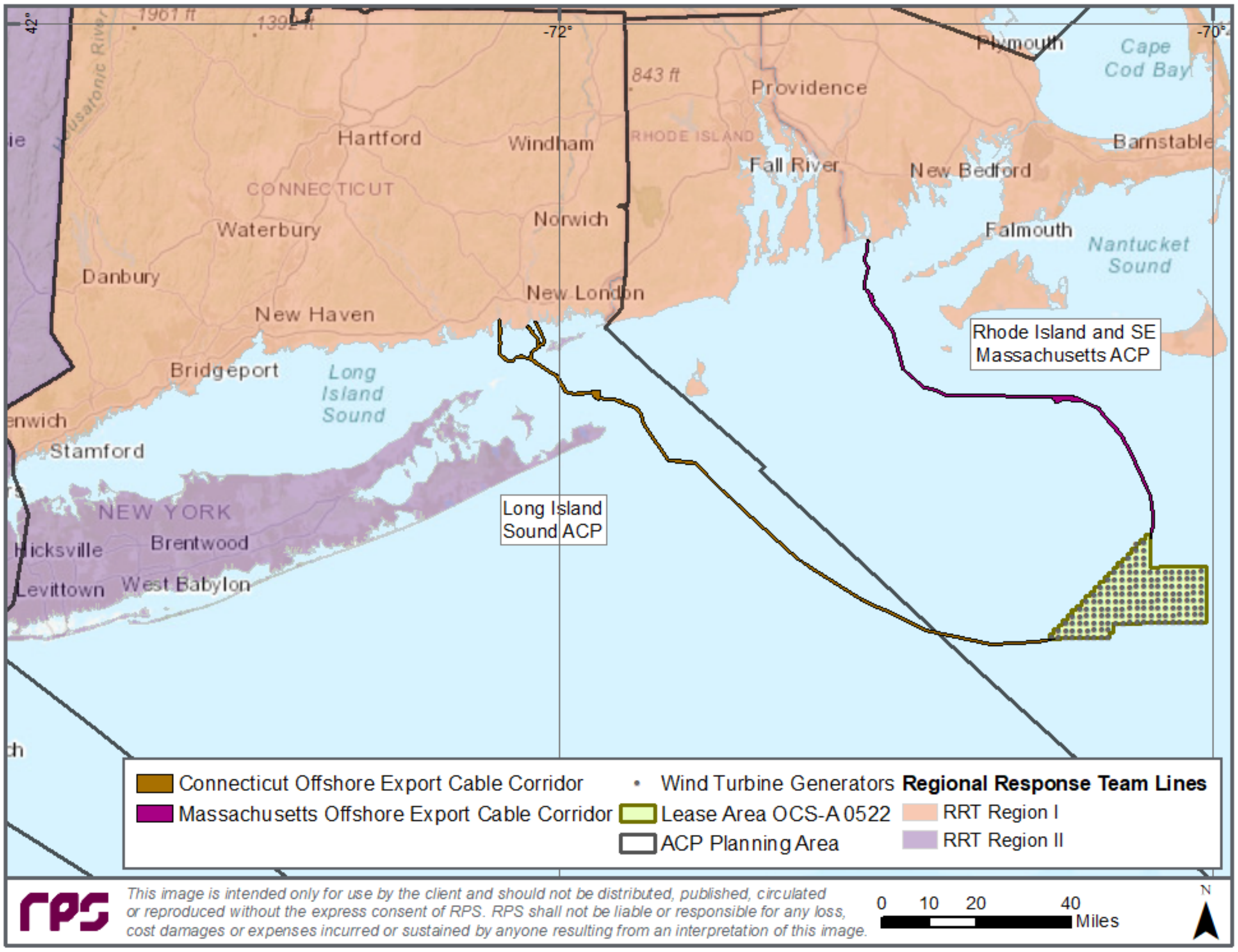


Figure 1-2. Vineyard Northeast OCS-A 0522 Lease Area in relation to federal regulatory areas.

Figure 1-3. Location of USCG Districts and Areas (from www.boatharbors.com).

Pursuant to 30 CFR 585.627(c), as part of the requirement to submit an Oil Spill Response Plan (OSRP) in accordance with 30 CFR 254.1, the OSRP should include:

> "An appropriate trajectory analysis specific to the area in which the facility is located. The analysis must identify onshore and offshore areas that a discharge potentially could affect. The trajectory analysis chosen must reflect the maximum distance from the facility that oil could move in a time period that it reasonably could be expected to persist in the environment."

This analysis is included in this OSRP as Annex 10. From the Large ESP (ESP 1), this study showed that there would be a less than 10% probability that oil above a minimum thickness of 100 μm (100 g/m^2 on average over the grid cell) would reach the shorelines of Nantucket within three to five days of the spill for the spring, summer, and fall scenarios. In the winter season, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 μm (100 g/m^2 on average over the grid cell). However, due to the close proximity of Connecticut and Long Island, New York to the Lease Area, Vineyard Northeast is prepared to make all appropriate notifications in the event these areas are threatened. During an incident that impacts more than one region, a lead RRT would be agreed upon to provide guidance. For a response impacting these additional areas, the FOSCs from the appropriate Coast Guard Sectors could be involved in the response with the USCG Sector Southeastern New England FOSC as the lead.

The OSRP is consistent with the RCP and ACPs as it provides a method and process for communication, coordination, containment, removal, and mitigation of pollution and other emergencies. The preparation of this plan utilized the detailed information provided in the Region 1 RCP, the Rhode Island and Southeastern Massachusetts ACP, and the Sector Long Island Sound ACP. The specific guidelines presented in this plan have been carefully thought out, prepared in accordance with safe practices, and are intended to prepare personnel to respond to oil spills and other environmental emergencies. Vineyard Northeast commits to provide and coordinate the necessary resources to implement this plan.

Specifically, this OSRP:

- Identifies the QIs or Person in Charge having full authority to implement this response plan;
- Requires immediate communication with the appropriate federal, state, and local officials, and entities/persons providing personnel and equipment;
- Identifies, and ensures by contract or other means, the availability of personnel and equipment necessary to remove a worst-case discharge and mitigate or prevent a substantial threat of such a discharge; noting that the specific Oil Spill Removal Organizations (OSROs) need to be selected; and
- Describes training, equipment testing, periodic unannounced drills, and response actions.

1.2 Regulatory Applicability

The NCP, RRT 1 RCP, the Rhode Island and Southeastern Massachusetts ACP, and the Long Island Sound ACP were reviewed, and this plan was written to comply with all federal, state, and local oil spill response regulations. The Commonwealth of Massachusetts does not require planning and response submittals for review and approval with regards to offshore oil.

1.3 General Facility Information

The Lease Area is located on property in the OCS in BOEM Lease Area OCS-A 0522. At its closest point, the 536 km^2 (132,370 acre) Lease Area is approximately 46 km (29 miles) from Nantucket. The closest WTG/ESP position within the Lease Area is approximately 49 km (31 miles) from Nantucket and approximately 63 km (39 miles) from Martha's Vineyard. Vineyard Northeast is depicted in Figure 1-1. The mailing address for Vineyard Northeast is 200 Clarendon Street, 18th Floor, Boston, Massachusetts.

Vineyard Northeast consists of WTGs, ESPs, a booster station, and associated foundations; inter-array and inter-link cables; offshore export cables; and onshore facilities, including onshore substations. The sources of oil in the WTGs include transformer oil, drive train main bearing oil, hydraulic oil, and grease (which could be hydrocarbon-based), which total approximately 6,604 gallons (157.2 bbl) for the largest WTG. Oil sources in the ESPs include power transformers, reactors, auxiliary/earthing transformers, diesel tanks, an emergency generator day tank, an emergency generator, and naphthenic oil for a platform crane. Oil sources associated with one ESP total approximately 236,754 gallons (5,637 bbl). The oil sources associated with one booster station are similar to that of an ESP and total approximately 185,978 gallons (4,428 bbl).

Table 1-2 provides general information for Vineyard Northeast as it pertains to planning for potential oil spills. Annexes 1, 3, and 7 provide discussion of facility operations in greater detail regarding equipment description, drainage, secondary containment, and emergency planning scenarios.

1.4 Plan Review and Revision

This OSRP will be reviewed at least every three years from its effective date. It is important to note that this is a living document that will be updated as project details change. Documentation of this review will be provided in the Review Table presented at the front of this OSRP. If the review does not result in modifications to the OSRP, the Chief of BSEE Oil Spill Preparedness Division (Chief of OSPD) or designee will be notified in writing that there are no changes.

The OSRP will be modified and submitted to the Chief of OSPD for approval within 15 days when the following occurs:

- A change occurs which significantly reduces response capabilities;
- A significant change occurs in the worst case discharge scenario or in the type of oil being handled, stored, or transported at the facility;
- A change in the name(s) or capabilities of the OSROs cited in the OSRP;
- A significant change to the ACP(s) for the region; or
- The Chief of OSPD requires that the OSRP be resubmitted if it becomes outdated, numerous revisions make its use difficult, or if the OSRP contains significant inadequacies.

Table 1-2. Facility Summary Information.

Facility Owner	Vineyard Northeast LLC
Facility Name	Vineyard Northeast
Facility Mailing Address	200 Clarendon Street, 18th Floor Boston, MA 02116
Facility Qualified Individual	Rachel Pachter
Facility Phone Number	(508) 680-6455
E-mail Address	rpachter@vineyardoffshore.com (email of Qualified Individual)
Latitude	N 40.682
Longitude	W 70.228
SIC Code	4911
Wind Turbine Generators (WTGs)	Largest oil source in the WTGs is the 66-kilovolt transformer: 3,963 gallons Total oil storage is 6,604 gallons WTGs are equipped with secondary containment which is sized according with the largest container.
Electrical Service Platforms (ESPs): Emergency Generators, Diesel Engine, and Fuel Oil Storage Tank	Each ESP contains emergency generators containing diesel day tanks and lubrication oil, a diesel engine, and a fuel oil storage tank totaling 19,959 gallons.
ESP: Transformers and Reactors	ESP will have power transformers, auxiliary / earthing transformers, and reactors Total naphthenic oil storage is 215,616 gallons per ESP
ESP: Other	Naphthenic hydraulic oil for platform crane: 569 gallons per ESP Additional naphthenic oil per ESP: 610 gallons
Booster Station	Total oil storage is 185,978 gallons
Operations and Maintenance (O&M) Facilities	TBD, multiple ports identified in COP Volume 1, Table 4.4-1
Materials Stored / Oil Storage Start-Up Date	Petroleum-based and synthetic oil / To Be Determined (TBD)
Worst Case Discharge Volume[1]	236,754 gallons per ESP and 185,978 gallons for the Booster Station
Maximum Most Probable Discharge Volume (United States Coast Guard [USCG]) [2]	23,675 gallons per ESP and 18,598 gallons for the Booster Station
Average Most Probable Discharge Volume (USCG) [2]	2,368 gallons per ESP and 1,860 gallons for the Booster Station
Oil Spill Removal Organization (OSRO)	TBD

Notes:

1. The BSEE/BOEM “Oil Spill Response Plan (OSRP) for Offshore Wind Facilities Discussion Handout” provided guidance on worst-case discharge volume for an offshore wind facility.
2. Definitions in 33 CFR 155.1020 are based on the percentage of oil cargo capacity from a vessel during an oil transfer operation.

2. Core Plan Elements

2.1 Oil Spill Detection, Notifications, and Initial Response

Detection of a spill or emergency is the first step in a response. There are several methods by which an emergency situation at the Lease Area may be discovered including the following:

- Reported by company personnel;
- Abnormal operating conditions observed by operator; or
- Reported by private citizens or by public officials.

In every case, it is important to collect accurate information and immediately notify the On-Duty Supervisor and any affected area personnel. Initial response will take place as indicated in Table 2-1 Initial Response Actions Checklist. The Initial Notification Data Sheet Form (Annex 4) will be completed by the On-Duty Supervisor while discussing the incident when it is initially reported by the person detecting the spill/discharge. Information not immediately known may be added to the form as it becomes available.

The On-Duty Supervisor will notify the QI or AQI upon receiving notification of an emergency event. The QI, AQI, or designee will make notifications as discussed in Section 2.2 to federal, state, and local agencies (Figure 2-1 and Table 2-3) immediately and shall assure that all required documentation is kept.

When making the initial notifications to the On-Duty Supervisor and affected personnel, one should attempt to provide the following information:

- Name of caller and callback number;
- Exact location and nature of the incident (e.g., fire, oil spill);
- Time of incident;
- Name and quantity of material(s) involved, or to the extent known;
- The extent of personal injuries, damage and/or fire, if any;
- The possible hazards to human health, or the environment, outside the facility;
- Body of water or area affected;
- Quantity in water (size and color of slick or sheen) or amount discharged to the land or atmosphere;
- Present weather conditions–wind speed and direction, movement of slick or sheen, current/tide;
- Potential for fire; and
- Action being taken to control the discharge

A log will be maintained documenting the history of the events and communications that occur during the response (see Annex 4). It is important to remember that the log may become instrumental in legal proceedings, therefore:

- Record only facts, do not speculate.
- Do not criticize the efforts and/or methods of other people/operations.

- Do not speculate on the cause of the spill.
- If an error is made in an entry, do not erase; draw a line through it, add the correct entry above or below it and initial the change.
- Always evaluate safety throughout the response actions.

Table 2-1. Initial Response Checklist.

Action	Comments
First Person on Scene	
Take personal protective measures and/or distance.	
Identify and control source if possible (close valve, turn off pump, blind the flange). Eliminate ignition sources.	
Notify the On-Duty Supervisor.	
Notify the affected personnel of the incident.	
Warn personnel in the area and enforce safety and security measures.	
If possible, implement countermeasures to control the emergency. If personal health and safety is not assured, do not attempt to reenter the emergency site.	
Designate a Staging Area where the Emergency Response personnel and equipment can safely report to without becoming directly exposed to the spilled product (until QI arrives).	
On-Duty Supervisor	
Activate local alarms and evacuate non-essential personnel.	
Notify QI.	
Initiate defensive countermeasures and safety systems to control the emergency (booms, sorbent material, loose dirt, sandbags, or other available materials). Eliminate ignition sources.	
Initiate Emergency Response notification system.	
Dispatch response resources as needed.	
Monitor and or facilitate emergency communications until QI arrives.	
Keep the public a safe distance from the spill.	
Qualified Individual (QI) or Designee	
Notify federal, state, and local agencies and other external stakeholders.	
Establish On-Scene Command and an Incident Command Post.	
Assess situation and classify incident.	
Perform air monitoring surveys prior to entering the operational area.	
Determine extent and movement of the spill.	
Identify sensitive areas and determine protection priorities.	
Request additional or specialized response resources.	
Establish Isolation Zones (Hot, Warm, Cold) and Direct On-Scene Response Operations.	
Keep the public a safe distance from the spill.	
Form Unified Command with the USCG, Federal On-Scene Coordinator (FOSC) and State On Scene Coordinator (SOSC).	

Action	Comments
Direct operations until relieved by Incident Management Team's Incident Commander, Owner's Representative, or the incident response is complete.	

2.2 Notifications

2.2.1 When to Notify

When there is a discharge of oil, a substantial threat of a discharge of oil, or a sheen observed in or in close proximity outside the Lease Area, the notifications described in Sections 2.2.2 and 2.2.3 must be made.

2.2.2 Internal Notifications

The individual who discovers the spill will call the On-Duty Supervisor immediately and report initial facts about the incident. The On-Duty Supervisor will record the facts (see forms in Annex 4) and immediately (within 15 minutes) notify the QI. Table 2-2 lists the various key personnel and their 24-hour contact information. The QI or designated alternate on duty will be available 24-hours per day and capable of arriving to Vineyard Northeast's facility to establish the initial incident command and begin coordinating a response within a reasonable amount of time after contacting. A Spill Response Coordinator and Alternate Spill Response Coordinator will also be available to assist in the oil spill response effort. The Spill Response Coordinators will be members of a Spill Management Team (SMT) that will be available to mobilize to the incident 24 hours a day, 7 days a week. This SMT will staff an incident response organization set up in a standard National Incident Management System Incident Command System organization with appropriate positions activated, as needed. A Spill Response Operating Team will also be available on a 24-hour basis to deploy and operate spill-response equipment at the Lease Area.

Other than the Spill Response Operating Team, the Vineyard Northeast response personnel listed in Table 2-2 will manage any incident from the O&M facility, which will act as the Spill-Response Operations Center, and will include provisions for primary and alternate communications systems available for use in coordinating and directing spill-response operations.

Table 2-2. Vineyard Northeast Internal Notification List.

Name	Position	Cell	Email
Rachel Pachter	Qualified Individual, Vineyard Northeast	+1 (508) 680-6455	rpachter@vineyardoffshore.com
Jennifer Simon Lento	Alternate Qualified Individual, Vineyard Northeast	+1 (215) 485-8580	jsimonlento@vineyardoffshore.com
Ian Campbell	Spill Response Coordinator, Vineyard Northeast	+1 (781) 983-8943	icampbell@vineyardoffshore.com
Person D	Alternate Spill Response Coordinator, Vineyard Northeast	(XXX) XXX-XXXX	XXX@XXX.com
Persons E-Z	Other Spill Management Team Members, Vineyard Northeast	(XXX) XXX-XXXX	XXX@XXX.com

2.2.3 External Notifications

- Any person or organization responsible for an oil spill is required to notify the federal government when the amount reaches a federally-determined limit. This federally-determined limit is based on the “Discharge of Oil” regulation. The Discharge of Oil regulation is more commonly known as the "sheen rule." Under the Clean Water Act, this rule provides the framework for determining whether an oil spill should be reported to the federal government. In particular, the regulation requires the person in charge of a facility or vessel responsible for discharging oil that may be "harmful to the public health or welfare" to report the spill to the federal government. The regulation establishes the criteria for determining whether an oil spill may be harmful to public health or welfare, thereby triggering the reporting requirements, as follows:
- Discharges that cause a sheen or discoloration on the surface of a body of water;
- Discharges that violate applicable water quality standards; and
- Discharges that cause a sludge or emulsion to be deposited beneath the surface of the water or on adjoining shorelines.

Anyone who discovers an oil spill meeting any of the above criteria must contact the National Response Center (NRC) at (800) 424-8802 as soon as knowledgeable of the spill. Notifying the NRC meets all federal reporting requirements, including reporting requirements to USCG, BSEE, and BOEM. The Proponent will provide the following information, if it is known:

- Name, location, organization, and telephone number
- Name and address of the party responsible for the incident; or name of the carrier or vessel, the railcar/truck number, or other identifying information
- Date and time of the incident
- Location of the incident
- Source and cause of the spill
- Types of material(s) spilled
- Quantity of materials spilled
- Medium (e.g., land, water) affected by spill
- Danger or threat posed by the spill
- Number and types of injuries or fatalities (if any)
- Weather conditions at the incident location
- Whether an evacuation has occurred
- Other agencies notified or about to be notified
- Any other information that may help emergency personnel respond to the incident

Once contacted, the NRC Duty Officer will guide the caller through a detailed series of questions based on the Standard Report Form to gather as much information as possible concerning the spill. The information is immediately entered into the Incident Reporting Information System (IRIS) and based on several pre-established criteria including material involved, mode of transportation, injuries, damage, and fatalities, select federal agency notification will take place within 15 minutes of receipt.

Several steps are followed for initial determination of external notifications, as outlined herein. **Initial calls to the Massachusetts Department of Environmental Protection (MassDEP) will be made within two**

<u>hours of discovery of a spill of more than 10 gallons of gasoline or oil on land within a 24 hour period or a spill of any quantity of gasoline or oil that creates a sheen on a surface water body.</u>

Vineyard Northeast will also notify the Massachusetts State Historic Preservation Officer (SHPO) in the event that sensitive historic and prehistoric resources could be impacted by the spill. The SHPO will evaluate areas where response actions are to be conducted for potential impact to historic and culturally sensitive sites.

Additional Notifications

The QI, AQI, or designee will make all initial and follow-up federal, state, and local agency notifications. Vineyard Northeast will use forms provided in Annex 4 to document details of notifications and ensure accurate information is being passed along. Although notification to NRC completes ALL federal agency notification requirements, Vineyard Northeast will follow-up directly with the appropriate agencies as needed. Specific phone numbers for initial federal, state, and local response agencies are included in Table 2-3. Although not required by regulations, courtesy calls can be placed directly to local offices of federal agencies in order to establish lines of communication, if desired. A complete list of phone numbers for agencies, resources, and stakeholders who may need to be contacted during a particular incident are provided in Annex 2.

The Vineyard Northeast-contracted OSRO will be notified immediately following any oil spill that cannot be contained on the ESP or WTG. They may initially be placed on standby as more details are being gathered about the spill, or they may be immediately activated to the scene.

There are a number of other contacts that will be made <u>if required</u>, and they may include:

- Connecticut Department of Energy and Environmental Protection (CT DEEP), if the spill is equal to or greater than 5 gallons over a 24 hour period expected to threaten Connecticut;
- Emergency Medical Personnel;
- Occupational Safety & Health Administration (OSHA); and
- Wildlife rehabilitation personnel.

Table 2-3 lists initial emergency notifications. Annex 2 provides a complete list of potential response resources, trustees, and federal, state, and local agencies.

Media

In the event that the media becomes interested in the oil spill response effort, be prepared to discuss the following:

- An explanation of any injuries or deaths and what safety measures were put in place to mitigate any further injuries/deaths;
- The nature and extent of the economic losses that have occurred or are likely to occur;
- The persons who are likely to incur economic losses;
- The geographical area that is affected or is likely to be affected;
- The most effective method of reasonably notifying potential claimants of the designated source; and

- Any relevant information or recommendations.

Table 2-3. Initial Agency Notifications.

Agency	Phone	Requirements for Notifications
Federal Agencies		
National Response Center (NRC)	(800) 424-8802 (serves to notify all federal agencies)	Immediate notification is required for all discharges of oil sufficient to produce a sheen on navigable waters of the United States. Spills of dielectric insulating fluid or other synthetic oil may not produce a sheen capable of being detected visually. Known spills of these fluids must also be reported to the NRC immediately.
EPA Region 1	(888) 372-7341 or (617) 918-1111	NRC will notify EPA for all oil discharges into inland navigable waters of the United States sufficient to create a sheen. A written report is not required.
USCG Sector Southeastern New England	(508) 457-3211 or (508) 538-2300	NRC will notify the USCG for all oil discharges into coastal navigable waters of the United States sufficient to create a sheen. A written report is not required. The NRC will also provide details to the USCG Sector if the incident is a "serious marine incident" which is defined as (1) One or more deaths, (2) Injury to a crewmember, passenger, or other person which requires professional medical treatment beyond first aid, (3) Damage to property greater than $100,000, (4) Actual or total constructive loss of any vessel, or (5) Discharge of oil of 10,000 gallons or more into the navigable waters of the U.S.
USCG Sector Long Island Sound	(203) 468-4401	Vineyard Northeast should notify USCG Long Island Sound if the spill is predicted to threaten Connecticut.
BSEE Atlantic OCS Region	(504) 736-0557	Pursuant to 30 CFR 250.187(d) and 30 CFR 254.46(b), Vineyard Northeast will notify BSEE without delay for a spill that is one (1) barrel or more or, if the volume is unknown, is thought to be one barrel (1) or more.
BOEM Atlantic OCS Region	1-800-200-4853	Vineyard Northeast will directly notify BOEM for a spill on the OCS.
State Agencies		
Massachusetts Department of Environmental Protection (MassDEP)	(888) 304-1133	Immediate notification (less than two hours) is required for all discharges of oil to water resulting in a sheen on the water surface and any spill equal to or greater than 10 gallons on land. In addition, the local fire department should be notified.
Connecticut Department of Energy and Environmental Protection (CT DEEP)	(860) 424-3338 or (866)-DEP-SPIL	Vineyard Northeast will notify CT DEEP immediately for any spill equal to or greater than 5 gallons over a 24 hour period if the spill is predicted to threaten Connecticut.
Local Authorities		
Dukes County REPC	(508) 696-4240	Contact for any spill, fire, or explosion which could threaten human health, or the environment for Martha's Vineyard.
OSRO		
TBD		
Contact information for additional agencies or services that may become involved in an incident is provided in Annex 2.		

2.3 Establishment of a Unified Command

The QI at the facility will initially be the incident commander during any spill. As the incident escalates, personnel from the facility, as well as federal, state, and local agencies, will augment the response forming a Unified Command managed by an interagency Incident Management Team (IMT). The National Incident Management System (NIMS) will be used by the facility, in concert with OSROs and federal, state, and local agencies. An outline of the Incident Command System (ICS) structure can be found in Annex 3. Because the use of NIMS ICS is mandated for all levels of government by Homeland Security Presidential Directive 5 (HSPD-5), the Proponent will ensure that this flexible system is implemented in the event of an incident. The designated QI or AQI for Vineyard Northeast is English-speaking, located in the United States, available on a 24-hour basis, familiar with implementation of this response plan, and trained in their responsibilities under the plan. The QI or designated AQI has full written authority to implement this response plan, including:

- Activating and engaging in contracting with identified oil spill removal organization(s);
- Acting as a liaison with the pre-designated FOSC and SOSC; and
- Obligating, either directly or through prearranged contracts, funds required to carry out all necessary or directed response activities.

2.4 General Spill Mitigation

Vineyard Northeast will ensure that spill containment measures (e.g., offshore-certified dry-break connectors and drip trays) are implemented for any temporary connections transporting oily substances (e.g., between diesel storage container and emergency generator).

All fluids used on the offshore structures are contained on the structure. The WTGs and ESPs are equipped with a secondary containment structure that will be sized according to the largest container. A simple oil spillage kit, sufficient to mitigate small, local spillage during maintenance, will be included during installation of the WTGs.

While the above design parameters will act to prevent spills, incidents can still occur. In case of an oil discharge, the highest priority is always the safety of the personnel. The mitigation procedures included in this section provide general guidance in responding to an oil spill. Training of the Spill Response Operating Team and onboard drills on all emergency procedures will be provided to mitigate the potential for environmental impact.

Maps of the facility showing spill response equipment storage sites and staging locations to be deployed in the event of a discharge will be provided prior to construction.

For Vineyard Northeast, discharge scenarios could occur at any of the different components of the offshore facility where oil is stored. It is important to note that Vineyard Northeast's offshore cables do not include fluids, and there is no risk for an oil discharge from the offshore cables. General mitigation procedures by which Vineyard Northeast and the listed/contracted OSROs would respond to such discharges are included below. Annex 6 of this OSRP contains additional spill mitigation considerations.

(1) WTG spill – The largest potential spill from a total loss of a WTG would be 6,604 gallons with the largest source of oil being 3,963 gallons of transformer oil (a dielectric or synthetic oil). The WTGs would also contain 660 gallons of hydraulic oil (a petroleum-based oil). These quantities are relatively small. Sorbents, booms, and other methods that are appropriate for the type of oil spilled

may be used to recover as much oil as possible (see Section 2.5). However, these small quantities of oil will quickly weather in the environment and will likely not impact the shoreline.

(2) ESP spill – The largest potential spill from a total loss of an ESP would be 236,754 gallons. The largest source of oil in the ESPs would be the naphthenic oils in the power transformers, auxiliary/earthing transformers, and reactors. Each ESP would contain 215,616 gallons. The largest spill from a total loss of the potential booster station would be 185,978 gallons of oil. Overall, the oil mixture discharged from the loss of an entire ESP or the booster station would be a combination of naphthenic oil, mineral oil, biodegradable oil, and diesel, with the majority of this mixture dominated by the naphthenic oil. For the trajectory analysis conducted at Vineyard Northeast, from both spill spites modeled, there is less than a 10% probability that oil would reach the shoreline during any season. In addition, this modeling did not consider response actions and thus is highly conservative. In any spill scenario, after securing the source, containing the oil on scene as soon as possible would be the most important response action to take. Oil Spill Recovery Vessels (OSRVs) will immediately be mobilized to the scene to recover the oil. The majority of the oil mixture contained in the ESPs is a dielectric or synthetic oil, which require different techniques for detection and response than petroleum oils. Containment and recovery methods for different oil types are detailed further in Section 2.5. Dispersant and in-situ burning should also be considered. These response measures are explained in detail in Sections 2.7 and 2.8, respectively. Smaller spills of the individual oils stored on the ESP must also be considered. The naphthenic oil would be more persistent in the environment than diesel oil, which would more readily evaporate.

2.4.1 Preliminary Assessment

To identify that a spill from a WTG. ESP, or the booster station has occurred, it is anticipated that the first indicator will be the detection of a spill via camera or a fluid level gauge/low fluid level indicator. Another sign of a discharge may be the creation of a visible sheen on the water's surface or a spill into secondary containment.

Following the protection of the safety of responders and the public, taking action to secure the source of the spill is the main priority. After initial response is taken to secure the source of the spill, and notifications are made to the required agencies, further spill containment, recovery, and disposal operations can begin. It is important to first identify the magnitude of the problem and resources threatened. The QI or designee will:

1. Classify the type and size of spill.
2. Determine chemical and physical properties of spilled material for potential hazards (see Annex 9, Safety Data Sheets). Ensure that cleanup techniques and procedures selected are appropriate for the type of oil spilled.
3. Obtain on-scene weather forecast such as wind speed, wind direction, and tide schedules (12, 24, 48, and 72-hour).
4. Track oil movement or projected movement. Consider the need for overflights and possible challenges in visually detecting spills of dielectric insulating fluid or synthetic oil.
5. Continuously assess human health and environmental concerns based on the type of oil spilled.
6. Determine extent of contamination and resources threatened (i.e., waterways, wildlife areas, economic areas).
7. Start chronological log of the incident.

As part of this Preliminary Assessment, Vineyard Northeast will classify the incident to quickly categorize the appropriate level of response, notifications, and resources that may be necessary to mitigate the emergency. The incident will be categorized based upon the nature of the incident, degree of containment and isolation, materials involved or size of the spill, and any other additional information provided by the person reporting the spill. Incident levels may be upgraded or downgraded from the initial determination as further information is determined or the situation changes. The Incident Classification levels are presented in Figure 2-1. A Level One incident will require only the mobilization of Vineyard Northeast personnel.

Based on the preliminary assessment, additional cleanup personnel and equipment will be dispatched to the site and deployed to control and contain the spill.

Level One – Minimal danger to life and property and the environment. Project personnel are capable of responding to the incident. The problem is limited to the immediate work area or spill site and spills are generally less than 55 gallons.

Level Two – Serious situation or moderate danger to life, property, and the environment. The problem is currently limited to the Lease Area, but it does have the potential for either involving additional exposures or migrating offsite. The incident could involve a large spill of oil, a fire, and loss of electrical power.

Level Three – Crisis situation or extreme danger to life, property, and the environment. The problem cannot be brought under control, goes beyond the Lease Area, and/or can impact public health and safety, and the environment, or a large geographic area for an indefinite period of time. Such incidents include a vessel fire or discharge of oil in a volume that can impact surrounding areas.

Figure 2-1. Guidelines for Determining Incident Classification.

2.4.2 Establishment of Objectives and Priorities

Emergency conditions will be managed in a controlled manner, and oil spill response operations will be conducted with the following objectives:

1. Provide for the safety and security of responders and maximize the protection of public health and welfare.
2. Initiate actions to stop or control the source, and minimize the total volume discharged.
3. Determine oil fate and trajectories.
4. Contain, treat, and recover spilled materials from the water's surface using techniques appropriate for the type of oil spilled.
5. Conduct an assessment and initiate shoreline cleanup efforts appropriate for the type of oil spilled.
6. Identify and protect sensitive sites, including wildlife, habitats, and historic properties. Develop strategies for protection and conduct pre-impact shoreline debris removal.
7. Identify threatened species and prepare to recover and rehabilitate injured wildlife.
8. Investigate the potential for and, if feasible, use alternative technologies to support response efforts.
9. Establish and continue enforcement of safety and security zones.
10. Manage a coordinated interagency response effort that reflects the composition of the Unified Command.
11. Inform the public, stakeholders, and the media of response activities.

During a major oil spill, resource, time, and various response constraints may limit the extent of areas that can be immediately protected. Every attempt should be made to prevent impacts to areas surrounding a spill site.

Vineyard Northeast is located in the OCS. The island of Nantucket, which is the closest land mass, is located approximately 46 km (29 mi) north of the Lease Area. (The closest WTG/ESP position within the Lease Area is approximately 49 km [31 miles]) from Nantucket.) Together with the small islands of Tuckernuck and Muskeget, the island of Nantucket is comprised of one town, Nantucket, and a National Historic Landmark. The National Congress of American Indians (NCAI) designated Nantucket Sound as a National Historic Landmark in order to permanently protect and preserve the Sounds as a site of historical and cultural significance to tribal nations. Key locations on Nantucket include Madaket, Polpis, Wauwinet, Miacomet, and Siasconset. Resources of special economic or environmental importance located on Nantucket include:

- National Historic Landmark of Nantucket Sound;
- Public drinking water well and distribution systems;
- Cisco Beach, Surfside Beach, Pebble Beach, Low Beach, Sconset Beach, Madaket Beach, and Jetties Beach;
- Brant Point Shellfish Hatchery; and
- Nantucket National Wildlife Refuge and Coskata-Coatue Wildlife Refuge.

Environmental Sensitivity Index maps, available from the National Oceanic & Atmospheric Administration (NOAA), provide a summary of coastal resources that are at risk if an oil spill occurs in the area. Maps with coverage of Nantucket would be contained in Massachusetts and Rhode Island: Volume 3 Buzzards Bay. The maps are available in pdf format at: https://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html.

2.4.3 Implementation of Tactical Plan

The general procedures for implementation of a tactical plan are likely to include:

- Maximize protection of response personnel.
- Deploy containment resources, and, if appropriate, divert spill to a suitable collection point that is accessible and causes the least impact to surrounding areas.
- Boom off sensitive areas.
- Maximize on-water containment and recovery operations.
- Handle wastes to minimize secondary environmental impacts.

Vineyard Northeast will establish contractual agreements with an OSRO to conduct oil spill response operations. Facility personnel will use containment equipment available at the site to surround or divert the spill until the OSRO arrives on scene. If the spill is large enough to require a Unified Command and Incident Management Team, the Incident Action Planning cycle will begin and will establish incident objectives, strategies, and tactics. The Unified Command would likely be made up of the USCG FOSC, the MassDEP State OSC, and the Vineyard Northeast Incident Commander.

2.5 Response Strategies for Containment, Recovery, and Protection of Sensitive Sites

The WTGs, ESPs, and booster station will be located in the OCS. Offshore export cables will move power from the ESPs to two onshore substations (one per point of interconnection or POI) in Westport, Fall River, or Somerset, Massachusetts and in Montville, Connecticut that will increase or decrease the voltage of the power transmitted by the export cables in preparation for interconnection to the electric grid at the POIs. Details regarding the onshore export cable routes, onshore substation sites, and grid interconnection routes are presented in COP Volume I. The Proponent will develop a Spill Prevention, Control, and Countermeasure (SPCC) Plan for each onshore substation site as part of the state permitting process, which will describe onshore spill prevention and response procedures. Thus, onshore discharges are not addressed in this OSRP.

Containment and recovery refer to techniques that can be employed to contain and recover onshore and aquatic petroleum spills. Responses on water should therefore emphasize stopping the spill, containing the oil near its source, and protecting sensitive areas before they are impacted. The objective of the initial phase of the containment procedure prevents the spread of the spill, especially on water, and confines it to as small an area as possible. The containment goals are to prevent liquid or vapors from reaching a possible ignition source (i.e., boat engines, electrical equipment) and any environmentally sensitive area (i.e., water, wetland, wildlife management area).

The primary methods to be used in containing a discharge would be sorbent boom or pads, if available, or containment boom, if the oil reaches water. It may be necessary to use several methods in one spill.

Sorbents can be used to remove minor on-water spills and spills on the WTGs, ESPs, and the booster station. Traditional polyethylene sorbents are best used for petroleum-based oils, such as the hydraulic oil in the WTG or the diesel oil in the ESP or booster station. Sorbent boom or pads made of natural fiber (e.g., coconut husk) can be more effective to cleanup spills of dielectric fluids/synthetic oils, such as the naphthenic or ester oils in the WTGs, ESPs, and/or the booster station. In addition, floating barriers or other mechanical means can be used to contain the oil. Once contained, skimmers can collect these oils in order to remove them from the environment. Drum and disk skimmers work best for removing spills of dielectric fluids/synthetic oils.

For larger spills, Vineyard Northeast will use mechanical recovery as the first response measure following an oil spill. These operations will include removing oil using advancing and stationary recovery systems. Oil Spill Recovery Vessels (OSRVs) will be mobilized by the OSRO to remove fresh oil from the water's surface. Adequate storage for recovered oily water will be available to ensure skimming operations can continue. Storage on-board vessels, as well as storage bladders and tanks, may be used in order to extend the recovery operations. In order to protect shorelines from any oil, booming strategies from the applicable ACP's Geographic Response Strategies (GRS) will be employed to divert, deflect, and exclude oil from impacting particularly sensitive areas. The GRS booming strategies developed by the respective Area Committees are shown in Figure 2-2.

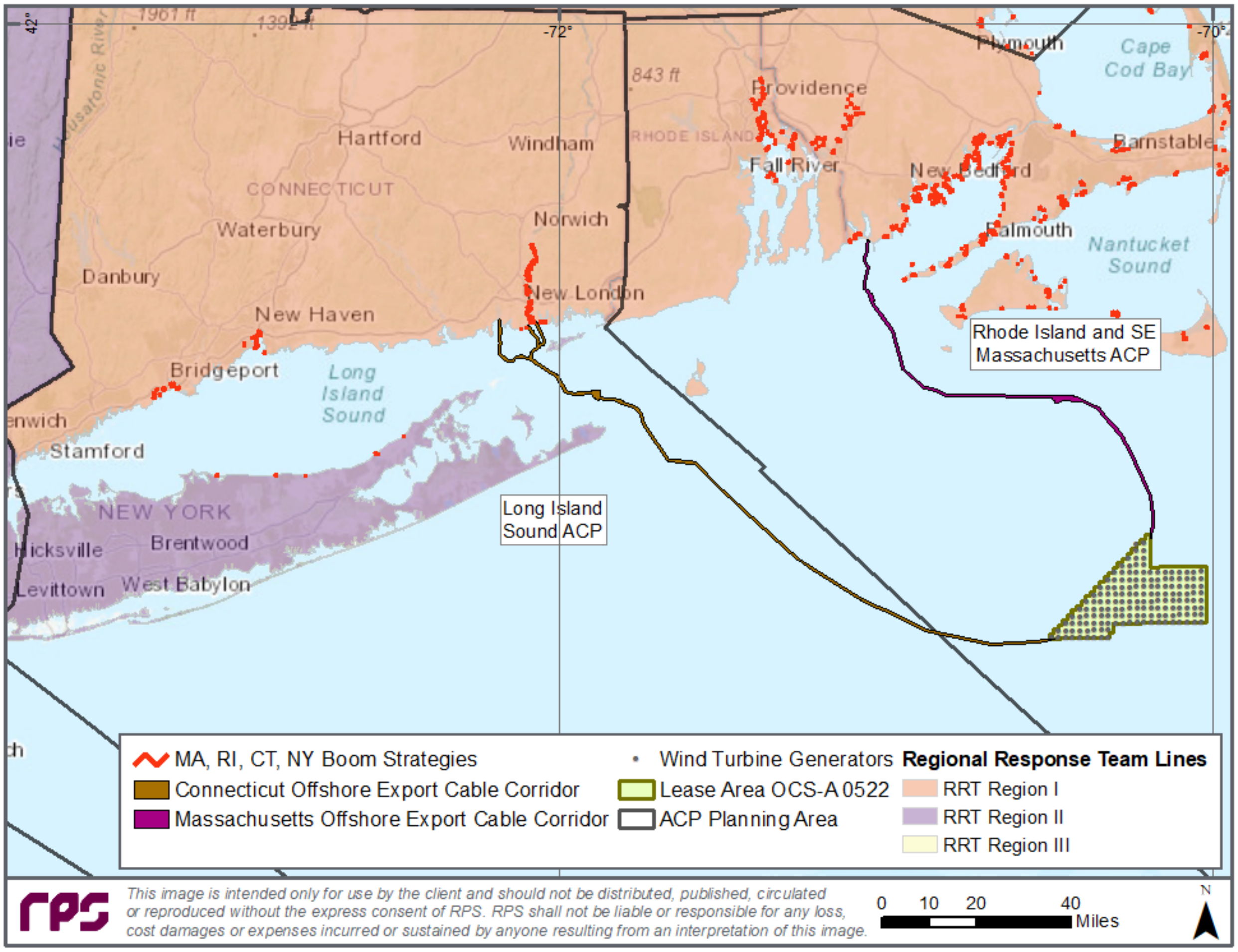


Figure 2-2. Long Island Sound and Rhode Island and Southeastern Massachusetts Area Committee Booming Strategies from the GRS.

Containment booming will be used to protect sensitive areas and to position oil so it can be removed with skimmers or vacuum trucks (in the unlikely event oil reaches the shoreline). Due to entrainment, booming is not effective when the water moves faster than one knot, or the waves exceed 1.5 feet (ft) in height. Angling a boom will minimize entrainment. Using multiple parallel booms will also improve recovery in adverse conditions. A summary of booming techniques is provided in Table 2-4.

Table 2-4. Booming Techniques.

Type of Boom	Use of Boom
Containment Booming	Boom is deployed around free oil. Boom may be anchored or left to move with the oil.
Diversion Booming	Boom is deployed at an angle to the approaching oil. Oil is diverted to a less sensitive area. Anchor points may cause minor disturbances to the environment.
Exclusion Booming	Boom deployed to protect a sensitive area by preventing oil from entering that area

2.5.1 Atlantic Ocean

Oils stored in the WTGs and ESPs have a specific gravity of less than 1.0 and would float on the surface of the water. Feasible protection methods therefore include skimming, booming, and improvised barriers. Sorbent boom should not be used in wide, open ocean environments, unless the oil was in close proximity to an offshore structure. As described above, large spills in open waters can be contained instead with floating barriers or other mechanical means and collected using skimming equipment.

2.5.2 Banks

The nearest land mass to the WTGs and ESPs (excluding the potential booster station) is Nantucket, which is located approximately 49 km (31 mi) north of Vineyard Northeast's offshore facilities. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket. Therefore, it is not anticipated that a discharge of oil would impact the terrain alongside the bed of a river, creek, or stream. However, the following response discussion is made available for planning of such an event.

Vegetated Banks

Oil may penetrate the area and coat plants and ground surfaces. Oil can persist for months. A no-action alternative may be appropriate to minimize environmental impacts. Cleanup is usually unnecessary for light coatings, but heavier accumulations may require sediment surface removal to allow new growth. Low-pressure spraying and neutralization solutions may aid removal.

Sand Beaches

Heavy accumulations of wastes can cover an entire beach surface and subsurface. Oil can penetrate the sand from six to 24 inches deep. Organisms living along the beach may be smothered or dangerously contaminated. Fine sand beaches are generally easier to clean. Clean by removing oil above the swash zone after all oil has come ashore. Minimize sand removal to prevent erosion. Soil treatment may be possible as well.

Muddy Beaches

Mud habitats are characterized by a substrate composed predominantly of silt and clay sediments, although they may be mixed with varying amounts of sand or gravel. The sediments are mostly water saturated and have low bearing strength. In general, mud shorelines have a low gradient. These fine-grained habitats often are associated with wetlands. Mud habitats are highly sensitive to oil spills and subsequent response activities. Response methods may be hampered by limited access, wide areas of shallow water, fringing vegetation and soft substrate. Natural recovery is typically the best response action for light crude. Vacuum trucks may be used to remove pooled oil on the surface if accessible. Avoid digging trenches to collect oil because that can introduce oil deeper into the sediment.

Riprap Structures

Oil contamination may penetrate deeply between the rocks. If left, oil can asphaltize and fauna and flora may be killed. If possible, remove all contaminated debris and use sorbents to remove oil in crevices. The best response may be to remove and replace heavily contaminated riprap to prevent chronic sheening.

Walls/Pier/Barriers and Docks

Mussels, shellfish, and algae are often found attached to these structures, which may be constructed of concrete, stone, wood, or metal. Contamination may percolate between joints and coat surfaces. Heavy accumulations will damage or kill the biota. High-pressure spraying may remove oil and prepare the substrate for recolonization of fauna/flora. Consider concentration of oil in order to make a determination as to whether an action is required to remove contamination from these structures.

2.5.3 Wetlands

MassDEP's Priority Resource Map and the National Wetlands Inventory identify wetlands on the southern shoreline of Nantucket. Although these resources do not identify any wetland areas along the southern shoreline of Martha's Vineyard, wetlands are located in the vicinity of Allen Point and Cobbs Point in Chilmark, and Swan Neck Point, King Point, and Butler Neck Point in Edgartown. Regions of wetlands are sensitive habitats and must be protected in the unlikely event of an oil spill from Vineyard Northeast.

Wetlands are characterized by water, unique soils, and vegetation adapted to wet conditions. Wetlands include a range of habitats such as marshes, bogs, and swamps. The surfaces of wetlands usually have a low gradient, and vegetated areas are typically at, or under, the water level. Wetlands are highly sensitive to oil spills. The biological diversity in these habitats is significant and they provide critical habitat for many types of animals and plants. Oil spills affect both the habitat and the organisms that directly and indirectly rely on the habitat. Wetlands support populations of fish, amphibians, reptiles, birds, and mammals; many species are reliant upon wetlands for reproduction and early life stages when they are most sensitive to oil. Moreover, migratory water birds depend heavily on wetlands as summer breeding locations, migration stopovers, and winter habitats.

For small to moderate spills and lighter oils, natural recovery avoids the damage often associated with cleanup activities. However, the threat of direct oiling of animals using the wetland often drives efforts to remove the oil. Sorbents may be used, but overuse generates excess waste materials. Flooding can be used selectively to remove localized heavy oiling, but it can be difficult to direct water and oil flow towards recovery devices. Pooled oil can be removed by vacuum truck, if accessible, and trampling of vegetation can be avoided. The removal of heavily oiled vegetation may reduce the contamination of wildlife. Time of year is an important consideration for any cleanup method used in a wetland area.

2.5.4 Small Lakes

Edgartown Great Pond, Tisbury Great Pond, and Katama Bay are located along the southern portion of Martha's Vineyard with direct access to the Atlantic Ocean. It is anticipated that a discharge of oil from the WTGs and ESPs could be contained prior to reaching the navigational channels for the ponds. However, should this occur, the following response discussion is made available for planning of such an event.

Lakes and ponds are standing bodies of water of variable size and water depth. Water levels can fluctuate over time. The bottom sediments close to shore can be soft and muddy, and the surrounding land can include wetlands and marshes. Floating vegetation can be common. Lakes provide valuable habitat for migrating and nesting birds and mammals and support important fisheries. Wind will control the distribution of oil slicks, holding the oil against a shore, or spreading it along the shore and into catchment areas. Wind shifts can completely change the location of oil slicks, contaminating previously clean areas. Thus, early protection of sensitive areas is important. Oil impacts on floating vegetation depend to a large degree on dose, with possible elimination of plants at high doses. The best possible response method is to deploy booms to prevent oil from entering the lakes. If oil does enter any lakes, containing the oil to a small area with booms is the next best response.

2.5.5 Offshore Environments

The Lease Area is located approximately 46 km (29 mi) from the island of Nantucket. The closest WTG/ESP position within the Lease Area is approximately 49 km (31 miles) from Nantucket and approximately 63 km (39 miles) from Martha's Vineyard. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket. Therefore, it is anticipated that a discharge of oil from the WTGs, ESPs, or the booster station should be contained prior to reaching the coastline. However, should this occur, the following response information is included in this plan to assist in planning of such an incident.

Every effort will be made to clean up the spill from the WTG or ESP before it enters the water. Sorbents will be used to recover minor on-water spills. Traditional polyethylene sorbents are best used for petroleum based oils, such as the hydraulic oil in the WTG or the diesel oil in the ESP and booster station. Boom made of natural fiber (e.g., coconut husk) can be more effective to cleanup spills of dielectric fluids/synthetic oils, such as the naphthenic or ester oils in the WTGs, ESPs, and/or. For larger spills, containment booming is used to protect sensitive areas and to position oil; thus, it can be removed. Large OSRVs or other advancing skimming systems would be used to recover the oil before it reaches the shoreline.

Oil discharged offshore is generally distributed by the wind. In addition, wave action causes emulsification of the oil, decreasing the recoverable amount, and increasing the area of contamination. If the oil does reach the shoreline, Geographic Response Strategies from the ACP will be utilized to protect environmentally sensitive sites.

2.5.6 Wildlife

Several National Wildlife Refuges located in Massachusetts, Rhode Island, Connecticut, and New York could be impacted by a spill from Vineyard Northeast. The most significant National Wildlife Refuge in the region is the Nantucket National Wildlife Refuge. This refuge is one of eight refuges that comprise the Eastern Massachusetts National Wildlife Refuge Complex. It is located on the tip of the Coskata-Caotue Peninsula of the island of Nantucket. Because this refuge is found on the northern side of the island, it is unlikely to be impacted from any spill at Vineyard Northeast. Figure 2-3 shows the location of the National Wildlife Refuges located closest to the Lease Area.

Because it is illegal to possess wildlife without a permit in Massachusetts, Vineyard Northeast will ensure any injured, orphaned, or ill wildlife are taken directly to a permitted wildlife rehabilitator. Permitted wildlife rehabilitators by county can be found at Find a wildlife rehabilitator | Mass.gov.

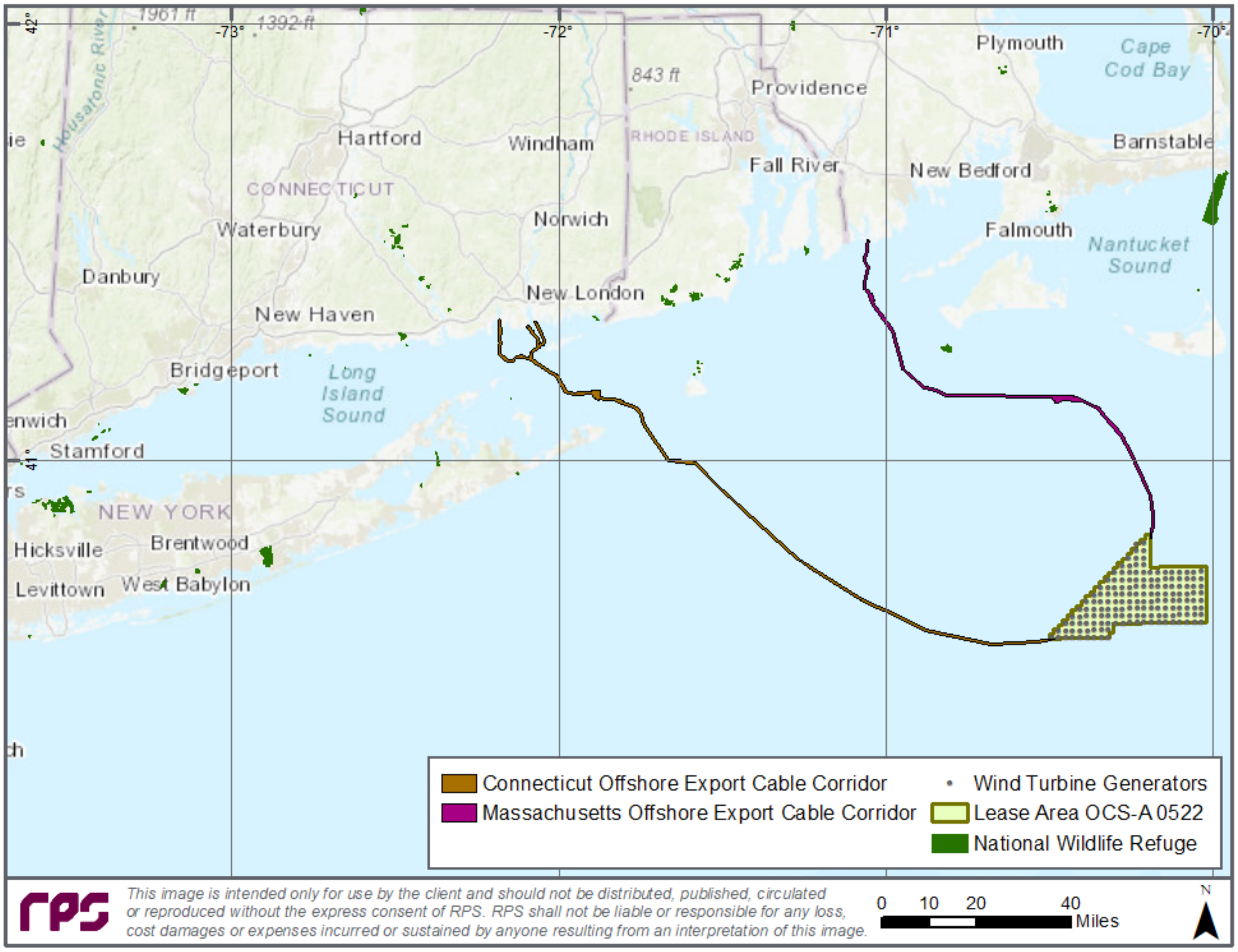


Figure 2-3. National Wildlife Refuges in relation to the Vineyard Northeast OCS-A 0522 Lease Area.

2.6 Waste Disposal and Oil Recovery

Oil spill cleanup from recovery operations will involve the further handling of recovered oil and oiled materials. These will be directed to a state-approved reclamation/disposal site. Normally, the waste generated from a recovery operation will be classified as a non-Resource Conservation & Recovery Act state regulated waste. Waste Code MA01 is appropriate for used or unused waste oil that is not otherwise Resource Conservation & Recovery Act hazardous waste. Waste Code MA97 is appropriate for Class A regulated recyclable material (including, but not limited to, specification used oil fuel) that is shipped using a hazardous waste manifest. Waste Code MA98 is appropriate for off-specification used oil fuel that is shipped using a hazardous waste manifest. In rare instances, where it is suspected that extraneous substances have been introduced into a spill, it is appropriate to test the recovered oil for hazardous waste characteristics (ignitability, reactivity, corrosivity, and toxicity).

The different types of wastes generated during response operations require different disposal methods. Waste will be separated by material type for temporary storage prior to transport to an approved recovery or treatment/storage/disposal facility.

Skimmer tanks allow for gravity separation of the oil from the water. The separated water is transferred through a hose and discharged forward of the recovery pump. This method is called “decanting”. This process is vital to the efficient mechanical recovery of spilled oil because it allows maximum use of limited storage capacity, thereby increasing recovery operations. Vineyard Northeast will obtain approval from federal and state agencies before any decanting is used.

Recovered oil may be transferred to portable tanks. It is important to ensure temporary storage devices are of sufficient size to allow continued operations.

Oily debris collected requires specific handling. Contaminated materials will be placed in leak proof, sealable containers, such as drums or roll-off boxes, and transported to appropriate facilities for processing, recycling, or disposal.

Clean sand and shoreline materials can be separated from oiled materials and returned to the shoreline. Not only is this cost effective from an operations perspective, but it also provides an efficient means of returning clean, excavated material back to the shoreline as a restorative measure.

2.7 Use of Dispersants

Although it is highly unlikely that dispersants will be required for a spill from offshore facilities in Lease Area OCS-A 0522, Vineyard Northeast will consider the use of dispersants in any appropriate scenario as an effective means to quickly remove oil from the water’s surface and disperse it into the water column. If the Unified Command determines that dispersants could be an effective countermeasure, Vineyard Northeast will follow the Dispersant Pre-Authorization Policy contained in the applicable ACP and RCP that are in effect at the time of the spill.

When an OSRO is contracted, Vineyard Northeast will update details in this section of the OSRP to include an inventory and location of the dispersants that could be used on the oils handled, stored, or transported; a summary of toxicity data for the dispersants; a description and location of the application equipment required and an estimate of time to begin application after approval is obtained; and the vessel and aerial application procedures.

2.8 Use of In-Situ Burning

Although it is very unlikely in-situ burning will be required for a spill from the facility, Vineyard Northeast will consider the use of in-situ burning in any appropriate scenario as another response countermeasure that can be employed to remove oil from the water surface. A controlled burn reduces the oil on the water’s surface by releasing the particles into the atmosphere. Spilled oil is contained within a fire boom and ignited using an ignition source. The spilled oil must be approximately 2-3 mm thick in order to burn.

According to the American Petroleum Institute, in-situ burning offers a practical method to remove large quantities of oil from the water very quickly. However, there are many limiting factors that should be considered before a burn is conducted. Physical limitations, such as wind speed, wave height, thickness of the oil, oil type, how weathered the oil is, and how emulsified the oil is, will limit the ability to conduct an in-situ burn operation. Environmental impacts that must be considered are human exposure to smoke, monitoring requirements, accessibility to the impacted site, and recovery of burned/unburned product and residue.

As with dispersant use, the use of in-situ burning can provide a means of oil removal when mechanical recovery cannot be effective or timely.

The Region 1 RRT developed a Memorandum of Understanding for pre-approval of in-situ burning in certain areas of Region 1. The Lease Area is located in Zone A where open water in-situ burning is authorized. Zone "A" is defined as waters under the jurisdiction of RRT 1 that lie 6 nautical miles and seaward of the Territorial Sea Baseline (as defined in 30 CFR 2.05-10). Within Zone "A," the decision to use in-situ burning rests solely with the FOSC. No further concurrence or consultation on the part of the FOSC is required with EPA, NOAA, DOI, or the states. However, if threatened or endangered species are present in the burn area, then the trustee agency must be consulted prior to initiating burning operations.

The USCG will immediately notify EPA, NOAA, DOI, and the Commonwealth of Massachusetts of a decision to conduct burning within Zone A via each agency's respective RRT representative. In the case of a spill at the Lease Area, the Unified Command would decide whether to use in-situ burning as a response countermeasure. Figure 2-5 shows the pre-authorization zones for in-situ burning in Region 1. The Special Consideration Areas for in-situ burning include the 20-foot water depth year-round area, the National Marine Fisheries Service areas in Jeffreys Ledge (April 1st-September 30th), Great South Channel (April 1st-June 30th, October 1st-November 15th), and Cape Cod Bay (February 1st-May 15th), and National Ocean Service year-round area for Stellwagen Bank National Marine Sanctuary.

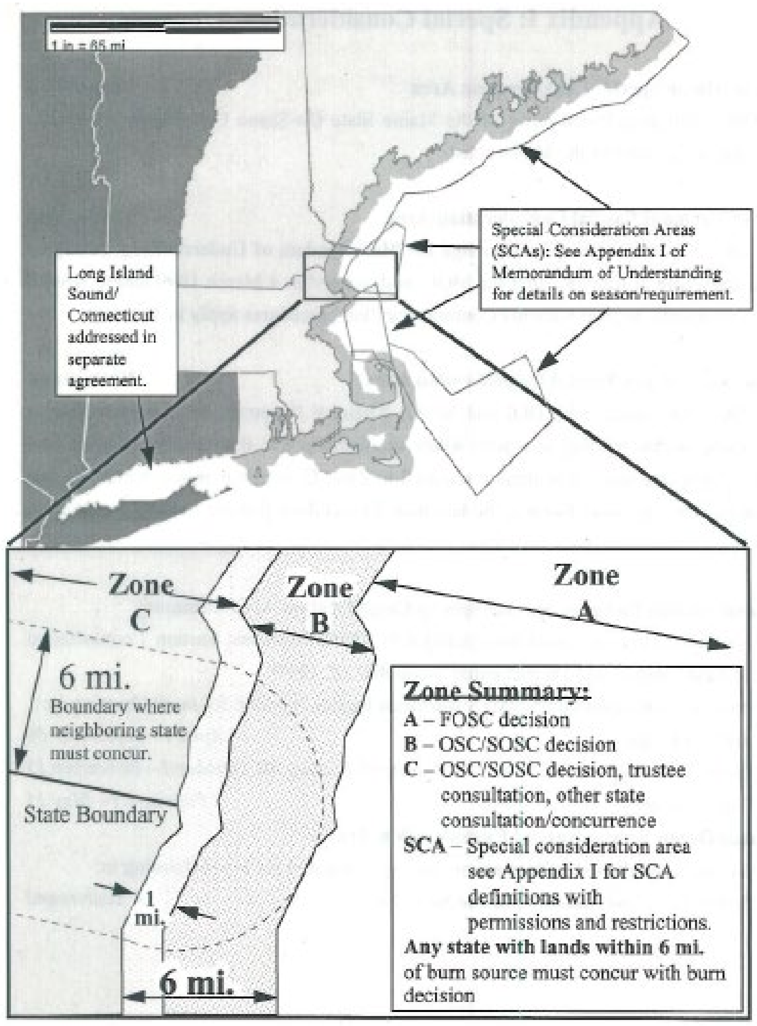


Figure 2-4. In Situ Burning Zone Boundaries from the Region 1 RCP.

When an OSRO is contracted, Vineyard Northeast will update details in this section of the OSRP to include a description of in-situ burn equipment (including its availability, location, and owner), a description of the in-situ burning procedures (including ignition), and safety guidelines.

2.9 Potential Failure Scenarios

Specific mitigation actions and responses to be taken will depend on the nature of the situation. However, certain failure scenarios share common characteristics for mitigation. Mitigation procedures will be performed with consideration for health and safety as the top priority.

Vineyard Northeast is being developed and permitted using a Project Design Envelope (PDE). The PDE outlines a reasonable range of project design parameters. Potential failure scenarios will be developed as key Vineyard Northeast components are selected.

The physical-chemical properties of the oils used are important in spill response contingency planning. Any spill response at Vineyard Northeast's offshore facilities should be guided by the Safety Data Sheets (SDSs) (see Annex 9). For example, dielectric insulating fluids or synthetic oils have environmental fate/transport and affinity for sorbent boom different from petroleum oils. Boom made of natural fiber (e.g., coconut husk) can be more effective than traditional polyethylene boom to cleanup spills of these fluids/oils. These fluids/synthetics are commonly light-colored, milky white, or frothy in appearance on the water surface in relatively protected marine environments. There may be no obvious rainbow sheen. In un-protected marine environments, these sheens might be very difficult to detect. In the open ocean where Vineyard Northeast's offshore facilities are located, the high-energy environment will readily disperse this oil into the water column. This tendency will be considered when selecting a response option to this type of spill. Drum or disk skimmers have been shown in lab tests to be most effective on these oils. In addition, due to the difficulty in visually locating these sheens and their tendency to disperse, a spill of dielectric insulating fluid or synthetic oil can continue for a period of time without detection and without being able to locate and secure the source. Although there are challenges in detecting these oils, Vineyard Northeast's offshore facilities will be closely monitored for any incidents, and the likelihood of any spills is very low. All equipment will be carefully maintained at all times to reduce the possibility of an incident.

2.10 Procedures for Mobilization of Resources

A major consideration during a spill is the organization and direction of the transportation of manpower, equipment, and materials used in response operations. The QI will work with local authorities (state police) to establish land routes to expedite the movement of personnel, equipment, materials, and supplies to the Staging Area and waste products from the Staging Area. The Staging Area is an ICS facility used as a forward operations location to mobilize response resources to the spill site. A Staging Area Manager will be responsible for managing the Staging Area and will utilize status boards to coordinate all equipment, personnel, and materials mobilized to the spill site. Equipment will first be mobilized from the OSRO warehouse to the Staging Area. The Staging Area Manager will direct response equipment to the appropriate Branch/Division/Group/Task Force/Strike Team.

Vineyard Northeast expects to use one or more onshore O&M facilities to support the operation of Vineyard Northeast's offshore facilities. During operations, the offshore and onshore facilities will be continuously remotely monitored from one or more control center(s) located at the Proponent's operations and maintenance (O&M) facilities and/or a third party's facilities. The O&M facilities may also include offices, a control room, training space for technicians, employee parking, and/or warehouse space for parts and tools. The O&M facilities are expected to include dock space for service operation vessels (SOVs), service accommodation and transfer vessels (SATVs), crew transfer vessels (CTVs), and/or other support vessels.

Details regarding spill response materials, services, equipment, and response vessels have not been finalized at this time. Vineyard Northeast will retain a third-party OSRO that is licensed as a hazardous waste transporter and can provide emergency response services and cleanups of oil and/or other hazardous material (OHM) spills. MassDEP Southeast Regional Office (SERO) emergency response contractors located in close proximity to Vineyard Northeast's offshore facilities include Frank Corporation (New Bedford, MA), Global Remediation Services, Inc. (Taunton, MA), Clean Harbors, Inc. (Norwell, MA), Moran Environmental Recovery, LLC (Randolph, MA), New England Disposal Technologies (Sutton, MA), NRC East Environmental Services (Franklin, MA), Cyn Oil Corporation (Stoughton, MA), and Western Oil, Inc. (Lincoln, RI). In addition, U.S. Coast Guard-certified OSROs for the USCG District 1 can be found at https://cgrri.uscg.mil/UserReports/OSROPOCReport.aspx. Response times for mobilization of OSRO resources will be dependent on the location of the OSRO.

2.11 Sustained Actions

"Sustained" action is a term regularly used in oil spill response to capture the ongoing response once the initial emergency response phase is complete. This phase includes establishing an incident management organization, procuring response and support resources, implementing security measures at the ICS facilities, establishing oil waste decontamination and disposal procedures, and initiating public relations outreach.

The Unified Command will manage response operations 24 hours a day, seven days a week, until the operation is complete. Vineyard Northeast's IMT will cascade in to support response operations when necessary. Once the initial emergency stage of the spill situation transitions to the sustained action stage, the response management structure will also transition to prolonged mitigation and/or recovery action strategies.

The WTGs and ESPs are equipped with secondary containment, which reduces the potential need for a sustained action. Most incidents would be handled by a few individuals without implementing an extensive response management system and would not continue into this sustained action phase.

2.12 Termination and Follow-Up Actions

Cleanup will be conducted as thoroughly as possible, but will be terminated when, in the opinion of the FOSC and the QI/Vineyard Northeast Incident Commander:

- There is no recoverable oil in the water;
- Further removal actions would cause more environmental harm than the remaining oil;
- Cleanup measures would be excessive in view of their insignificant contribution to minimizing a threat to the public health, welfare, or the environment; and
- Actions required to repair unavoidable damage resulting from removal activities have been completed.

Once the determination has been made that the response can be terminated, certain regulations may become effective once the "emergency" is declared over. Orderly demobilization of response resources will need to occur. Follow-up actions such as accident investigation, response critique, plan review, and written follow-up reports will be needed.

The Vineyard Northeast IMT Planning Section will develop a Demobilization Plan to ensure that an orderly, safe, and cost-effective demobilization of personnel and equipment is accomplished. General considerations for the Demobilization Plan include ensuring that comprehensive check-out procedures are developed, that a process for equipment return is included, and that all personnel return to their home location safely.

Resources will be demobilized in accordance with priorities and procedures set by the Unified Command/Incident Command. As the response transitions from the emergency response phase to a planned recovery effort, the demobilization of incident resources must be conducted in an efficient and safe manner and shall not interfere with ongoing incident operations.

The Unified Command/Vineyard Northeast Incident Commander will approve the demobilization of critical resources identified by command staff prior to demobilization from the incident. Those resources will be identified daily in the daily operational period planning cycle. All demobilizations from the incident will be initiated by the Planning Section's Demobilization Unit after Unified Command/Incident Commander approval.

In accordance with 30 CFR 254.56(b), Vineyard Northeast will file a written follow-up report for any spill from the facility of 1 barrel or more to the Chief of OSPD within 15 days after the spillage is secured. All reports will include the cause, location, volume, and remedial action taken. Reports of spills of more than 50 barrels will include information on the sea state, meteorological conditions, and the size and appearance of the slick. Vineyard Northeast will provide additional information to the BSEE Regional Supervisor if it is determined that an analysis of the response is necessary.

2.13 References

Provincetown Center for Coastal Studies (PCCS). 2005. Toward an Ocean Vision for the Nantucket Shelf Region. Provincetown Center for Coastal Studies (PCCS), Provincetown, MA, 1-61.

Annex 1 – Facility Diagrams

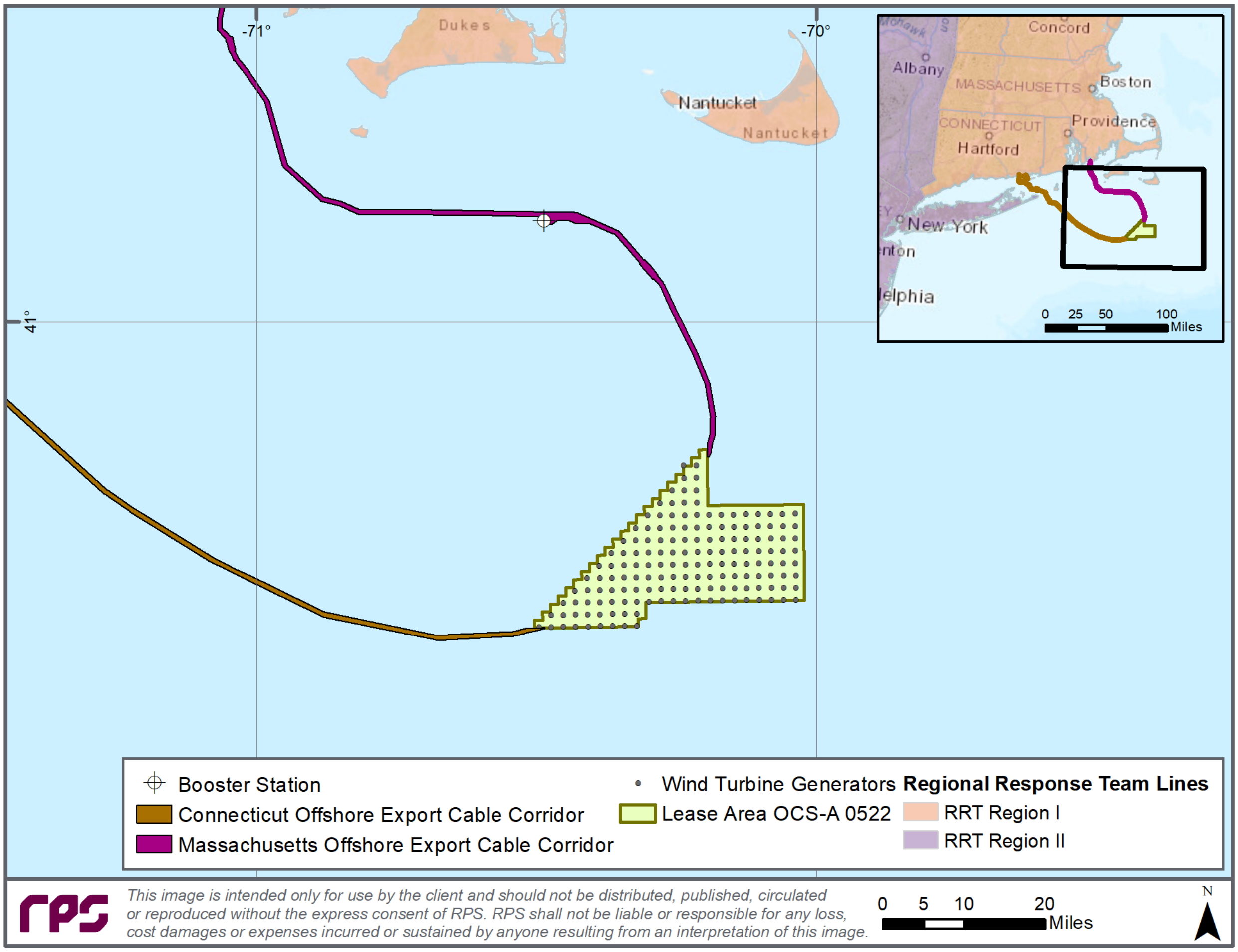


Figure A1-1: Vineyard Northeast OCS-A 0522 Lease Area Overview

Annex 2 – Notification Contact List

Table A2-1 Internal Notification List

Vineyard Northeast has not yet been approved. Details regarding QI personnel will be finalized prior to construction.

Name	Position	Cell	Email
Rachel Pachter	Qualified Individual, Vineyard Northeast	+1 (508) 680-6554	rpachter@vineyardoffshore.com
Jennifer Simon Lento	Alternate Qualified Individual, Vineyard Northeast	+1 (215) 485-8580	jsimonlento@vineyardoffshore.com
Ian Campbell	Spill Response Coordinator	+1 (781) 983-8943	icampbell@vineyardoffshore.com
Person D	Alternate Spill Response Coordinator	(XXX) XXX-XXXX	XXX@XXX.com
Persons E-Z	Other Spill Management Team Members	(XXX) XXX-XXXX	XXX@XXX.com

Table A2-2 External Notification and Call Lists

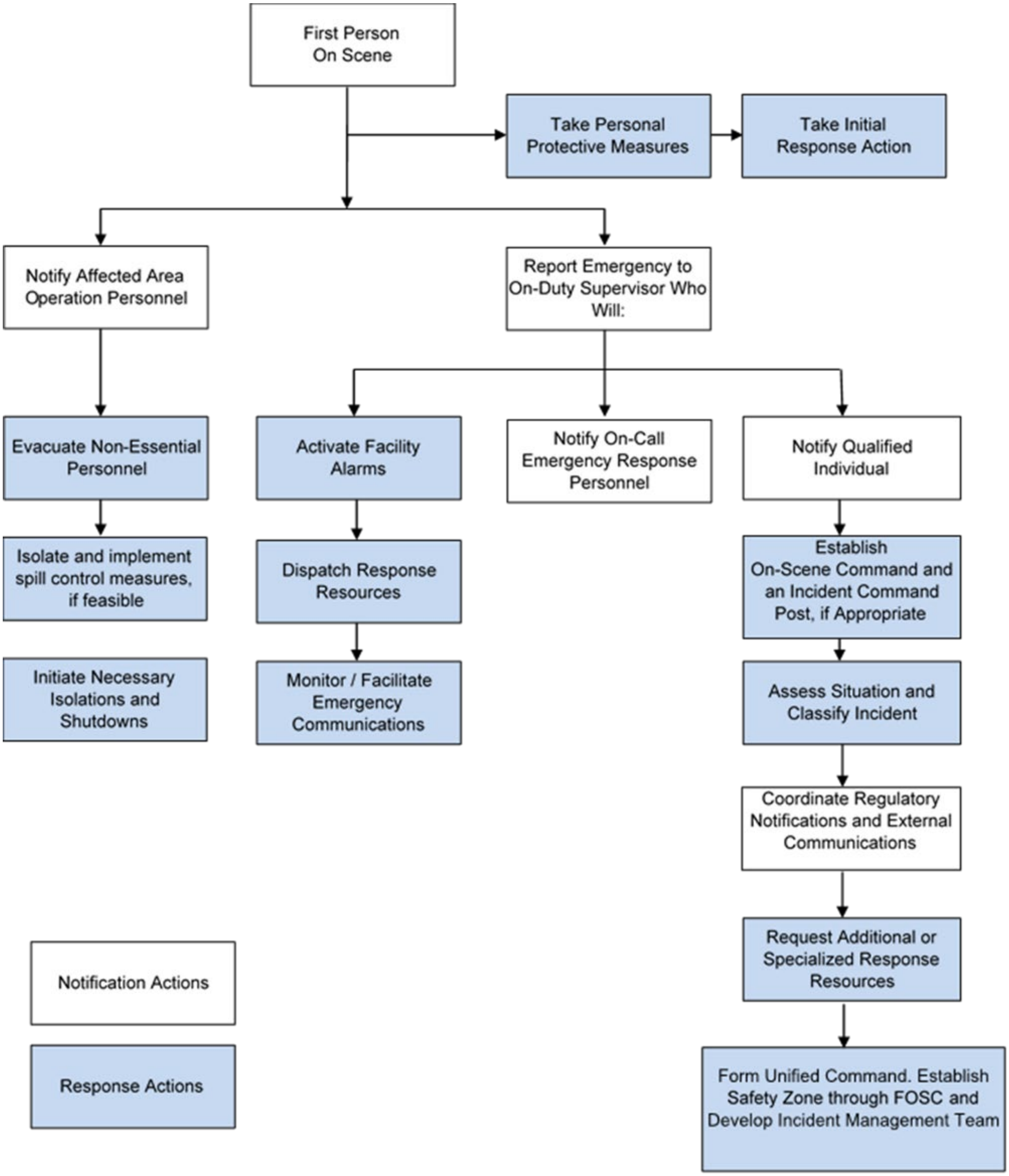
Agency	Location	Telephone
National Response Center	2703 Martin Luther King Jr. Avenue SE Washington, D.C. 20593	800-424-8802 (24 hr)
US Coast Guard Sector Southeastern New England	30 Little Harbor Road Woods Hole, MA 02543	508-457-3211 or 508-538-2300
US Coast Guard Sector Long Island Sound (if oil spill threatens CT waters)	120 Woodward Avenue New Haven, CT 06512	203-468-4401
BSEE Atlantic OCS Region	1201 Elmwood Park Boulevard New Orleans, LA 70123	504-736-0557
BOEM Atlantic OCS Region	1201 Elmwood Park Boulevard New Orleans, LA 70123	1-800-200-4853
EPA Region 1	5 Post Office Square, Suite 100 Boston, MA 02109	888-372-7341 or 617-918-1111
OSHA (fatality or 3 or more employees sent to hospital)	200 Constitution Avenue Washington, D.C. 20210	800-321-6742
Massachusetts Department of Environmental Protection	1 Winter Street Boston, MA 02108	888-304-1133
Massachusetts State Emergency Response Commission	Massachusetts Emergency Management Agency 400 Worcester Road Framingham, MA 01702	508-820-2010
Connecticut Department of Energy and Environmental Protection (if oil spill threatens CT waters)	79 Elm Street Hartford, CT 06106	860-424-3338 or 866-DEP-SPIL
Dukes County REPC (Threat to Martha's Vineyard)	32 Water Street Tisbury, MA 02568	508-696-4240
Wampanoag Tribe of Gay Head (Threat to tribal lands on MV)	20 Black Brook Road Aquinnah, MA 02535	508-645-9265
Mashpee Wampanoag Tribe	483 Great Neck Road South Mashpee, MA 02649	508-477-0208
Barnstable County REPC (Threat to Nantucket)	3195 Main Street Barnstable, MA 02630	508-375-6908
Nantucket Sound Keeper		508-775-9767
USCG Classified Oil Spill Removal Organizations (OSRO)		
Vineyard Northeast has not selected an OSRO at this time. USCG Classified OSROs for USCG District 1 can be found at: https://cgrri.uscg.mil/UserReports/WebClassificationReport.aspx.		
Weather		
National Oceanic & Atmospheric Administration (NOAA) National Weather Service National Weather Service	445 Myles Standish Boulevard Taunton, MA 02870	508-822-0634 (forecasts) 508-828.2672 (general info) http://www.weather.gov/box/
NOAA Weather Radio Hyannis, MA	Camp Edwards Hyannis, MA	Call sign: KEX73 VHF: 162.550
NOAA National Data Buoy Center	http://www.ndbc.noaa.gov/maps/Northeast.shtml	
Martha's Vineyard Airport (MVY)	http://mvyairport.com/	
Aviation Resources		
Vineyard Northeast has not selected aviation resources at this time. A list of Massachusetts charter operators is available at: http://www.aircharterguide.com/US_Operators/MA/Massachusetts		
Marine Resources		
Steamship Authority	1 Cowdry Road Woods Hole, MA 02543	508-548-5011

Agency	Location	Telephone
Hyline Ferry - Nantucket	34 Straight Wharf Nantucket, MA 02554	508-228-3949
Hyline Ferry – Martha's Vineyard	12 Circuit Ave Ext Oak Bluffs, MA 02557	508-693-0112
Island Queen Ferry	75 Falmouth Heights Rd Falmouth, MA 02540	508-548-4800
Regulatory Agencies for Wildlife		
US Fish and Wildlife Service Northeast Regional Office	300 Westgate Center Drive Hadley, MA 01035	413-253-8200
US Fish and Wildlife Service New England Field Office	70 Commercial Street Suite 300 Concord, NH 03301	603-223-2541
Massachusetts Environmental Police (fish kills)	251 Causeway Street Boston, MA 02114	800-632-8075
MassWildlife	1 Rabbit Hill Road Westborough, MA 01581	508-389-6300
MA Department of Fish and Game	251 Causeway Street Boston, MA 02114	617-626-1500
CT Bureau of Natural Resources (impact to CT fisheries/wildlife)	79 Elm Street Hartford, CT 06106	860-424-3010
Other Wildlife Resources		
Mass Audubon	208 South Great Road Lincoln, MA 01773	781-259-9500 or 800-823-8266
Felix Neck Wildlife Sanctuary	100 Felix Neck Drive Edgartown, MA 02539	508-627-4850
Long Point Wildlife Refuge	Off Edgartown-West Tisbury Road Martha's Vineyard, MA 02575	508-639-3678
International Fund for Animal Welfare	290 Summer Street Yarmouth Port, MA 02675	508-743-9548
New England Aquarium	1 Central Wharf Boston, MA 02110	617-973-5247
NOAA Greater Atlantic Fisheries Office	55 Great Republic Drive Gloucester, MA 01930	866-755-6622
National Audubon Society	New York, NY	212-979-3196
Licensed Wildlife Rehabilitation Providers		
The Commonwealth of Massachusetts maintains a list of licensed wildlife rehabilitators at: Find a wildlife rehabilitator | Mass.gov		
Medical Facilities		
Martha's Vineyard Hospital	1 Hospital Road Oak Bluffs, MA 02557	508-693-0410
Vineyard Medical Care (Walk-in Clinic)	364 State Road Vineyard Haven, MA 02568	508-693-4400
Nantucket Cottage Hospital	57 Prospect St. Nantucket, MA 02554	508-825-8165
Ambulances		
Tri-Town Ambulance	West Tisbury, MA	508-693-4922
Oak Bluffs Ambulance Department	Oak Bluffs, MA	508-693-5380
Tisbury Ambulance	Vineyard Haven, MA	508-696-4112
American Ambulance Service	Norwich, CT	860-886-1463
Boston MedFlight (Air lift)	Bedford, MA	781-863-2213
Coast Guard Air Station Cape Cod (Medevac)	Buzzards Bay, MA	508-968-6673
Fire Aid (911)		

Agency	Location	Telephone
Edgartown Fire Department	Edgartown, MA	508-627-5167
Oak Bluffs Fire Department	Oak Bluffs, MA	508-693-0077
West Tisbury Fire Department	West Tisbury, MA	508-693-2749
Chilmark Fire Department	Chilmark, MA	508-645-2207
Vineyard Haven Fire Department	Vineyard Haven, MA	508-696-6726
Nantucket Fire Department	4 Fairgrounds Road Nantucket, MA 02554	508-228-2324
Westport Fire Department	54 Hixbridge Road Westport, MA 02790	508-636-1110
Montville Fire Department	77 CT-163 Uncasville, CT 06382	860-848-8070
Police Aid (911)		
Massachusetts State Police	Oak Bluffs, MA	508-693-0545
Connecticut State Police	Uncasville, CT	860-848-6500
Dukes County Sherriff	Edgartown, MA	508-627-5328
Nantucket Police	4 Fairgrounds Rd Nantucket, MA 02554	508-228-7246
Massachusetts Environmental Police	Boston, MA	800-632-8075
Massachusetts Department of Public Safety	Boston, MA	617-727-3200
US Marshals Services	Boston, MA	617-748-2500
Federal Bureau of Investigation	Chelsea, MA	857-386-2000
Local Government and Agencies		
Wampanoag Tribe of Gay Head (Aquinnah)	Aquinnah, MA	508-645-9265
Dukes County Health Department	Vineyard Haven, MA	508-696-3844
Martha's Vineyard Chamber of Commerce	Vineyard Haven, MA	508-693-0085
Edgartown Town Hall	Edgartown, MA	508-627-6100
Oak Bluffs Town Hall	Oak Bluffs, MA	508-693-3554
Town of Tisbury	Vineyard Haven, MA	508-696-4200
West Tisbury Town Hall	West Tisbury, MA	508-696-4700
Chilmark Town Hall	Chilmark, MA	508-645-2100
Aquinnah Town Selectman	Aquinnah, MA	508-645-2310
Nantucket Island Chamber of Commerce	Zero Main St 2nd Floor Nantucket, MA 02554	508-228-1700
Other Industrial Facilities in Local Area		
Not Applicable		

Annex 3 – Response Management System

Figure A3-1 Initial Response Flowchart



Annex 4 – Incident and Other Documentation Forms

The QI will coordinate the documentation during the incident, and for post-incident review, in conjunction with federal, state, and local officials, as well as with others familiar with the incident. Forms to assist in documentation and presentation of consistent notification information are presented at the end of this Annex for use during an incident. These include:

- Initial Notification;
- Agency Call Back for Information;
- Chronological Log of Incident; and
- Incident Report.

As an alternative, or in addition to, the NIMS ICS Forms noted below may also be used. These can be accessed online at: https://www.fema.gov/media-library/assets/documents/103505. Table A4-1 NIMS ICS Forms

ICS Form No.	Description
IAP	Cover Sheet Incident Action Plan
201	Incident Briefing
202	Incident Objectives
203	Organization Assignment List
204	Assignment List
204a	Assignment List Attachment
205	Incident Communications Plan
206	Medical Plan
207	Incident Organization Chart
208	Site Safety Plan
209	Incident Status Summary
210	Resource Status Change
211	Incident Check-In List
213	General Message
213-RR	Resource Request
214	Unit Log
215	Operational Planning Worksheet
215a	IAP Safety Analysis Form
218	Support Vehicle/Equipment Inventory
219	Resource Status Card (T-Cards)
220	Air Operations Summary
221	Demobilization Checkout
224	Crew Performance Rating
225	Incident Personnel Performance Rating
230	Daily Meeting Schedule
232	Resources at Risk Summary
232a	ACP Site Index
233	Incident Open Action Tracker

ICS Form No.	Description
234	Work Analysis Matrix
235	Facility Needs Assessment

The post-incident investigation will begin after the source of the incident has been corrected, eliminated, or repaired, and the facility has been declared safe by the QI. The QI will take the following steps during a post-accident investigation:

- Obtain all data, information, and reports pertaining to the incident.
- Interview in person, or by telephone, each person knowledgeable of the incident.
- Review the response of operations personnel to see if procedures and training were adequate or if changes are warranted.
- Evaluate other potentially dangerous situations which could have occurred, and if the response of personnel and safety systems would have accommodated those situations had they occurred.
- Prepare recommendations as appropriate for changes to:
    - Design of facility;
    - Operating procedures;
    - Training;
    - Communications; and
    - Emergency response plans and procedures.
- The QI will prepare and issue a written report to all supervisors with any changes deemed appropriate.

The QI will prepare a post-incident report. This report will contain an account of the incident, including proof that Vineyard Northeast met its legal notification requirements for any given incident (i.e., signed record of initial notifications and certified copies of written follow-up reports submitted after a response). Examples of routine equipment and maintenance checklists/logs are also provided. These include:

- Response Equipment Inspection Log;
- Secondary Containment Checklist and Inspection Form;
- Tank Inspection Form; and
- Maintenance Log.

Form A4-10 Initial Notification Data Sheet

Date:	Time:
INCIDENT DESCRIPTION	
Reporters Name:	Position:
Reporters Phone Number:	Address:
Company:	
Latitude:	Longitude:
Date of Incident:	Time of Incident:
Spill/Incident Location:	Source and/or Cause of spill/incident:
Material spilled and total volume:	Vessel Name and Number (if applicable):
Is the material spilled in water?	Is the source secured?
Weather conditions:	Precipitation?
Incident Description:	
Name of Incident Commander:	Where is the Incident Command Post (directions)?
RESPONSE ACTIONS	
Actions taken to correct, control or mitigate incident:	
Number of injuries:	Number of deaths:
Were there evacuations?	Number of evacuated:
Areas affected:	Damage estimate:
Any other information about impacted medium:	
CALLER NOTIFICATIONS	
National Response Center (NRC): 800-424-8802	MassDEP
NRC Incident Assigned Number:	Other Agencies Notified: □ USCG □ EPA □ BSEE □ BOEM □ OSHA □ USFWS □ NMFS
Other Information Not Recorded Elsewhere:	

Note: Do Not Delay Notifications Pending Collection of All Information. Notify NRC immediately.

Form A4-11 Agency Call Back Information

Incident Number: ____________

Document all information that agencies request.

Date:	**Time:**
Agency:	**Person Contacted:**
Reason for Call Back:	
Document all dialogue with agency below:	

Form A4-12 Chronological Log of Events

Incident No.___________

Document all events chronologically.

Date/Time	Record of Event

Form A4-13 Incident Report

Incident No. ___________

Reviewed by:	Final Date:
□ Attach Initial Notification Form for basic data, update as incident progresses.	
Incident Duration (dates and time):	Type and Location of Incident:
Categorical Level of Incident and what portions of response team were assembled? Identify all leader positions and names.	Does the incident create a potential compliance issue? If yes, describe.
Material discharged:	Final discharged volume:
Were there any abnormal operating conditions immediately before the emergency? If yes, describe.	Were there any equipment problems or changes immediately before the emergency? If yes, describe.
Description of media impacted:	Was all media cleaned up to satisfaction of regulatory agencies?
Type and volume of waste generated (attach waste tracking log if applicable):	How and where was waste disposed or recovered?
Were all spilled materials recovered? If not, describe what was not recovered and why.	
Provide description of cleanup methods utilized:	
Describe decontamination procedures and include pieces of equipment decontaminated:	
Has stock of emergency equipment been replenished to pre-incident conditions?	Date demobilization was completed:

Describe what worked and did not work during incident:
Recommendations for improvement:

Form A4-14 Response Equipment Inspection Log

Incident No. ___________

Inspector	Date	Equipment	Comments

Vineyard Northeast is being developed and permitted using a Project Design Envelope (PDE). The PDE outlines a reasonable range of project design parameters and installation techniques. Specific details will be identified in the final version of the OSRP.

Form A4-15 Secondary Containment Checklist and Inspection Form

Incident No. ___________

Area(s) Inspected:	Date/Time:	Inspected By:
Inspection Item	**Acceptable (Y/N)**	**Comments/Corrective Action**
Level of precipitation in containment		
Presence of spilled or leaked material		
Operational status of drainage valves		
Debris		
Location/status of pipes, inlets, drainage		
Cracks		
Discoloration		
Corrosion		
Valve conditions		

Vineyard Northeast is being developed and permitted using a Project Design Envelope (PDE). The PDE outlines a reasonable range of project design parameters and installation techniques. Specific details will be identified in the final version of the OSRP.

Form A4-16 Monthly Checklist and Inspection Form

Incident No. ___________

Tank(s) Inspected:	**Date/Time:**	**Inspected By:**
Inspection Item	**Acceptable (Y/N)**	**Comments/Corrective Action**
Emergency Generator (Day Tank and Lubrication Oils)		
Diesel Tank		
Platform Crane		
Power Transformers		
Reactors		
Auxiliary/Earthing Transformers		
Wind Turbine Generators		

Inspect for the following:

- Support structure is in good condition (no corrosion or damage)
- External shell structure is in good condition (no corrosion or damage)
- Drip pans are in place (if applicable)
- Foundation is in good condition (stable and level)
- Liquid level gauge is in place and in good working condition (if applicable)

Remarks:

Form A4-17 Response Equipment Maintenance Log

This may be maintained on computer log or paper but must be kept on-site. Include description of maintenance activities performed (i.e., repaired boat motor, gate valves lubricated, booms cleaned, etc.).

Date	Equipment	Maintenance Performed

Annex 5 – Drills and Exercises, Training, and Logs

Facility response training, ICS training, personnel response training, drills/exercises, and spill prevention meetings in this section comply with the requirements of 30 CFR 254.41. Training certificates and training attendance records must be maintained and retained in a designated location for at least three years and provided to BSEE upon request. Vineyard Northeast will maintain documentation of training in the Boston, Massachusetts office. Training records must be made available to any authorized BSEE representative upon request. The Emergency Response Critique forms used to document inspections, drills, and training are included in Table A5-1.

A5.1 Drills and Exercises

Per 30 CFR 254.42(a), the entire OSRP must be exercised at least once every three years. However, to satisfy this requirement, separate exercises may be conducted over a three-year period. Exercises will simulate conditions in the area of operations, including seasonal weather variations, to the extent practicable. In addition, exercises will cover a range of scenarios, such as spills of a short duration and limited volume and the worst case discharge scenario.

A schedule of exercises will be determined by management in accordance with 30 CFR 254.42(b). The Chief of OSPD may require a change in the frequency of required exercises. Actual training exercises will be coordinated with the OSRO. Response training programs will comply with the Preparedness for Response Exercise Program (PREP) and the USCG/EPA training guidelines for oil spill response. Table A5-1 includes a list of regular personnel training exercises. This annex includes Drill/Exercise Documentation Forms to be used to document drills and exercises. The Chief of OSPD and BOEM must be notified at least 30 days prior to the following exercises: annual incident management team tabletop exercise; annual deployment exercise of response equipment identified in the OSRP that is staged at onshore locations; and semi-annual deployment exercises of any response equipment which the BSEE Regional Supervisor requires Vineyard Northeast to maintain at the facility or on dedicated vessels. The annual Incident Management Team (IMT) tabletop exercise will include the actual notification to the National Response Center (NRC), BSEE Regional Supervisor, BOEM, and the OSRO to determine availability and response times. Each call that is made will begin with the statement “This is a drill.”

As detailed in this annex, several types of drills are conducted as part of the drill program as follows:

- Notification drills to test communications procedures will be conducted monthly.
- QI notification drills will be conducted at least quarterly to verify that the QI can be reached in an emergency situation to perform required duties.
- The Spill Management Team will participate in a table-top drill annually. A tabletop drill will also be included in other drills as often as possible.
- Unannounced annual notification drills will be performed. These drills will be conducted with BSEE OSPD, BOEM, and OSRO participation. These annual drills will simulate a response action and conveyance of key information between the QI, BOEM, and the BSEE OSPD.
- Every effort is made to cooperate in local drills requested by regulatory agencies and neighbors.
- OSROs under contract will be drilled at least annually.
- Full-scale exercises will be conducted every four years and will involve federal, state, and local government agencies, including BSEE, BOEM, and USCG

The annual notification drill will be an opportunity for the QI, BOEM, and BSEE OSPD to simulate an incident command post setting that is capable of supporting response efforts (e.g., deployment of personnel and equipment, tracking containment efforts, taking samples, shoreline cleanup, etc.) for a variety of spill scenarios. Prior to the drill, the size and scope of the drill will be defined and will be structured of various levels of complexity to test events ranging from implementation of specific components of the OSRP to full implementation of the plan.

Facility spill response drills are comprehensive and designed to improve response actions at the level of the first responder. A tabletop planning session is held prior to the drill, with a limited number of supervisory personnel informed of the drill.

Drills are conducted to enable personnel who will act as initial responders during an actual spill to become familiar with response equipment. During spill drills, the techniques of pulling and placing boom such as for diversion, deflection, and containment are practiced. Drills are also conducted to allow personnel to become familiar with climatic conditions, such as the interactions of wind, tide, and wave actions and their effect on oil movement. In spill drills, consideration is given to sensitive areas which may be affected and need protection.

As part of the drill process, a critique is held following the drill. All personnel who participate in the drill, including observers, also participate in the critique. The purpose of this is to review the drill for procedures which worked well and procedures which did not work well. Each individual has an opportunity to provide input. Recommendations are submitted to management.

Annually, at least one of the exercises listed in Table A5-1 must be unannounced. Unannounced means the personnel participating in the exercise must not be advised in advance of the exact date, time, and scenario of the exercise. The staff from Vineyard Northeast will also participate in unannounced exercises as directed by the lead federal agency. The objectives of the unannounced exercises will be to test notifications and equipment deployment for response to the average most probable discharge. After Vineyard Northeast personnel successfully complete a Government-Initiated Unannounced Exercise (GIUE), they will not be required to participate in another one for at least 36 months from the date of the exercise.

Vineyard Northeast personnel will also participate in exercises of the ACP as directed by the USCG FOSC. As part of the National Preparedness for Response Exercise Program (PREP), the USCG Sector Southeastern New England FOSC will either direct a government-led PREP exercise where Vineyard Northeast could participate as the Responsible Party, or Vineyard Northeast could lead the exercise design and facilitation effort for an industry-led PREP exercise. These exercises are typically full-scale exercises involving both an Incident Command Post element exercising the IMT and a field deployment element where spill response equipment is actually deployed. Area exercises test the ACP and are required on a quadrennial schedule. In either a government-led or industry-led PREP exercise, Vineyard Northeast would be a main player on the Exercise Design Team along with the USCG, MassDEP, and other federal, state, and local stakeholders.

An Exercise Drill Log will be developed and maintained by the Training Department at Vineyard Northeast to record all drills and exercises completed at the facility. An example training log form is presented in this Annex. Records of these activities will be maintained for a period of three years, as per 30 CFR 254.42(e).

A5.2 Planned Training

Planned training sessions are held for staff and operations personnel on an annual basis to gain an understanding of the OSRP process. The intent of these sessions is to keep personnel informed of their obligation to respond to all emergencies, to prevent pollution incidents, to improve spill control and response techniques, and to gain a comprehensive understanding of the ICS and their responsibilities on the IMT. These briefings highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures to prevent spills.

Members of the Spill Response Operating Team who are responsible for operating response equipment will attend hands-on training classes at least annually. This training will include the deployment and operation of all response equipment. Supervisors of the team will receive this training and will also be trained annually on directing the deployment.

All field personnel and members of the spill response management team or IMT, including the Spill Response Coordinator and alternate Spill Response Coordinators, will receive annual training on their duties. This training will include:

- The proper procedures for the reporting of spills, including procedures for contacting the QI on a 24-hour basis.
- Locations, intended use, deployment strategies, and operational and logistical requirements of response equipment. They will also review procedures on how and where to place facility containment/recovery materials depending on where the spill occurs and various seasonal conditions. Personnel will be informed that detergents or other surfactants are prohibited from being used on an oil spill in the water.
- Oil spill trajectory analysis and predicting spill movement.
- Other responsibilities of the IMT, including ICS procedures and roles.

The QI, Spill Response Coordinator, and alternate Spill Response Coordinators will receive specific training to ensure they are sufficiently trained to perform their duties.

Records of all training activities are maintained and retained for at least three years following completion of training. The facility will maintain records for each individual as long as these individuals are assigned duties in this plan. Individuals will sign documentation when participating in training classes or exercises as provided in the example in Table A5-2 within this Annex.

Credit for any of the above drills and exercises may be taken by Vineyard Northeast if an actual incident occurs, and records of the incident will be maintained to show evidence of complying with any of the above drill or exercise requirements.

Table A5-1 Drills and Exercises

Exercise	Purpose/Scope	Objectives	Frequency	Participants
QI Notification Exercise	Ensure the QI can be contacted in a spill response emergency in order to carry out required duties.	Contact QI by telephone, radio, fax, or email. Confirmation received from QI of notification.	Monthly	Qualified Individuals
Incident Management Team (IMT) Tabletop Exercise (TTX)	Ensure the IMT is familiar with the emergency response procedures and the Incident Command System.	IMT is familiar with emergency response procedures. Employs proper procedures during a simulated emergency response.	Annually	IMT, BSEE OSPD, BOEM
On-Site Equipment Deployment Exercise	Verify that required response equipment is operable and facility personnel are capable of deploying the equipment.	Verify that designated equipment is available. Deploy at least the minimum required equipment during exercise. Verify that personnel tasked with deployment have received required training.	Annually	Spill Response Operating Team, BSEE OSPD, BOEM, OSRO
OSRO Equipment Deployment Exercise	Same as above, but performed by OSRO	Same as above	Annually	OSRO
Discharge Prevention Briefings	Conduct Discharge Prevention Briefings	Personnel have adequate understanding of the OSRP. Describe known discharges or failures. Discuss any recently developed precautionary measures.	Annually (optional)	Oil-handling Personnel
Simulated Spill Drill[2]	Test the resources and response capabilities of the OSRO.	Demonstrate OSRO's ability to deploy resources to include: On water containment and recovery Sensitive habitat protection Storage	Every three years	Oil-handling Personnel
Full-Scale Exercise (FSE)	Test the IMT's capability of establishing a Unified Command (UC) and developing an Incident Action Plan. In addition to the work within the Incident Command Post, field personnel will deploy equipment in the field using the same exercise scenario.	Demonstrate IMT's ability to establish the ICS, transfer incident management to a UC formed with government personnel, and produce an Incident Action Plan Demonstrate field personnel's capability to deploy oil spill response equipment to protect sensitive sites	Every four years	QI, Spill Response Coordinator, IMT, federal, state, and local government personnel including OSPD, field personnel

Notes:

1. In a three year period, at least one of these exercises must include a worst case discharge scenario.
2. In a three year period, all components of the response plan must be exercised.
3. Annually at least one of the first three exercises listed must be unannounced to participants.

A5.3 Training Documentation and Record Maintenance

Spill response personnel training records will be maintained at the Vineyard Northeast office in Boston, MA. The address for Vineyard Northeast's Boston office is 200 Clarendon Street, 18th Floor, Boston, Massachusetts. An example training record is provided in Table A5-2. Records will be maintained and retained at this location for three years and provided to BSEE upon request. These records will include:

- Documentation of annual training associated with the OSRP provided to the QI, Alternate QI, Spill Response Coordinator, alternate Spill Response Coordinator, IMT members, and other facility personnel;
- Records of personnel training in accordance with OSHA 29 CFR §1910.120 regulations;
- Records of training provided for response contractor personnel will be maintained at the respective contractor's office and will be verified by facility personnel on-site; and
- Logs of volunteer workers (if applicable) and activities performed.

Table A5-2 Spill Response Drill Form Notification Exercise

VINEYARD NORTHEAST LLC
SPILL RESPONSE DRILL/EXERCISE DOCUMENTATION FORM

NOTIFICATION EXERCISE

1. Date performed: ____
2. Exercise or actual response: _______________________________________
3. Facility initiating exercise:____
4. Name of person notified:____

   Is this person identified in your response plan as qualified individual or designee?____
5. Time initiated:____

   Time in which qualified individual or designee responded:____________________
6. Method used to contact:

   ____Telephone

   ____Radio

   ____Other______________________________
7. Description of notification procedure:

   ____
   ____
   ____
8. Evaluation of Drill:

   ____
   ____
   ____
9. Changes to be implemented (if any):

   ____
   ____
   ____

Certifying Signature____

Table A5-3 Incident Management Team Tabletop Exercise

VINEYARD NORTHEAST LLC
SPILL RESPONSE DRILL/EXERCISE DOCUMENTATION FORM

INCIDENT MANAGEMENT TEAM TABLETOP EXERCISE

1. Date performed:____
2. Exercise or actual response:____
   If an exercise, announced or unannounced:_______________________________________
3. Location of tabletop:____
4. Time started:____
   Time completed:____
5. Response plan scenario used (check one):
   ____Average most probable discharge ____Worst case discharge
   ____Maximum most probable discharge ____Size of (simulated) spill-bbls/gals
6. Describe how the following objectives were exercised:

a) Spill management team's knowledge of oil-spill response plan:

____
____
____

b) Proper notifications:

____
____
____

c) Communications system:

____
____
____

d) Spill management team's ability to access contracted oil spill removal organizations:

____
____
____

e) Spill management team's ability to coordinate spill response with Federal On-Scene Coordinator, State On-Scene Coordinator, and other applicable agencies:

____
____
____

f) Spill management team's ability to access sensitive site and resource information in the Area Contingency Plan:

INCIDENT MANAGEMENT TEAM TABLETOP EXERCISE (Continued)

____
____
____

7. Evaluation of Exercise:

____
____
____
____
____
____

8. Lessons Learned:

____
____
____
____
____
____

9. Changes to be implemented (if any):

____
____
____
____
____
____

Certifying Signature:____

Table A5-4 Spill Response Drill Form Equipment Deployment Exercise

VINEYARD NORTHEAST LLC
SPILL RESPONSE DRILL/EXERCISE DOCUMENTATION FORM

EQUIPMENT DEPLOYMENT EXERCISE

1. Date performed:____
2. Exercise or actual response:____

   If an exercise, announced or unannounced:____________________________________
3. Deployment location(s):

   ____

   ____

   ____
4. Time started:____

   _______Time OSRO called (if applicable)

   _______Time on-scene

   _______Time boom deployed

   _______Time recovery equipment arrives on-scene

   _______Time completed
5. Equipment deployed was:

   _______Facility-owned

   _______OSRO-owned; if so, which OSRO:______________________________________

   _______Both
6. List type and amount of all equipment (e.g., boom and skimmers) deployed and number of support personnel employed:

   ____

   ____

   ____

   ____

   ____
7. Describe goals of the equipment deployment and list any Area Contingency Plan strategies tested. Attach a sketch of equipment deployments and booming strategies:

   ____

   ____

   ____

   ____

   ____
8. For deployment of facility-owned equipment, was the amount of equipment deployed at least the amount necessary to respond to your facility's average most probable spill?

EQUIPMENT DEPLOYMENT EXERCISE (Continued)

____
____
____

9. Was the equipment deployed in its intended operating environment?

____
____
____

10. For deployment of OSRO-owned equipment, was a representative sample (at least 1000 feet of each boom type and at least one of each skimmer type) deployed?

____
____
____

11. Was the equipment deployed in its intended operating environment?

____
____
____

12. Are all facility personnel that are responsible for response operations involved in a comprehensive training program, and all pollution response equipment involved in a comprehensive maintenance program?

____
____
____

13. Date of last equipment inspection:________________________________

14. Was the equipment deployed by personnel responsible for its deployment in the event of an actual spill?________________________________

15. Was all deployed equipment operational? If not, why not?

____
____
____

16. Evaluation of Exercise:

____
____
____

17. Lessons Learned:

____
____
____

18. Changes to be implemented (if any):

____
____
____

EQUIPMENT DEPLOYMENT EXERCISE (Continued)

____

____

Certifying Signature:____

Table A5-5 Vineyard Northeast Training Log

VINEYARD NORTHEAST LLC
TRAINING LOG

EMPLOYEE TRAINING

Employee Name	Date	Hours of Training	Training Topic

Annex 6 – Worst-Case Discharge – Planning Calculations for Discharge Volumes, Response Equipment, and Detailed Spill Response Plan

Per 30 CFR 254.26, the volume of the worst-case discharge scenario must be determined using the criteria in 30 CFR 254.47. The criteria in 30 CFR 254.47 applies to oil production platform facilities and pipeline facilities. Per BSEE/BOEM guidance titled, "Oil Spill Response Plan (OSRP) for Offshore Wind Facilities Discussion Handout" dated August 21, 2019, the worst-case discharge for a renewable energy facility is defined as the discharge of all oil from a component located at an offshore facility, such as a WTG or an ESP.

A6.1 Facility Information

Vineyard Northeast LLC proposes to construct, operate, and decommission offshore renewable wind energy facilities in Lease Area OCS-A 0522 along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." Vineyard Northeast includes 160 WTG and ESP positions located in the Lease Area. Additionally, if high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[3] of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket.

At its closest point, the Lease Area is located just over 46 km (29 mi) from Nantucket, Massachusetts and approximately 64 km (40 mi) from Martha's Vineyard. The WTGs, ESP(s), and booster station will be oriented in fixed east-to-west rows and north-to-south columns with one nautical mile (1.9 km) spacing between positions.

The 536 km^2 (132,370 acre) Lease Area is within the Massachusetts/Rhode Island WEA identified by BOEM, following a public process and environmental review, as suitable for wind energy development. Between the Lease Area and shore, the offshore export cables will be installed within offshore export cable corridors (OECCs) that connect to onshore transmission systems in Massachusetts and/or Connecticut. The worst case oil discharge associated with Vineyard Northeast is conservatively assessed as a catastrophic spill of all oil contents from the topple of an ESP located closest to shore within the Lease Area.

The oil sources in the WTGs include transformer oil, drive train main bearing oil, and hydraulic oil, which total approximately 6,604 gallons (157.2 barrels [bbl]) for the largest WTG. Oil sources in the ESPs and the booster station include diesel oil from the emergency generator, diesel engine, and fuel oil storage tank and naphthenic oil from the emergency generator, platform crane, power transformers, reactors, auxiliary/earthing transformers, and other general sources. The oil sources associated with one ESP total approximately 236,754 gallons (5,637 bbl). The volume of oil in the booster station is 185,978 gallons (4,428 bbl).

[3] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

Table A6-1 WTG Oil Storage

Oil Source	WTG	
	Volume (Liters)	Approximate Gallons
Drive Train Main Bearing	5,625	1,486
Hydraulic System	2,500	660
Transformer	15,000	3,963
Grease	1,875	495
TOTAL		**6,604**

Table A6-2 ESP and Booster Station Oil Storage

Oil Source	Volume (Liters)	Gallons
Emergency Generator – Diesel Day Tank	75,460	19,934
Diesel Engine		
Fuel Oil Storage Tank		
Emergency Generator – Lubrication Oil (Naphthenic Oil)	96	25
Platform Crane – Hydraulic Oil (Naphthenic Oil)	2,154	569
Power Transformers (two units) – Naphthenic Oil	816,200	215,616
Reactors (two units) – Naphthenic Oil		
Auxiliary/Earthing Transformer – Naphthenic Oil		
General Oil – Naphthenic Oil	2,310	610
ESP TOTAL		**236,754**
BOOSTER STATION TOTAL		**185,978**

A6.2 Oil Volume and Spill Containment

If all the oils associated with the ESPs or the booster station were discharged, the largest worst case discharge scenario would be 236,754 gallons. However, control measures (e.g., containment structures) would be in place to contain a spill of oil. Where possible, biodegradable oils will be used. In addition, monitoring equipment will be used to detect a spill. Monitoring equipment being considered include closed circuit televisions, supervisory control and data acquisition, alarm systems (e.g., tank level, containment liquids, etc.), and oil detection equipment for the sump tank. The equipment will be monitored remotely from a “control room”. Specific details will be identified in the final version of the OSRP.

Based on the current conceptual ESP design and subject to ongoing refinements, the ESP platform is expected to be equipped with a drain system consisting of containment structures, piping, an oil/water separator (OWS), and a sump tank. The containment structures are sized according to the largest container and are connected via a piping system, draining liquids under gravity to an OWS and a sump tank. The sump tank must be dimensioned for the largest amount of oil, deluge water, and firewater coming from an oil-filled equipment during the greatest incident plus spare capacity (15% recommended). The sump tank may be emptied by a service vessel for proper disposal of the oily substances onshore.

The ESPs will likely include an OWS, subject to the final ESP design. Rainwater and oily substances are separated in the OWS before water is led overboard. Water being led overboard is monitored for oil contamination. As per maritime regulations, the oil content in the water processed from the OWS must be less than 15 parts per million of oil. The 15 ppm alarm shall activate to indicate when this level cannot be maintained and initiate automatic stop of overboard discharge of oily mixtures where applicable. The overboard line will be closed, and the drained liquids are fed to the sump tank and stored, in the event of a discharge.

In general, all equipment that contains an environmentally harmful substance is placed above drip trays. The area of the platform where the transformers are placed is expected to be a plated area with drains, acting as drip trays. Drip trays that have the potential to collect rainwater are connected via the OWS to the sump tank. Other drip trays (e.g., indoor) which collect only harmful substances may be connected directly to the sump tank.

Any temporary piping connections transporting oily substances (e.g., between diesel storage container and emergency generator) will be made using off-shore certified dry-break connectors and placed above a drip tray. A simple oil spillage kit, allowing to mitigate small, local spillage during maintenance, will be part of the delivery.

The WTGs contain up to approximately 6,604 gallons of oil per WTG. The WTGs are designed to have a fiberglass secondary containment system, which would be sized according to the largest container.

A6.3 Oil Spill Trajectory

Based on 30 CFR 254.26, an appropriate oil spill trajectory analysis was conducted. This analysis identified the onshore and offshore areas that a discharge could potentially affect. The oil spill modeling study assessed the trajectory and weathering of oil following a catastrophic discharge of all oil contents from the topple of the ESP located the closest to shore within the Lease Area (during a time period that oil could reasonably be expected to persist in the environment). These would be the worst case discharge scenarios, involving a relatively small and finite discharge of oil (on the order of 5,637 bbl in comparison to a larger multi-million barrel catastrophic incident, such as the Deepwater Horizon oil spill). A discharge of all oil contents in the booster station is also evaluated. It is important to note that the modeling conducted includes the conservative assumption that no oil spill response or mitigation would occur. In fact, Vineyard Northeast would employ containment and recovery methods, including response equipment employed on water that would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted. A full description of the oil spill modeling and results are provided in Annex 10 of this OSRP.

A6.4 Resources of Special Economic or Environmental Importance

According to the RRT 1 RCP, MassDEP is the designated representative of Region I RRT for the Commonwealth of Massachusetts. In addition, MassDEP is the Trustee for Natural Resources under the Oil Pollution Act of 1990 (Public Law 101-380). MassDEP has established a Priority Resource Map, which includes data such as sole source aquifers, wellhead protection areas, protected open space areas, areas of critical environmental concern, and estimated habitats of rare wildlife. The mapping does not include the Lease Area since it is in the OCS.

At its closest point, the Lease Area is located just over 46 km (29 mi) from Nantucket, Massachusetts and 64 km (40 mi) from Martha's Vineyard. The closest WTG/ESP position within the Lease Area is approximately 49 km (31 miles) from Nantucket and approximately 63 km (39 miles) from Martha's Vineyard. The National Congress of American Indians (NCAI) designated Nantucket Sound as a National Historic Landmark in order to permanently protect and preserve the Sound as a site of historical and cultural significance to tribal nations. The island of Martha's Vineyard is an EPA designated sole source aquifer. The central and eastern portions of Martha's Vineyard have been identified as potentially productive aquifers. An area that has been designated as a National Heritage and Endangered Species Program Estimated Habitat of Rare Wildlife is located south of Martha's Vineyard in the Atlantic Ocean. This area extends approximately one mile offshore in the western and central portions of Martha's Vineyard to approximately 4.5 miles offshore in the eastern portion of Martha's Vineyard. Open spaces on Martha's Vineyard include Manuel F. Correllus State Forest in the central portion of the island and several beaches located along the perimeter of the island.

ESI maps, available from the National Oceanic & Atmospheric Administration, provide a summary of coastal resources that are at risk if an oil spill occurs in the area. Maps with coverage of Nantucket and Martha's Vineyard are contained in: Massachusetts and Rhode Island: Volume 3 Buzzards Bay. The maps are available in pdf format at: https://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html.

The oil spill modeling results (provided in Annex 10 of this OSRP) conservatively assume that no oil spill response or mitigation would occur. This is a very conservative assumption as the ESP will be designed with containment, and Vineyard Northeast would employ containment and recovery methods to contain and recover onshore and aquatic petroleum spills. Under these very conservative assumptions, the modeling results indicate, at the Large ESP 1 (BG-49) location (Figure 1-1), there is <10% probability that oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) would reach the shorelines of Nantucket within three to five days of the discharge for the spring, summer, and fall scenarios. In the winter season, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell). Similarly, at the Large ESP 2 (BV-36) location, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell).

When comparing the oil spill modeling results with the ESI data for Massachusetts and Rhode Island, the southern shores of Martha's Vineyard and Nantucket, which would likely be the first shorelines to be impacted by a spill (prior to response equipment being deployed), are primarily dominated by tidal flats. The shorelines of Rhode Island and Massachusetts are predominately comprised of sand and gravel beaches and riprap. Some of the specific areas of environmental concern along the southern shores of Martha's Vineyard and Nantucket that would be taken into special consideration in the event of an oil spill include the Long Point Wildlife Refuge, Katama Plains Nature Preserve, Head of Plains Wildlife Management Area, Smooth Hummock Coastal Preserve and Miacoment Heath Wildlife Management Area. National Wildlife Refuges in the area are shown in Figure 2-3.

A6.5 Response

Vineyard Northeast has not yet been approved. Details regarding spill response materials, services, equipment, and response vessels have not been finalized at this time.

The WTGs and ESPs have been designed to utilize secondary containment systems to prevent a discharge of oil to the environment. Containment will be provided considering the size of the largest container. The secondary containment for the ESPs is connected to a sump tank. In addition, an oil/water separator will likely be in use. It is unlikely that a discharge of oil would not be contained by the containment systems.

Oils used by Vineyard Northeast have a specific gravity of less than 1.0. Therefore, any discharges of oil to water would float on the surface of the water, and on-water mechanical recovery techniques could be used to recover the spilled oil.

Vineyard Northeast will retain a third-party OSRO to assist in the unlikely event of a discharge of oil to the environment. In addition, Vineyard Northeast will maintain pier space for crew transfer vessels (CTVs) and/or other support vessels. CTVs are purpose built to support offshore wind energy projects and are set up to safely and quickly transport personnel, parts, and equipment. In addition to vessels, Vineyard Northeast will maintain spill response equipment such as a spill overpack drum, containment bladders, absorbent booms, pigs, socks, and other sorbent materials. In addition, Vineyard Northeast will have on-hand personal protective equipment (PPE) such as goggles or safety glasses, face shields, gloves, and disposable chemical and oil resistant suits (e.g., Tyvek suits).

MassDEP maintains a list of companies licensed as hazardous waste transporters who provide emergency response services and cleanups OHM spills. MassDEP SERO emergency response contractors located near the Lease Area include Frank Corporation (New Bedford, MA), Global Remediation Services, Inc. (Taunton, MA), Clean Harbors, Inc. (Norwell, MA), Moran Environmental Recovery, LLC (Randolph, MA), New England Disposal Technologies (Sutton, MA), NRC East Environmental Services (Franklin, MA), Cyn Oil Corporation (Stoughton, MA), and Western Oil, Inc. (Lincoln, RI). These companies maintain boats and other equipment to respond to spills of oil on the in a marine environment.

In addition, U.S. Coast Guard-certified OSROs for the USCG District 1 can be found at https://cgrri.uscg.mil/UserReports/OSROPOCReport.aspx. Response times for mobilization of OSRO resources will be dependent on the location of the OSRO.

Once an OSRO is contracted, additional details will be provided regarding spill response resources and the time needed for procurement. In addition, a discussion of response to worst case scenario in adverse weather conditions will be addressed. Per 33 CFR 115.1020, factors to consider when evaluating adverse weather include, but are not limited to, significant wave height, ice, temperature, weather-related visibility, and currents.

Sections 2.4 and 2.5 address the overall response to a possible oil spill at Vineyard Northeast. The use of dispersants is covered in Section 2.7, and the use of in-situ burning is covered in Section 2.8. Please refer to those sections for more complete details on the response.

Annex 7 – Agreement with Oil Spill Removal Organization

Vineyard Northeast has not yet been approved. Details regarding contractual agreements will be finalized prior to construction.

Per 30 CFR 254.25, this contractual agreements' annex must furnish proof of any contracts or membership agreements with OSROs, cooperatives, spill-response service providers, or spill management team members who are not Vineyard Northeast employees that are cited in the OSRP. Documentation should include copies of the contracts, or membership agreements, or certification that contracts or membership agreements are in effect. The contract or membership agreement must include provisions for ensuring the availability of the personnel and/or equipment on a 24-hour-per-day basis.

Vineyard Northeast will retain a third-party OSRO. MassDEP SERO emergency response contractors located near the Lease Area include Frank Corporation (New Bedford, MA), Global Remediation Services, Inc., (Taunton, MA), Clean Harbors, Inc. (Norwell, MA), Moran Environmental Recovery, LLC (Randolph, MA), New England Disposal Technologies (Sutton, MA), NRC East Environmental Services (Franklin, MA), Cyn Oil Corporation (Stoughton, MA), and Western Oil, Inc. (Lincoln, RI).

In addition, U.S. Coast Guard-certified OSROs for the USCG District 1 can be found at https://cgrri.uscg.mil/UserReports/OSROPOCReport.aspx. Response times for mobilization of OSRO resources will be dependent on the location of the OSRO.

The selected spill contractor will be responsible for the inspection and maintenance of their equipment. The equipment should be inspected on at least a monthly basis.

Annex 8 – Equipment Inventory

Details regarding spill response materials, services, equipment, and response vessels for Vineyard Northeast's offshore facilities will be confirmed at a later date.

Appendix 9 of the RRT 1 RCP contains the USCG/EPA Response Jurisdiction Boundary. This document demarcates the boundary between inland and coastal zones for the purpose of pre-designation of on-scene coordinators for pollution response. Martha's Vineyard, Nantucket, and all other islands lying off the coast of Massachusetts are the responsibility of the USCG for providing the predesignated FOSC. USCG will be responsible for general agency and incident specific responsibilities under the NCP and ACP.

The Proponent will ensure that its contracted response equipment is maintained in proper operating condition, ensure that all maintenance, modification, and repair records are kept for a minimum of three years, and provide these records to BSEE upon request. The Proponent or the Proponent's OSRO will provide BSEE with physical access to the Proponent's equipment storage depots and perform functional testing of the Proponent's response equipment upon BSEE's request.

A8.1 Maintenance Facilities

Vineyard Northeast expects to use one or more onshore O&M facilities to support the operation of Vineyard Northeast's offshore facilities. These facilities could be located near several possible ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, or Canada. See COP Volume 1, Table 4.4-1 for the full list of locations. The O&M facilities may also include offices, a control room, training space for technicians, employee parking, and/or warehouse space for parts and tools. The O&M facilities are expected to include dock space for service operation vessels (SOVs), service accommodation and transfer vessels (SATVs), crew transfer vessels (CTVs), and/or other support vessels.

The O&M facilities would likely be used for dispatching technicians and crew exchange, bunkering, and loading supplies and spare parts onto vessels. The Proponent may also lease space at an airport hangar for aircraft and helicopters used to support operations. Onshore maintenance and repair activities are expected to require minimal use of worker vehicles and construction equipment. Offshore equipment during maintenance and repair activities could include generators, welding equipment, surface preparation equipment (i.e., to remove rust and prepare the surface for coating touch-ups), pressure washers, and other larger offshore construction equipment (e.g., cranes, cable burial tools).

It is anticipated that Vineyard Northeast will maintain spill response equipment such as a spill overpack drum, containment bladders, absorbent booms, pigs, socks, and other sorbent materials. In addition, Vineyard Northeast will have on-hand PPE such as goggles or safety glasses, face shields, gloves, and disposable chemical and oil resistant suits (e.g., Tyvek suits).

A8.2 Electrical Service Platform and Booster Station (if used)

The ESPs will include step-up transformers and other electrical gear. Vineyard Northeast will maintain spill response equipment at the ESPs and at the potential booster station. Brooms, shovels, sorbents, pigs, socks, and a spill overpack drum will be maintained at the ESP for response to minor leaks and spills. In addition, Vineyard Northeast will have on-hand PPE such as goggles or safety glasses, face shields, gloves, and disposable chemical and oil resistant suits (e.g. Tyvek suits).

A8.3 Oil Spill Removal Organization

Vineyard Northeast will retain a third-party OSRO. MassDEP maintains a list of companies licensed as hazardous waste transporters who provide emergency response services and cleanups of OHM spills. The list is updated annually by MassDEP and is organized by MassDEP Regions. The SERO is affiliated with Martha's Vineyard and New Bedford. The list of contractors for the SERO Region is available at: https://www.mass.gov/doc/southeast-region-emergency-responsehazardous-waste-transporter-companies/download. MassDEP SERO emergency response contractors located near the Lease Area include the following:

- Frank Corporation (New Bedford, MA) – Phone: 508-995-9997
- Global Remediation Services, Inc. (Taunton, MA) – Phone: 508-828-1005
- Clean Harbors, Incorporated (Norwell, MA) – Phone: 800-645-8265
- Moran Environmental Recovery, LLC (Randolph, MA) – Phone: 888-233-5338
- New England Disposal Technologies (Sutton, MA) – Phone: 800-698-1865
- NRC East Environmental Services (Franklin, MA) – Phone: 800-899-4672
- Cyn Oil Corporation (Stoughton, MA) – Phone: 800-242-5818
- Western Oil, Inc. (Lincoln, RI) – Phone: 800-240-5540

In addition, U.S. Coast Guard-certified OSROs for the USCG District 1 can be found at https://cgrri.uscg.mil/UserReports/OSROPOCReport.aspx. Response times for mobilization of OSRO resources will be dependent on the location of the OSRO.

The selected spill contractor will be responsible for the inspection and maintenance of their equipment. The equipment should be inspected on at least a monthly basis.

A8.4 Response Equipment

Response equipment on the WTGs, ESPs, and/or booster station will be inspected at least quarterly and maintained to ensure optimal performance. Records of inspections of response equipment must be maintained for at least three years and made available to authorized BSEE representatives upon request. Inspections of contractor equipment are addressed in A8.8.

The program of maintenance and testing of emergency response equipment involves four activities: Operability Check, Inventory, Inspection, and Maintenance. The Spill Response Coordinator or designee is required to sign the inspection form and will be responsible for any follow-up actions that may be required as a result of the inspection, inventory, or test of emergency response equipment. For any items that cannot be replaced or repaired during the inspection, test, or inventory, the inspector will indicate the need for further action on the inspection form. It will then become the responsibility of the ERT Coordinator to take further actions(s) as required.

A8.5 Operability Check (Semi-annual)

This activity is intended to periodically ensure the operability of certain items of equipment in the Vineyard Northeast emergency equipment inventory, so that it is in a constant state of readiness for deployment. The designated inspector will check the operability of equipment including safety monitoring equipment and outboard motors. Any equipment that is electronic, electrical, or mechanical will be tested under actual load or use conditions.

During the operability check, the inspector will also perform routine maintenance on the equipment, as needed, such as battery replacements, oil and filter changes, and cleaning of boom. The inspector will indicate on the inspection form any problems encountered with the equipment and corrective measures taken or needed.

A8.6 Inventory (Monthly)

The inspector will verify the availability and condition of the variety of supplies, materials, and tools that are maintained in storage. The inspector will work from a list of items that are required to be maintained at all times. Any discrepancies in the list, or item replacement needs, will be noted on the inventory form. Inspection for condition of emergency resources will be checked semi-annually.

A8.7 Inspections

The semi-annual inspection of the sorbent booms will involve complete removal of booms from storage and the laying-out of the booms in an area that would not cause damage to the fabric of the booms. The inspector will examine each length of boom closely, making note of any fabric damages or wear, broken or frayed cable, missing weights, and damaged connectors. The inspector will also verify the quantity of boom that is in storage to ensure there is sufficient supply. Any damages will be repaired, if possible. If the length of boom cannot be economically repaired, the inspector will request replacement.

A8.8 Contractor Equipment

The Spill Response Coordinator will ensure that the contractor has a maintenance program established for its equipment. A copy of the program would be requested and kept on file.

Annex 9 – Safety Data Sheets

The Safety Data Sheets (SDS) included in this Annex are for oil products that may be used in Vineyard Northeast's offshore facilities. The various oil products have been separated into the project component (i.e., wind turbine generators [WTGs] and electrical service platforms [ESPs]) in which they may be found.

The SDSs have been redacted in their entirety.

Annex 10 – Vineyard Northeast 522 Offshore Wind Oil Spill Modeling Study

VINEYARD NORTHEAST LEASE 522
OFFSHORE WIND OIL SPILL MODELING STUDY

Oil Spill Risk Assessment

Oil Spill Risk Assessment

Vineyard Northeast 21-P-216691
Final

July 5, 2022

www.rpsgroup.com

Document Status					
Version	**Purpose of document**	**Authored by**	**Reviewed by**	**Approved by**	**Review dates**
Draft	Worst Case Discharge Oil Spill Modeling, Vineyard Northeast 522	See below	JR	JR	5/13/2022, 5/17/2022
Draft 2	Update with Annex for Booster Station Modeling Results	See below	JR	JR	6/11/2022
Final	Address Client Comments	See below	JR	JR	7/5/2022

Approval for issue	
Jill Rowe	2022-07-05

Prepared by:

RPS Group, Inc.

Lisa McStay, Paxton Albert, Mahmud Monim, Tayebeh Tajalli Bakhsh, Hilary Robinson, Matthew Frediani, Jill Rowe, Julia Bancroft, and Gabrielle McGrath

Project Manager: Jill Rowe

Director, Ocean Science

55 Village Square Drive

South Kingstown, RI 02879

T 401-661-8629

E jill.rowe@rpsgroup.com

Prepared for:

Epsilon Associates, Inc.

Maria Hartnett

Principal

3 Mill & Main Place, Suite 250

Maynard, MA 01754

T **978-897-7100**

E **mhartnett@epsilonassociates.com**

EXECUTIVE SUMMARY

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." Vineyard Northeast includes up to 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area; up to three of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut.

The Lease Area is approximately 63 kilometers (km) (39 miles [mi]) from Martha's Vineyard and approximately 46 km (29 mi) from Nantucket. While the final ESP locations have not yet been determined, two representative locations at the northeast and southwest corners of the Lease Area were selected for analysis. One of the representative ESP locations (ESP 1) is located approximately 66 km (41 mi) from Martha's Vineyard and 49 km (31 mi) from Nantucket, while a second representative ESP location (ESP 2) is located approximately 87 km (54 mi) from Martha's Vineyard and 83 km (52 mi) from Nantucket. These two representative ESP locations provide an Envelope for the up to three ESPs that could be installed at any location in the Lease Area.

Additionally, if high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[1] of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket. Further discussion of the booster station is provided in Appendix A.

Pursuant to 30 CFR 585.627(c), as part of the requirement to submit an Oil Spill Response Plan (OSRP) in accordance with 30 CFR 254.1, the OSRP should include:

> "An appropriate trajectory analysis specific to the area in which the facility is located. The analysis must identify onshore and offshore areas that a discharge potentially could affect. The trajectory analysis chosen must reflect the maximum distance from the facility that oil could move in a time period that it reasonably could be expected to persist in the environment."

Therefore, as an Annex to the Vineyard Northeast OSRP (see COP Appendix I-F), an oil spill modeling study was performed to assess the trajectory and weathering of oil following a catastrophic discharge of all oil contents from the toppling of the largest volume ESP at two representative locations within the Lease Area. These would be the worst case discharge scenarios and involve a relatively small and finite discharge of oil (5,637 barrels [bbl]), which is considerably smaller than potential worst case spills from offshore oil and gas platforms (which could be on the order of multi-million bbl). Based on the results of a previous BOEM study (Bejarano et al. 2013) assessing potential catastrophic oil spills from offshore wind structures,

[1] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

the probability of occurrence of this type of catastrophic discharge, such as the toppling of an ESP, is very low (on the order of 1 in ≥ 1,000 years). As described in COP Volume I, the ESPs are designed to site-specific conditions in accordance with international and U.S. standards and the designs will be reviewed by a third-party Certified Verification Agent that certifies the design conforms to all applicable standards.

In addition to the low probability of such an event, the oil spill scenarios modeled in this study assume that no oil spill response or mitigation would occur. This is also a very conservative assumption as the ESPs will be designed with containment measures and Vineyard Northeast would employ containment and recovery methods to contain and recover onshore and aquatic petroleum spills. As discussed in further detail in Section 2.5 of the OSRP (see COP Appendix I-F), response equipment employed on water would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

The oil spill model, OILMAP/SIMAP, was used to conduct this assessment. Model inputs included winds, currents, chemical composition and properties of oils of interest, and specifications of the spill (amount, location, etc.). Environmental conditions (i.e., wind and current forcing, water temperature, and salinity) play a critical role in the assessment of the trajectory and weathering of oil in a marine spill. Therefore, a data analysis of these conditions as input to the model was also performed. The data analysis also helped to identify the site-specific seasons in which the modeling scenarios should be performed. As a result of this analysis, a total of eight stochastic modeling scenarios (one per season for two spill sites) were assessed.

Based on the environmental datasets analyzed as input for the oil spill modeling, the following conclusions can be drawn:

- During winter months in the Area of Interest (AOI), winds are predominantly northwesterly with higher speeds. Throughout summer months, the winds are mostly southwesterly with lower speeds. Spring and fall months show characteristics of transitional seasons.
- Annually averaged HYCOM surface currents near the spill sites are west/west-southwestward with moderate speed and some transitions in direction over the region close to ESP 1.
- Currents at the ESP 1 low show very little seasonality. However, at the ESP 2 location, current direction is predominantly westward/west-northwestward during Spring and Fall. In the remaining portions of the year, the current direction is relatively more variable.

Based on the results of the stochastic spill trajectory analysis assessing potential spills of all oil contents from the two modeled ESP locations at ESP 1 and ESP 2, the following conclusions can be made:

- The sea surface area exposed to oil exceeding the 10 g/m^2 threshold is predicted to be contained within a radius up to 35 km (22 mi) of the ESP 1 location and up to 40 km (25 mi) of the ESP 2 location for all four seasons. The stochastic footprint of exposed surface waters was smallest for the winter simulation, likely due to increased winds and surface waves that enhanced vertical entrainment into the water column.
- At the ESP 1 location, there is <10% probability that oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) would reach the shorelines of Nantucket within three to five days of the spill for the spring, summer, and fall scenarios. In the winter season, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell). Similarly, at the ESP 2 location, there are no predicted areas of

shoreline probability >1% with oil contamination above a minimum thickness of 100 μm (100 g/m^2 on average over the grid cell).

As noted, the stochastic spill trajectory analysis conservatively assesses a catastrophic discharge of all oil contents from ESP 1 or ESP 2 in the Lease Area and does not consider mitigation measures. In the unlikely event of a worst case discharge, Vineyard Northeast will implement all available and appropriate response countermeasures to contain the spill, to protect environmental, cultural, and socioeconomic sensitive sites, and to recover the oil as quickly as possible. Therefore, any potential impacts from an oil spill are likely to be less than predicted by the modeling results for the conservative worst case discharge scenario.

Contents

Tables

Figures

1 INTRODUCTION

1.1 Project Background

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast." Vineyard Northeast includes up to 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area; up to three of those positions will be occupied by ESPs and the remaining positions will be occupied by WTGs. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut.

The Lease Area is approximately 63 kilometers (km) (39 miles [mi]) from Martha's Vineyard and approximately 46 km (29 mi) from Nantucket. While the final ESP locations have not yet been determined, two representative locations at the northeast and southwest corners of the Lease Area were selected for analysis. One of the representative ESP locations (ESP 1) is located approximately 66 km (41 mi) from Martha's Vineyard and 49 km (31 mi) from Nantucket, while a second representative ESP location (ESP 2) is located approximately 87 km (54 mi) from Martha's Vineyard and 83 km (52 mi) from Nantucket. These two representative ESP locations provide an Envelope for the up to three ESPs that could be installed at any location in the Lease Area.

Additionally, if high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[2] of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket. Further discussion of the booster station is provided in Appendix A.

Pursuant to 30 CFR 585.627(c), as part of the requirement to submit an OSRP in accordance with 30 CFR 254.1 with an appropriate trajectory analysis, this Annex documents the oil spill modeling study performed in support of the Construction and Operations Plan (COP) for Vineyard Northeast.

As described in the Vineyard Northeast OSRP (See COP Appendix I-F), Vineyard Northeast components containing oil include the WTGs placed on a foundation support structure and ESPs. Oil sources in the ESPs include power transformers, reactors, auxiliary/earthing transformers, diesel tanks, an emergency generator day tank, an emergency generator, and naphthenic oil for a platform crane. Oil sources presented in this document are associated with the single largest ESP. The oil sources associated with one ESP total approximately 236,754 gallons (5,637 barrels [bbl]). Table 1 and Figure 1 display the location of the spill sites and local geographic points of reference.

Based on the results of a previous BOEM study (Bejarano et al. 2013) assessing potential catastrophic oil spills from offshore wind structures, the probability of occurrence of this type of catastrophic discharge, such as the

[2] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

topple of an ESP, is extremely small. As described in COP Volume I, the ESPs are designed to site-specific conditions in accordance with international and United States (US) standards and the designs will be reviewed by a third-party Certified Verification Agent that certifies the design conforms to all applicable standards. In addition to the low probability of such an event, the oil spill scenarios modeled in this study assume that no oil spill response or mitigation would occur. This is also a very conservative assumption as the ESP will be designed with containment measures and Vineyard Northeast would employ containment and recovery methods to contain and recover onshore and aquatic petroleum spills. As discussed in further detail in Section 2.5 of the OSRP (See COP Appendix I-F), response equipment employed on water would be used to prevent the spread of the spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

Table 1. Discharge locations used in oil spill modeling

Site	Description	Latitude N (decimal degrees)	Longitude W (decimal degrees)
ESP 1	NE corner of 522	40.806262	70.215082
ESP 2	SW corner of 522	40.587561	70.495609

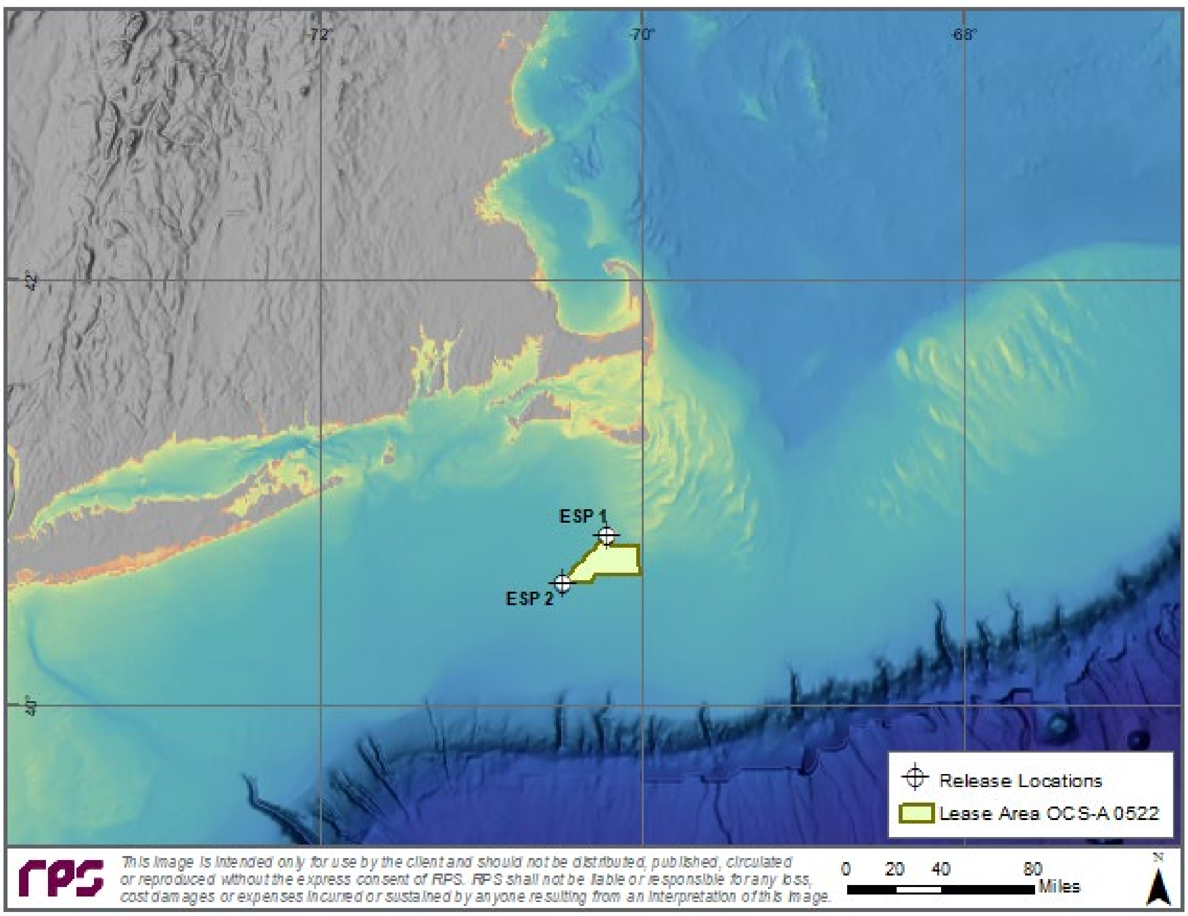


Figure 1. Oil spill model domain defined for this study, south of Martha's Vineyard

1.2 Objectives, Tasks and Study Output

The goals of spill modeling include projecting the probable behavior of accidentally spilled oil using a state-of-the-art three-dimensional (3-D) transport model and producing modeled trajectory and fate output such as visual representations (e.g., probability of oiling and minimum travel time maps) for various scenarios. RPS's proprietary oil spill modeling framework, OILMAP/SIMAP, was used for the simulations performed in this study. Model inputs included winds, currents, chemical composition, and properties of oils of interest, and specifications of the spill (amount, location, etc.). The model was run in stochastic mode, as described further in Section 3, providing two types of information: (1) the footprint of sea surface and shoreline areas exposed to oil above a certain threshold of concern and the associated probability of oil contamination, and (2) the shortest time required for oil to reach any point within the areas predicted to be oiled.

Environmental conditions (i.e., wind and current forcing, water temperature, and salinity) play a critical role in the assessment of the trajectory and weathering of oil in a marine spill. Therefore, a data analysis of these conditions as input to the model was performed. The data analysis also helped to identify the site-specific seasons in which the modeling scenarios should be performed. As a result of this analysis, a total of eight stochastic modeling scenarios (one per season for two spill locations) were assessed.

This report describes the models, modeling approach, model inputs, and outputs used in this study. A description of environmental data sources is provided in Section 2. The oil spill modeling approach and scenario specifications are provided in Section 3. Section 4 provides a summary of the stochastic modeling results and conclusions. References are provided in Section 5. Appendix A provides a description of the oil spill modeling conducting assuming a spill at the potential booster station. A description of the SIMAP/OILMAP modeling system is provided is Appendix B.

2 ENVIRONMENTAL CONDITIONS AND DATA ANALYSIS

To understand the behavior of marine spills, it is necessary to analyze and evaluate the predominant environmental conditions in the area of interest (AOI). Winds and currents are the key forcing agents that control the transport and weathering of an oil spill. To reproduce the natural variability of the environment, the oil spill model requires wind and current datasets that vary both spatially and temporally. Optimally, the minimum window of time for stochastic simulations is 5 to 10 years; therefore, long-term records of wind and current data were obtained from the outputs of global numerical atmospheric and ocean circulation models for this study.

The following sections describe the key environmental conditions that are dominant in the region of interest and, more specifically, in the model domain. Figure 2 below presents the locations of environmental data collected for this study, as described in the following sections.

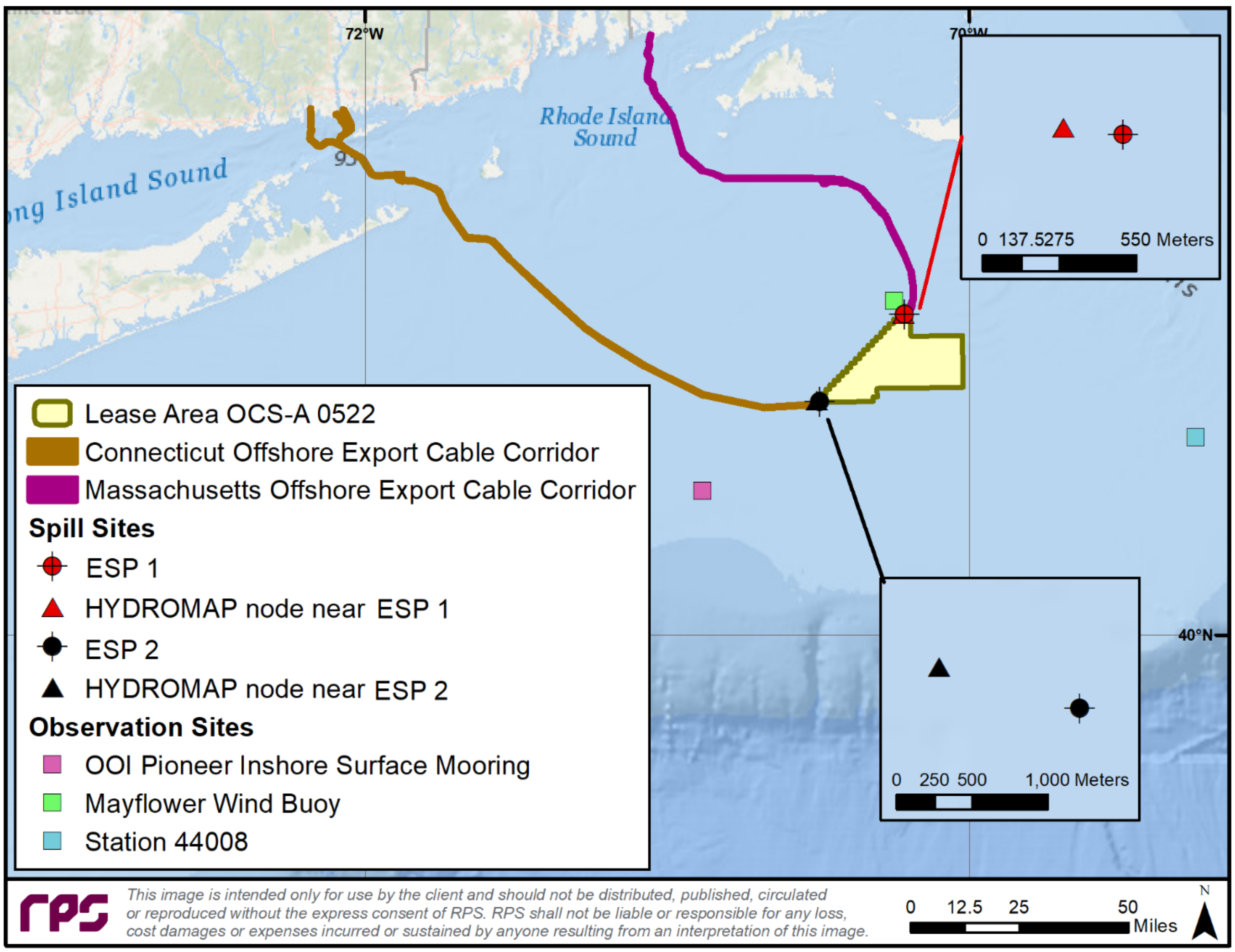


Figure 2. Hypothetical spill sites and relevant locations for this study, Northwest Atlantic.

2.1 General Dynamics and Climatology

The AOI for this study is located south of Nantucket Island in the Mid-Atlantic Bight (MAB) region, which extends from Cape Hatteras, North Carolina to Cape Cod, Massachusetts. The depth-average mean currents over the MAB shelf are typically southwestward and follow the same bathymetric contour lines. This flow turns offshore near Cape Hatteras and is entrained into the Gulf Stream. The dynamics of this mean circulation is not entirely forced by the local wind stress. The observed mean circulation (Figure 3) flows westward/southwestward on the New England shelf, opposing the local wind stress. Lentz (2008) discussed that the depth-averaged flow along the shelf of the MAB is mainly driven by a balance between an along-shelf pressure gradient and mean wind stress (which acts in the opposite direction of pressure gradient force). Although the wind stress does not significantly impact the mean flow, it is important to note that the wind stress forces the near-surface offshore flow.

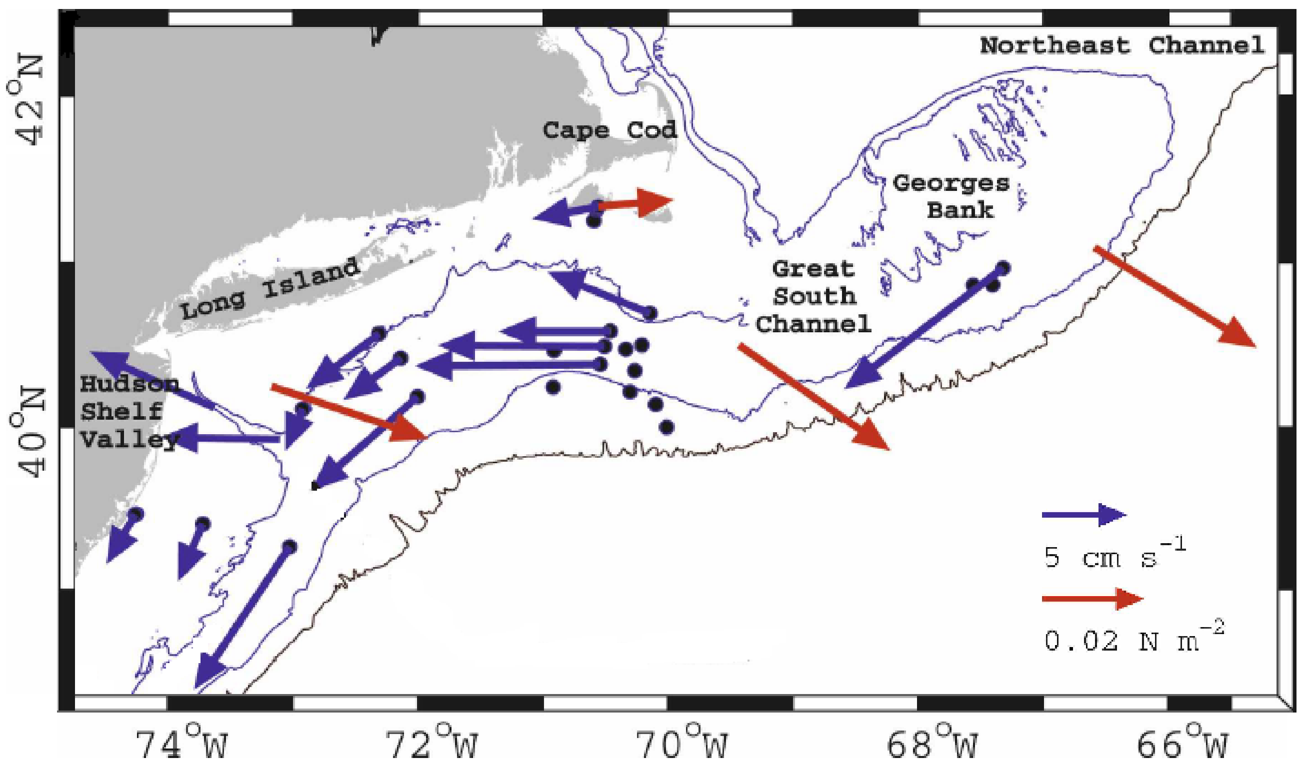


Figure 3. Map of the MAB showing mean depth-averaged current vectors in blue, and mean wind stress vectors in red based on observations (modified from Lentz 2008).

Wind speeds and directions throughout the MAB show seasonal variation. During the winter months, a northwesterly wind with mean wind stresses of ~0.07 Nm^{-2} is observed. In the summer months, the wind is predominantly from the southwest with mean wind stresses of ~0.02 Nm^{-2} (Lentz 2008). This summertime wind creates upwelling conditions and drives the flow eastward through both Nantucket Sound and along the southeast coast of Nantucket Island. However, there is also eastward flow to the south of Martha's Vineyard around 41°N, where tides drive a much stronger opposing westward mean current. This current branches from the tidal residual anticyclonic flow encircling the Nantucket Shoals and prevails the wind-driven flow (Figure 4; Wilkin 2006).

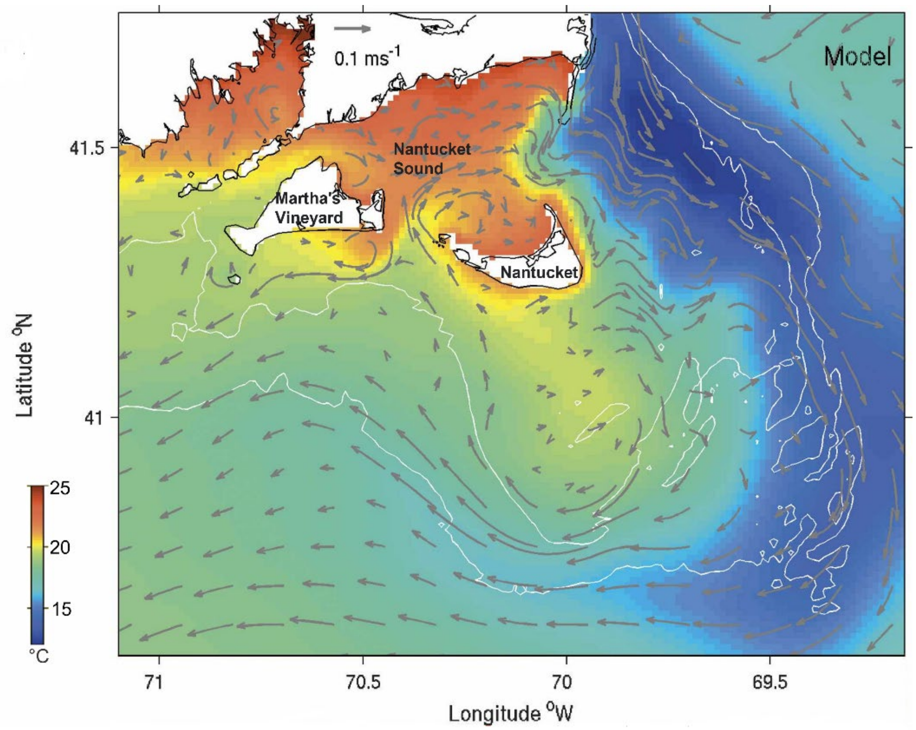


Figure 4. Arrows presenting model derived mean currents at 2 m depth and a colormap showing surface temperature during the summer (Wilkin 2006).

The shelf waters of the MAB also show a significant seasonal variation in terms of temperature and stratification (Beardsley et al. 1985). Due to strong surface heating and weak wind stresses during the summer months, water remains relatively warm and thermally stratified in this season. However, in the winter months, the water becomes colder and weakly stratified, which is caused by stronger wind stresses and surface cooling. Due to the river discharges in the MAB, salinity near the coast is relatively lower (32 ppt) compared to water near the shelf break, where salinity is approximately 34 ppt (Chapman and Beardsley 1989). A front located near the shelf break of the MAB separates the cooler, fresher shelf water from the warmer, saltier slope water (Linder and Gawarkiewicz 1998).

Another important oceanographic feature of the MAB water is the Cold Pool, a 20–60 m thick band of cold water near the bottom over the mid-shelf and outer shelf, which extends from the southern flank of Georges Bank to near Cape Hatteras for approximately 1000 km (Figure 5). Although the Cold Pool is remnant winter water, it persists from spring to fall and is bounded above by the seasonal thermocline and offshore by warmer slope water (Lentz 2017). The seasonal patterns in atmospheric forcing (solar heating and wind) play an important role in the creation and evolution of the Cold Pool. At the start of spring, reduced mixing and increased solar heating cause the water column to become stratified (Lentz 2017). Additionally, freshwater runoff (usually dominated by the Hudson River) in the spring can further strengthen the stratification (Castelao et al. 2010). The warming rate of the Cold Pool varies along the shelf, with a relatively higher rate over Georges Bank and smaller in the Southern MAB. The rate of warming also depends on water depth as the Cold Pool section located in shallow water is thinner and warms faster. In the New England shelf, the Cold Pool temperature steadily increases at a rate of 1°C per month from April to September.

Cold Pool waters are nutrient-enriched and, when upwelled toward the surface, can drive phytoplankton growth and high concentrations of particulate organic matter in the water column (Voynovaet et al. 2013), which creates unique habitat conditions that provide thermal refuge to colder water species in the ecosystem of the MAB (Lentz 2017).

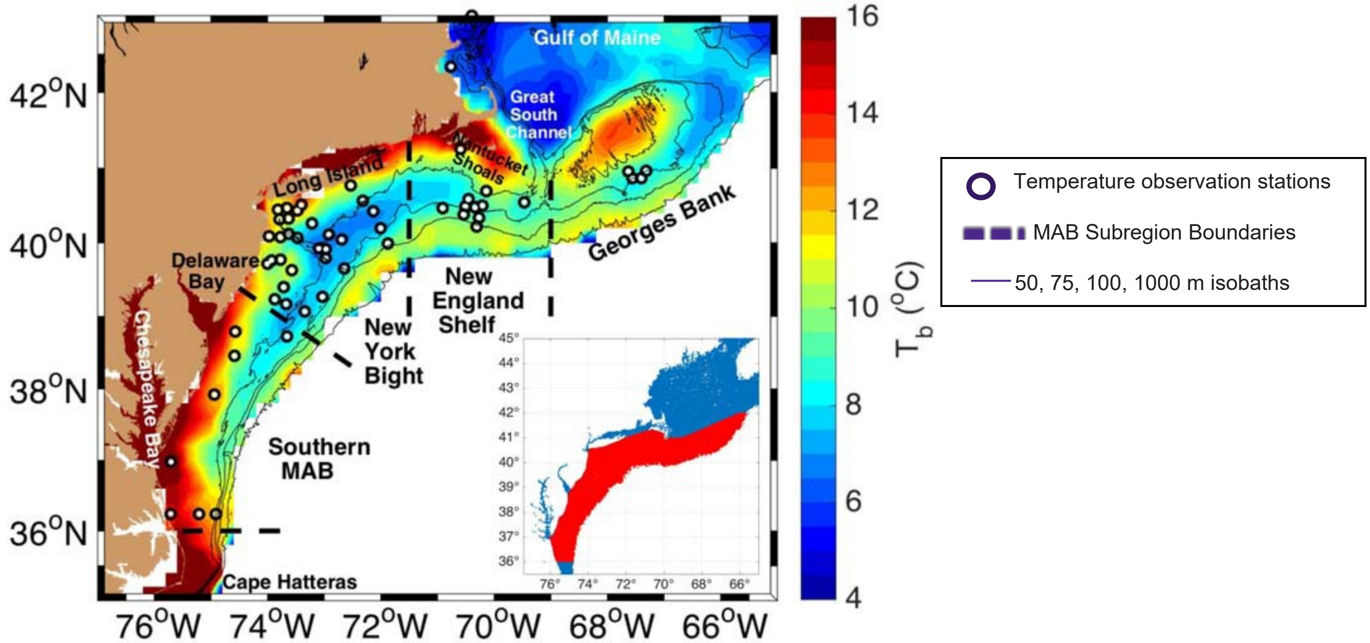


Figure 5. Mean near-bottom temperatures from historical temperature profiles for July in the MAB and southern Gulf of Maine. Inset depicts entire region of compiled temperature profiles with the region of the Cold Pool shown in red (Lentz 2017).

An analysis of the seasonal breakdown used in the oil spill modeling is presented in Table 2. This is based on existing literature and the wind analysis of the U.S. National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) dataset (discussed in Section 2.2 and shown in Figure 12 and Figure 13) at the spill sites.

Table 2. Seasonal breakdown for the spill sites.

Season	Representative Months	Season Description
Spring	March-May	Transition of wind direction from Northwest to Southwest with relatively lower wind speed than Winter
Summer	June-August	Lower wind speed, predominantly from Southwest
Fall	September-November	Transitional wind directions, from Southwest to Northeast with relatively higher wind speed than Summer
Winter	December-February	Higher Wind, predominately from Northwest

Data obtained from the World Ocean Atlas (WOA) climatology dataset (Zweng et al. 2018 and Locarnini et al. 2018) near ESP 1 and ESP 2 show the monthly Sea Surface Temperature (SST) typically varies from 5°C to 25°C (Figure 6). SST starts to increase from early spring and peaks during late summer. After this period, temperature decreases and drops to 5°C in February. Sea Surface Salinity (SSS) predominately fluctuates between roughly 32.0 to 32.8 ppt near ESP 1, while it ranges from 32.4 to 33.2 ppt near ESP 2.

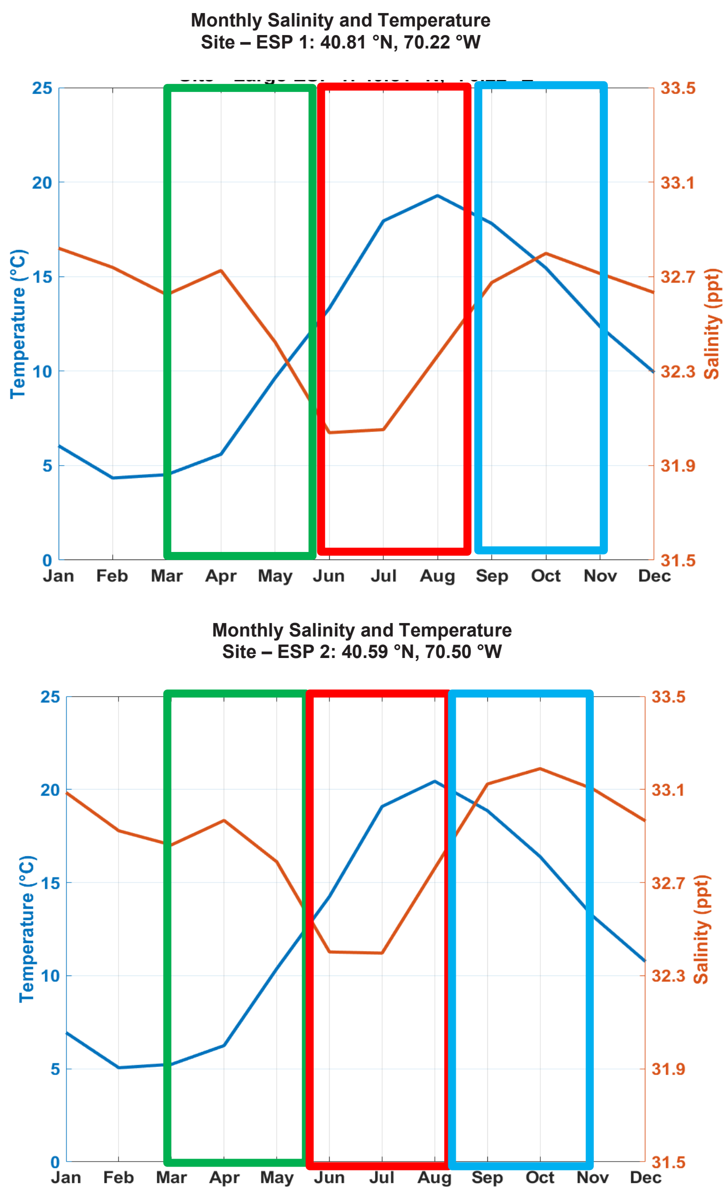


Figure 6. Monthly sea surface temperature (°C, blue), and salinity (ppt, orange) near ESP 1 (upper panel) and ESP 2 (lower panel). Spring, Summer and Fall seasons shown by green, red and blue boxes, respectively.

2.2 Wind Dataset – NCEP CFSR

For this study, wind data were obtained from the NCEP CFSR for a 10-year period (2001 to 2010; Table 3). The CFSR was designed and executed as a global, high-resolution, coupled atmosphere-ocean-land surface-sea ice system to provide the best estimate of the state of these coupled domains (Saha et al. 2010). This atmospheric model has a horizontal resolution of 38 km, with 64 vertical levels extending from the surface to the height at which air pressure reaches 0.26 hPa. CFSR winds were also one of the main driving forces used in the HYCOM Reanalysis, the hydrodynamic currents dataset used in this study.

Table 3. The specifics of wind dataset used for the modelling.

Name of Dataset	CFSR
Coverage	75°W - 69°W 42°N – 39°N
Owner/Provider	NCEP (US)
Horizontal Grid Size	0.5° x 0.5°
Hindcast Period	2001 - 2010
Time Step	6 hourly

2.2.1 CFSR Validation

Wind observations from Ocean Observatories Initiative (OOI) Pioneer Inshore Surface Mooring, Mayflower Wind Buoy, NDBC Station 44008, and (Table 4) were used to validate the global wind dataset. The wind measurement data along with station information were provided by the client (Table 4).

Table 4. Summary of wind observation record

Station	Period	Temporal Resolution	Latitude (°N)	Longitude (°W)	Elevation of Record (m)
OOI Pioneer Inshore Surface Mooring	9 May 2015 – 7 July 2017	1-minute	40.3633	70.8833	10
Mayflower Wind Buoy	13 April 2020 – 10 March 2021	24-hour	40.8411	70.2494	4
	11 March 2021 - 26 September 2021	10-minute			4
NDBC Station 44008	1 January 2001 - 31 December 2010	10-minute	40.498	69.251	4.1

To validate the wind forcing dataset, the model output was interpolated from the neighboring CFSR grid points to the observation location (Table 4). The wind speeds from Mayflower Wind Buoy and NDBC station 44008 were adjusted to 10 m height to be compared with 10 m-wind from CFSR, using the Bratton and Womeldorf (2011) equation:

$$V_2 = V_1 \left(\frac{H_2}{H_1}\right)^{\alpha}$$

where the wind velocity (V_2) at height (H_2) can be estimated using the wind speed velocity (V_1) recorded for a different elevation (H_1) at the same site. As the NDBC stations are located in open water, the value of wind shear exponent (α) was set as 0.1.

Figure 7 provides wind roses from measurement data (9 May 2015 – 7 July 2017) and CFSR output (1 January 2001 – 31 December 2010) at OOI Pioneer Inshore Surface Mooring. As the two wind datasets did not overlap in time, the entire period of the CFSR (2001-2010) was compared with the observation record. The comparison shows that the CFSR was able to capture the directionality of the wind at the observation site reasonably well; however, it slightly overpredicted the wind speeds.

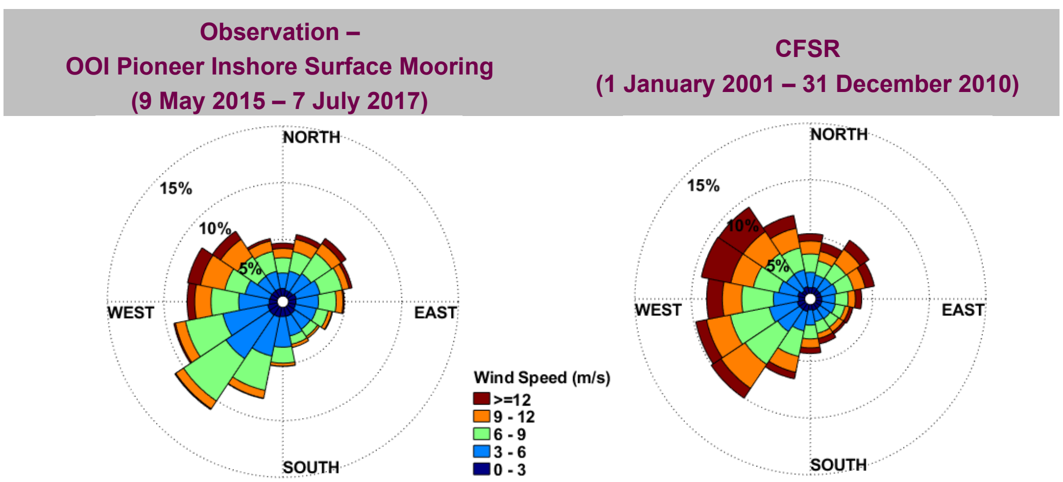


Figure 7. Comparison between wind measurement and CFSR at OOI Pioneer Inshore Surface Mooring.

Figure 8 shows wind roses from measurement data and CFSR output at Mayflower Wind Buoy. For this observation buoy, two observation records were available: a timeseries of speed and direction for the period of 13 April 2020 – 10 March 2021 with a 24-hour timestep, and a second record from 11 March 2021 to 26 September 2021 with a 10-minute timestep.

To compare with the 24-hourly observation dataset, daily CFSR output from 2001 to 2010 was used to create the rose (Figure 8). The comparison shows that the directionality of CFSR was mostly consistent with the observation record. However, CFSR did not capture the northerly wind shown by observation. CFSR also predicted higher wind speeds.

For the comparison of second Mayflower Wind Buoy dataset (10-minute timestep), 6-hourly CFSR output for March-September period (2001 to 2010) was used. The comparison shows that the CFSR was able to capture the directionality (specially from southwest quadrant) and speed of wind at the observation site reasonably well.

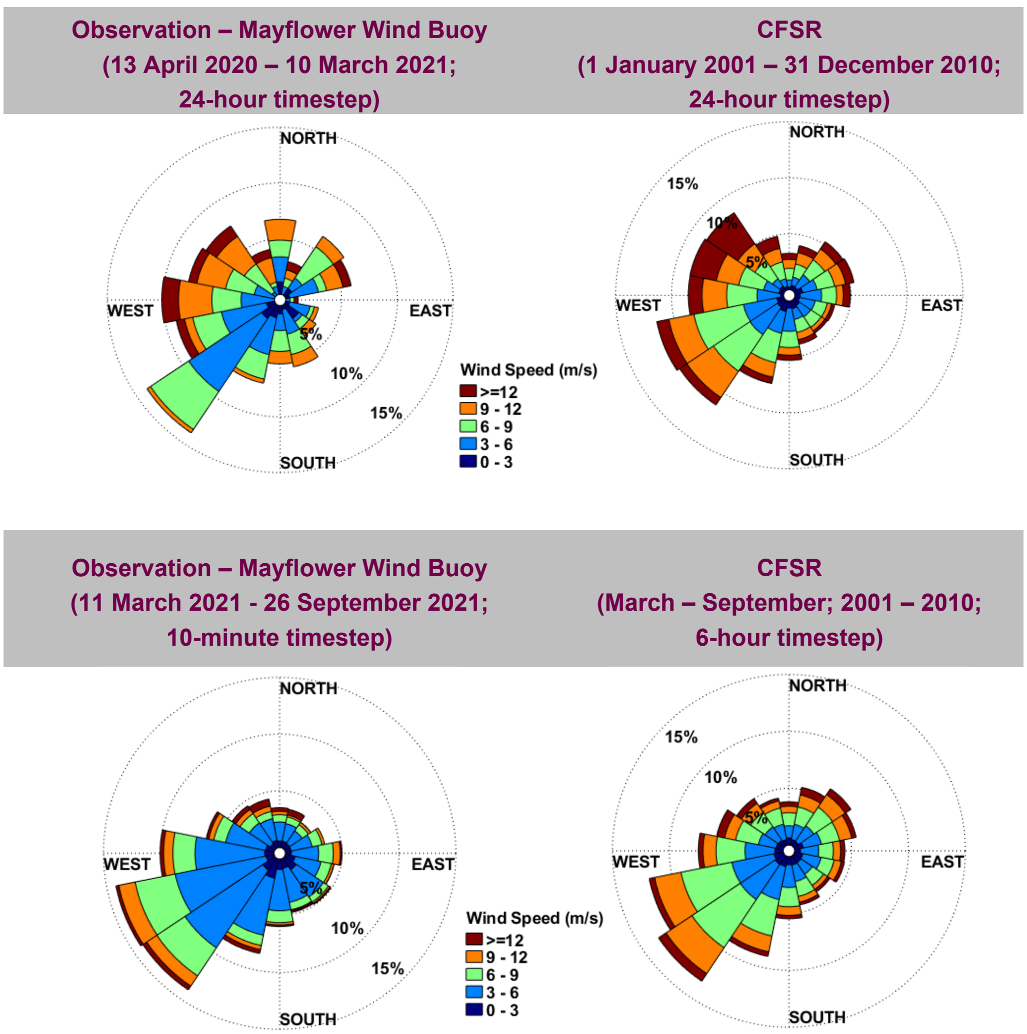


Figure 8. Comparison between wind measurement and CFSR at Mayflower Wind Buoy.

Figure 9 shows wind roses from measurement data (1 January 2001 – 31 December 2010) and the CFSR output (1 January 2001 – 31 December 2010) at Station 44008. As these two wind datasets had overlap in time, both observation and the CFSR were analyzed for the period of 2001-2010. The comparison shows that the CFSR was able to capture both speed and directionality of the wind at the observation site reasonably well, with slightly underprediction of wind from south and south-southwest, thus being an appropriate choice for the oil spill modelling and forcing the surface trajectories.

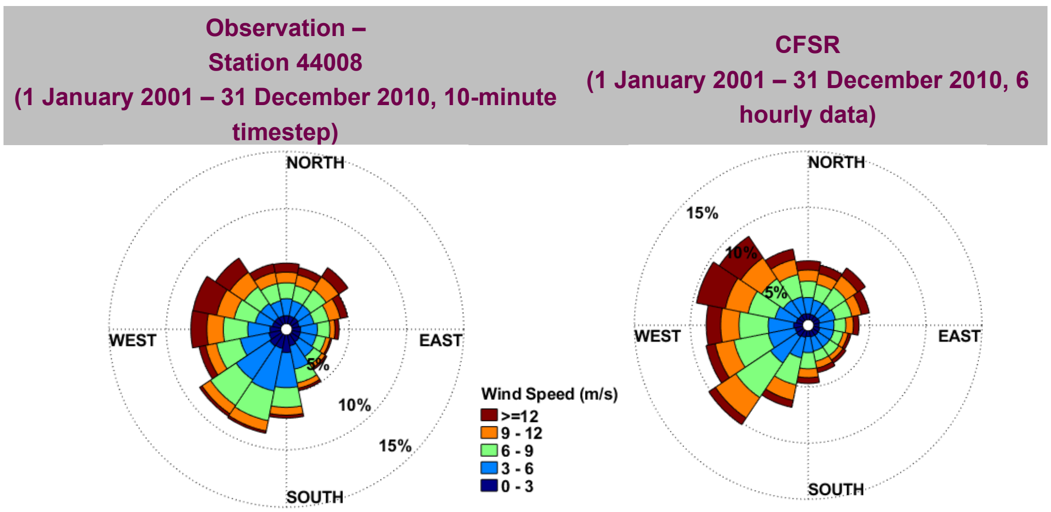


Figure 9. Comparison between wind measurement and CFSR at Station 44008.

2.2.2 CFSR Analyses at the Spill Sites

As wind speeds and directions are very similar at both spill sites, only figures for ESP 1 are presented in this report. The wind figures (Figure 11 - Figure 13) at the location of spill sites were developed using a distance-weighted interpolation from the four surrounding CFSR nodes. The following figures provide a graphical description of the CFSR winds in this region, to understand their variability, both spatially and temporally:

- Wind rose map (Figure 10): Spatial distribution of the CFSR annual wind roses over the area of interest, expressed in m/s and the direction the wind is coming from;
- Annual wind rose (Figure 11): Annual CFSR wind rose at ESP 1, in m/s and the direction the wind is coming from;
- Wind speed statistics (Figure 12): Monthly average and 95th percentile CFSR wind speed statistics at ESP 1, in m/s; and
- Monthly wind roses (Figure 13): Monthly CFSR wind roses at ESP 1, in m/s in the direction the wind is coming from.

Based on this global wind dataset, the following conclusions can be drawn:

- Near the spill sites in Northwest Atlantic, winds are predominantly blowing from the northwest (winter months) and southwest (summer months) sectors.
- Monthly average wind speeds ranges from 6 to 10 m/s at ESP 1, with the weakest winds found during summer months. The 95th percentile wind speed varies between 10 and 17 m/s and reaches maximum during winter.
- Winds are mostly consistent during winter and summer months, in terms of direction and speed. During winter (December - February), the wind is predominantly northwesterly with higher speed while throughout summer (June - August), it is mostly southwesterly with lower speed. Spring (March-May) and fall (September - November) are the transition seasons. Spring marks the period when predominant wind direction changes from northwest to southwest and average wind speed decreases, while in fall season predominant wind direction transitions with relatively increased wind speed.

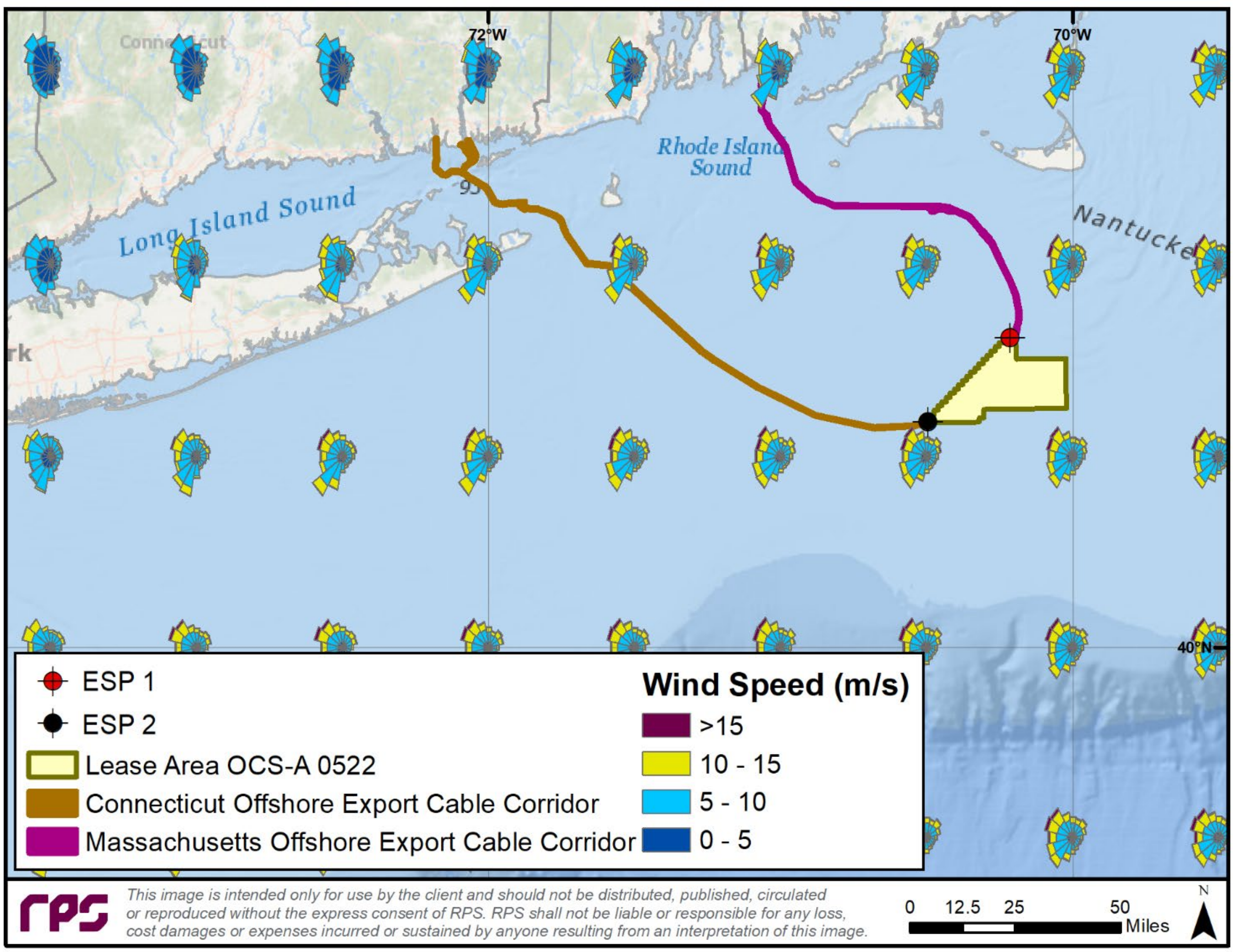


Figure 10. Spatial distribution of CFSR annual wind speed and direction near the spill sites (in m/s). Red mark shows ESP 1, and black mark shows ESP 2.

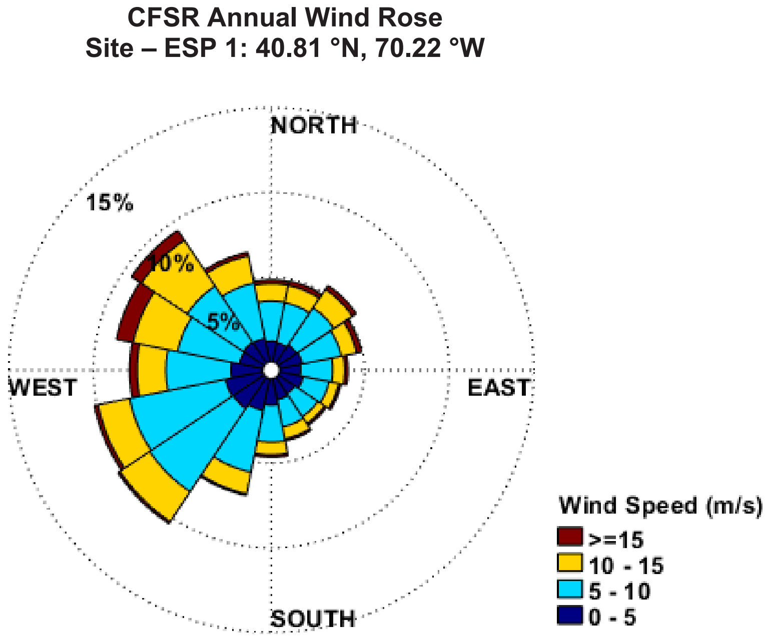


Figure 11. Annual CFSR rose near ESP 1. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from).

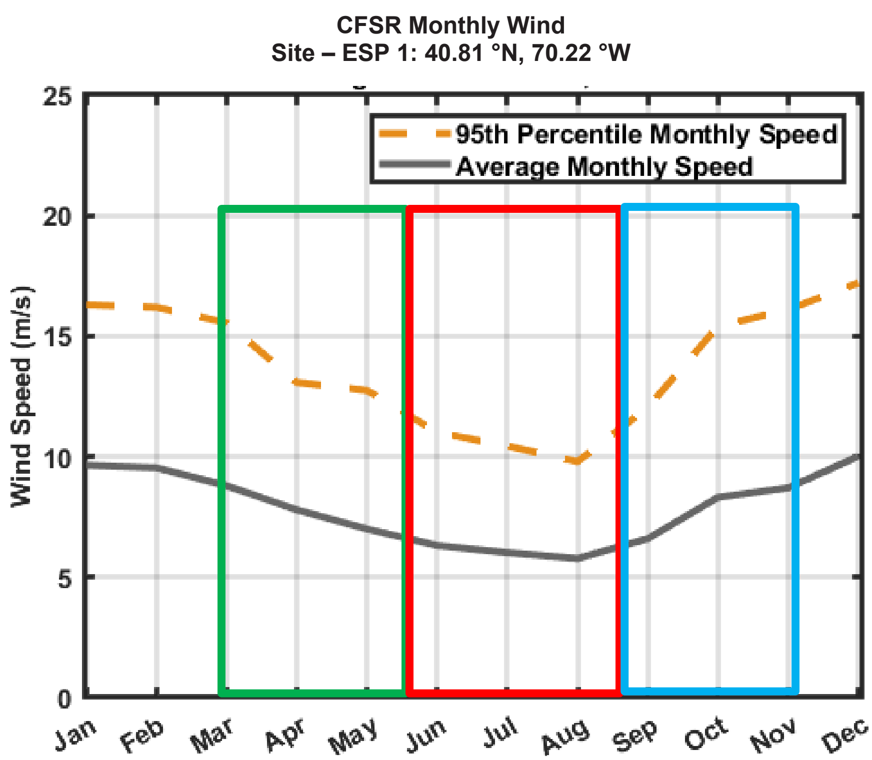


Figure 12. Monthly average and 95th percentile CFSR wind speed statistics near ESP 1: monthly average (grey solid) and 95th percentile (orange dashed); wind speed reported in m/s. Spring, Summer and Fall seasons are shown by green, red and blue boxes, respectively.

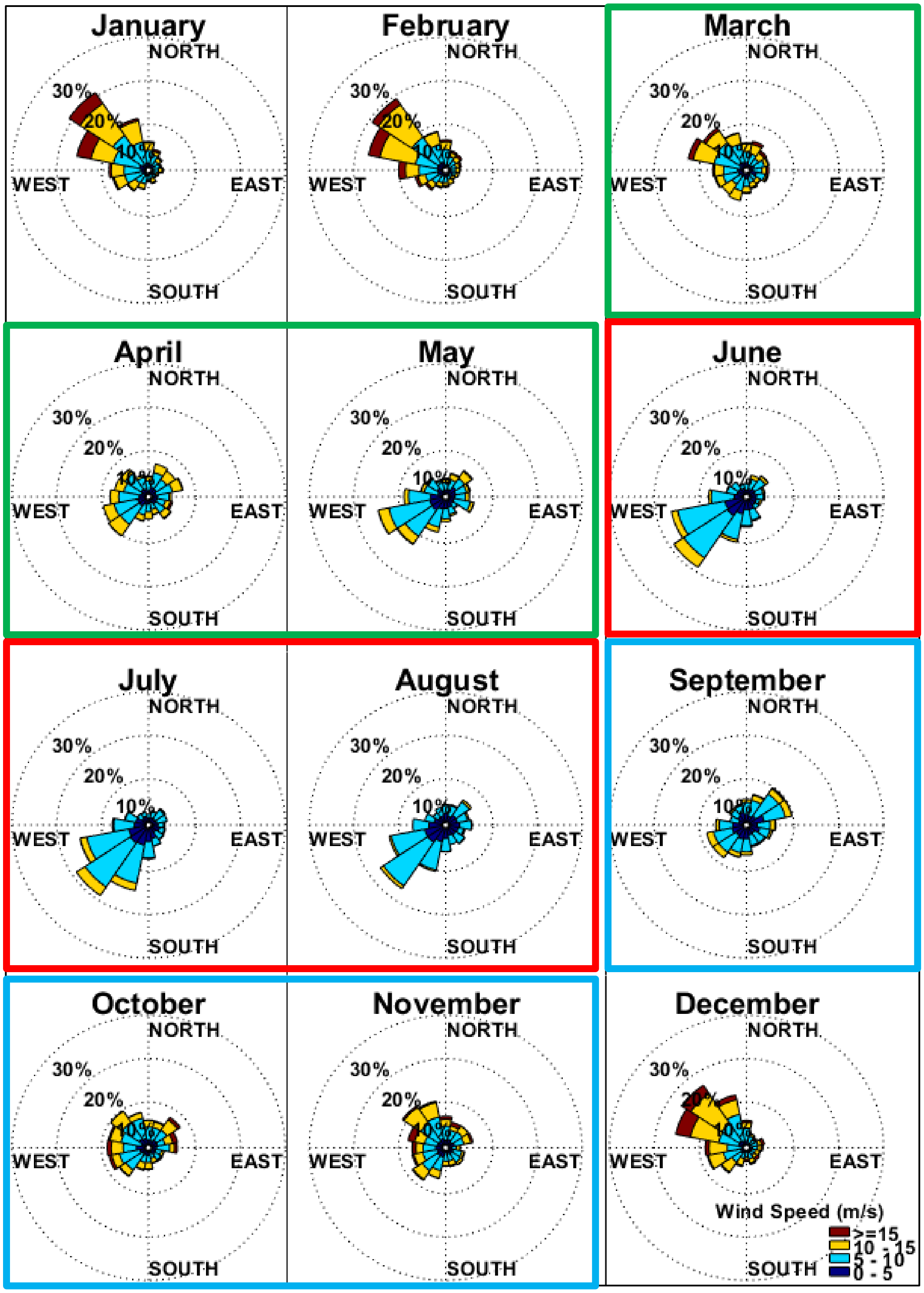


Figure 13. Monthly CFSR wind roses near ESP 1. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from). Spring, Summer and Fall seasons are shown by green, red, and blue boxes, respectively.

2.3 Current Datasets

To capture the complex nature of regional and coastal circulation for the area of study, two different current datasets have been combined in this modeling study: a regional hindcast dataset capturing general mesoscale circulation and a higher resolution dataset developed for this project to capture tidal circulation important in coastal areas (Table 5).

Table 5. The specifics of the current datasets used for the modeling.

	Residual	Regional Tidal
Name of Dataset	HYCOM (GLBu0.08/ expt_19.1)	HYDROMAP
Owner/Provider	Naval Research Laboratory (USA)	RPS
Bathymetry	GEBCO	GEBCO
Wind Forcing	CFSR (US)	-
Tides	-	TPXO 7.2
Horizontal Grid Size	~9 km	0.1 - 2.0 km
Hindcast Period	2001 - 2010	Periodic tidal constituents' phase and amplitude
Output Frequency	Daily	30-minute processing

2.3.1 Global Current dataset – HYCOM Reanalysis

Current data were obtained from the HYCOM (HYbrid Coordinate Ocean Model) hindcast reanalysis, a 1/12-degree global simulation assimilated with NCODA (Navy Coupled Ocean Data Assimilation) from the US Naval Research Laboratory (Halliwell 2004). This dataset (Table 5) captures the oceanic large-scale circulation in the study area. NCODA uses the model forecast as a first guess in a three-dimensional (3D) variational scheme and assimilates available satellite altimeter observations from the Naval Oceanographic Office (NAVOCEANO) Altimeter Data Fusion Center, in-situ Sea Surface Temperature (SST), and available in-situ vertical temperature and salinity profiles from XBTs (Expendable Bathythermographs), Argo floats, and moored buoys. Details of the data assimilation procedure are described in Cummings and Smedstad (2013) and Cummings (2005). Forcing for the model come from the NCEP CFSR (Saha et al. 2010). Ocean dynamics including geostrophic and wind driven currents are reproduced by the model. The most recent reanalysis experiment (GLBu0.08/expt_19.1) includes data collected between August 1, 1995 and December 31, 2012. However, as this version of HYCOM does not include tidal information, a separate model (HYDROMAP Tidal Model) was used to supplement HYCOM and generate tidal currents.

2.3.2 Tidal Currents – HYDROMAP Tidal Model

HYDROMAP, a hydrodynamic model developed by RPS, was used to simulate local circulation from tides for this study. HYDROMAP is a globally re-locatable three-dimensional hydrodynamic model (Isaji et al. 2001a, 2001b) capable of simulating complex circulation patterns driven by tidal forcing, wind stress, and freshwater flows. HYDROMAP employs a novel step-wise-continuous-variable-rectangular gridding strategy with up to six levels of resolution. The term "step-wise continuous" implies that the boundaries between successively smaller and larger grids are managed in a consistent integer step. HYDROMAP has been applied in numerous sediment dispersion and transport studies in the U.S. and worldwide.

HYDROMAP can be used to make constant, cyclical, or time varying current fields. The constant and cyclical current fields are generated for each component of the circulation separately, whereas the time varying current fields represent the integration of all components simultaneously for a specific timeframe. Tidal currents generated from the HYDROMAP model were then combined with the HYCOM circulation to present a complete hydrodynamic dataset for the area. A brief description of the model application to the AOI is provided in Section 2.3.2.1.

2.3.2.1 HYDROMAP Model Application to the Area of Interest

A model grid of the study area was developed with grid resolution (0.1 - 2.0 km) sufficient to capture shoreline and bathymetric features over the expected area of potential oil spill impacts, and to capture the large scale, tidal circulation features (Figure 15 and Figure 16). The grid was developed for the area off the coast of southern New England as well as the area adjacent to Long Island. The model grid cells were assigned depth based on the General Bathymetric Chart of the Oceans (GEBCO; Jones 1994). An illustration of the model grid bathymetry is shown in Figure 14.

The hydrodynamic model simulations were forced with tides, based on the global Oregon State University (OSU) TOPEX/Poseidon Global Inverse Solution TPXO (Egbert and Erofeeva 2002), which is a global model used for predicting harmonic constituent of ocean tides. The tidal boundary conditions were applied along the open boundaries of the grid (Figure 14) and were characterized based on 6 harmonic constituents (M2, S2, N2, K2, O1 and K1) which comprise the majority of the tidal energy in the area.

Tidal constituent phase and amplitude from OSU TPXO model grid cells were interpolated to the HYDROMAP boundary cells. Both phase and amplitude vary continuously along the boundaries. The phase is the timing at which the maximum elevation from that constituent occurs relative to a base case equilibrium tide and amplitude refers to the height that the water level may be either above or below mean sea level.

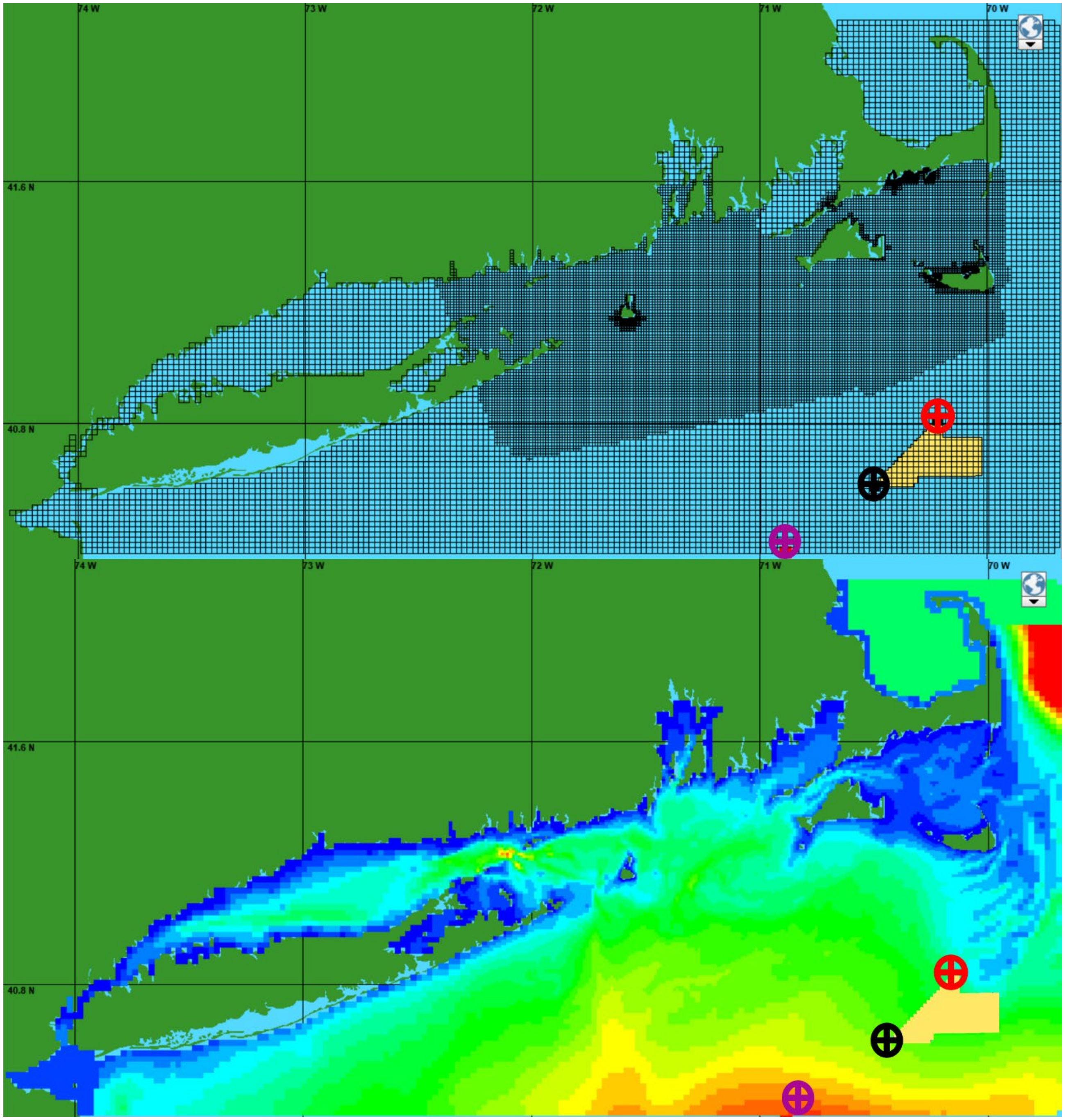


Figure 14. Illustration of the HYDROMAP model grid (upper panel) and bathymetry (relative to Mean Sea Level) (lower panel) for entire tidal domain. Red mark shows ESP 1, black mark shows ESP 2, and purple mark shows OOI Pioneer Inshore Surface Mooring. The yellow area between ESP 1 and ESP 2 is Lease Area OCS-A 0522.

2.3.2.2 Hydrodynamic Model Simulation Results

The HYDROMAP model application was used to generate tidal circulation data for use in the spill scenarios. The tidal constituents result in variable current speeds due to the timing of individual constituents. In the AOI, the semi-diurnal constituents dominate the tidal regime which results in reversing currents twice a day. Near ESP 1, the amplitude of tidal current is relatively stronger compared to SP 2 (Figure 15).

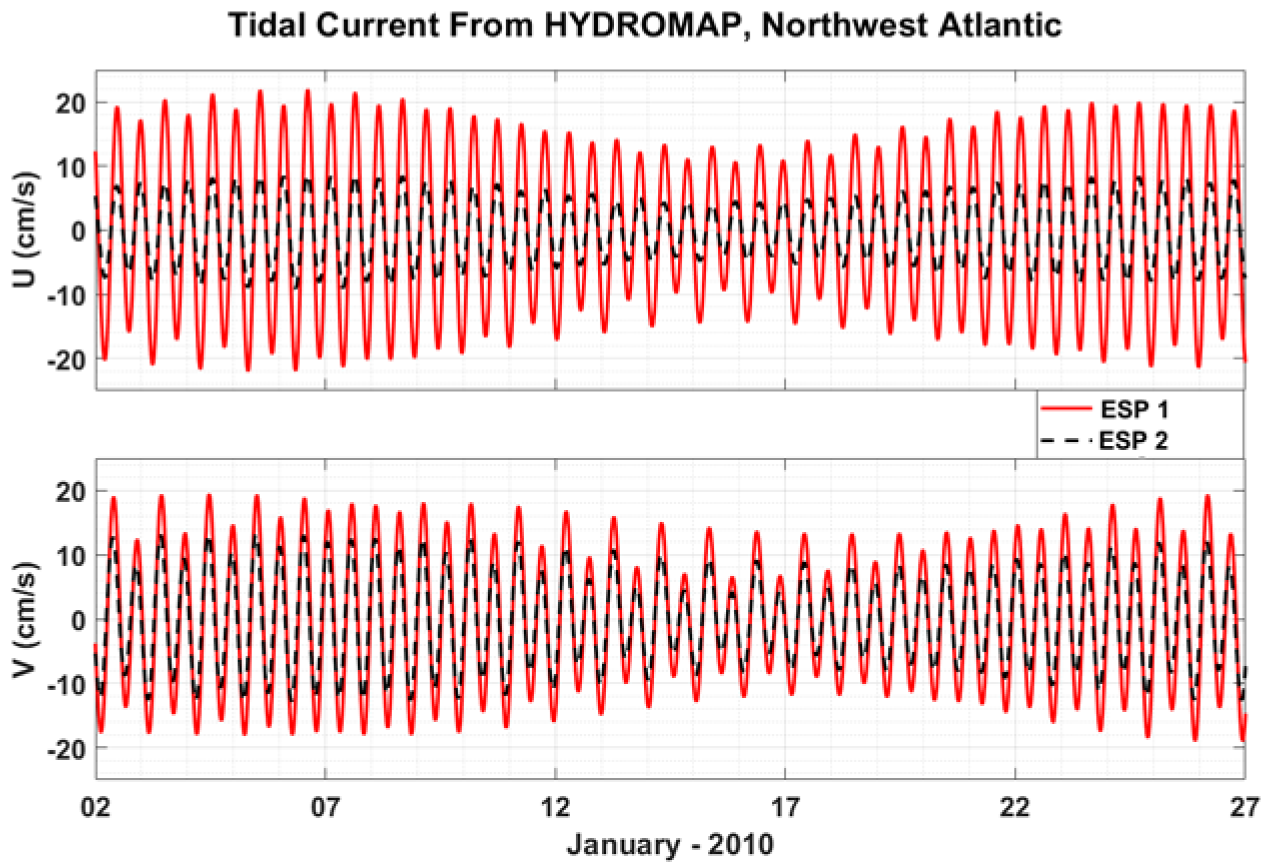


Figure 15. Timeseries of U and V component of tidal current from HYDROMAP near the spill sites; red lines show ESP 1, and black dotted lines show ESP 2.

Snapshots of typical flood and ebb circulation patterns of the combined constituents in the study area are shown in Figure 16. The model predictions show tidal influence near the spill sites with tidal current aligned in the southwest and northeast direction.

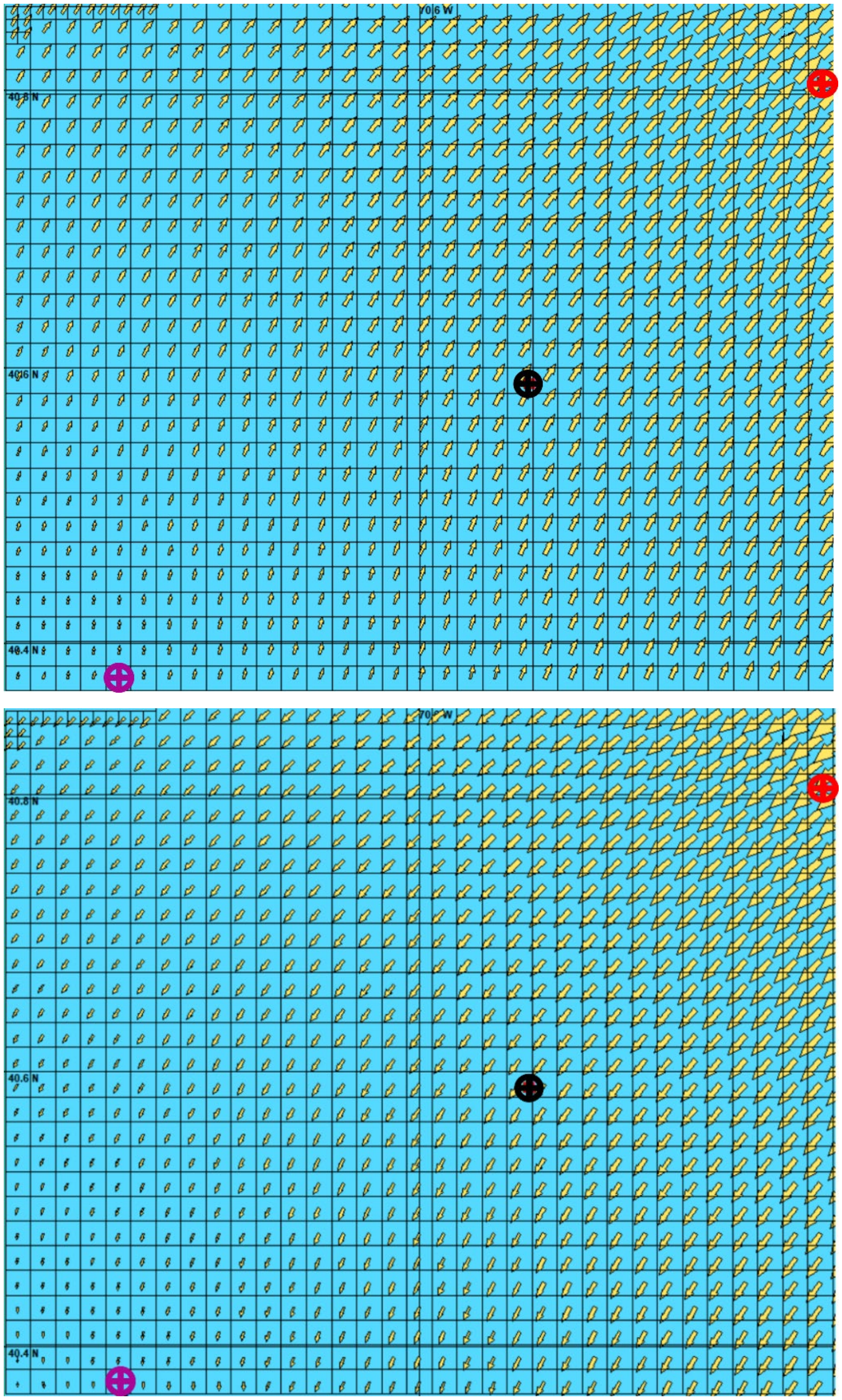


Figure 16. Illustration showing flood (upper panel) and ebb current pattern (lower panel) near ESP 1, ESP 2, and OOI Pioneer Inshore Surface Mooring showed by red, black, and purple marks, respectively.

2.3.3 HYCOM and HYDROMAP Validation

In order to validate the adequacy of the HYCOM aggregated with HYDROMAP datasets, the combined modeled data was compared against available in-situ current measurements provided by the client. For comparison, the HYCOM output was interpolated from the neighboring global grid points to the coordinates of the observation station (Table 6), and tidal current at the site from HYDROMAP was added. As the observation and model datasets do not overlap in time, the entire period of HYCOM + HYDROMAP (2001-2010) was compared with the observation record.

Table 6. Summary of hydrodynamic observation record

Station	Observation Period	Temporal Resolution	Latitude (°N)	Longitude (°W)	Depth (m)
OOI Pioneer Inshore Surface Mooring	14 December 2014 – 13 March 2022	15-minute	40.3633	70.8833	92

The current rose comparisons at OOI Pioneer Inshore Surface Mooring between measurements at available water depths (7 m and 92 m) and HYCOM + HYDROMAP data are shown in Figure 17. For comparison with measurement from a particular depth, HYCOM output from the nearest depth layer to observation were combined with depth averaged HYDROMAP. Based on this analysis, the current intensity from the measurement data is consistent with the HYCOM+HYDROMAP output for both depth layers. HYCOM+HYDROMAP also captured the directionality of the ADCP current reasonably well.

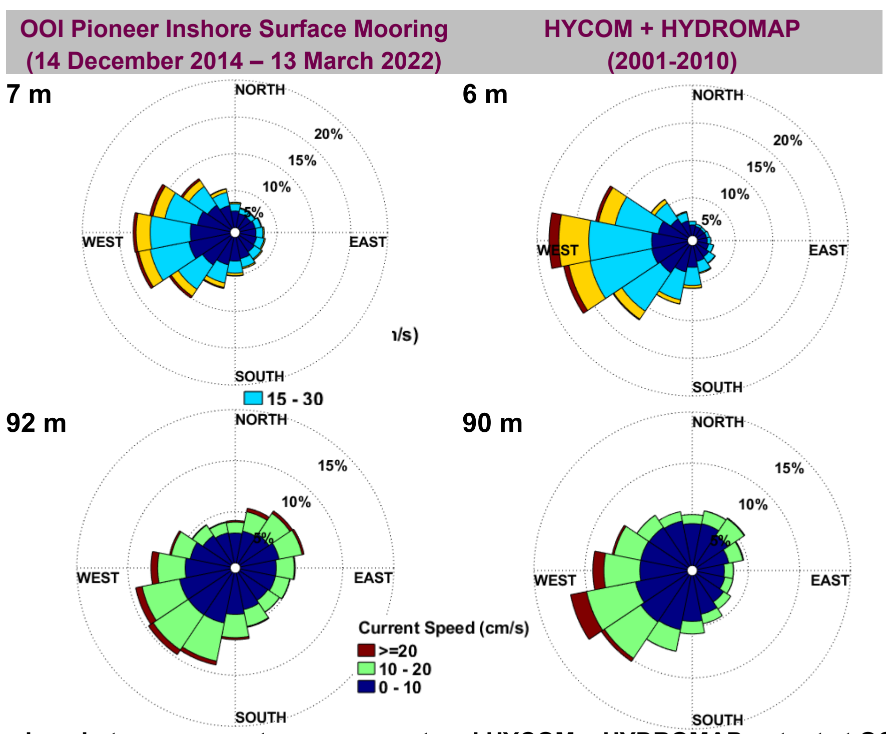


Figure 17. Comparison between current measurement and HYCOM + HYDROMAP output at OOI Pioneer Inshore Surface Mooring.

2.3.4 Current Analysis: HYCOM + HYDROMAP

Daily HYCOM files were augmented with a HYDROMAP tidal hydrodynamics file as explained in the previous section, at a temporal resolution of 30 minutes. For this study, a 10-year period of daily HYCOM model output was collected (2001 to 2010) and combined with the tidal model predicted datasets.

The figures (Figure 19 to Figure 24) at the location of spill sites were developed using a distance-weighted interpolation from the four surrounding HYCOM nodes. The following figures describe the variability of current speed and direction near the ESP 1 and ESP 2, based on the hydrodynamic dataset:

- Current intensity and direction map (Figure 18): Spatial distribution of HYCOM averaged surface current speeds and current directions in the area of interest, in cm/s;
- Annual current roses (Figure 19): Annual HYCOM + HYDROMAP surface current roses at ESP 1and ESP 2; following oceanographic convention (currents heading to), current speeds in cm/s.
- Monthly current speed statistics (Figure 20): Monthly average and 95th percentile HYCOM + HYDROMAP current speed at ESP 1 and ESP 2;
- Monthly current roses (Figure 21 and Figure 22): Monthly HYCOM + HYDROMAP surface current roses at ESP 1 and ESP 2; following oceanographic convention (currents heading to), current speeds in cm/s.
- Vertical profile of horizontal current speed (Figure 23 and Figure 24): Annual average and 95th percentile of HYCOM + HYDROMAP horizontal current speed variation (cm/s) with depth at ESP 1 and ESP 2, and the current roses for different water depths.

Based on the analysis of these regional data, the following conclusions can be drawn:

- HYCOM-averaged surface current speeds near the spill sites indicate current is west/west-southwestward with moderate speed, with some transitions in direction over the region close to ESP 1.
- Yearly-average current roses indicate both sites have current flowing to all direction. Predominant direction at ESP 1 is west/west-southwest and at ESP 2 current is predominantly westward/west-northwestward.
- Monthly-average current speed at ESP 1 and ESP 2 varies around a mean of 23 cm/s and 20 cm/s, respectively. The 95th percentile current oscillates between 38 and 53 cm/s at ESP 1, while at ESP 2 it ranges from 34 to 54 cm/s throughout the year, with the highest values in March and October.
- Currents at ESP 1 shows some minor seasonal variabilities with current speed and direction slightly changing throughout the year. However, at ESP 2 current direction is predominantly westward/west-northwestward during spring and fall, and more variable in the rest of the year.
- The vertical profile at ESP 1 shows the average and 95th percentile current speed decreases from the surface to the bottom layer from 23 cm/s and 46 cm/s to 17 cm/s and 28 cm/s, respectively. The predominant current direction shifts from west/west-southwestward at the surface to west-southwestward at the mid layer and the bottom layer, with some components towards northeast in all water layers. At ESP 2, vertical profile shows the average and 95th percentile current speed decreases from the surface to the bottom layer from 20 - 42 cm/s to 11 - 20 cm/s, respectively. The predominant current direction shifts from west/west-northwestward at the surface and mid-layer to west-southwestward at the bottom layer.

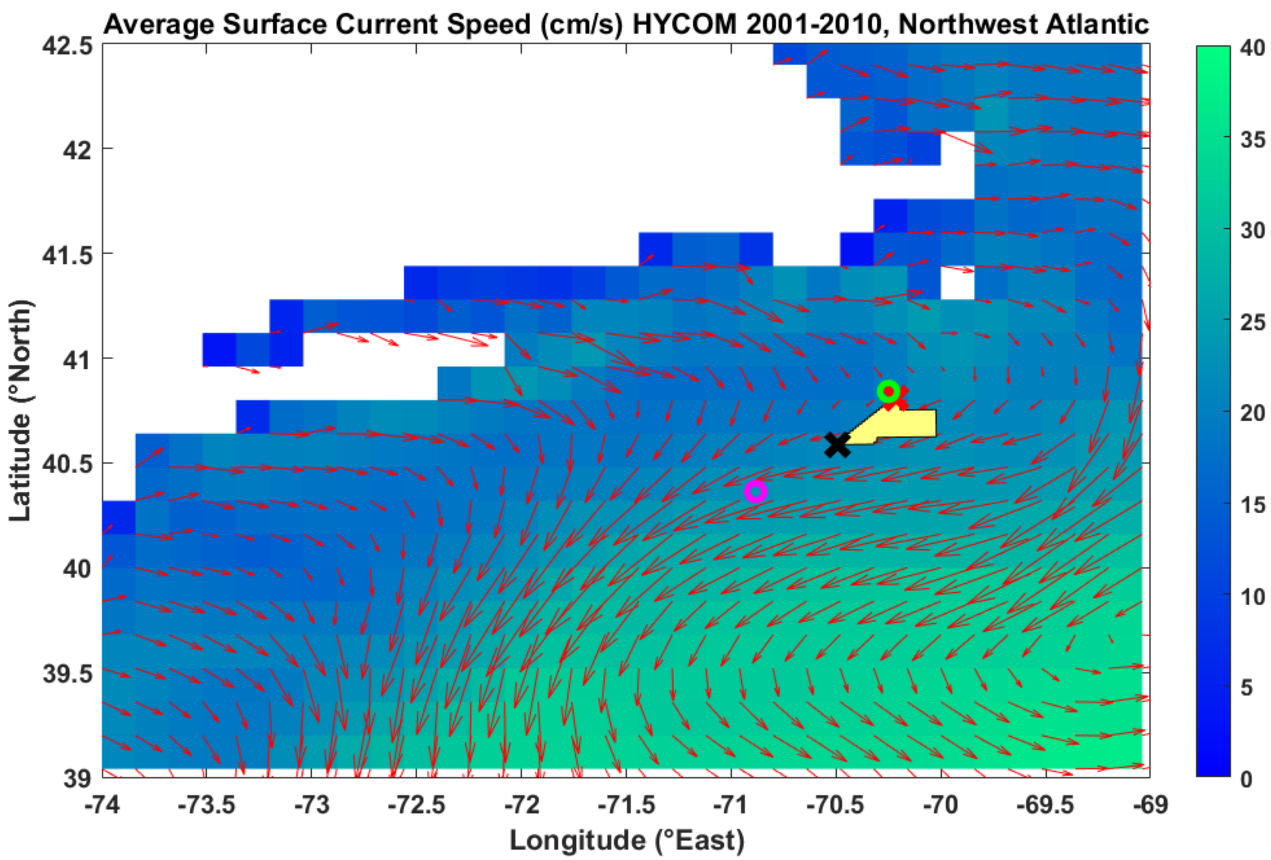
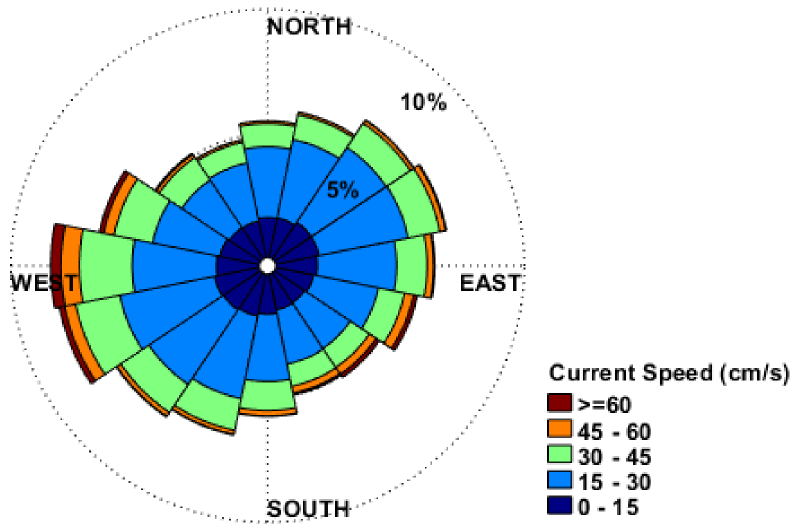


Figure 18. HYCOM surface current speed averaged over 2001-2010, Northwest Atlantic. Red and black "X"s show spill sites ESP 1 and ESP 2, respectively. The observation site of OOI Pioneer Inshore Surface Mooring is shown by the purple circle. The yellow area between ESP 1 and ESP 2 is Lease Area OCS-A 0522.

Annual HYCOM+HYDROMAP Surface Current Rose
Site – ESP 1: 40.81 °N, 70.22 °W



Annual HYCOM+HYDROMAP Surface Current Rose
Site – ESP 2: 40.59 °N, 70.50 °W

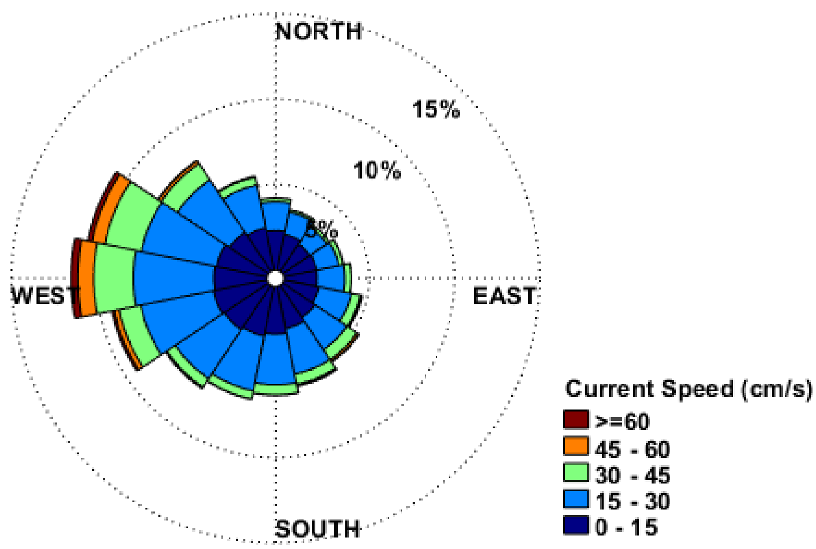
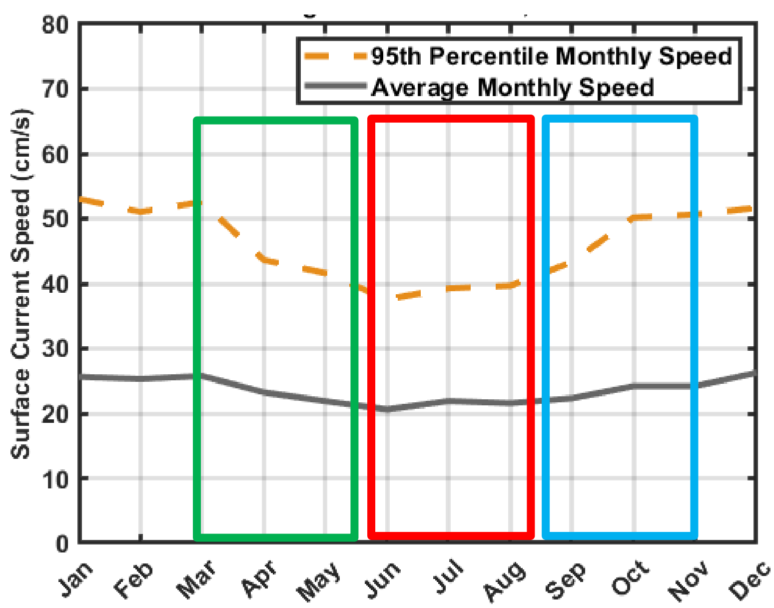


Figure 19. Annual HYCOM + HYDROMAP roses near ESP 1 (upper panel) and ESP 2 (lower panel) for 2001-2010. Current speeds in cm/s, using oceanographic convention (i.e., direction current is going to).



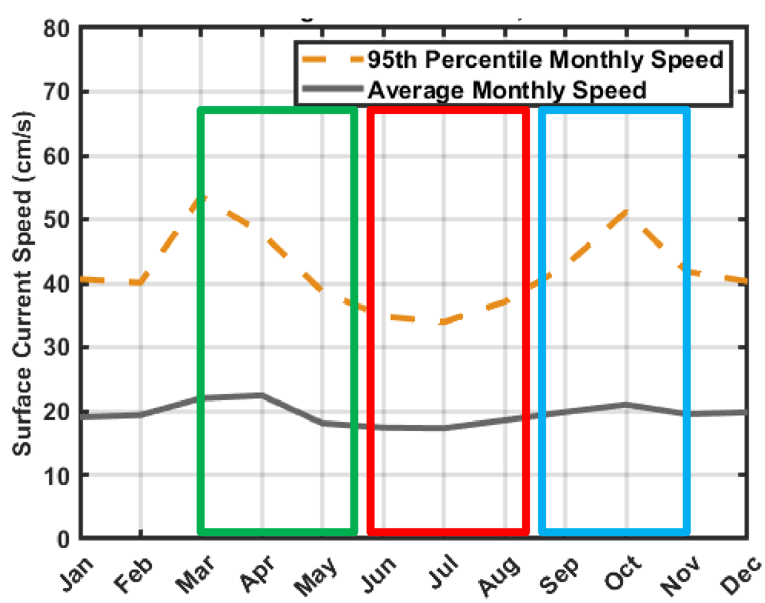


Figure 20. Monthly average and 95th percentile HYCOM + HYDROMAP current speed statistics near ESP 1 (upper panel) and ESP 2 (lower panel) for 2001-2010: monthly average (grey solid) and 95th percentile (orange dashed); current speed reported in m/s. Spring, Summer, and Fall seasons indicated by green, red, and blue boxes, respectively.

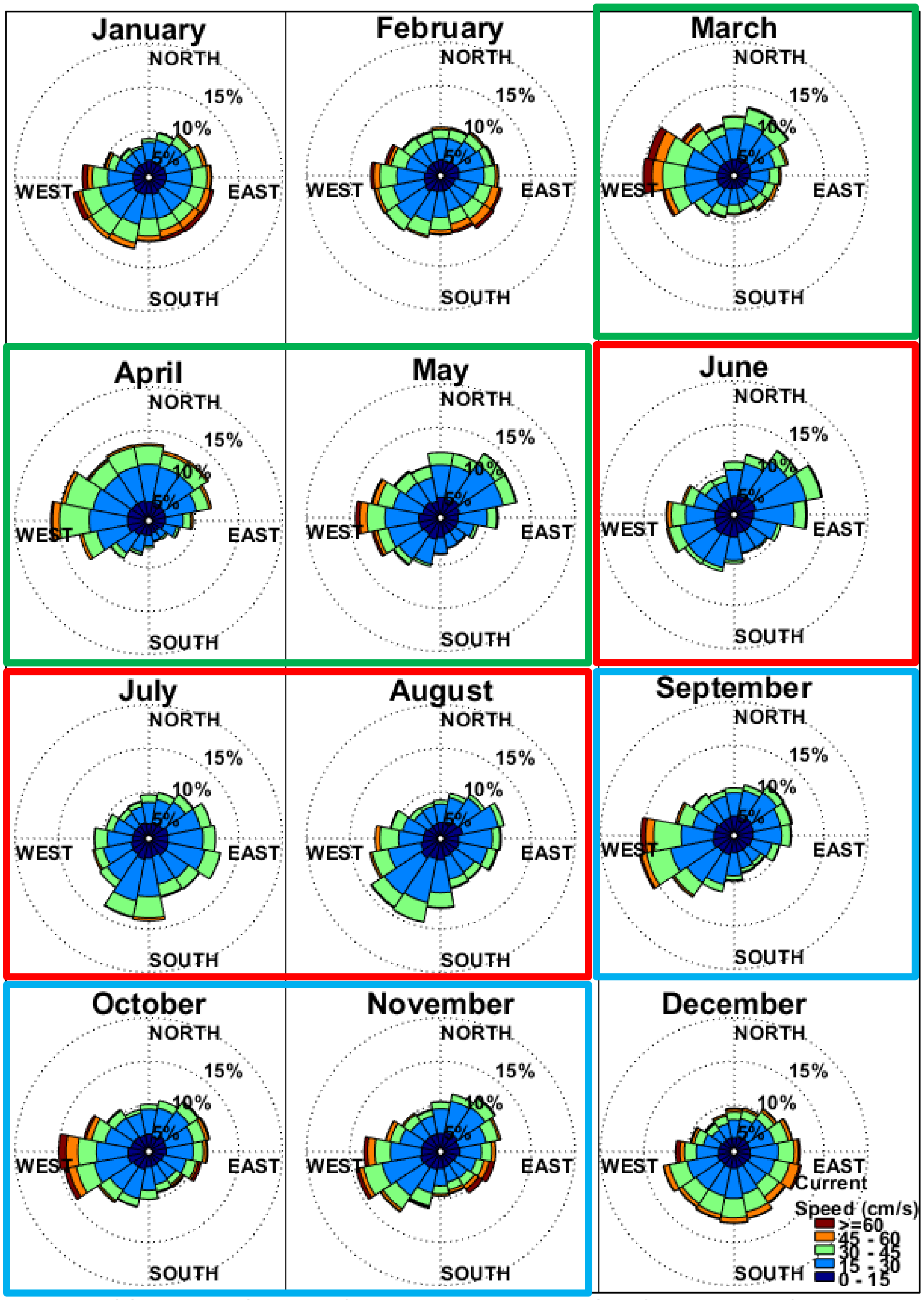


Figure 21. Monthly HYCOM + HYDROMAP surface current roses near ESP 1 for 2001-2010; following oceanographic convention (currents heading to), current speeds in cm/s. Spring, Summer and Fall seasons are shown by green, red and blue boxes, respectively.

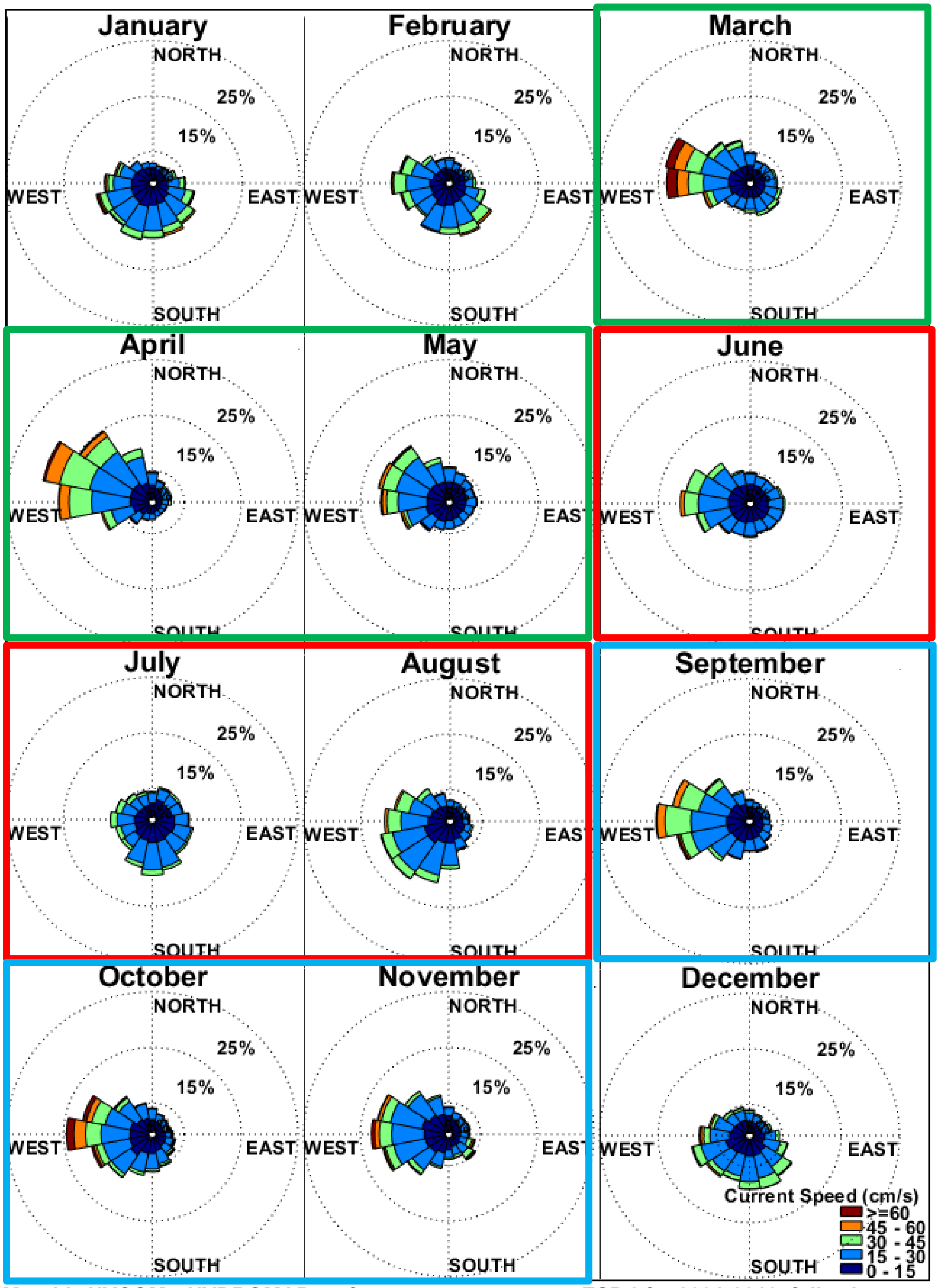


Figure 22. Monthly HYCOM + HYDROMAP surface current roses near ESP 2 for 2001-2010; following oceanographic convention (currents heading to), current speeds in cm/s Spring, Summer and Fall seasons are shown by green, red and blue boxes, respectively.

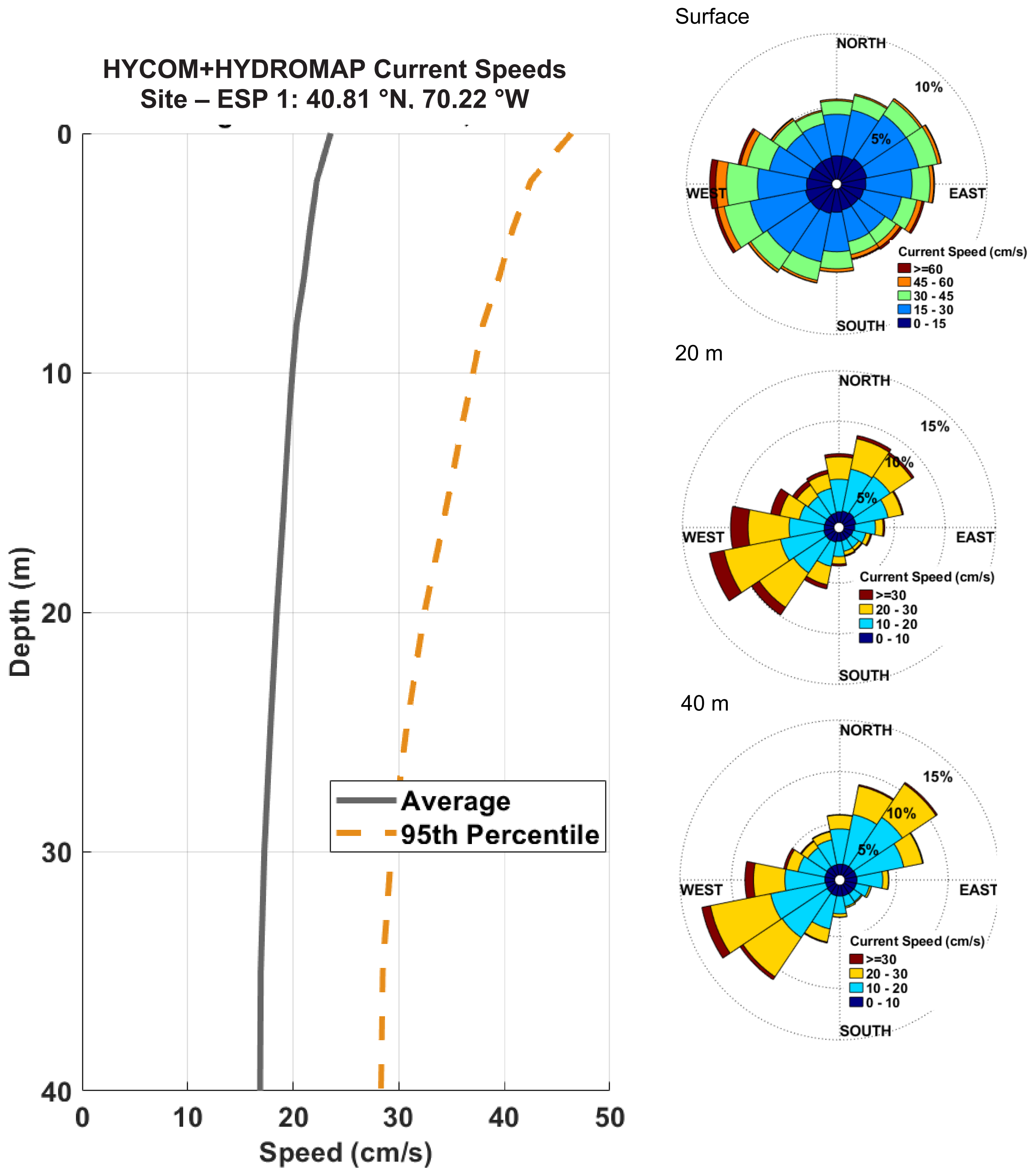


Figure 23. HYCOM average (solid grey) and 95th percentile (dashed orange) of horizontal current speed (cm/s) dataset from 2001-2010, variation with depth near ESP 1; and the current roses at surface, 20 m, and 40 m water depths. The roses show the direction that current is flowing towards.

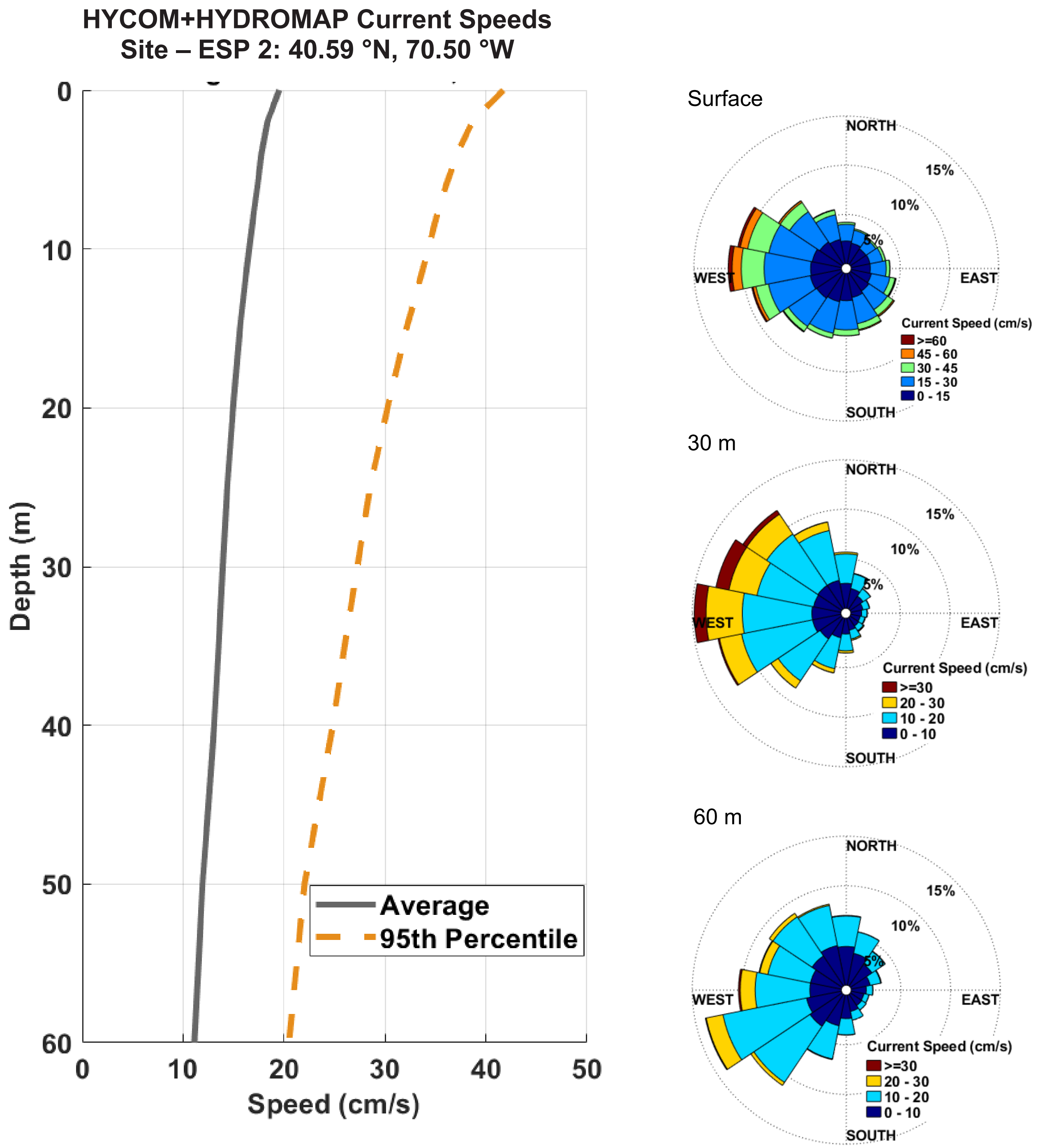


Figure 24. HYCOM average (solid grey) and 95th percentile (dashed orange) of horizontal current speed (cm/s) dataset from 2001-2010, variation with depth near ESP 2; and the current roses at surface, 30 m, and 60 m water depths. The roses show the direction that current is flowing towards.

2.4 Surface Transport

To compare the potential for surface wind-driven transport versus current-driven transport, an assessment of the wind drift speed versus current speed was performed at ESP 1 and ESP 2 as shown in Figure 25. For this study, the wind drift was estimated as 3.5% of the wind speed. Based on this analysis, at ESP 1 wind and current contributes almost equally to the movement of floating slicks during summer months. However, for the rest of the year wind drift controls the movement of the surface floating slicks. At ESP 2, wind is the primary agent of the surface transport throughout the year.

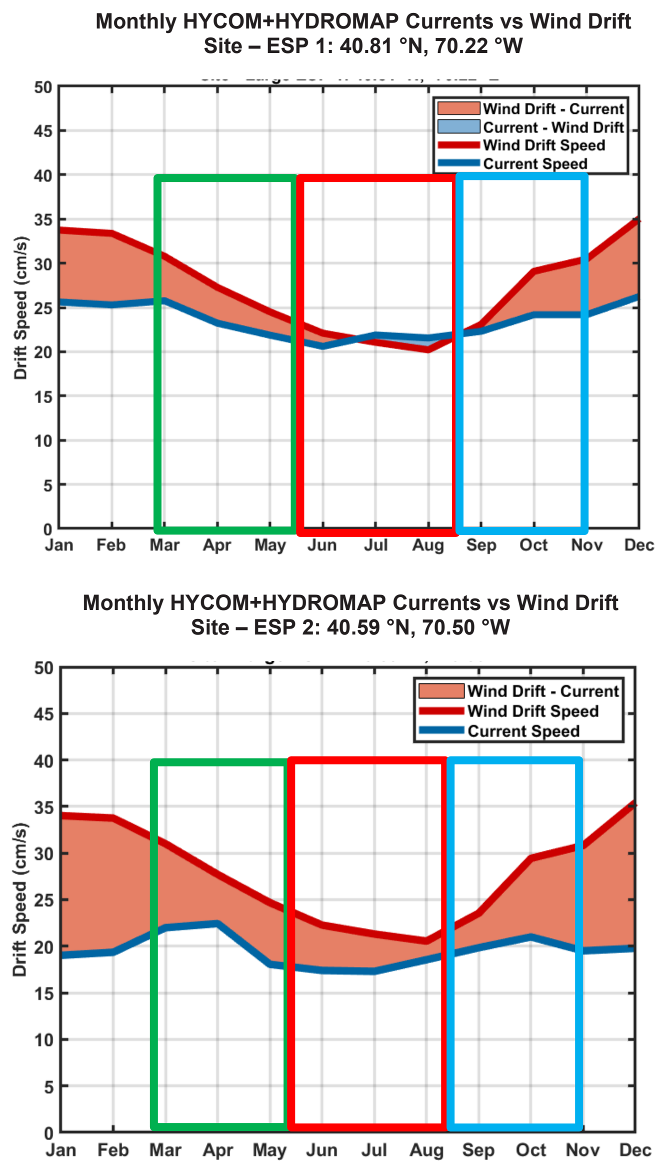


Figure 25. Surface drift forcing statistics near ESP 1 (upper panel) and ESP 2 (lower panel): monthly-averaged CSFR wind drift compared with HYCOM + HYDROMAP current speed. Wind drift is calculated as 3.5% of the wind speed. Predominant current transports are shaded blue and predominant wind drift is shaded pink. Spring, Summer, and Fall seasons are shown by green, red, and blue boxes, respectively.

3 OIL SPILL MODELING SETUP

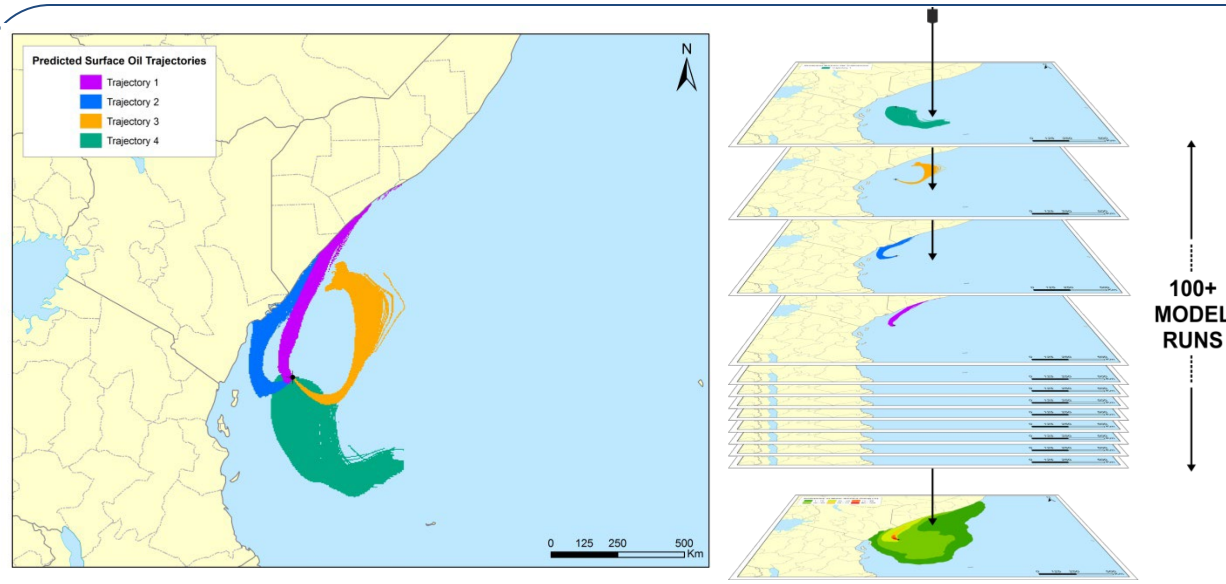
3.1 Modeling Methodology

RPS's proprietary oil spill modeling framework, OILMAP/SIMAP, was used for all simulations performed in this study. The model quantifies the transport and fate of different components of hydrocarbon mixtures through different compartments of the marine environment over time. The modeling system uses a 3-D Lagrangian model where each component of the spilled oil (floating, dispersed, shoreline, etc.) is represented by an ensemble of independent mathematical particles or "spillets". Each spillet comprises a subset of the total mass of hydrocarbons spilled and is transported by both currents and surface wind drift. Additional information on the modeling system is contained in Appendix B.

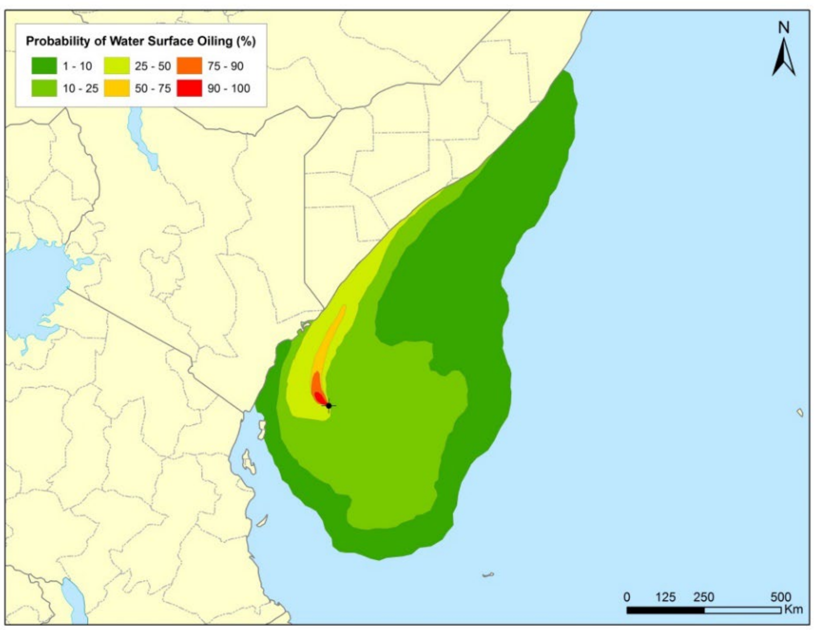
Stochastic Simulations

Stochastic simulations provide insight into the probable behavior of potential oil spills in response to temporally- and spatially-varying meteorological and oceanographic conditions in the study area. The stochastic model computes surface trajectories for an ensemble of hundreds of individual cases for each spill scenario, thus sampling the variability in regional and seasonal wind and current forcing by starting the simulation at different dates within the timeframe of interest.

The stochastic analysis provides two types of information: (1) the footprint of sea surface and shoreline areas exposed to oil above a certain threshold of concern and the associated probability of oil contamination, and (2) the shortest time required for oil to reach any point within the areas predicted to be oiled. The areas and probabilities of oiling are generated by a statistical analysis of all the individual stochastic runs (Figure 26). It is important to note that a single run will encounter only a relatively small portion of this footprint. In addition, the simulations provide shoreline oiling data expressed in terms of minimum and average times for oil to reach shore, and the percentage of simulations in which oil is predicted to reach shore. Results from this modeling step are presented in Section 4.



Examples of four individual spill trajectories predicted by OILMAP/SIMAP for a particular spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all 100+ model runs are overlain (shown as the stacked runs on the right) and the number of times that a trajectory reaches a given location is used to calculate the probability for that location.



Probability of surface oil exceeding a given threshold for the example scenario. This figure overlays 100+ individual model runs to calculate the percentage of runs that caused oiling above the threshold in a given area. This figure does not depict the areal extent of a single model run/spill.

Figure 26. Diagram of RPS stochastic modeling approach; an ensemble of individual trajectories creates the stochastic probability footprint.

3.2 Thresholds of Concern and Weathering

The stochastic approach applied in the spill risk assessment provided an evaluation of the likelihood of exposure to oil above ecological thresholds of concern, expressed as mass per unit area and concentration. The thresholds listed in Table 7 were used in the stochastic analysis, and followed a similar methodology as used in BOEM's previous study assessing potential catastrophic oil spills from offshore wind structures (Bejarano et al. 2013).

Table 7. Oil thickness thresholds applied in the spill risk assessment for sea surface and shoreline probability determinations

Threshold Type	Average Concentration Threshold	Rationale	Visual Appearance	References
Oil on Sea Surface	10 g/m^2 ≈ 10 µm (0.01 mm) on average over the grid cell	**Ecological:** Observed lethal effects to birds on water at this threshold. Sublethal impacts to marine mammals, sea turtles, and floating Sargassum mats.	Fresh oil at this thickness corresponds to a slick being a dark brown or metallic sheen.	French et al. 1996; French McCay 2009;French McCay et al. 2011; French McCay et al. 2012; French McCay 2016
Shoreline Oil	100 g/m^2 ≈ 100 µm (0.1 mm) on average over the grid cell	**Ecological:** This is a screening threshold for potential ecological effects on shoreline flora and fauna, based upon a synthesis of the literature showing that shoreline life has been affected by this degree of oiling. Sublethal effects on epifaunal intertidal invertebrates on hard substrates and on sediments have been observed where oiling exceeds this threshold. Assumed lethal effects threshold for birds on the shoreline.	May appear as black opaque oil.	French et al. 1996; French McCay 2009; French McCay et al. 2011; French McCay et al. 2012; French McCay 2016

3.3 Oil Spill Scenarios

Vineyard Northeast identified two representative ESP locations at the northeast corner and the southwest corner of the Lease Area, respectively. Scenarios for the stochastic simulations assumed a spill from an instantaneous, catastrophic loss of the complete contents of the ESP at each representative location (Table 8). Thousands of particles were used in OILMAP/SIMAP to simulate the surface discharge of oil as a near instantaneous spill tracked over the course of 20 days. The stochastic model was run for the two different scenarios using 478 simulations covering the span of 10 years (2001 to 2010). These results were then reanalyzed over four seasons, each consisting of over 100 simulations (Table 9). As described in Section 2, a combination of HYCOM Reanalysis and HYDROMAP modeled tidal circulation was used as current inputs to the model, while CFSR was used as wind inputs.

Table 8. Discharge locations used in oil spill modeling.

Site	Description	Latitude N (decimal degrees)	Longitude W (decimal degrees)
ESP 1	NE corner of 522	40.806262	70.215082
ESP 2	SW corner of 522	40.587561	70.495609

Table 9. Oil spill scenarios defined for the oil spill modeling.

<table>
<tr><th>ID</th><th>Site</th><th>Oil Type</th><th>Season</th><th>Total Volume Spilled</th></tr>
<tr><td>1</td><td rowspan="4">ESP 1</td><td rowspan="4">Oil Mixture
(Diesel + Naphthenic Oil)</td><td>Spring:
(March–May)</td><td rowspan="4">5,637 bbl
(236,754 gal)</td></tr>
<tr><td>2</td><td>Summer:
(June–August)</td></tr>
<tr><td>3</td><td>Fall:
(September-November)</td></tr>
<tr><td>4</td><td>Winter:
(December–February)</td></tr>
<tr><td>5</td><td rowspan="4">ESP 2</td><td rowspan="4">Oil Mixture
(Diesel + Naphthenic Oil)</td><td>Spring:
(March-May)</td><td rowspan="4">5,637 bbl
(236,754 gal)</td></tr>
<tr><td>6</td><td>Summer:
(June–August)</td></tr>
<tr><td>7</td><td>Fall:
(September–November)</td></tr>
<tr><td>8</td><td>Winter:
(December–February)</td></tr>
</table>

3.4 Oil Characteristics

Two main oil types were chosen as representative oils to be used within the Lease Area after communication between Vineyard Northeast and RPS. The two oils in order of prevalence in the final mixture are: (1) Naphthenic oil produced by Nynas known as “Nytro 10X” and; (2) diesel fuel, using the properties of “Diesel 2002” as presented on Environment Canada’s oil property database.

Using these components, one theoretical “combination oil” was generated by creating two mass-weighted averages of the two-constituents calculated by utilizing the volumes specified by Vineyard Northeast. The naphthenic and diesel represent approximately 92% and 8%. Thus, the properties of the final combined oil most closely resemble the naphthenic oil which dominates the mixture. The compositional breakdown of scenarios is presented in Table 10 and the bulk properties of all component and mixtures of hydrocarbons are presented in Table 11.

Table 10. Composition of Oil Mixtures for the Modeled scenarios. Properties from Environment Canada oil properties database.

	Bulk Property	Naphthenic (Nytro 10x)	Diesel	Total
ESP	Volume (L)	824,508	71,703	896,211
	Volume (bbl)	5,186	451	5,637
	Total mass (kg)	709,082	61,659	770,741
	Mass fraction	92%	8%	100%

Table 11. Bulk properties for each of the component hydrocarbons and mixtures for the modeled ESPs. Oil properties from Environment Canada oil properties database.

Component Hydrocarbons				Oil Mixture
Bulk Property	**Naphthenic (Nytro 10x)**	**Diesel**	**Biodegradable (Midel 7131)**	**ESP**
Density at 25°C (g/cm^3)	0.8679	0.970	0.9682	0.874
Viscosity at 15°C centipoise (cP)	26.0	2.8	117.0	26.8
% mass with boiling point 0-180°C	0.0%	16.4%	0.0%	0.7%
% mass with boiling point 180-165°C	17.1%	49.0%	0.0%	18.1%
% mass with boiling point 265-380°C	66.4%	31.9%	1.0%	63.7%
% mass with boiling point >380°C	16.5%	2.7%	99.0%	17.6%
Surface Tension in millinewtons per meter (mN/m)	45	28	50	44

4 STOCHASTIC MODELING RESULTS

OILMAP/SIMAP's stochastic model computed the probable surface and shoreline trajectories of surface spills of oil mixtures from two ESPs for four seasons. Over 100 simulations define each seasonal spill scenario. Stochastic trajectory results were summed to calculate probabilities of surface oiling and minimum travel time for each spill scenario including oil contamination of the water surface and shoreline.

The stochastic results for all spill scenarios are summarized in Table 12. The average time to reach the shoreline and the average mass of oil washed ashore were calculated based on all the individual trajectories that led to oil reaching shore with more than 0.1% of the initial spilled volume. The percentage of simulations reaching shore was based on the number of trajectories out of the total number of individual simulations run for the stochastic modeling in which at least 0.1% of the spilled volume was predicted to reach shore. Thickness thresholds for shoreline contamination were not used in the below calculations, and as such results present conservative probabilities and timing. It is also important to note that the time to reach shore is based on the minimum time for any shoreline contamination to occur and does not indicate the thickness of shoreline contamination occurring at that time.

Table 12. Oil spill stochastic results—predicted shoreline impacts for each scenario.

ID	Spill Site	Oil Type	Season	Total Volume Spilled	Sims. Reaching Shore (%) [1]	Time to Reach Shore (days)		Contamination to shoreline (% of total spill)	
						Min.	Avg.	Max.	Avg.
1	ESP 1	Oil Mixture	Spring: (Mar.-May)	5,637 bbl	7.5%	1.76	5.58	6.5%	1.2%
2	ESP 1	Oil Mixture	Summer: (June-Aug.)	5,637 bbl	8.3%	2.95	3.95	17.8%	2.6%
3	ESP 1	Oil Mixture	Fall: (Sept.-Nov.)	5,637 bbl	4.2%	2.95	5.02	6.6%	1.9%
4	ESP 1	Oil Mixture	Winter: (Dec.-Feb.)	5,637 bbl	1.7%	2.02	4.29	0.6%	0.4%
5	ESP 2	Oil Mixture	Spring: (Mar.-May)	5,637 bbl	1.7%	5.79	13.29	0.1%	0.1%
6	ESP 2	Oil Mixture	Summer: (June-Aug.)	5,637 bbl	2.5%	8.15	8.66	0.4%	0.2%
7	ESP 2	Oil Mixture	Fall: (Sept.-Nov.)	5,637 bbl	0.0%	0.00	0.00	0.0%	0.0%
8	ESP 2	Oil Mixture	Winter: (Dec.-Feb.)	5,637 bbl	0.0%	0.00	0.00	0.0%	0.0%

Notes:

1. The percentage of simulations reaching shore is based on the number of trajectories out of the ensemble of stochastic individual simulations. Since these calculations are based on total mass reaching shore, thickness thresholds were not incorporated.

Results from the stochastic modeling are provided in maps depicting the probability and timing of oil contamination on the surface and shoreline in excess of the threshold oil thicknesses (0.01 millimeters [mm] for surface oil and 0.1 mm for shoreline oil) described in Section 3.2. Figure 28 to Figure 31 and Figure 36 to Figure 39 present surface oiling for the ESP 1 and ESP 2, respectively. Figure 32 to Figure 35 and Figure 40 to Figure 43 present shoreline oiling for the ESP 1 and ESP 2, respectively. Each figure contains two maps, portraying the following information:

1. **Probability of Oil Contact Figures**: The probability of oiling maps for each scenario defines the area and the associated probability in which sea surface and shoreline oiling above the defined thresholds (Table 7) would be expected should a worst case oil spill scenario occur. The colored area in the stochastic maps indicates areas that *may* receive oil contamination in the event of that particular spill scenario. The 'hotter' the color (e.g., reds), the more likely an area would be affected; the cooler the colors (e.g., greens), the less likely an area would be affected. The probability of oil contamination was based on a statistical analysis of the resulting ensemble of individual trajectories for each spill scenario. These figures do not imply that the entire contoured area would be covered with oil in the event of a spill, nor do they provide any information on the quantity of oil that would be found in a given area.

2. **Minimum Travel Time Figures**: The footprint of the minimum travel time corresponds to the oil contamination probability maps for oil above the threshold of concern. These figures illustrate the shortest time required for oil to reach any point within the footprint at a thickness or concentration

exceeding the defined threshold for surface and shoreline oil contamination. These results are based on the ensemble of all individual trajectories.

It is important to note that the probability of a spill trajectory passing through a certain water surface area and the probability of a spill trajectory hitting a shoreline segment near that water surface area are different. For example, in the schematic shown in Figure 27, there are four trajectories total, which do not overlap near the shore. Thus, the surface oiling probability at a surface water grid cell near the shore (yellow cell) is 25%, since only one out of four trajectories crosses that grid cell. However, the probability of shoreline oiling within the green bracketed segment near the yellow surface water cell is 75%, since three out of four trajectories intercept that particular shoreline segment. In the locations in which two of the four trajectories do overlap within a surface water grid cell, the probability of oiling is 50% (purple cell). In addition, oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can accumulate. In contrast, oil contamination on the surface only shows the maximum concentration at each grid cell for any given time (i.e., oil can move through a cell in cumulative excess of the threshold but still not exceed the threshold at any given time).

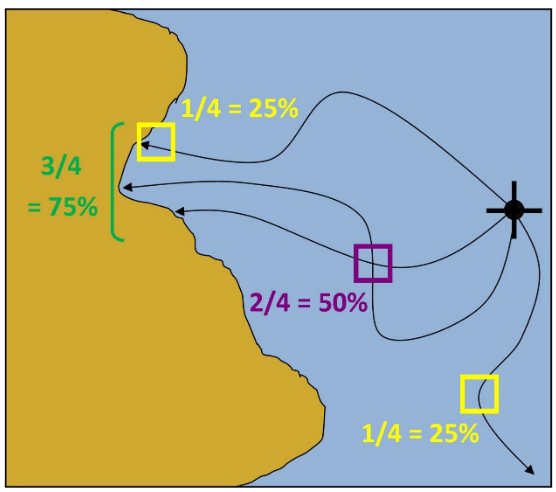


Figure 27. Example illustration of the difference between surface and shoreline oiling probabilities. Surface probabilities in yellow and purple, shoreline probabilities in green.

4.1 ESP 1 Stochastic Results

4.1.1 Oil Contamination to Water Surface

Figure 28 to Figure 31 provide the results of surface oil contamination for the spill scenarios modeled at the ESP 1 over each season. In all four seasons, the sea surface area exposed to oil exceeding the 10 μm (0.01 mm ≈ 10 g/m^2 on average over the grid cell) threshold is contained within a radius up to 35 km (22 mi) of the spill location, with the largest stochastic contour comprised of a 1–10% probability. The surface oiling probability footprint extended furthest to the south in the summer season and to the north in the spring season, where surface oil was predicted to occur within a minimum of one to three days of the spill. Three of the seasons (spring, summer and fall; Figure 28 to Figure 30, respectively) demonstrate similar water surface oil exposure footprints, while the winter scenario (Figure 31) depicts a relatively smaller footprint centralized around the spill site. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Northeast would implement in the case of a spill.

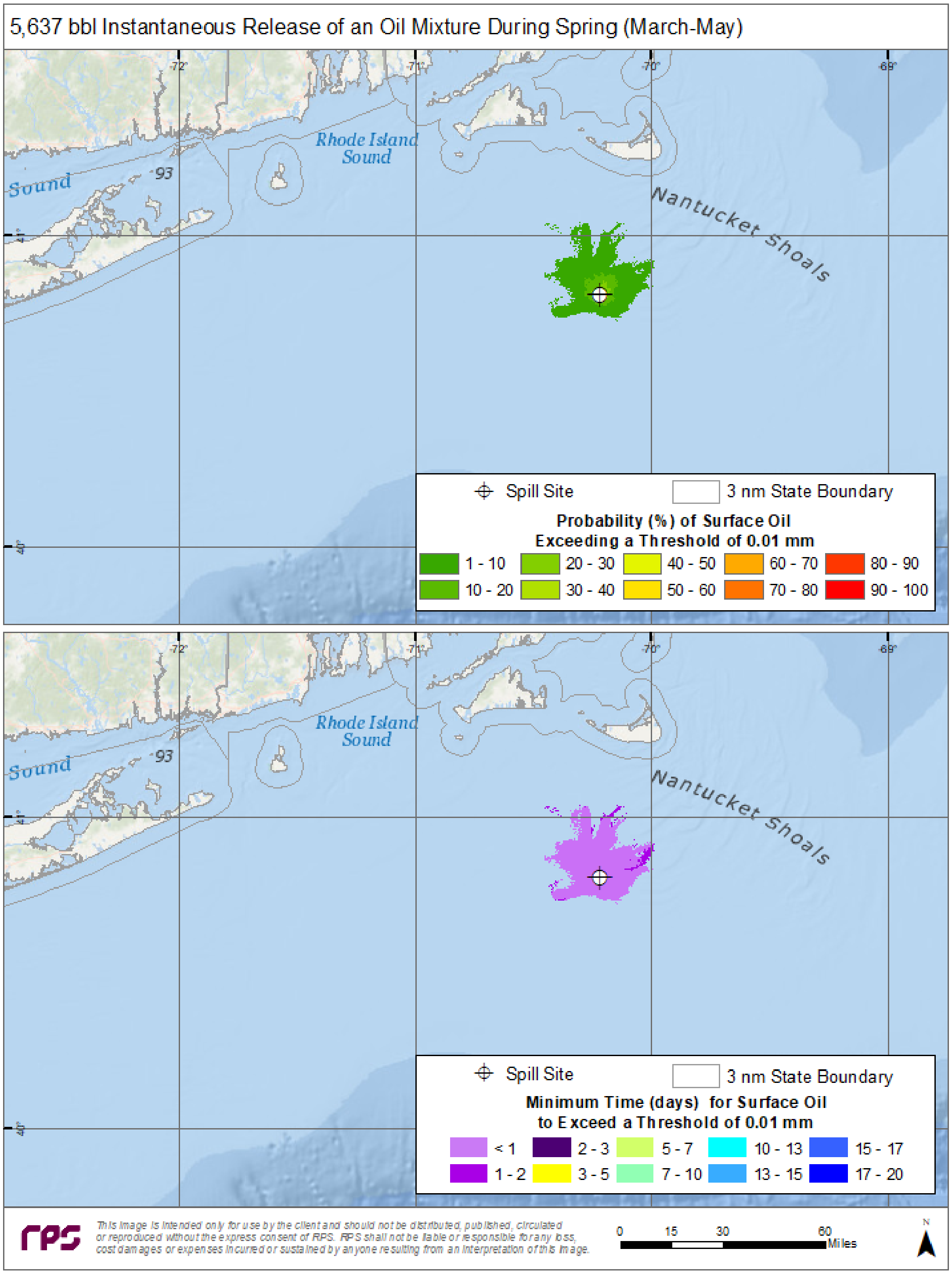


Figure 28. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during spring months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

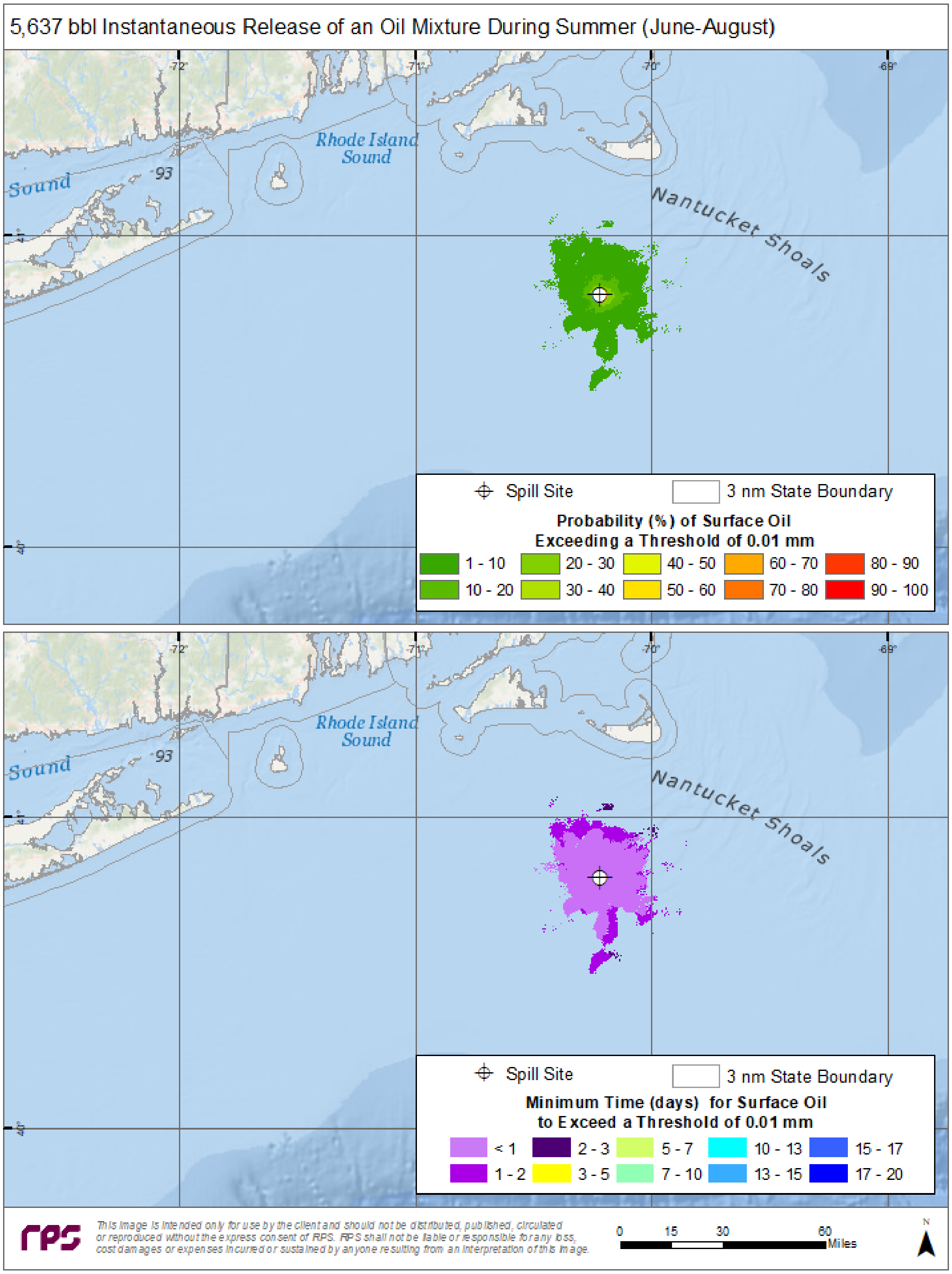


Figure 29. Top Panel–Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during summer months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m².

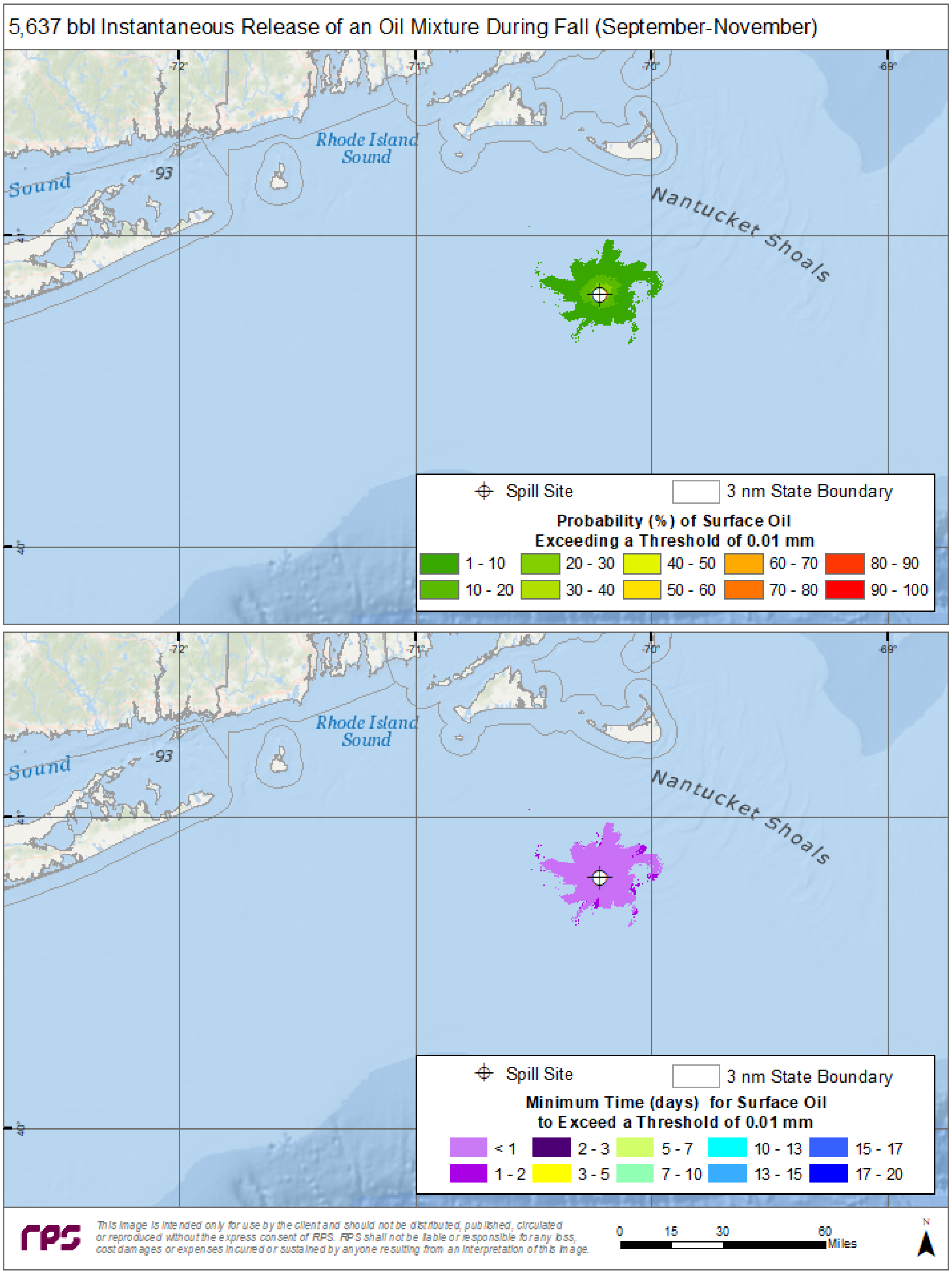


Figure 30. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

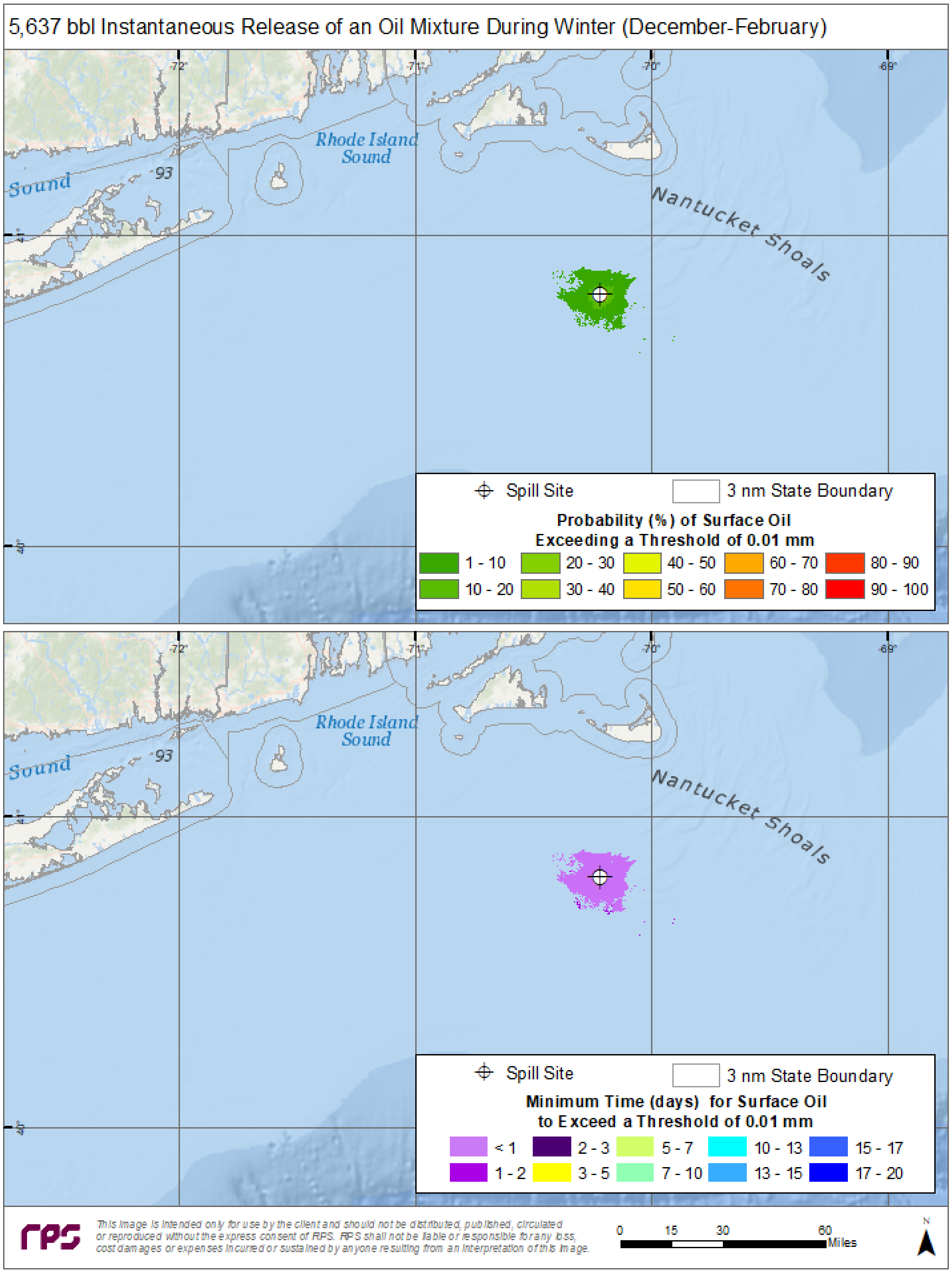


Figure 31. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during winter months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

4.1.2 Oil Contamination to Shore

The following figures illustrate the results of oil contamination to the shoreline for the worst-case oil spill scenarios over each season at the ESP 1 spill location. Figure 32 to Figure 35 indicate that, in all seasons, there is <10% probability that oil above a minimum thickness of 100 µm (0.1 mm ≈ 100 g/m^2 on average over the grid cell) spilled from the ESP 1 location would reach the shorelines of Nantucket within three to five days of the spill for the spring, summer, and fall scenarios. In the winter season, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell).

The spring and summer scenarios are expected to have the largest spatial extent of shoreline oiling due to the prevailing winds and currents during that season. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Northeast would implement in the case of a spill.

As described above and shown in Figure 27, the differences in the footprint for the surface and shoreline oil contamination are a result of the surface oil less than 100 µm (100 g/m^2 on average over the grid cell) traveling farther distances and beginning to pile up on shore. It is important to note that oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can accumulate.

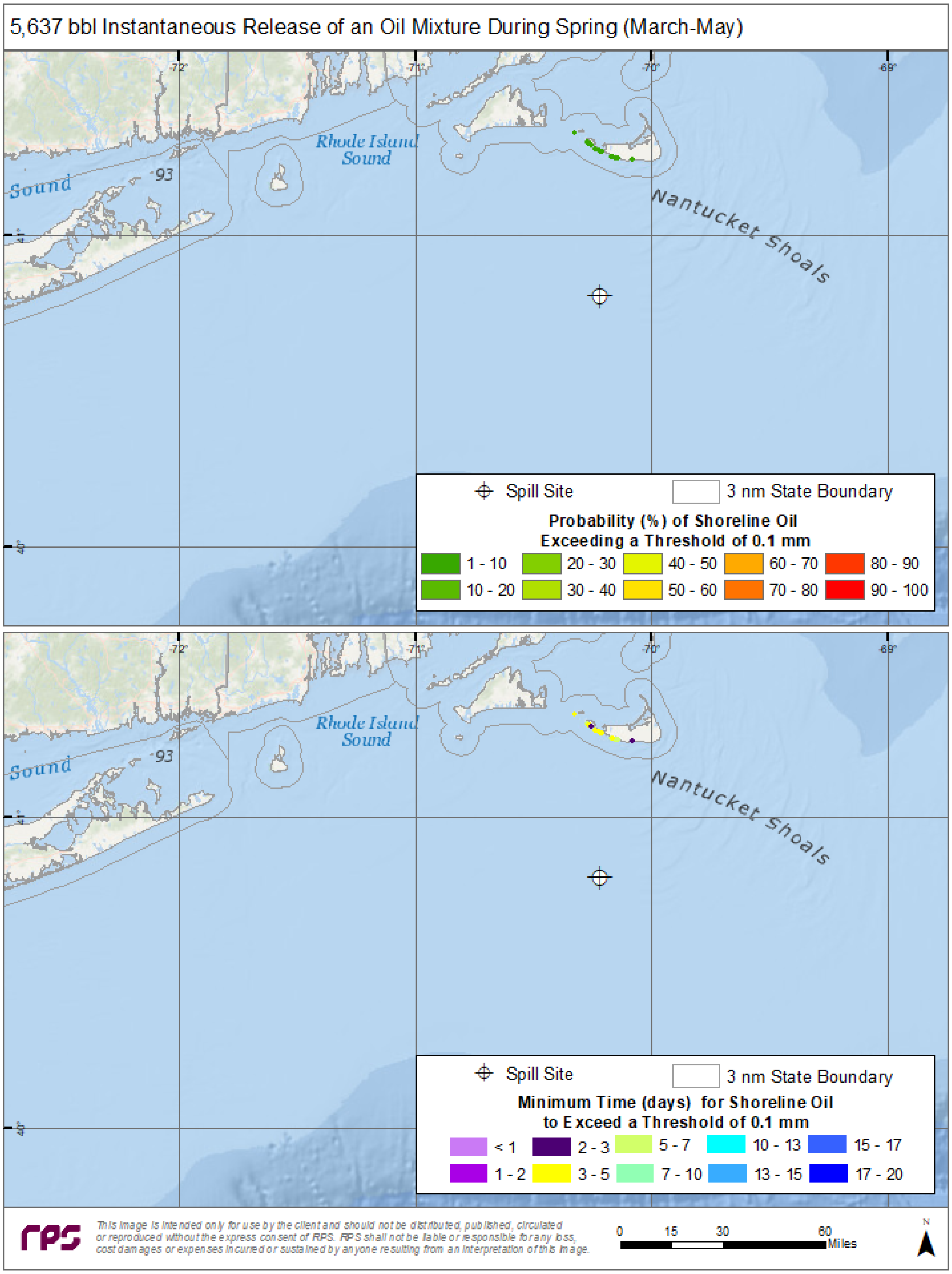


Figure 32. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during spring months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m².

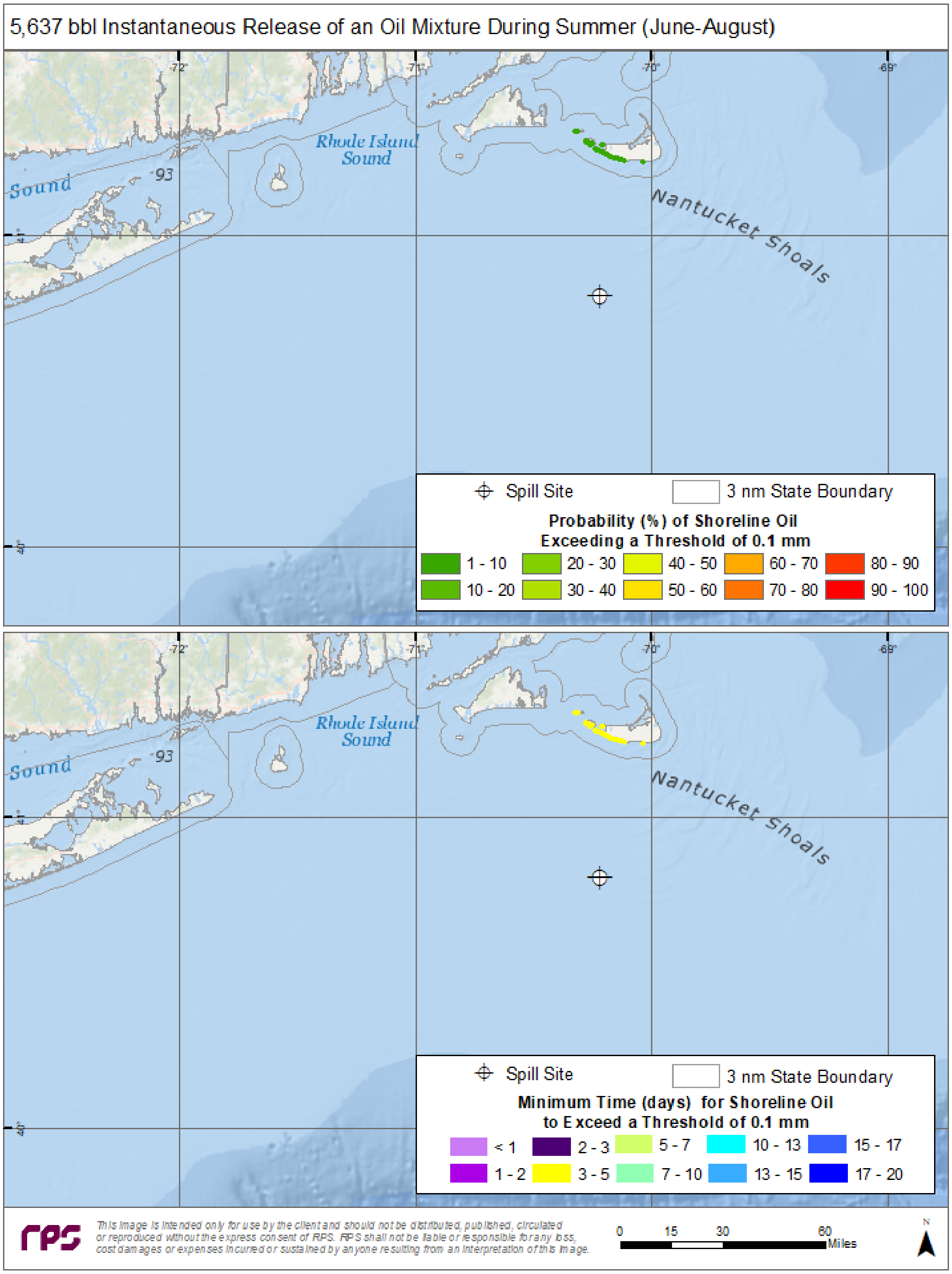


Figure 33. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during summer months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

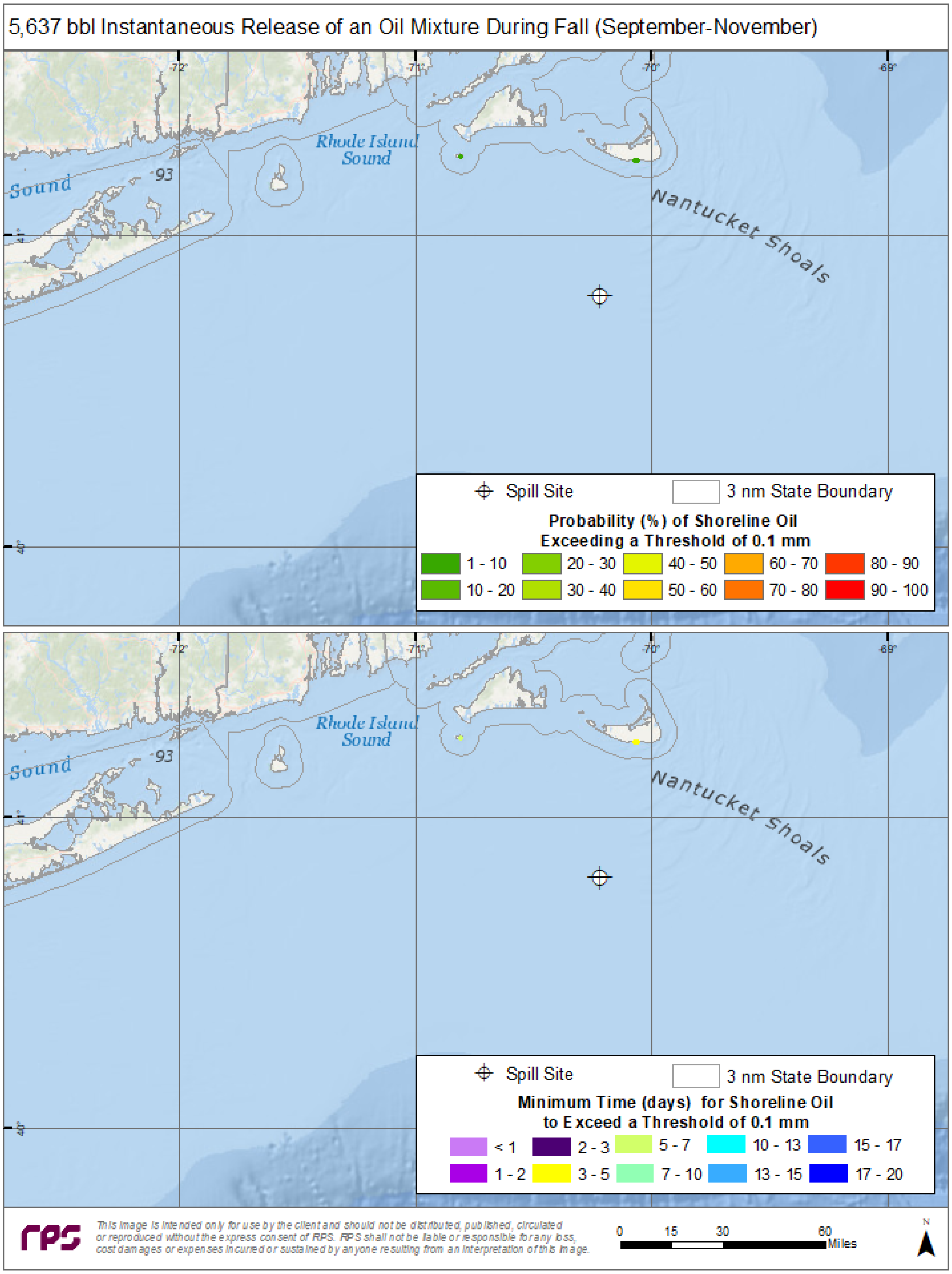


Figure 34. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

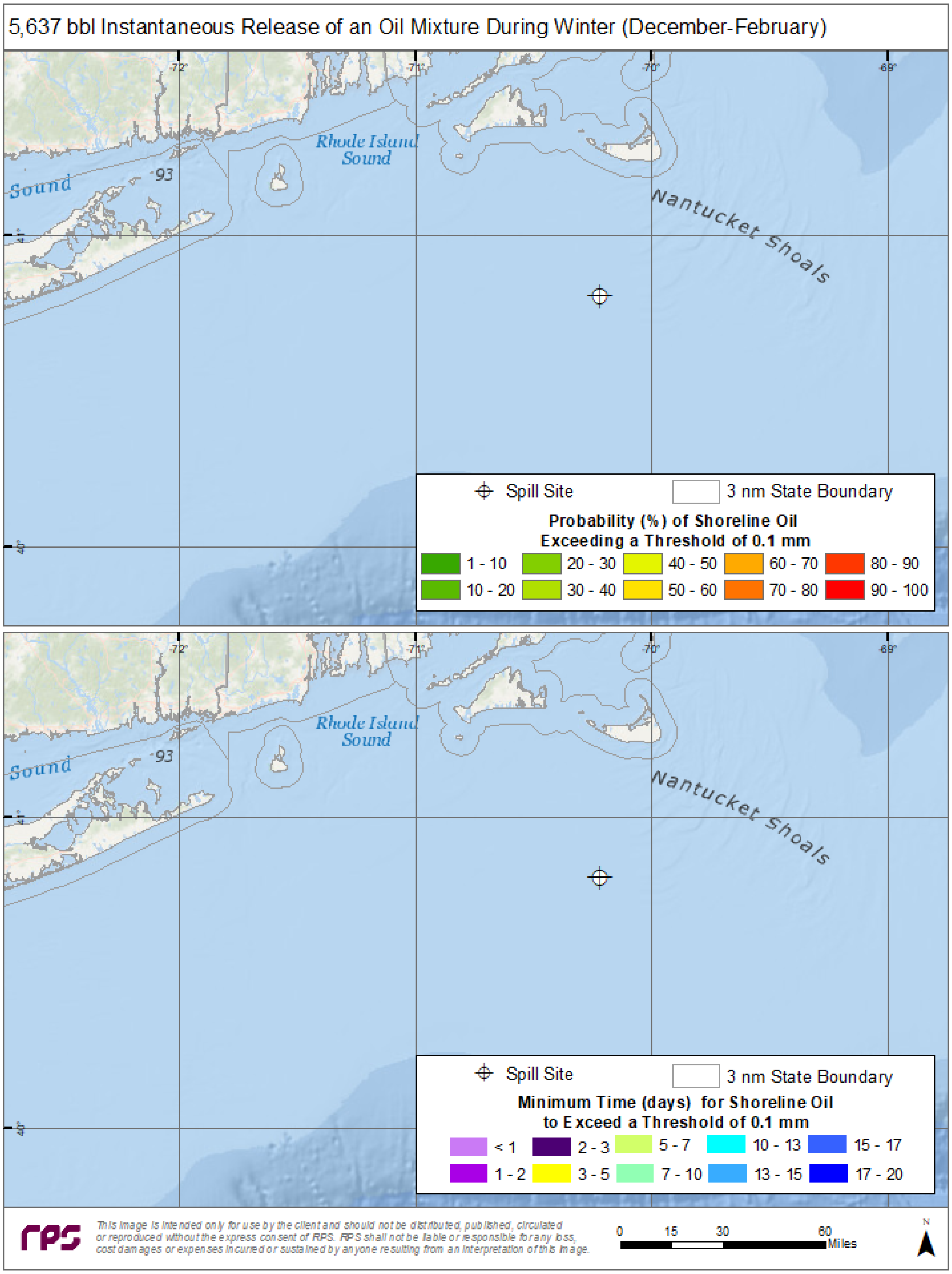


Figure 35. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during winter months for an instantaneous discharge from the ESP 1 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m².

4.2 ESP 2 Stochastic Results

4.2.1 Oil Contamination to Water Surface

Figure 36 to Figure 39 provide the results of surface oil contamination for the spill scenarios over each season. In all four seasons, the sea surface area exposed to oil exceeding the 10 µm (0.01 mm ≈ 10 g/m^2 on average over the grid cell) threshold is primarily contained within a radius up to approximately 40 km (25 mi) of the ESP 2 location, with the largest stochastic contour comprised of 1–10% probability. The probability footprint extended furthest to the west and northwest in the spring, summer, and fall seasons, where surface oil was predicted to occur within three days at minimum (Figure 36 to Figure 38). The spring, summer, and fall seasons demonstrate similar water surface oiling probability footprints while the winter scenario depicts a relatively smaller footprint. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which Vineyard Northeast would implement in the case of a spill.

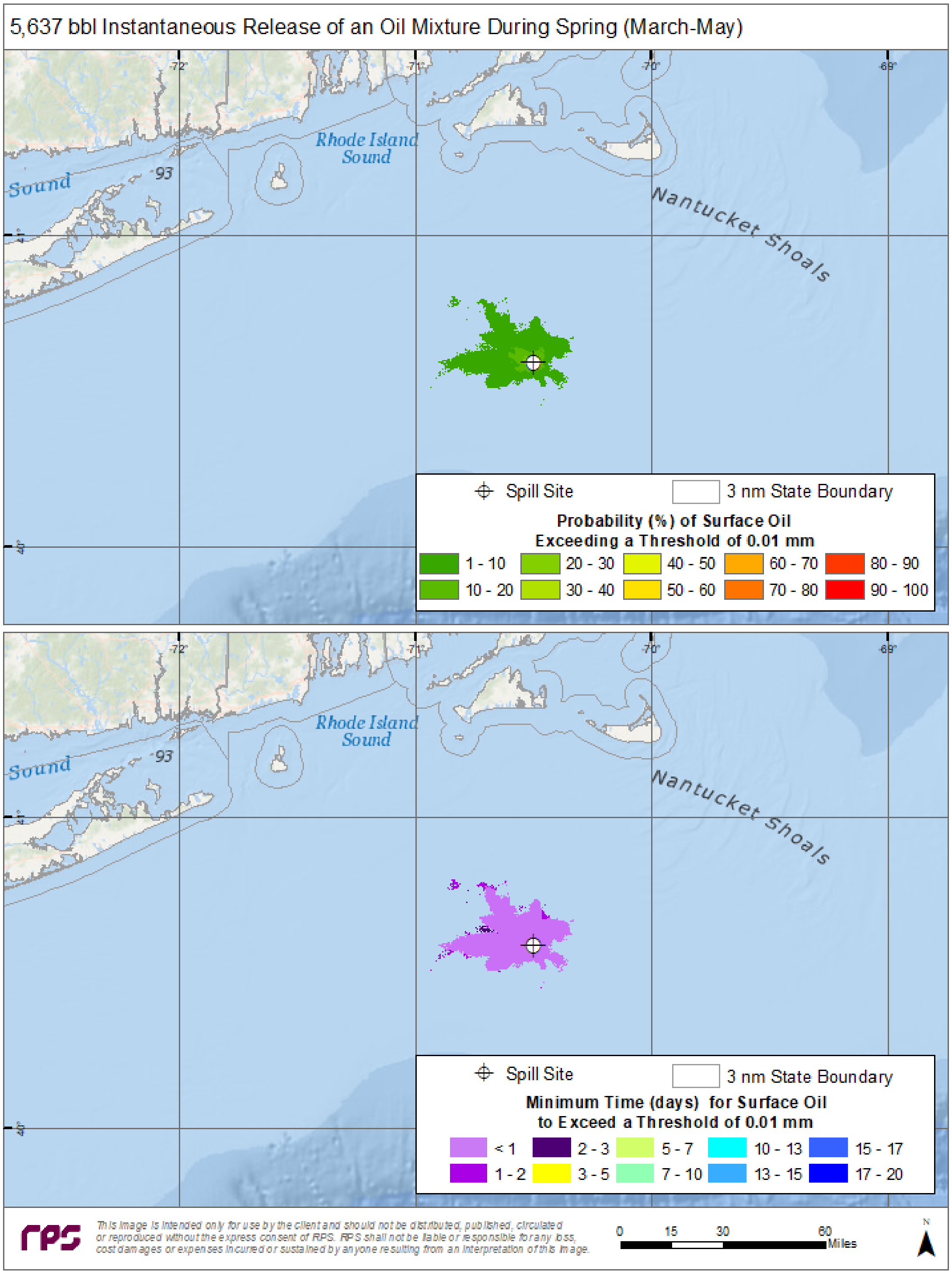


Figure 36. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m² on average over the grid cell) during spring months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m².

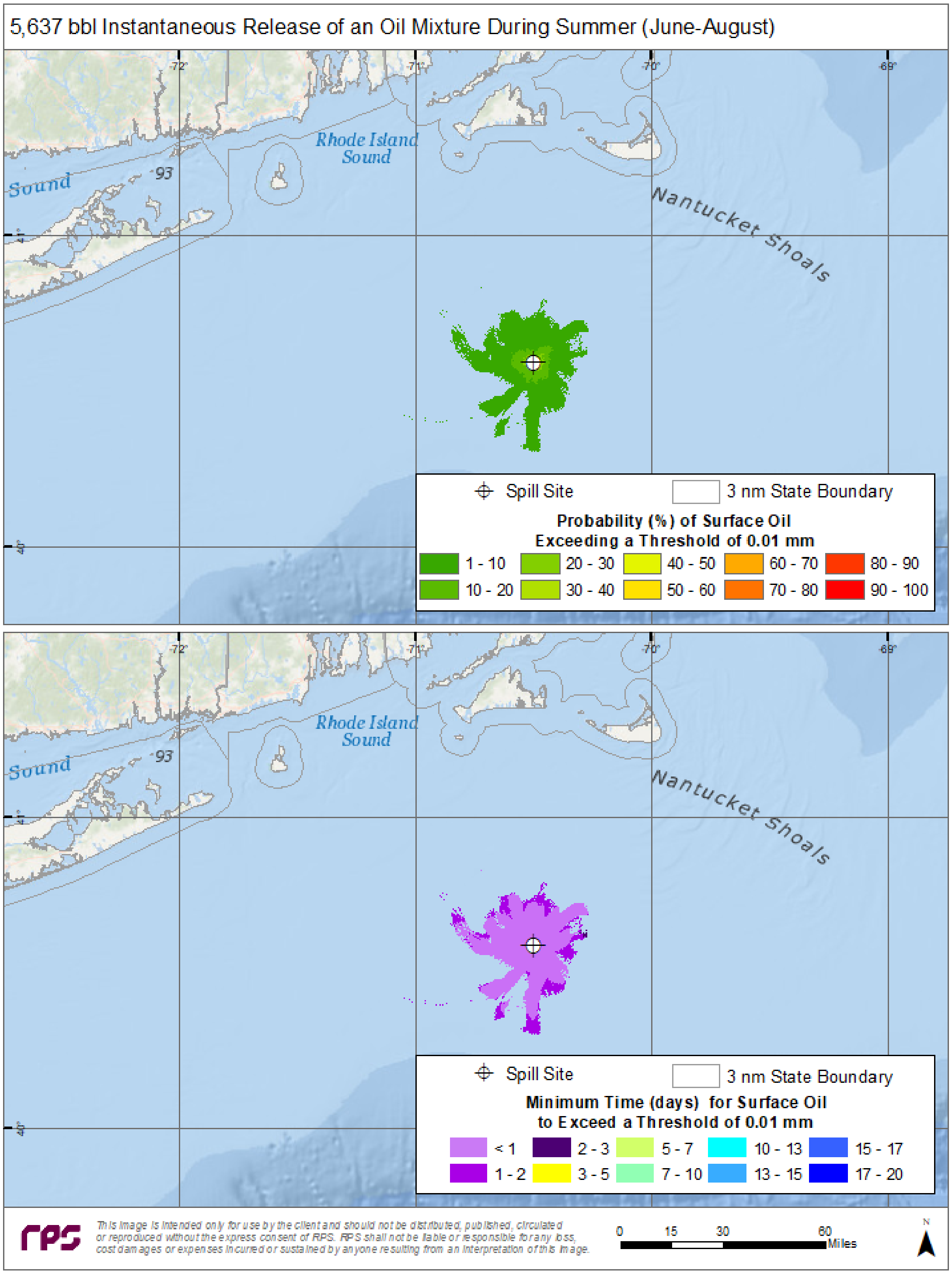


Figure 37. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during summer months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

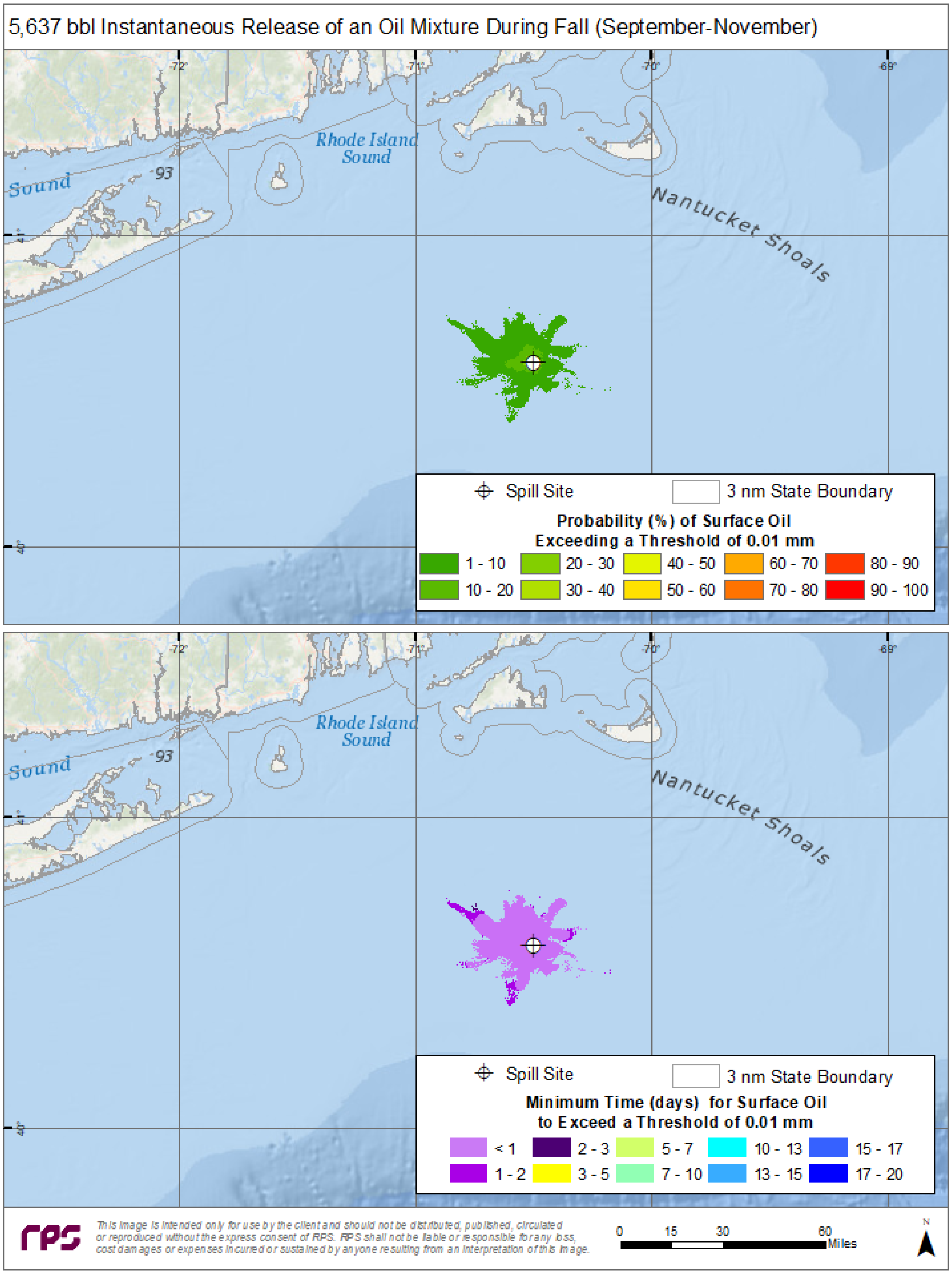


Figure 38. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

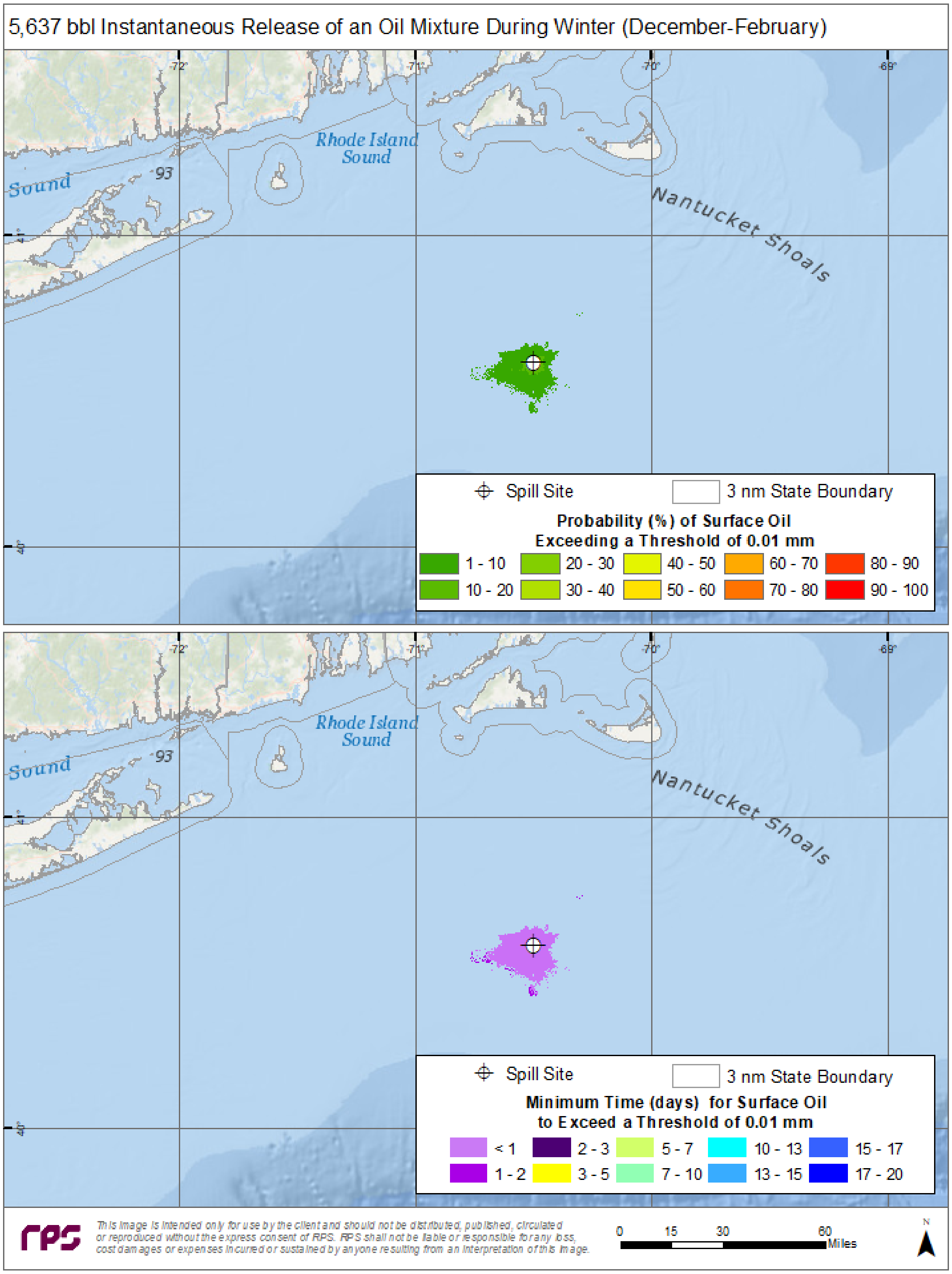


Figure 39. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during winter months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

4.2.2 Oil Contamination to Shore

The following figures illustrate the results of oil contamination to the shoreline for the worst-case oil spill scenarios over each season at the ESP 2 location. Figure 40 to Figure 43 indicate that, in all seasons, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (0.1 mm ≈ 100 g/m^2 on average over the grid cell) from oil spilled from the ESP 2 location.

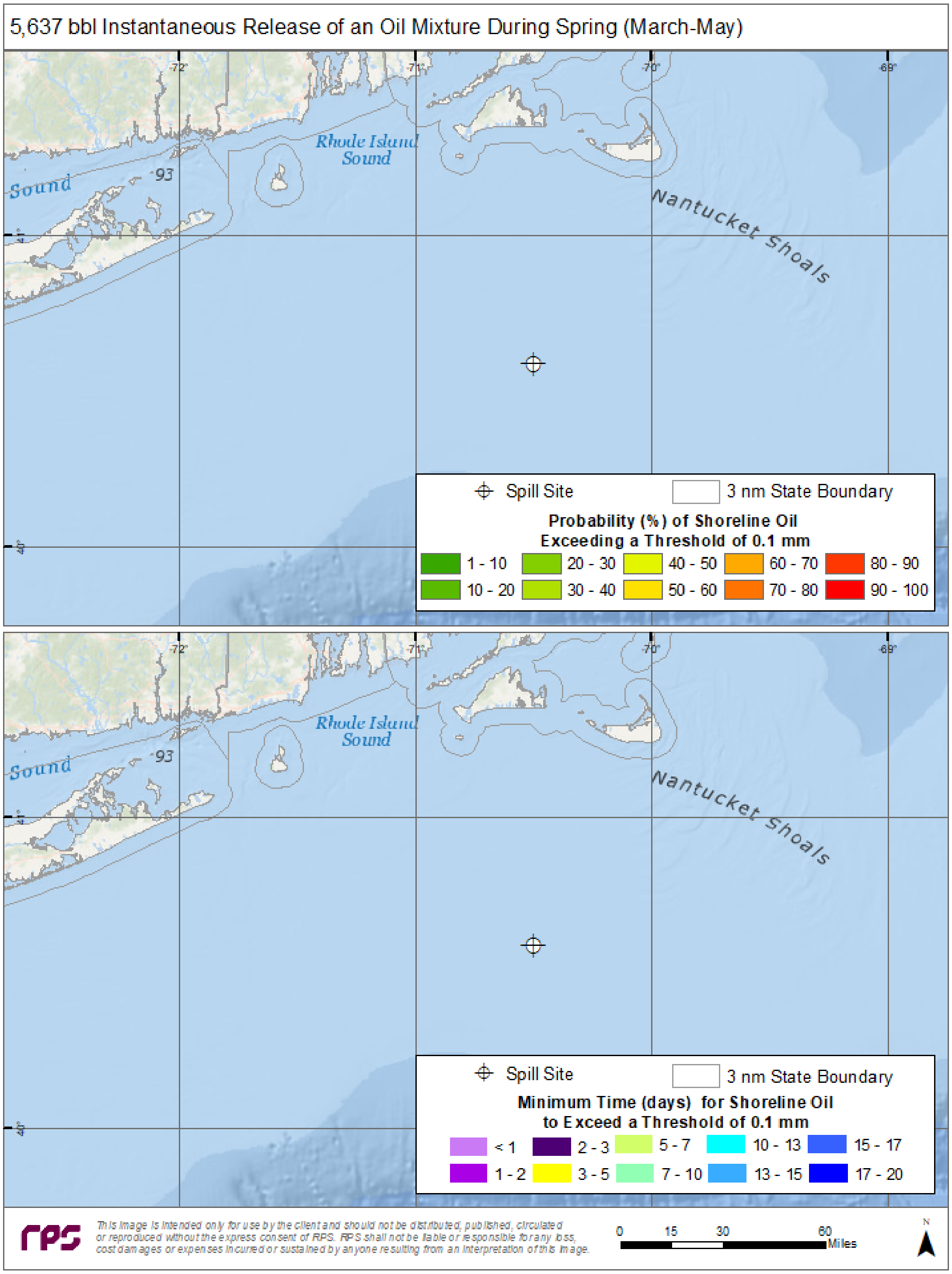


Figure 40. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during spring months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

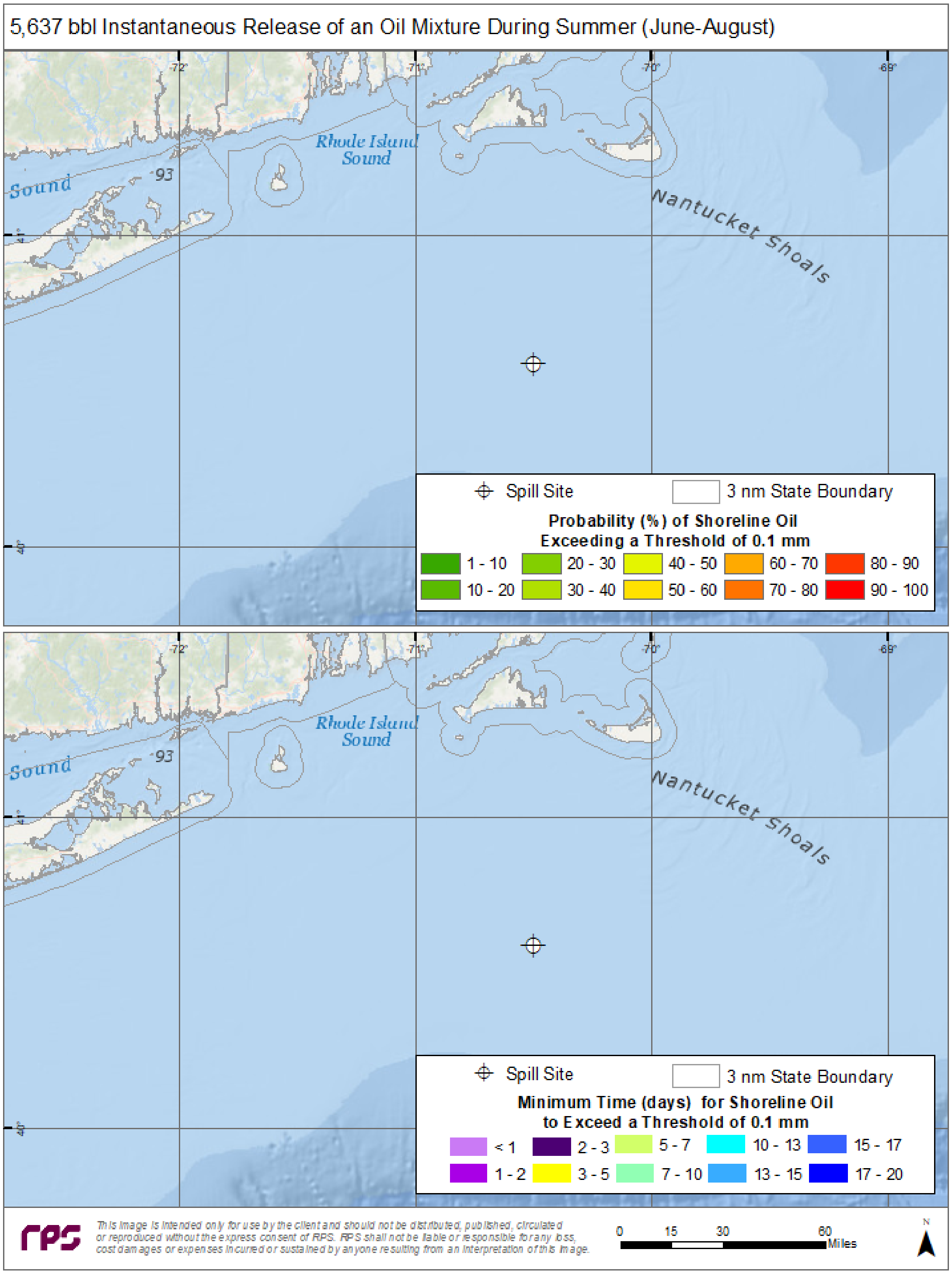


Figure 41. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during summer months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

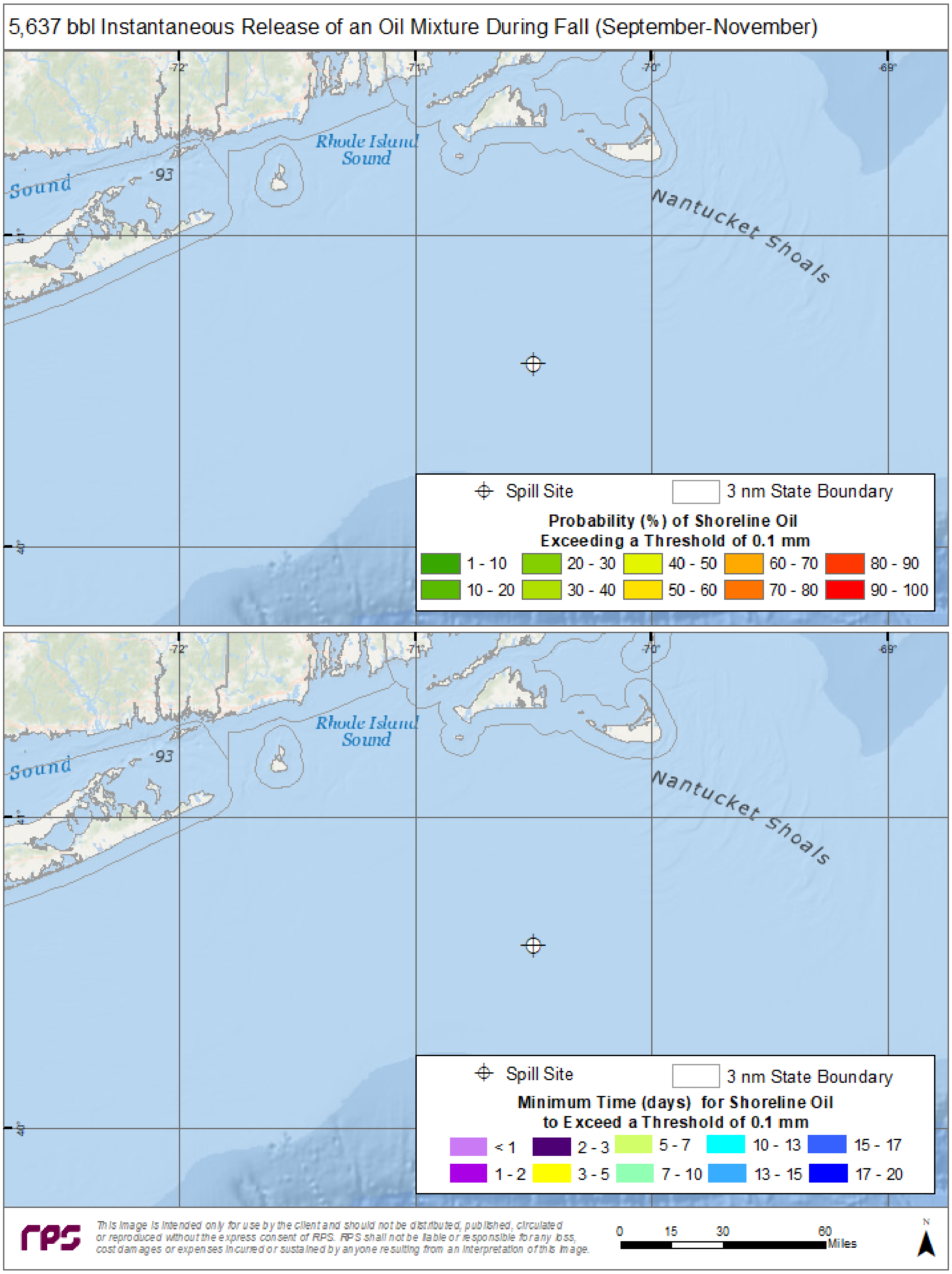


Figure 42. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

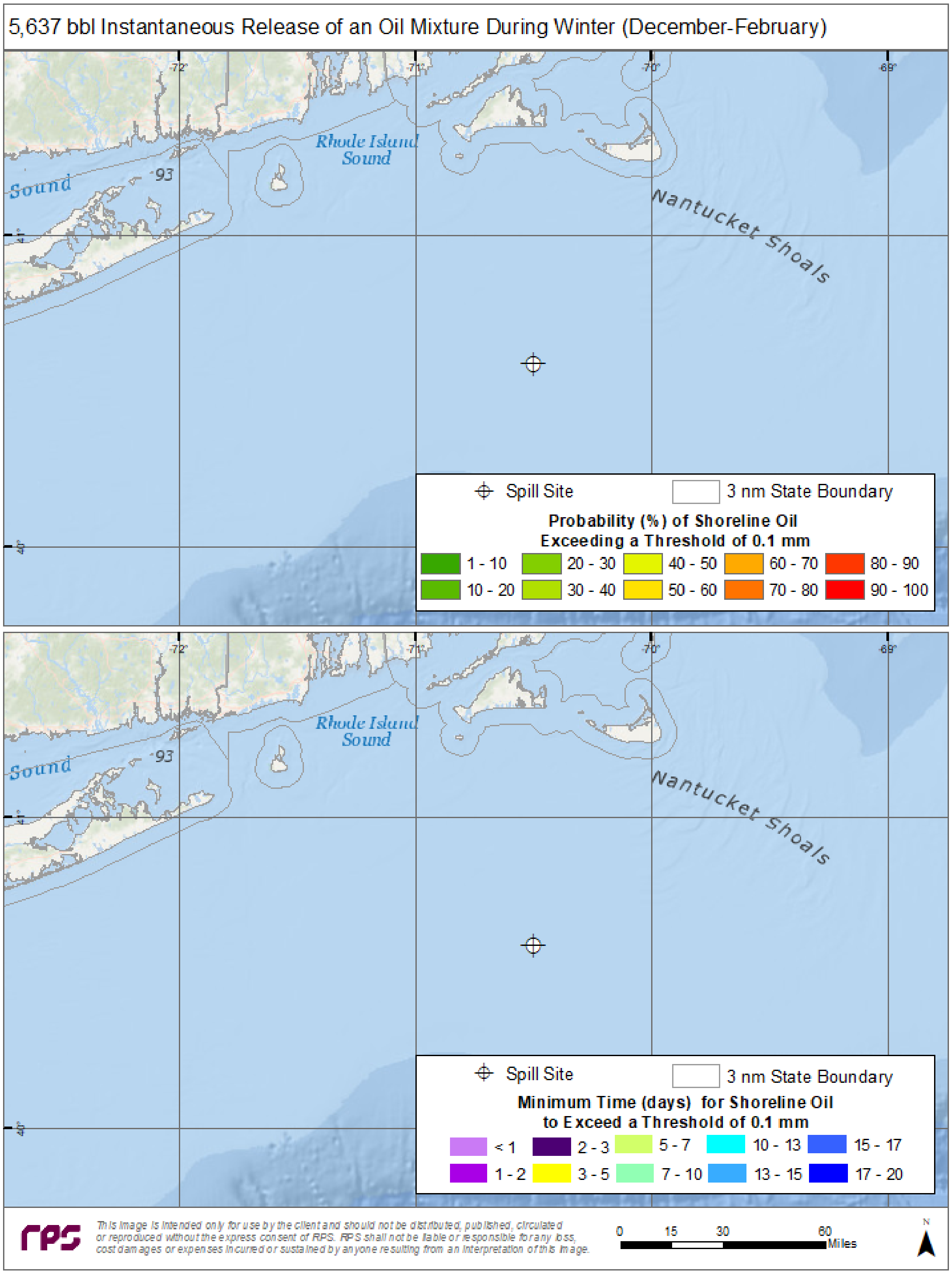


Figure 43. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during winter months for an instantaneous discharge from the ESP 2 location. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

4.3 Conclusions

This oil spill modeling study assesses the trajectory and weathering of a catastrophic discharge of all oil contents from the topple of an ESP located within the Lease Area at two different representative locations for four different seasons. These are the most conservative (i.e., highest) discharge volume. Each of the scenarios simulate worst case discharges with an extremely small probability of such a catastrophic event occurring. In addition to the low probability of such events, the oil spill scenarios modeled in this study are for relatively small volumes compared to container vessel spills or oil well platforms. The scenarios also assume that no oil spill response or mitigation would occur, which is a very conservative assumption and would not happen in practice. As discussed in further detail in Section 2.5 of the OSRP (See COP Appendix I-F), in the event of a spill, response equipment employed on water would be used to prevent the spread of a spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

Based on the environmental datasets analyzed as input for the oil spill modeling, the following conclusions can be drawn:

- During winter months in the Area of Interest (AOI), winds are predominantly northwesterly with higher speeds. Throughout summer months, the winds are mostly southwesterly with lower speeds. Spring and fall months show characteristics of transitional seasons.
- Annually-averaged HYCOM surface currents near the spill sites are west/west-southwestward with moderate speed and some transitions in direction over the region close to ESP 1.
- Currents at the ESP 1 location show very little seasonality. However, at the ESP 2 location, current direction is predominantly westward/west-northwestward during spring and fall. In the remaining portions of the year, the current direction is relatively more variable.

Based on the results of the stochastic spill trajectory analysis assessing potential spills of all oil contents of a ESP at the two representative locations within the Lease Area:

- The sea surface area exposed to oil exceeding the 10 g/m^2 threshold is predicted to be contained within a radius up to 35 km (22 mi) of the ESP 1 location and up to 40 km (25 mi) of the ESP 2 location for all four seasons. The stochastic footprint of exposed surface waters was smallest for the winter simulation, likely due to increased winds and surface waves that enhanced vertical entrainment into the water column.
- At the ESP 1 location, there is <10% probability that oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) would reach the shorelines of Nantucket within three to five days of the spill for the spring, summer, and fall scenarios. In the winter season, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell). Similarly, at the ESP 2 location, there are no predicted areas of shoreline probability >1% with oil contamination above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell).

As noted, the stochastic spill trajectory analysis conservatively assesses a catastrophic discharge of all oil contents from a ESP at the two representative locations in the Lease Area. In the unlikely event of a worst-case discharge, Vineyard Northeast will implement all available and appropriate response countermeasures to contain the spill, to protect environmental, cultural, and socioeconomic sensitive sites, and to recover the oil as quickly as possible (See COP Appendix I-F). Therefore, any potential impacts from an oil spill are likely to be less than predicted by the modeling results for the conservative worst case discharge scenario.

5 REFERENCES

Bejarano, A.C., J. Michel, J. Rowe, Z. Li, D. French McCay, L. McStay and D.S. Etkin. 2013. Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf. US Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213.

Beardsley, R.C., Chapman, D.C., Brink, K.H., Ramp, S.R. and Schlitz, R., 1985. The Nantucket Shoals Flux Experiment (NSFE79). Part I: A basic description of the current and temperature variability. Journal of Physical Oceanography, 15(6), pp.713-748.

Bratton, D.C. and Womeldorf, C.A., 2011, January. The wind shear exponent: comparing measured against simulated values and analyzing the phenomena that affect the wind shear. In Energy Sustainability (Vol. 54686, pp. 2245-2251).

Castelao, R., Glenn, S. and Schofield, O., 2010. Temperature, salinity, and density variability in the central Middle Atlantic Bight. Journal of Geophysical Research: Oceans, 115(C10).

Chapman, D.C. and Beardsley, R.C., 1989. On the origin of shelf water in the Middle Atlantic Bight. Journal of Physical Oceanography, 19(3), pp.384-391.

Cummings, J.A., 2005. Operational multivariate ocean data assimilation. Quarterly Journal of the Royal Meteorological Society: A journal of the atmospheric sciences, applied meteorology and physical oceanography, 131(613), pp.3583-3604.

Cummings, J.A. and Smedstad, O.M., 2013. Variational data assimilation for the global ocean. In Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications (Vol. II) (pp. 303-343). Springer, Berlin, Heidelberg.

Egbert, G.D. and Erofeeva, S.Y., 2002. Efficient inverse modeling of barotropic ocean tides. Journal of Atmospheric and Oceanic technology, 19(2), pp.183-204.

French McCay, D. 2016. Potential Effects Thresholds for Oil Spill Risk Assessments. In: Proceedings of the 39th AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada. p. 285-303.

French McCay, D., D. Reich, J. Michel, D. Etkin, L. Symons, D. Helton, and J. Wagner. 2012. Oil Spill Consequence Analyses of Potentially-Polluting Shipwrecks. In Proceedings of the 34th AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

French McCay, D., D. Reich, J. Rowe, M. Schroeder, and E. Graham. 2011. Oil Spill Modeling Input to the Offshore Environmental Cost Model (OECM) for US-BOEMRE's Spill Risk and Cost Evaluations. In Proceedings of the 34th AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

French McCay, D.P. 2009. State-of-the-Art and Research Needs for Oil Spill Impact Assessment Modeling. In Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 601-653.

French, D., M. Reed, K. Jayko, S. Feng, H. Rines, S. Pavignano, T. Isaji, S. Puckett, A. Keller, F. W. French III, D. Gifford, J. McCue, G. Brown, E. MacDonald, J. Quirk, S. Natzke, R. Bishop, M. Welsh, M. Phillips and B.S. Ingram. 1996. The CERCLA type A natural resource damage assessment model for coastal and marine environments (NRDAM/CME), Technical Documentation, Vol. I - Model Description. Final Report, submitted to the Office of Environmental Policy and Compliance, U.S. Dept. of the Interior, Washington, DC, April, 1996, Contract No. 14-0001-91-C-11.

Halliwell, G.R. 2004. Evaluation of vertical coordinate and vertical mixing algorithms in the HYbrid-Coordinate Ocean Model (HYCOM). Ocean Modelling, 7(3-4), 285-322.

Isaji, T., E. Howlett, C. Dalton, and E. Anderson. 2001a. Stepwise-Continuous-Variable-Rectangular Grid Hydrodynamic Model, Environment Canada's 24th Arctic and Marine Oilspill (AMOP) Technical Seminar.

Isaji, T., E. Howlett, C. Dalton, and E. Anderson. 2001b. Stepwise-Continuous-Variable-Rectangular Grid Hydrodynamic Model, Environment Canada's 24th Arctic and Marine Oilspill (AMOP) Technical Seminar.

Jones, M.T., Tabor, A.R. and Weatherall, P., 1994. Supporting Volume to the GEBCO digital atlas. British Oceanographic Data Centre.

Lentz, S.J., 2008. Observations and a model of the mean circulation over the Middle Atlantic Bight continental shelf. Journal of Physical Oceanography, 38(6), pp.1203-1221.

Lentz, S.J., 2017. Seasonal warming of the Middle A tlantic B ight C old P ool. Journal of Geophysical Research: Oceans, 122(2), pp.941-954.

Linder, C.A. and Gawarkiewicz, G., 1998. A climatology of the shelfbreak front in the Middle Atlantic Bight. Journal of Geophysical Research: Oceans, 103(C9), pp.18405-18423.

Locarnini, R. A., Mishonov, A. V., Baranova, O. K., Boyer, T. P., Zweng, M. M., Garcia, H. E., Reagan, J. R., Seidov, D., Weathers, K., Paver, C. R., and Smolyar, I. 2018. World Ocean Atlas 2018, Volume 1: Temperature. A. Mishonov Technical Ed.; NOAA Atlas NESDIS 81, p.52.

National Research Council (NRC). 1985. Oil in the Sea: Inputs, Fates and Effects. National Academy Press, Washington, D.C. 601p.

Saha, S. and coauthors. 2010. The NCEP climate forecast system reanalysis. Bull. Amer. Meteor. Soc. 91: 1015-1057.

Voynova, Y.G., Oliver, M.J. and Sharp, J.H., 2013. Wind to zooplankton: Ecosystem-wide influence of seasonal wind-driven upwelling in and around the Delaware Bay. Journal of Geophysical Research: Oceans, 118(12), pp.6437-6450.

Wilkin, J.L., 2006. The summertime heat budget and circulation of southeast New England shelf waters. Journal of physical oceanography, 36(11), pp.1997-2011.

Zweng, M. M., J.R. Reagan, D. Seidov, T.P. Boyer, R.A. Locarnini, H.E. Garcia, A.V. Mishonov, O.K. Baranova, K. Weathers, C.R. Paver, and I. Smolyar. 2018. World Ocean Atlas 2018, 2: Salinity. A. Mishonov Technical Ed.; in preparation.

APPENDIX A – OIL SPILL MODELING AT POTENTIAL BOOSTER STATION

A.1 INTRODUCTION

As outlined in Section 1 (Project Background) of this Annex to the Vineyard Northeast OSRP (COP Appendix I-F), if high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity. An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block. The potential booster station is located approximately 23 km (15 mi) from Martha's Vineyard and 26 km (16 mi) from Nantucket. Therefore, pursuant to 30 CFR 585.627(c), as part of the requirement to submit an OSRP in accordance with 30 CFR 254.1 with an appropriate trajectory analysis, this Appendix A to Annex describes the oil spill modeling performed assuming the topple of the potential booster station location in support of the Construction and Operations Plan for Vineyard Northeast.

As further described in the Vineyard Northeast OSRP (COP Appendix I-F), oil sources in the ESPs include diesel oil from the emergency generator, diesel engine, and fuel oil storage tank and naphthenic oil from the emergency generator, platform crane, power transformers, reactors, auxiliary/earthing transformers, and other general sources. The oil sources associated with one ESP total approximately 236,754 gallons (5,637 barrels [bbl]). The oil sources associated with one booster station is similar to that for one ESP and totals approximately 185,978 gallons (4,428 bbl). Therefore, this oil spill modeling study assesses the trajectory and weathering of a catastrophic discharge of all oil contents from the potential booster station in four seasons. Table A-1 and Figure A-1 display the location of the spill sites and local geographic points of reference.

Based on the results of a previous BOEM study (Bejarano et al. 2013) assessing potential catastrophic oil spills from offshore wind structures, the probability of occurrence of this type of catastrophic discharge, such as the topple of a booster station, is extremely small. As described in COP Volume I, the ESPs and booster station are designed to site-specific conditions in accordance with international and United States (US) standards and the designs will be reviewed by a third-party Certified Verification Agent that certifies the design conforms to all applicable standards. In addition to the low probability of such an event, the oil spill scenarios modeled in this study assume that no oil spill response or mitigation would occur. This is also a very conservative assumption as the booster station will be designed with containment measures and Vineyard Northeast LLC (the "Proponent") would employ containment and recovery methods to contain and recover onshore and aquatic petroleum spills. As discussed in further detail in the OSRP (see COP Appendix I-F), response countermeasures employed on water would be used to contain the spill, to protect environmental, cultural, and socioeconomic sensitive sites, and to recover the oil as quickly as possible.

Table A-1. Discharge location used in oil spill modeling

Site	Description	Latitude N (decimal degrees)	Longitude W (decimal degrees)
Booster Station	Potential Booster Station if high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC	41.136734	70.48595

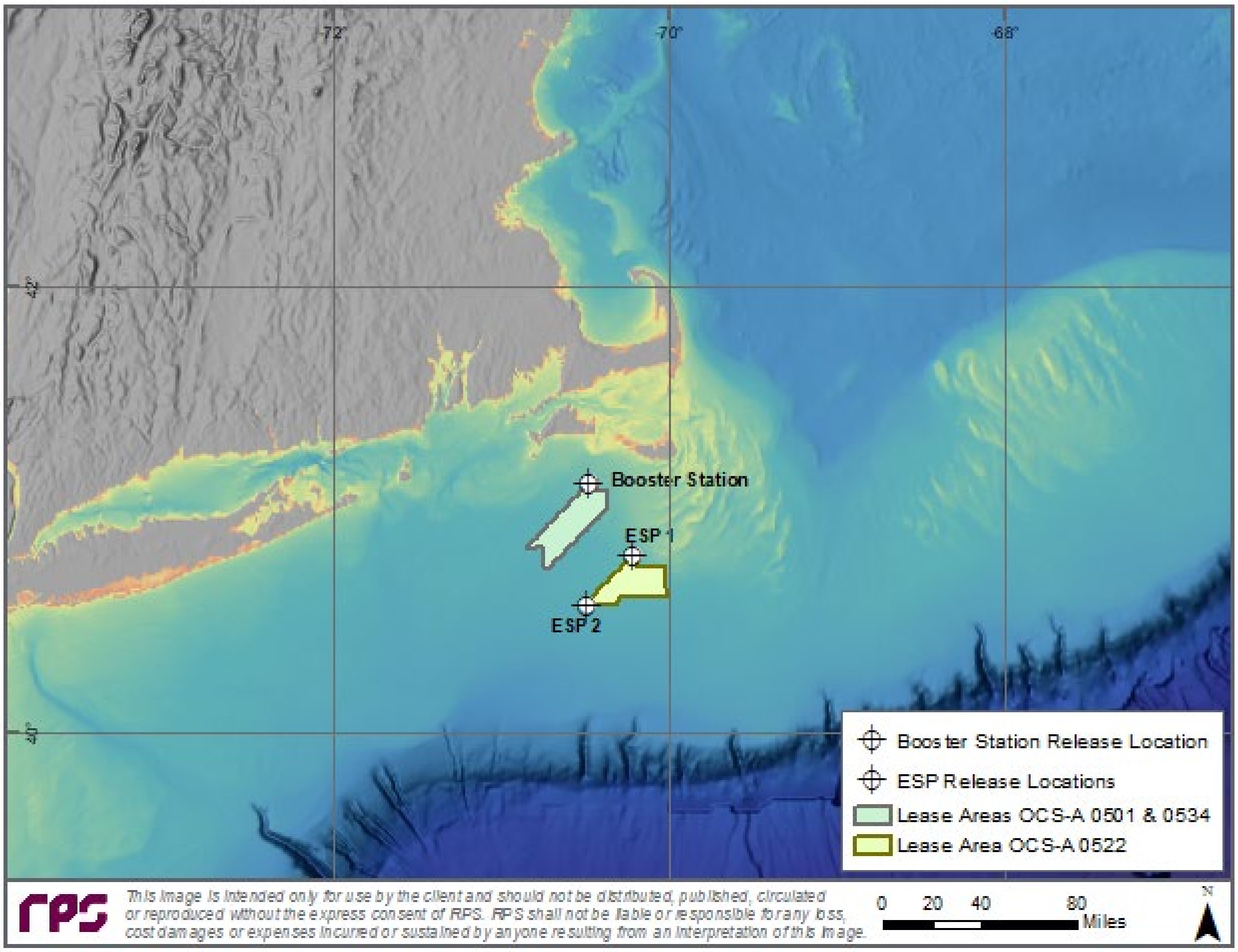


Figure A-1. Oil spill model domain defined for this study displaying location of potential booster station release location in relation to ESP 1 and ESP 2 spill locations.

The goals of spill modeling include projecting the probable behavior of accidentally spilled oil using a state-of-the-art three-dimensional (3-D) transport model and producing modeled trajectory and fate output such as visual representations (e.g., probability of oiling and minimum travel time maps) for various scenarios. RPS's proprietary oil spill modeling framework, OILMAP/SIMAP, was used for the simulations performed in this study. Model inputs included winds, currents, chemical composition, and properties of oils of interest, and specifications of the spill (amount, location, etc.). The model was run in stochastic mode, providing two types of information: (1) the footprint of sea surface and shoreline areas exposed to oil above a certain threshold of concern and the associated probability of oil contamination, and (2) the shortest time required for oil to reach any point within the areas predicted to be oiled.

Environmental conditions (i.e., wind and current forcing, water temperature, and salinity) play a critical role in the assessment of the trajectory and weathering of oil in a marine spill. Therefore, a data analysis of these conditions as input to the model was performed. The data analysis also helped to identify the site-specific seasons in which the modeling scenarios should be performed. As a result of this analysis, a total of four stochastic modeling scenarios (one per season for the potential booster station location) were assessed.

This appendix describes the models, modeling approach, model inputs, and outputs used in this study to assess the potential topple of the booster station. A description of environmental data sources is summarized in Section A.2. The oil spill modeling approach and scenario specifications is summarized in Section A.3. Sections A.4 and A.5 provide a summary of the stochastic modeling results and conclusions, respectively. References are provided in Section A.6.

A.2 ENVIRONMENTAL CONDITIONS AND DATA ANALYSIS

In order to understand the behavior of a marine oil spill, it is necessary to evaluate the predominant environmental conditions in the area. Winds and currents are the key forcing agents that control the transport and weathering of oil. To reproduce the natural variability of the environment, the OILMAP/SIMAP model requires wind and current datasets that vary both spatially and temporally. Optimally, the minimum time window for stochastic simulations is five to 10 years; therefore, long-term records of wind and current data were obtained from the outputs of global numerical atmospheric and circulation models.

A.2.1 General Dynamics and Climatology

The overview of the general dynamics and climatology of the area of interest provided in Section 2.1 of this Annex to the Vineyard Northeast OSRP (COP Appendix I-F) is also applicable to the area in the vicinity of the potential booster station.

The shallow continental shelf in which the potential booster station is located is a major biogeographic transition zone between northern and southern plant and animal species due to mixing of colder waters from the north and warmer waters from the south (PCCS 2005). North of this continental shelf lies Cape Cod and the Gulf of Maine which are dominated by the Labrador Current (PCCS 2005). The Labrador Current is a cold, southern flowing current from the Canadian Arctic that brings severe cooling to the area during the winter. The shallow continental shelf is also warmed by warm core rings off the northward flowing Gulf Stream (PCCS 2005).

This area has been heavily investigated in terms of the dynamics of depth-dependent across-shelf circulation caused by wind and wave forcing. Fewings et al. (2008) and Lentz et al. (2008) found significant across-shelf circulation driven by across-shelf winds, as well as evidence of a circulation resulting from waves in the inner shelf. The seasonal (both summer and winter) mean circulations found in the moored observations of Lentz et al. (2008) and Fewings et al. (2008) were generally attributed to the effects of pressure gradients (Fewings and Lentz 2010; Lentz 2008) or surface gravity waves (Lentz et al. 2008). North and east of the sites of interest in Vineyard Sound, Nantucket Sound, and Nantucket Shoals, the tidal range is relatively small (PCCS 2005). Despite the low tidal range, the circulation in this region is dominated by strong reversing semi-diurnal tidal currents. During the ebb tide, the current in Vineyard Sound and Nantucket Sound flows westward, whereas the flood tide is eastward (PCCS 2005). Through Muskeget Channel, between Nantucket and Martha's Vineyard, the ebb tidal current flows south into the Nantucket Shoals region and reverses during flood tides

(PCCS 2005). Modeling studies by He and Wilkin (2006) and Wilkin (2006) indicated that these large tidal velocities in the gap between the islands of Martha's Vineyard and Nantucket play a critical role in the formation of upwelling centers near Martha's Vineyard despite uniform winds.

Data obtained from the World Ocean Atlas climatology dataset (Locarnini et al. 2018; Zweng et al. 2018) for a location in the vicinity of the potential booster station show the monthly sea surface temperature typically varies from 4°C to 20°C (Figure A-2). Warmest temperatures are from July through September. The sea surface salinity at this site is on average roughly 32 parts per thousand (ppt), with the lowest sea surface salinity occurring in June and July (Figure A-2).

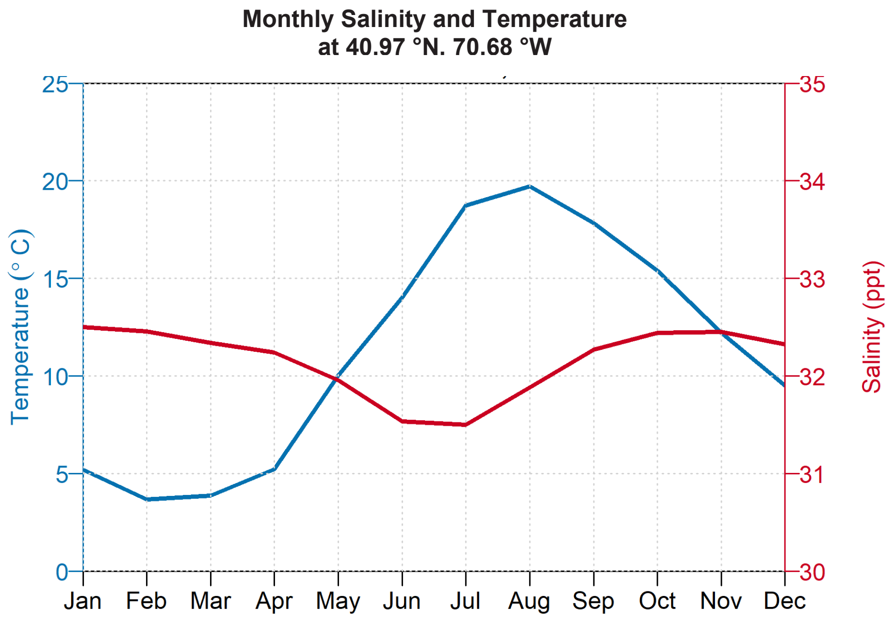


Figure A-2. Monthly sea surface temperature (°C) in blue and sea surface salinity (ppt) in red in the vicinity of the potential booster station (Locarnini et al. 2018; Zweng et al. 2018).

From a modeling perspective, the year was split into four representative periods corresponding to the meteorological seasons (winter, spring, summer, and fall; Table A-2).

Table A-2. Summary of season breakdown used for the oil spill modeling

Season	Representative Months	Season Description
Winter	December–February	Stronger wind speed, predominately from the NW
Spring	March–May	Transition of wind direction from NW to southwest (SW) with relatively weaker wind speed than winter
Summer	June–August	Weaker wind speed, predominantly from the SW
Fall	September–November	Transition of wind direction from SW to NW with relatively stronger wind speed than summer

A.2.2 Wind Dataset – NCEP CFSR

For this study, wind data were obtained from the US National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) for a 10-year period (2001 to 2010) (Table A-3). The CFSR was designed and executed as a global, high-resolution, coupled atmosphere-ocean-land surface-sea ice system to provide the best estimate of the state of these coupled domains (Saha et al. 2010). This atmospheric model has a horizontal resolution of 38 km, with 64 vertical levels extending from the surface to the height at which air pressure reaches 0.26 hectopascal (hPa). CFSR winds were also one of the main driving forces used in the HYCOM Reanalysis, the global hydrodynamic currents dataset used in this study.

Table A-3. The specifics of the wind dataset used for the modeling at the booster station.

Name of Dataset	CFSR
Coverage	-75 °E to -69°E 39 °N to 42 °N
Owner/Provider	NCEP (US)
Horizontal Grid Size	0.5°x0.5°
Hindcast Period	2001–2010
Time Step	six hourly

The following figures provide qualitative and statistical description of the CFSR winds in this region in order to understand their variability, both spatially and temporally:

- Wind rose map (Figure A-3): Spatial distribution of CFSR annual wind roses (in m/s and mph) off the southern coast of New England in the direction from which the wind is blowing;
- Annual wind rose (Figure A-4): Annual CFSR wind rose (in m/s) near the spill site in the direction from which the wind is blowing;
- Wind speed statistics (Figure A-5): Monthly average and 95th percentile CFSR wind speed (in m/s) statistics near the spill site;
- Monthly wind roses (Figure A-6): Monthly CFSR wind roses (in m/s) near the spill site, in the direction from which the wind is blowing; and
- Seasonal wind roses (Figure A-7): Monthly CFSR wind roses (in m/s) near the spill site, in the direction from which the wind is blowing.

Based on an analysis of the CFSR global wind dataset for a 10-year period (2001–2010), the following conclusions can be drawn:

- Wind direction is predominately from the northwest, west, and southwest throughout the domain with decreased wind speeds over land.
- In the vicinity of the booster station, the wind blows from all directions, but predominantly blows from the southwest and northwest.
- Monthly average wind speed ranges from 6–10 m/s (13–22 mph) and the 95th percentile wind speed ranges from 10–17 m/s (22–38 mph) in the vicinity of the booster station. Lowest speeds occur during summer (June–August) with the weakest winds occurring in August.During winter (December–February), wind is predominantly northwesterly with higher speed, while throughout the summer (June–August), wind is largely southwesterly with lower speed. Spring (March–May) and fall (September–

November) are transitional seasons. In spring, the predominant wind direction changes from northwest to southwest and average wind speed decreases. Fall marks the period when the wind speed increases compared to summer.

All figures display wind data in the meteorological convention (roses indicate the direction which winds are blowing *from*).

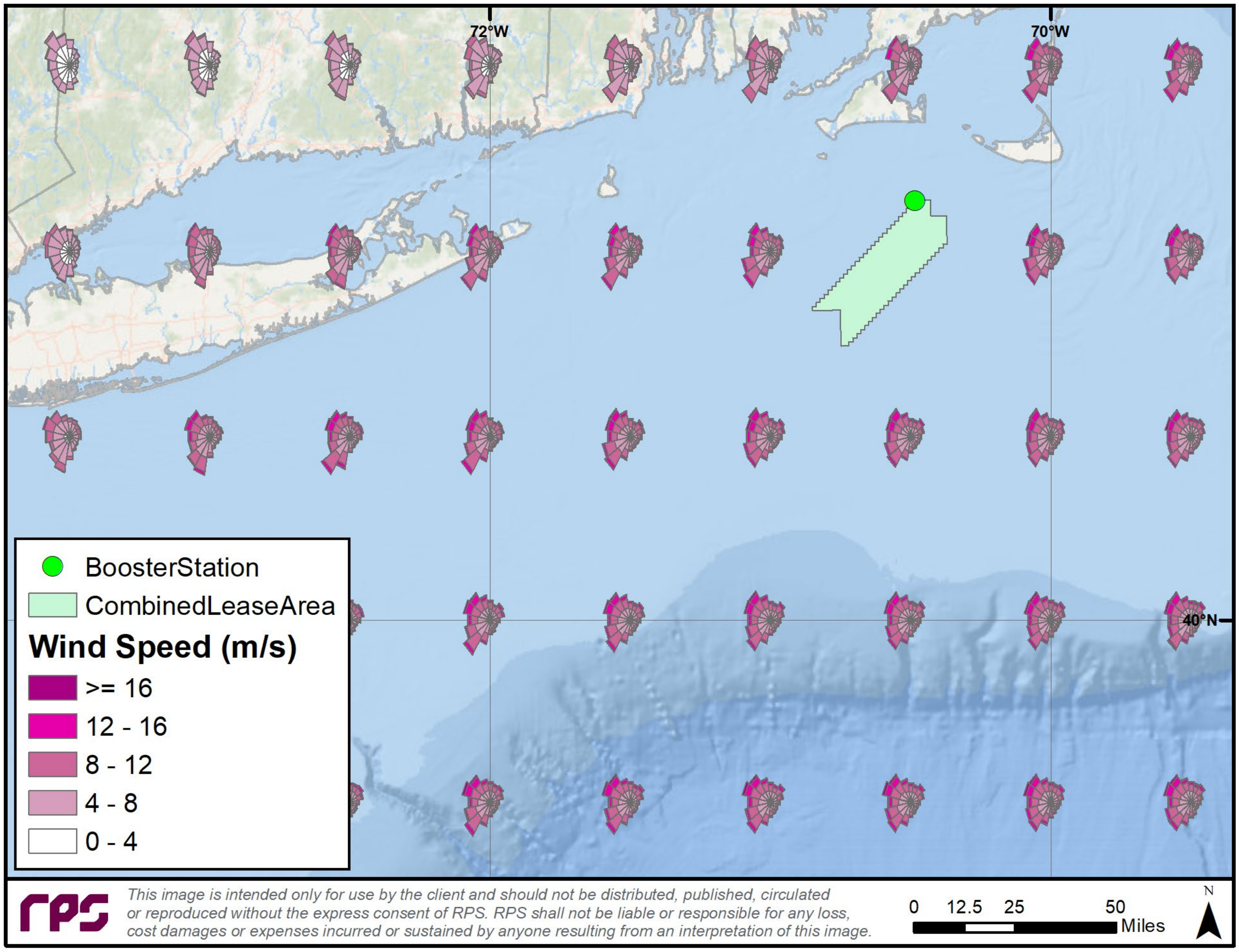


Figure A-3. Spatial distribution of Climate Forecast System Reanalysis (CFSR) annual wind speed and direction off the coast of New England (in m/s).

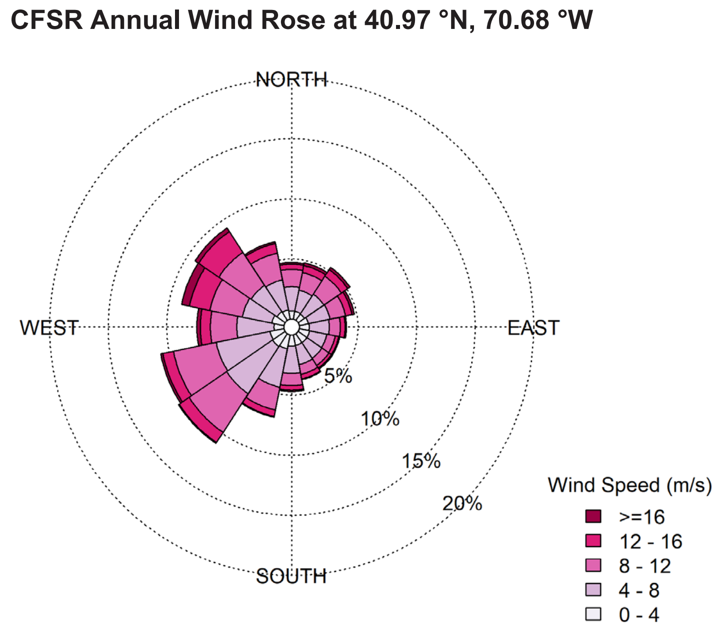


Figure A-4. Annual CFSR wind rose in the vicinity of the booster station. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from).

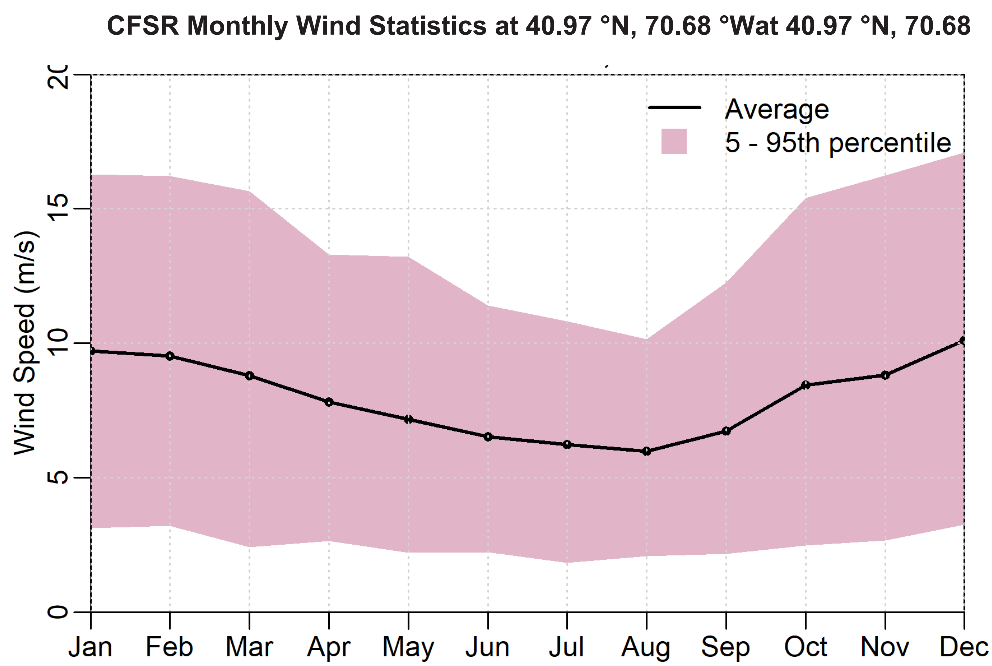


Figure A-5. Monthly average (black) and 5th to 95th percentile (pink polygon) CFSR wind speed statistics in the vicinity of the booster station. Wind speed is reported in m/s. The green box highlights summer.

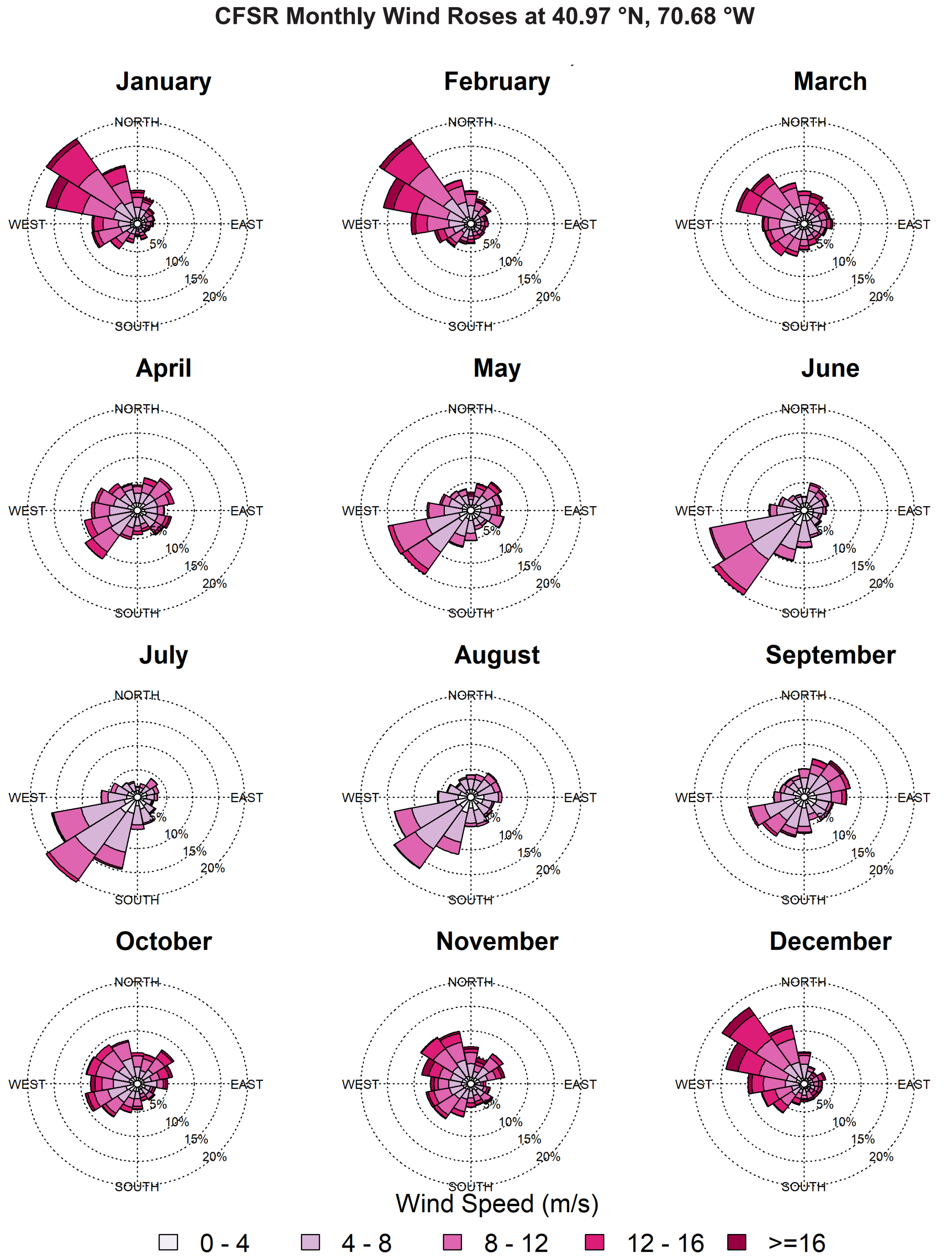


Figure A-6. Monthly CFSR wind roses in the vicinity of the booster station. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from)

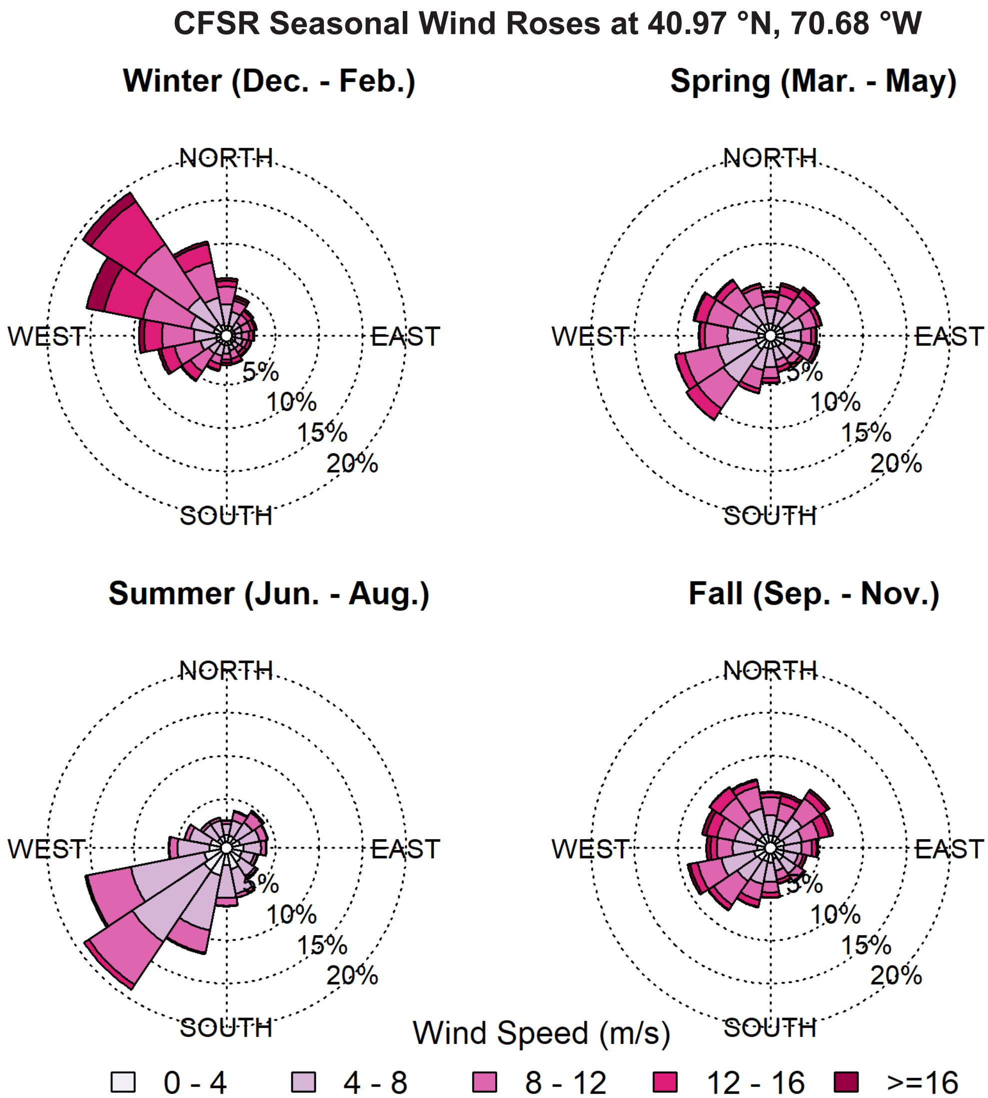


Figure A-7. Seasonal CFSR wind roses in the vicinity of the booster station. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from).

A.2.3 Hydrodynamic Data Used in Oil Spill Model

To capture the complex nature of the regional and coastal circulation for the area of study, two different current datasets have been combined in this modeling study: a regional hindcast dataset that captures the general mesoscale circulation (HYCOM) and a higher resolution dataset developed by RPS for this project to capture the tidal circulation important in the coastal areas (HYDROMAP; Table A-4). These models are summarized herein.

Table A-4. Specifics of the current datasets used for the modeling

	Global	Regional Tidal
Coverage	-74.5 °E to -69°E 39 °N to 42.7 °N	-74.5 °E to -69°E 39 °N to 42.7 °N
Name of Dataset	HYCOM (GLBu0.08/expt_19.1)	HYDROMAP
Owner/Provider	Naval Research Laboratory (US)	RPS
Bathymetry	GEBCO	GEBCO
Wind Forcing	CFSR (US)	No
Tides	No	Yes
Horizontal Grid Size	~9 km	Up to 0.125 km
Hindcast Period	2001–2010	Periodic tidal constituents' phase and amplitude
Output Frequency	Daily	30-minute processing

A.2.3.1 Global Current Dataset – HYCOM Reanalysis

Current data were obtained from the HYCOM + NCODA (Navy Coupled Ocean Data Assimilation; Table A-4) Global 1/12° Reanalysis (Halliwell 2004). This dataset (Table A-4) captures the oceanic large-scale circulation in the study area. Details of the data assimilation procedure are described in Cummings and Smedstad (2013) and Cummings (2005).

The reanalysis was carried out at the Naval Oceanographic Office Major Shared Resource Center. Forcing data for the model comes from the NCEP CFSR (Saha et al. 2010). The hindcast is comprised of 3-D temperature, salinity, sea surface height, zonal velocity, and meridional velocity fields. Ocean dynamics, including geostrophic and wind driven currents, are reproduced by the model. Data are provided as daily snapshots. The most recent reanalysis experiment (GLBu0.08/expt_19.1) includes data between August 1, 1995 and December 31, 2012. For this study, a 10-year period of daily model output was collected (2001 to 2010). However, as this version of HYCOM does not include tidal information, a separate model (HYDROMAP Tidal Model) was used to supplement HYCOM and generate tidal currents.

A.2.3.2 HYDROMAP Tidal Circulation Model

HYDROMAP, a hydrodynamic model (Table A-4) developed by RPS, was used to reproduce the local circulation due to tides for this study. HYDROMAP is a globally re-locatable hydrodynamic model (Isaji et al. 2001a; 2001b) capable of simulating complex circulation patterns due to tidal forcing, wind stress, and freshwater flows. HYDROMAP employs a novel step-wise-continuous-variable-rectangular gridding strategy with up to six levels of resolution. The term "step-wise-continuous" implies that the boundaries between successively smaller and larger grids are managed in a consistent integer step. HYDROMAP has been applied in numerous sediment dispersion and transport studies in the US and worldwide.

HYDROMAP can be used to make constant cyclical or time varying current fields. The constant and cyclical current fields are generated for each component of the circulation separately, whereas the time-varying current fields represent the integration of all components simultaneously for a specific timeframe. Once generated, the HYDROMAP model predicted tidal currents were then combined with the HYCOM circulation to present a complete hydrodynamic dataset for the area.

The regional hydrodynamic model application using HYDROMAP that encompassed the Offshore Development Area (i.e., Southern Wind Development Area and Offshore Export Cable Corridors) was developed for use in the sediment transport modeling of the cable installation activities. That model application (grid and tidal forcing) was used to generate cyclical tidal model output for the oil spill modeling.

The tidal component of the currents for off the coast of New England were generated utilizing superposition of each of the individual contributions from the various frequencies of astronomical forcing (constituents) that contribute to tidal variations. For this study, seven astronomical constituents were considered. These seven constituents (M2, N2, S2, K2, K1, O1, and P1) account for the majority of tidal energy in the region and are sufficient to reproduce the main tidal circulation patterns. Near the sites, tidal currents are weak to moderate with variable magnitude throughout the day. The tidal constituents result in variable current speeds due to the timing of individual constituents.

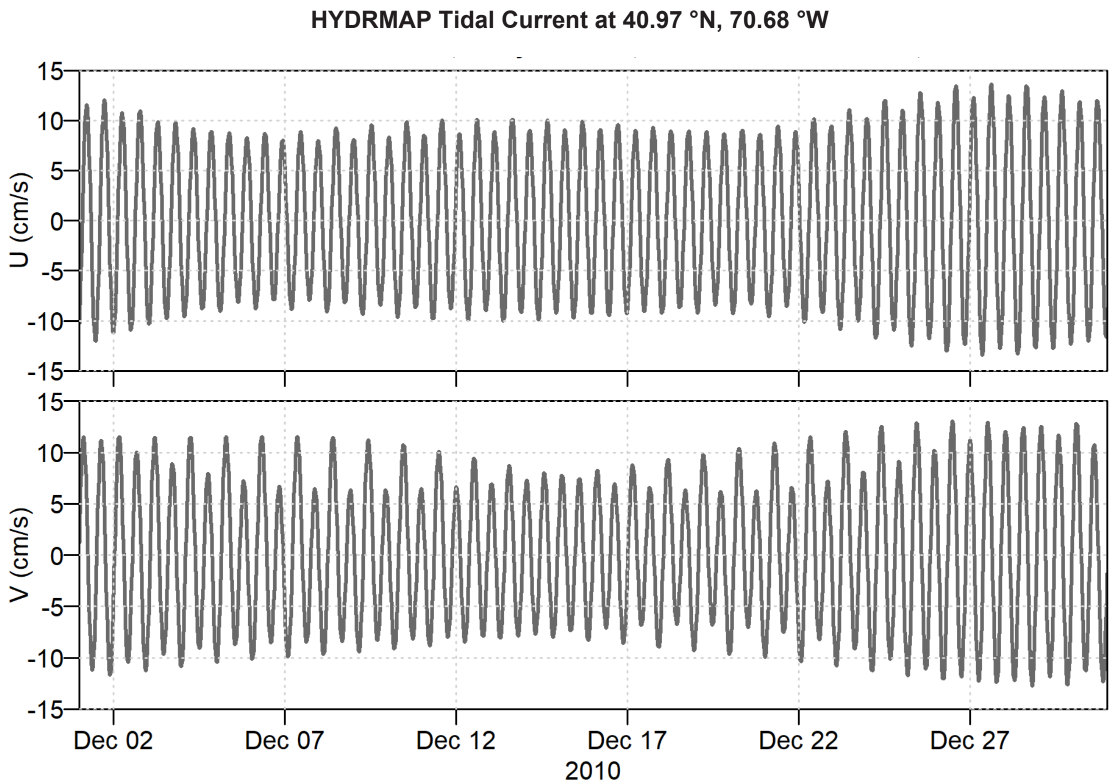


Figure A-8. Example of time series of U and V component of tidal current (from HYDROMAP) in the vicinity of the booster station.

A.2.3.3 Current Analysis – HYDROMAP + HYCOM

Daily HYCOM files were augmented by adding a HYDROMAP tidal hydrodynamics file at a temporal resolution of 30 minutes. For this study, a 10-year period of daily HYCOM model output was collected (2001 to 2010) and combined with the tidal model predicted datasets.

The following figures describe the variability of current speed and direction near the potential booster station based on the hydrodynamic datasets:

- Current intensity and direction map (Figure A-9): Spatial distribution of HYCOM averaged surface current speeds and current directions in the area of interest, in cm/s;
- Annual current rose (Figure A-10): Annual HYCOM+HYDROMAP current rose (in cm/s) in the vicinity of the booster station, and the direction towards which current is flowing;
- Monthly current speed statistics (Figure A-11): Monthly average and 5th to 95th percentile HYCOM+HYDROMAP current speed (in cm/s) in the vicinity of the booster station;
- Monthly current roses (Figure A-12): Monthly HYCOM HYDROMAP current roses (in cm/s) in the vicinity of the booster station, and the direction towards which current is flowing; and
- Seasonal current roses (Figure A-13): Seasonal HYCOM+HYDROMAP current roses (in cm/s) in the vicinity of the booster station, and the direction towards which current is flowing.

Based on the analysis of these regional data, the following conclusions can be drawn:

- Annually averaged surface currents at the spill site are moderate and largely east/east-southeastward with some towards a west/west-southwestward direction.
- Monthly average current speed ranges from about 17 cm/s to 21 cm/s in the vicinity of the booster station and the 95th percentile current speed ranges from 32 cm/s to 47 cm/s.
- Currents are largely consistent in direction and speed throughout the year. Current direction is mostly in the east/east-southeastward and west/west-southwestward directions, however, during the summer the current direction is predominately east/east-southeastward.

All figures display current data in the oceanographic convention (roses indicate the direction which currents are flowing *toward*).

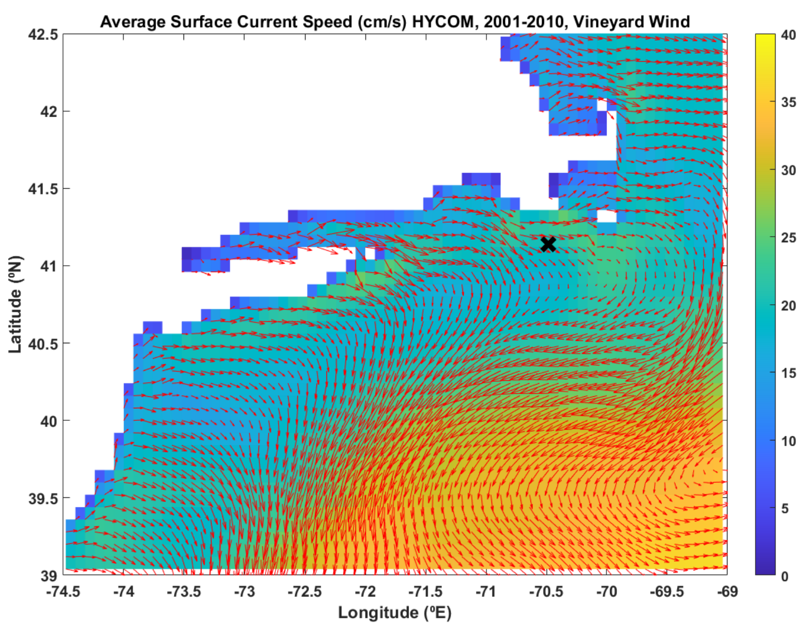


Figure A-9. Spatial distribution of HYCOM averaged surface current directions (current speeds in cm/s).

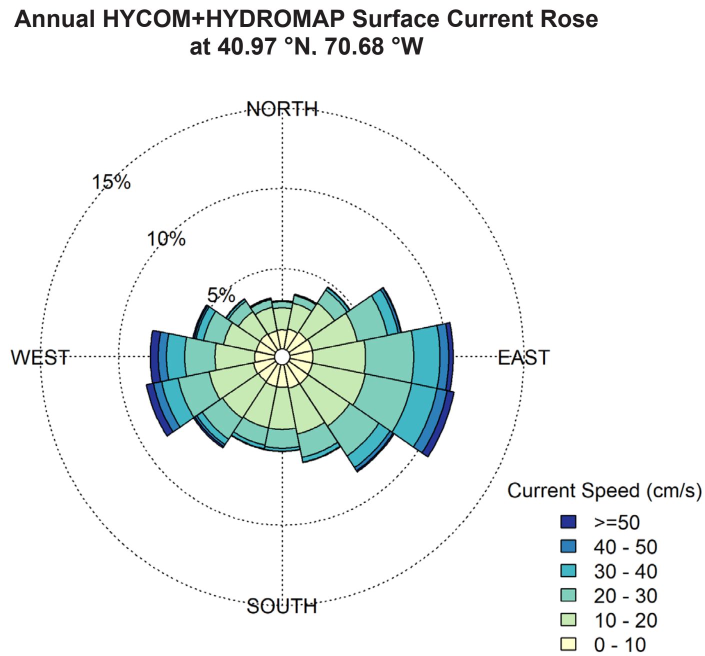


Figure A-10. Annual HYCOM+HYDROMAP surface current rose in the vicinity of the booster station following oceanographic convention (direction currents are heading towards). Current speeds are in cm/s.

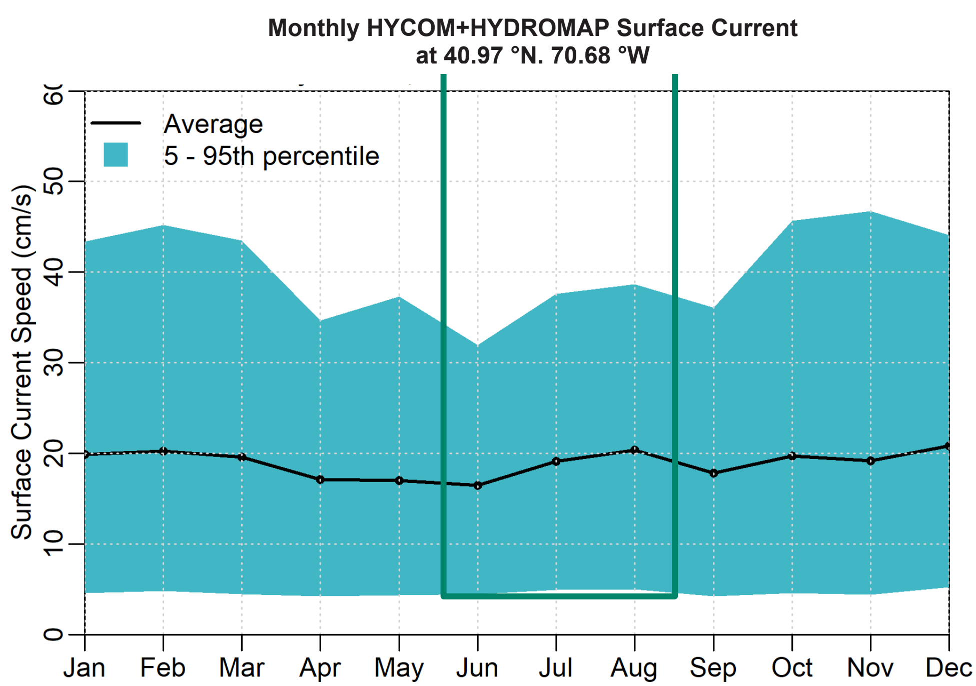


Figure A-11. Monthly average (black line) and 5th to 95th percentile (blue polygon) HYCOM+HYDROMAP current speed (cm/s) statistics in the vicinity of the booster station. The green box highlights summer.

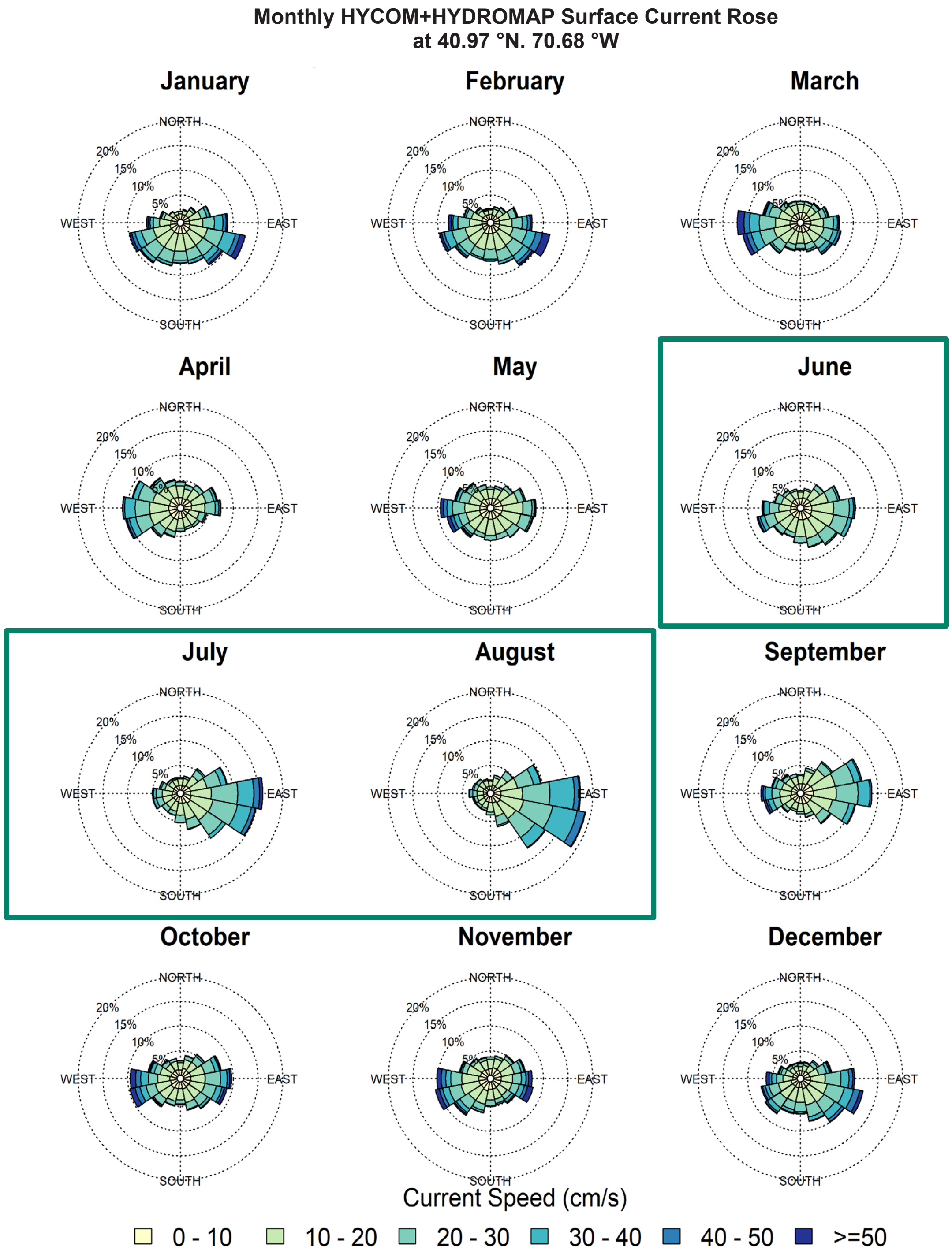


Figure A-12. Monthly HYCOM+HYDROMAP current roses in the vicinity of the booster station. Current speeds in cm/s, using oceanographic convention (direction currents are heading towards). The green box highlights summer.

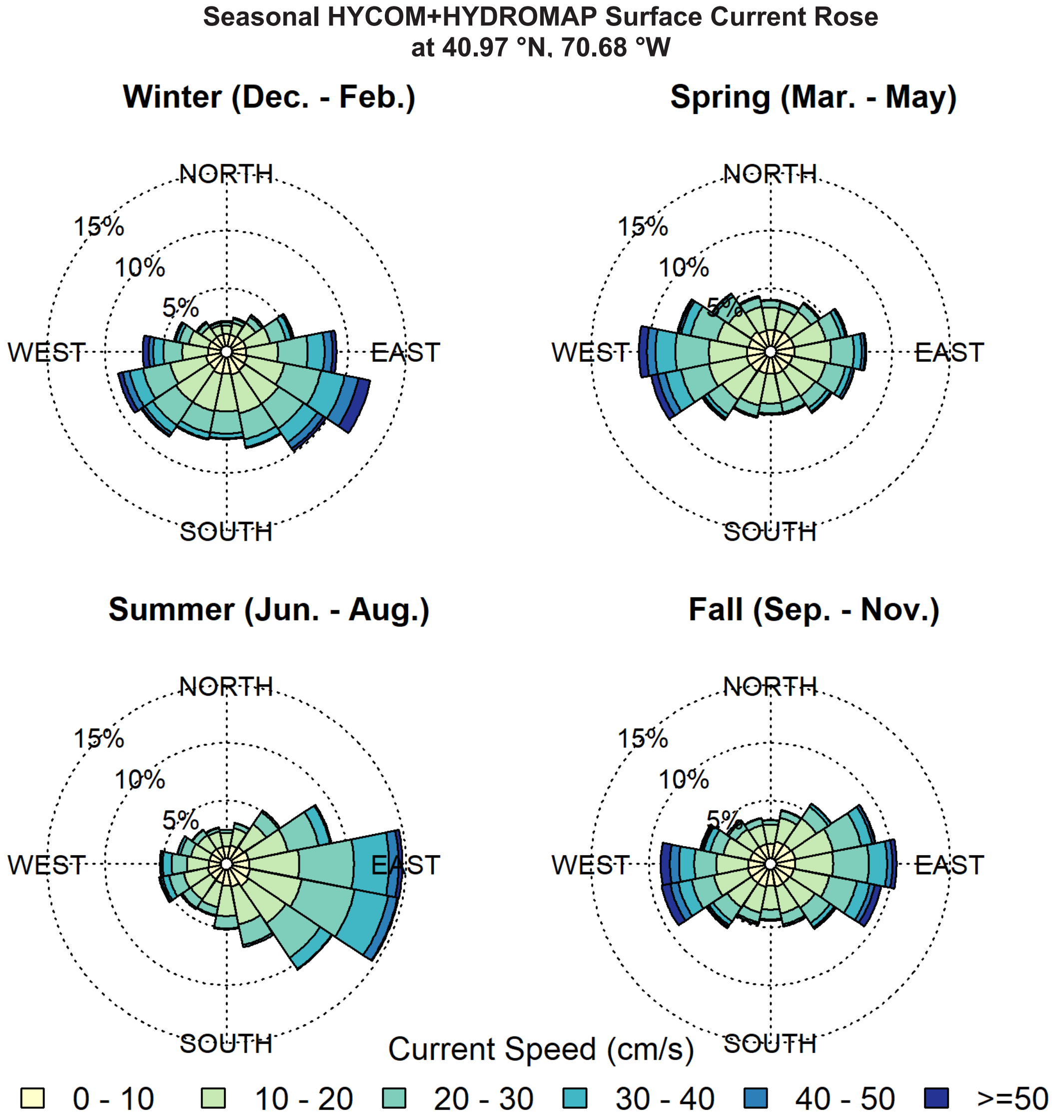


Figure A-13. Seasonal HYCOM+HYDROMAP current roses in the vicinity of the booster station. Current speeds in cm/s, using oceanographic convention (direction currents are heading towards).

A.2.4 Surface Transport

To compare the potential for surface wind-driven transport versus current-driven transport, an assessment of the wind drift speed versus current speed was performed close to the spill site as shown in Figure A-14. For this study, the wind drift was estimated as 3.5% of the wind speed. Based on this analysis, wind drift is the primary agent of surface transport at the site. However, during the month of August, wind intensity decreases to a point where winds and currents are almost equally influential on defining the surface drift.

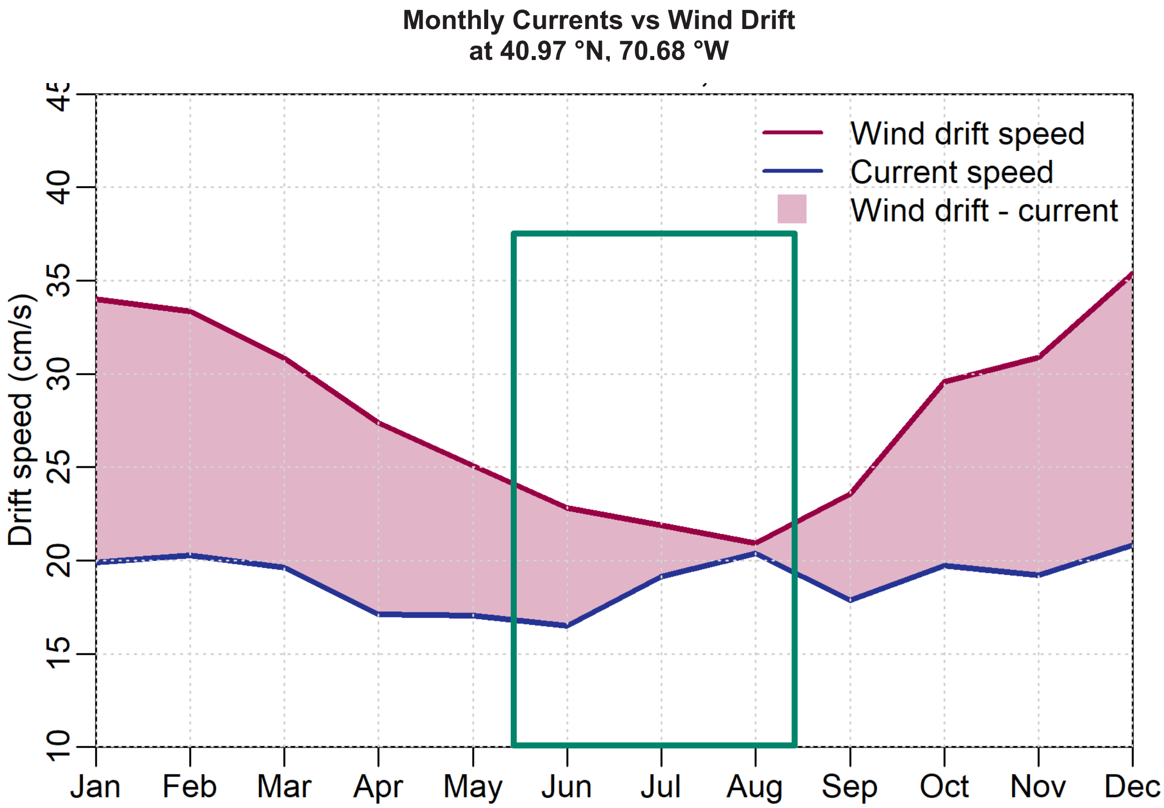


Figure A-14. Surface drift forcing comparison statistics in the vicinity of the booster station: monthly-averaged CSFR wind drift compared with HYCOM+HYDROMAP current speed. Wind drift is calculated as 3.5% of the wind speed. Periods with predominant wind transport are shaded pink. The green box highlights summer.

A.3 OIL SPILL MODELING SETUP

The modeling methodology and thresholds of concern used for the booster station oil spill scenarios were the same as outlined in Sections 3.1 and 3.2 of this Annex to the Vineyard Northeast OSRP (COP Appendix I-F) for the oil spill modeling at ESP 1 and ESP 2. The stochastic analysis provides two types of information: (1) the footprint of sea surface and shoreline areas exposed to oil above a certain threshold of concern and the associated probability of oil contamination, and (2) the shortest time required for oil to reach any point within the areas predicted to be oiled. The areas and probabilities of oiling are generated by a statistical analysis of all the individual stochastic runs. It is important to reiterate that a single run will encounter only a relatively small portion of this footprint. In addition, the simulations provide shoreline oiling data expressed in terms of minimum and average times for oil to reach shore, and the percentage of simulations in which oil is predicted to reach shore.

A.3.1 Oil Spill Scenarios

Spill scenarios for the stochastic simulations assumed a discharge from an instantaneous, catastrophic loss of the complete contents of the potential booster station (Table A-5). Two thousand particles were used in OILMAP/SIMAP to simulate the surface spill of oil as a near instantaneous discharge tracked over the course of 20 days. The stochastic model was run for the three different scenarios using 478 simulations covering the span of 10 years (2001 to 2010). These results were then reanalyzed over four seasons, each consisting of over 100 simulations (Table A-6). As described in Section A.2, a combination of HYCOM Reanalysis and HYDROMAP modeled tidal circulation was used as current inputs to the model, while CFSR was used as wind inputs.

Table A-5. Discharge locations used in oil spill modeling.

Site	Description	Latitude N (decimal degrees)	Longitude W (decimal degrees)
Booster Station	Potential Booster Station	41.136734	70.48595

Table A-6. Oil spill scenarios defined for the oil spill modeling.

ID	Site	Oil Type	Season	Total Volume Spilled
1	Booster Station	Oil Mixture (Napthenic/Mineral + Biodegradable + Diesel)	Spring: (March-May)	4,428 bbl (185,978 gal)
2			Summer: (June–August)	
3			Fall: (September–November)	
4			Winter: (December–February)	

A.3.2 Oil Characteristics

Three main oil types were chosen as representative oils to be used after communication between the Proponent and RPS. The three oils in order of prevalence in the final mixture are: (1) Naphthenic oil produced by Nynas known as “Nytro 10X”; (2) diesel fuel, using the properties of “Diesel 2002” as presented on Environment Canada’s oil property database; and (3) biodegradable, ester-based oil produced by Midel known as “Midel 7131”.

Using these components, two theoretical “combination oils” were generated by creating two mass-weighted averages of the three-constituents calculated by utilizing the volumes specified by the Proponent. The naphthenic, diesel, and biodegradable oils represent approximately 94%, 4%, and 2% of the final mixtures, respectively. Thus, the properties of the final combined oil most closely resemble the naphthenic oil which dominates the mixture. The compositional breakdown of scenarios is presented in Table A-7 and the bulk properties of all component and mixtures of hydrocarbons are presented in Table A-8.

Table A-7. Composition of Oil Mixtures for the Potential Booster Station Scenarios. Properties from Environment Canada oil properties database, NYNAS Nytro 4000x SDS, and Midel 7131 SDS.

	Bulk Property	Naphthenic (Nytro 10x)	Diesel	Biodegradable (Midel 7131)	Total
Booster Station	Volume (L)	660,290	31,046	12,672	704,008
	Volume (bbl)	4,153	195	79	4,428
	Total mass (kg)	581,055	25,799	12,314	619,169
	Mass fraction	94%	4%	2%	100%

Table A-8. Bulk properties for each of the component hydrocarbons and mixtures for the potential booster station scenarios. Oil properties from Environment Canada oil properties database, NYNAS Nytro 4000x SDS, and Midel 7131 SDS.

Component Hydrocarbons				Oil Mixture
Bulk Property	**Naphthenic (Nytro 10x)**	**Diesel**	**Biodegradable (Midel 7131)**	**Booster Station**
Density at 25°C (g/cm^3)	0.8679	0.970	0.9682	0.874
Viscosity at 15°C centipoise (cP)	26.0	2.8	117.0	26.8
% mass with boiling point 0-180°C	0.0%	16.4%	0.0%	0.7%
% mass with boiling point 180-165°C	17.1%	49.0%	0.0%	18.1%
% mass with boiling point 265-380°C	66.4%	31.9%	1.0%	63.7%
% mass with boiling point >380°C	16.5%	2.7%	99.0%	17.6%
Surface Tension in millinewtons per meter (mN/m)	45	28	50	44

A.4 STOCHASTIC MODELING RESULTS

OILMAP/SIMAP's stochastic model computed the probable surface and shoreline trajectories of surface spills of oil mixtures from the potential booster station for four seasons. Over 100 simulations define each seasonal spill scenario. Stochastic trajectory results were summed to calculate probabilities of surface oiling and minimum travel time for each spill scenario including oil contamination of the water surface and shoreline.

The stochastic results for the four booster station spill scenarios are summarized in Table A-9. The average time to reach the shoreline and the average mass of oil washed ashore were calculated based on all the individual trajectories that led to oil reaching shore with more than 0.1% of the initial spilled volume. The percentage of simulations reaching shore was based on the number of trajectories out of the total number of individual simulations run for the stochastic modeling in which at least 0.1% of the spilled volume was predicted to reach shore. Thickness thresholds for shoreline contamination were not used in the below calculations, and as such results present conservative probabilities and timing. It is also important to note that the time to reach shore is based on the minimum time for any shoreline contamination to occur and does not indicate the thickness of shoreline contamination occurring at that time.

Table A-9. Oil spill stochastic results—predicted shoreline impacts for each scenario.

ID	Spill Site	Oil Type	Season	Total Volume Spilled	Sims. Reaching Shore (%) [1]	Time to Reach Shore (days)		Contamination to shoreline (% of total spill)	
						Min.	Avg.	Max.	Avg.
1	Booster Station	Oil Mixture	Spring: (Mar.-May)	4,428 bbl	80.3%	0.53	3.74	47.4%	17.7%
2	Booster Station	Oil Mixture	Summer: (June-Aug.)	4,428 bbl	87.4%	0.60	2.58	59.2%	20.9%
3	Booster Station	Oil Mixture	Fall: (Sept.-Nov.)	4,428 bbl	37.8%	0.50	3.38	35.8%	11.1%
4	Booster Station	Oil Mixture	Winter: (Dec.-Feb.)	4,428 bbl	37.6%	0.50	3.44	35.8%	11.2%

Notes:

1. The percentage of simulations reaching shore is based on the number of trajectories out of the ensemble of stochastic individual simulations. Since these calculations are based on total mass reaching shore, thickness thresholds were not incorporated.

Results from the stochastic modeling are provided in maps depicting the probability and timing of oil contamination on the surface and shoreline in excess of the threshold oil thicknesses (0.01 millimeters [mm] for surface oil and 0.1 mm for shoreline oil). Each figure contains two maps, and in two different zoom layouts (for surface oil contamination), portraying the following information:

1. **Probability of Oil Contact Figures**: The probability of oiling maps for each scenario defines the area and the associated probability in which sea surface and shoreline oiling above the defined thresholds would be expected should a worst case oil spill scenario occur. The colored area in the stochastic maps indicates areas that *may* receive oil contamination in the event of that particular spill scenario. The 'hotter' the color (e.g., reds), the more likely an area would be affected; the cooler the colors (e.g., greens), the less likely an area would be affected. The probability of oil contamination was based on a statistical analysis of the resulting ensemble of individual trajectories for each spill scenario. These figures do not imply that the entire contoured area would be covered with oil in the event of a spill, nor do they provide any information on the quantity of oil that would be found in a given area.

2. **Minimum Travel Time Figures**: The footprint of the minimum travel time corresponds to the oil contamination probability maps for oil above the threshold of concern. These figures illustrate the shortest time required for oil to reach any point within the footprint at a thickness or concentration exceeding the defined threshold for surface and shoreline oil contamination. These results are based on the ensemble of all individual trajectories.

It is important to note that the probability of a spill trajectory passing through a certain water surface area and the probability of a spill trajectory hitting a shoreline segment near that water surface area are different. For example, in the schematic shown in Figure A-8, there are four trajectories total, which do not overlap near the shore. Thus, the surface oiling probability at a surface water grid cell near the shore (yellow cell) is 25%, since only one out of four trajectories crosses that grid cell. However, the probability of shoreline oiling within the green bracketed segment near the yellow surface water cell is 75%, since three out of four trajectories intercept that particular shoreline segment. In the locations in which two of the four trajectories do overlap within a surface water grid cell, the probability of oiling is 50% (purple cell). In addition, oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can accumulate. In contrast, oil contamination on the surface only shows the maximum concentration at each grid cell for any given time (i.e., oil can move through a cell in cumulative excess of the threshold but still not exceed the threshold at any given time).

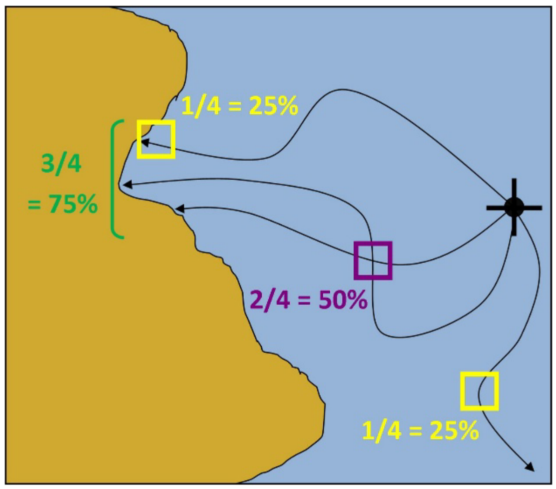


Figure A-15. Example illustration of the difference between surface and shoreline oiling probabilities. Surface probabilities in yellow and purple, shoreline probabilities in green.

A.4.1 Oil Contamination to Water Surface

Figure A-16 through Figure A-23 provide the results of surface oil contamination for the spill scenarios over each season. In all four seasons, the sea surface area exposed to oil exceeding the 10 g/m^2 threshold is contained within a radius up to 73 km (45 mi) of the potential booster station, with the largest stochastic contour comprised of 1–10% probability. The furthest extents of the 1–10% probability footprint generally lie on the edge of Rhode Island and Nantucket Sounds and were contacted by oil within less than one to three days from spill at the earliest. Three seasons (spring, summer, and fall; Figure A-16 through Figure A-21, respectively) demonstrate similar water surface oiling probability footprints while the winter scenario (Figures A-22 and A-23) depicts a relatively smaller footprint centralized around the spill site. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response countermeasures, which the Proponent would implement in the case of a spill.

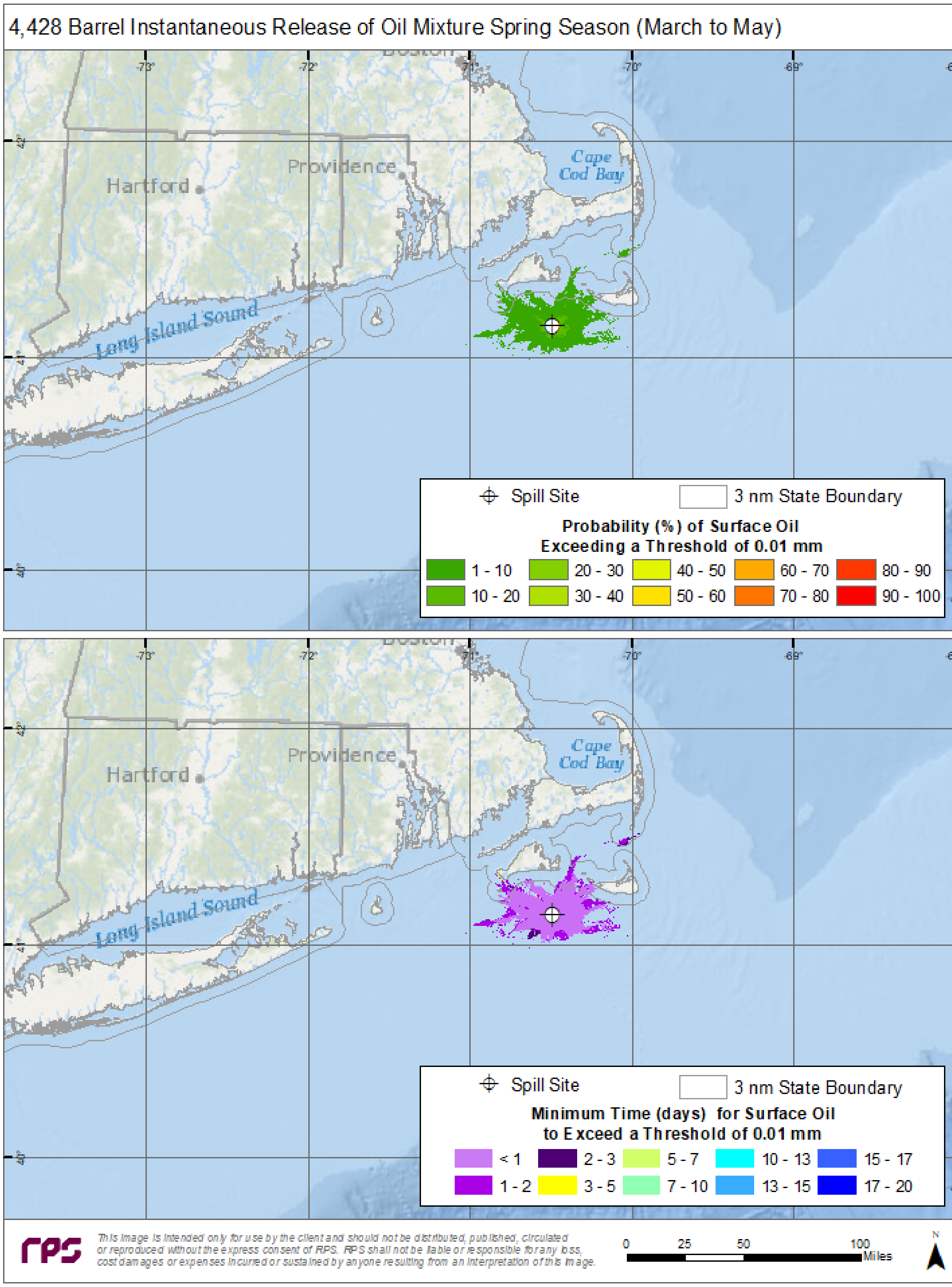


Figure A-16. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during spring months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

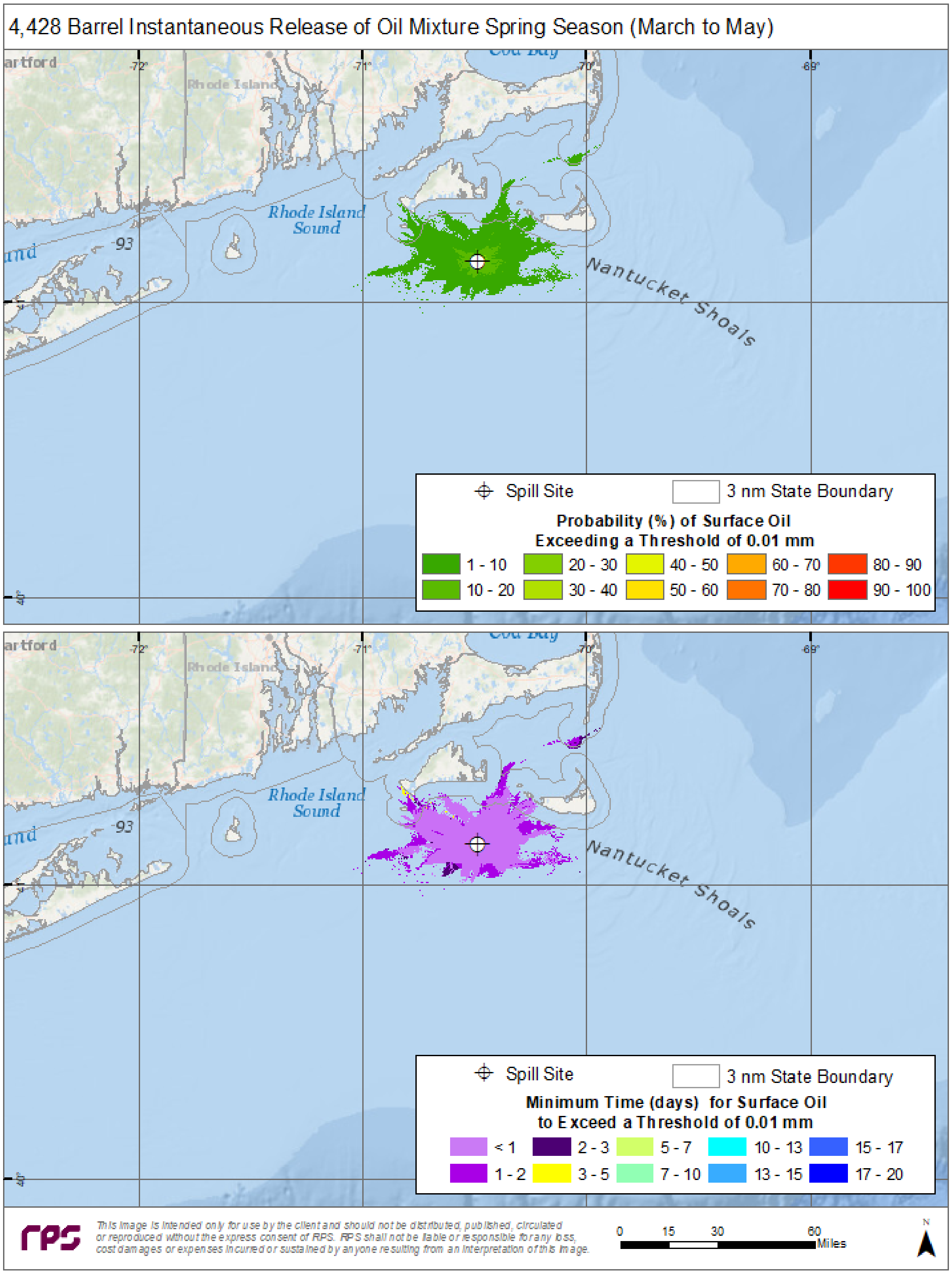


Figure A-17. Detail View. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during spring months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

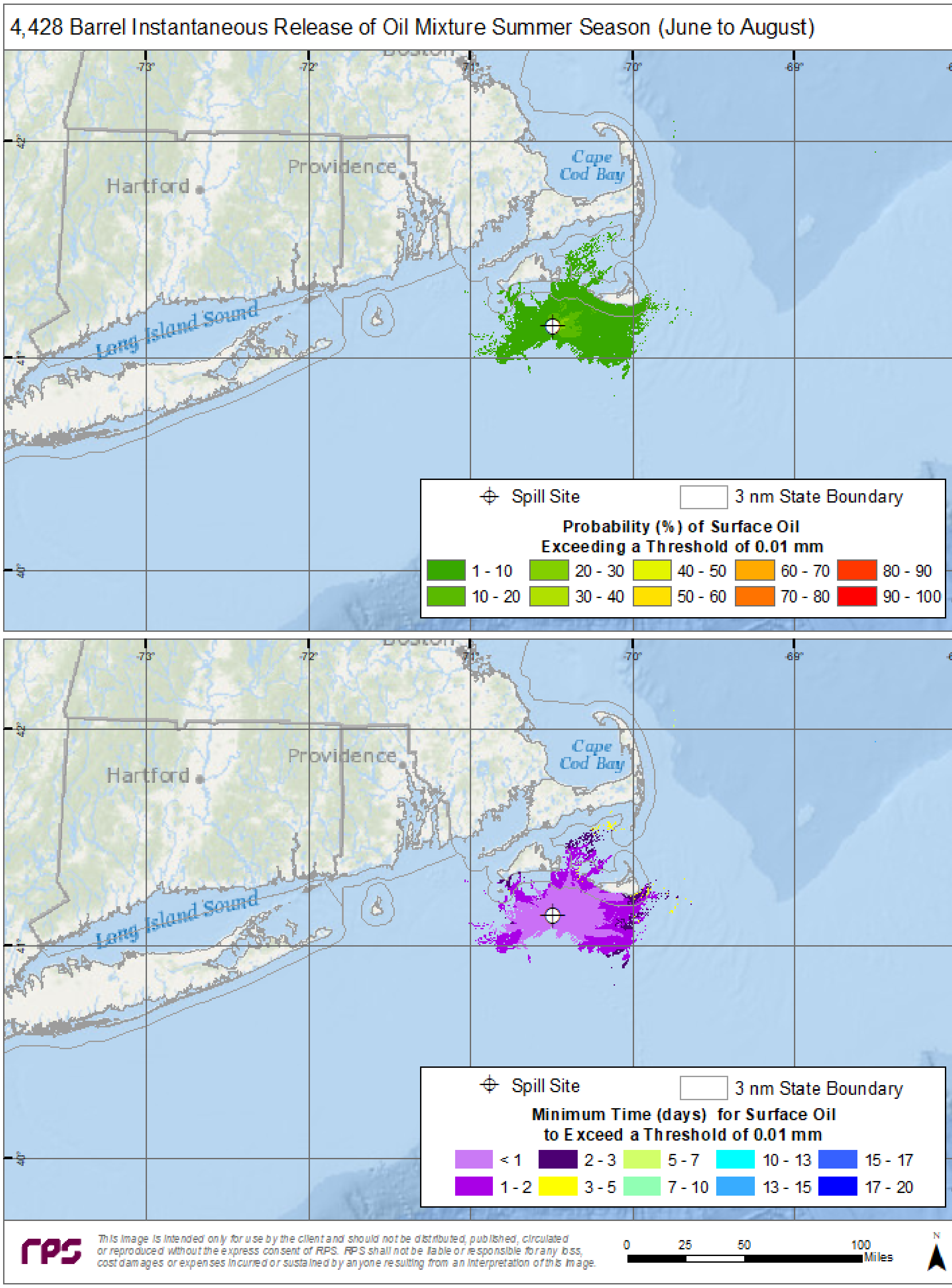


Figure A-18. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during summer months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

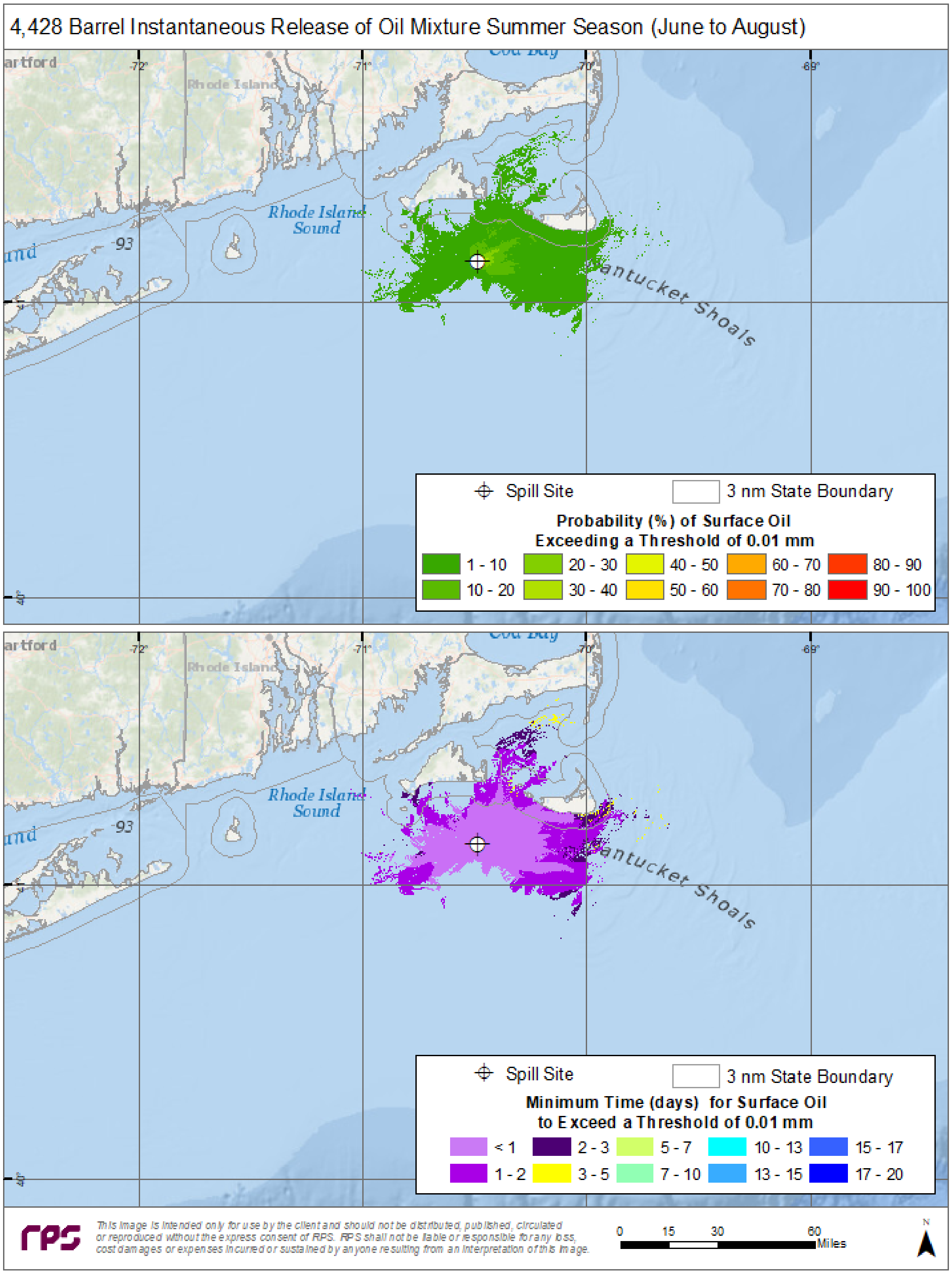


Figure A-19. Detail View. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during summer months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

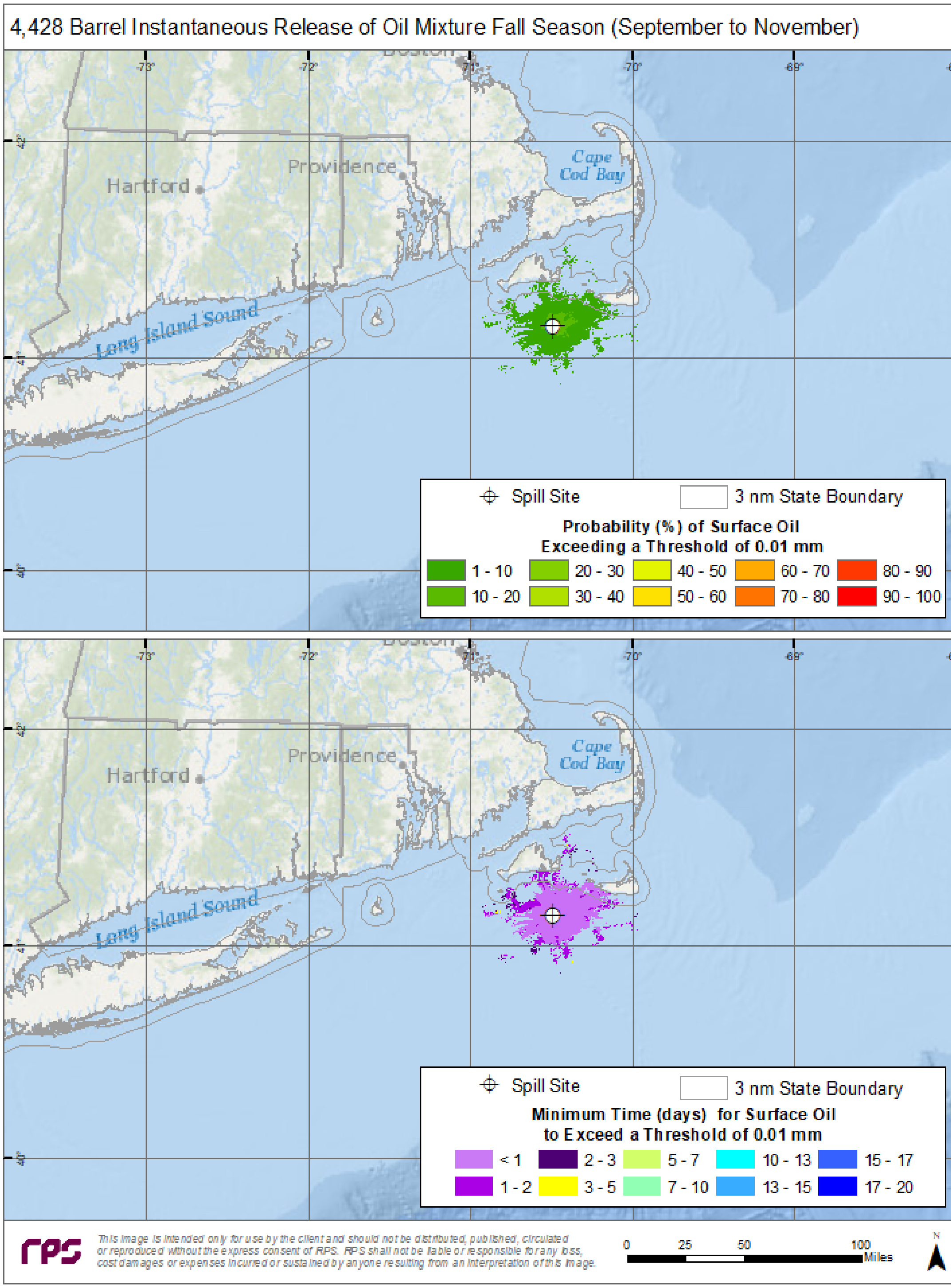


Figure A-20. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

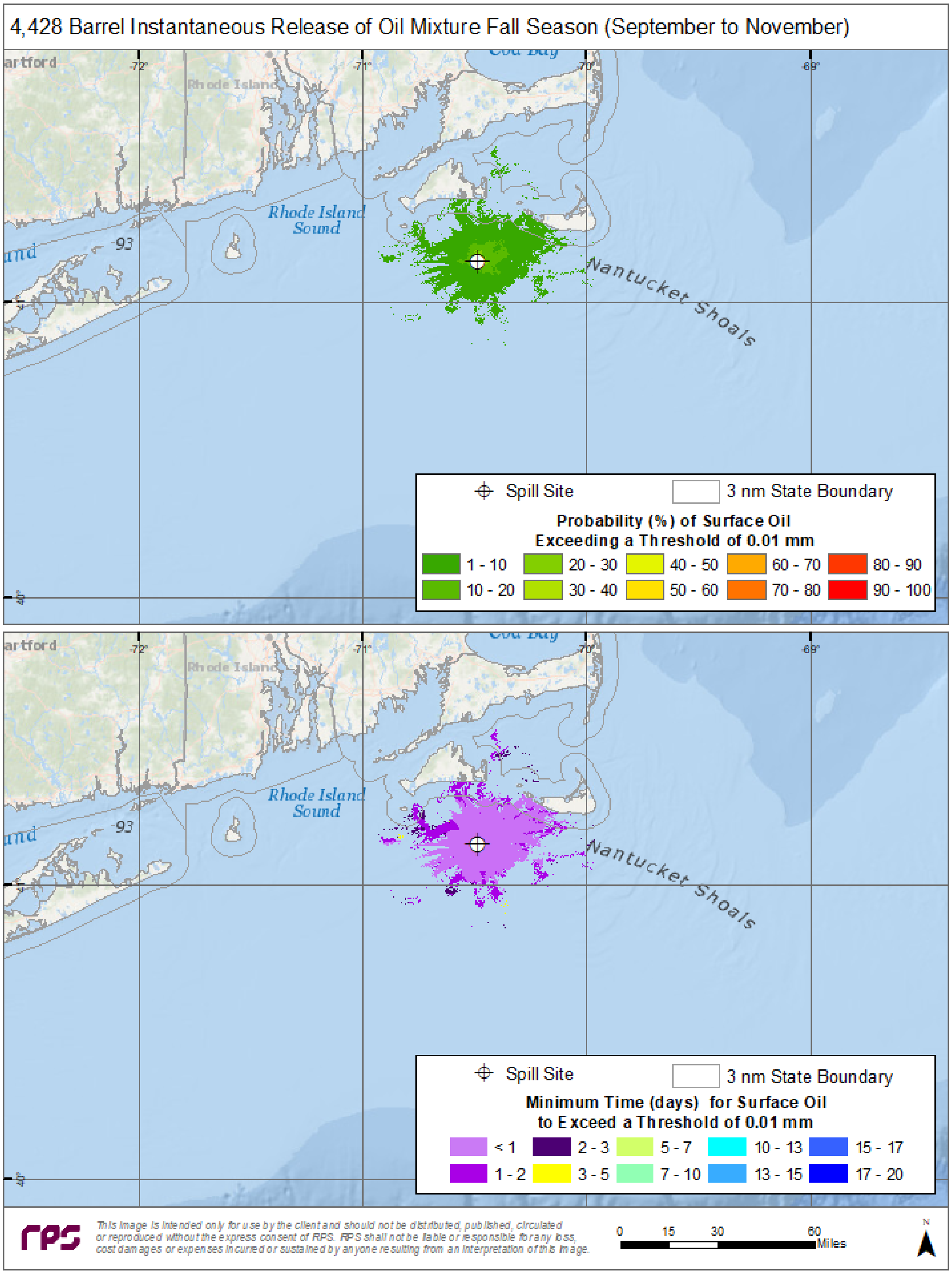


Figure A-21. Detail View. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

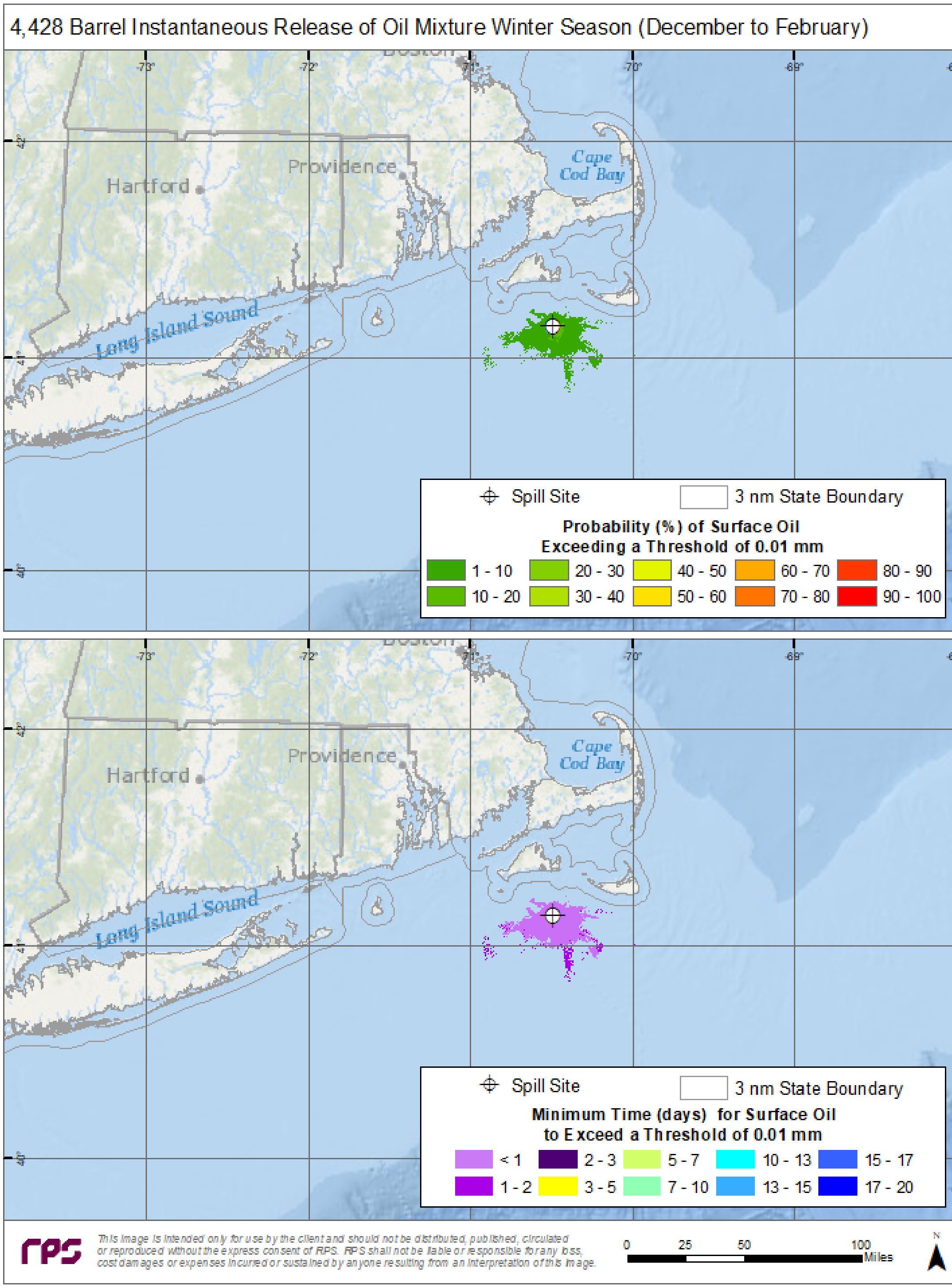


Figure A-22. Top Panel—Probability of surface oiling above a minimum thickness of 10 µm (10 g/m^2 on average over the grid cell) during winter months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.

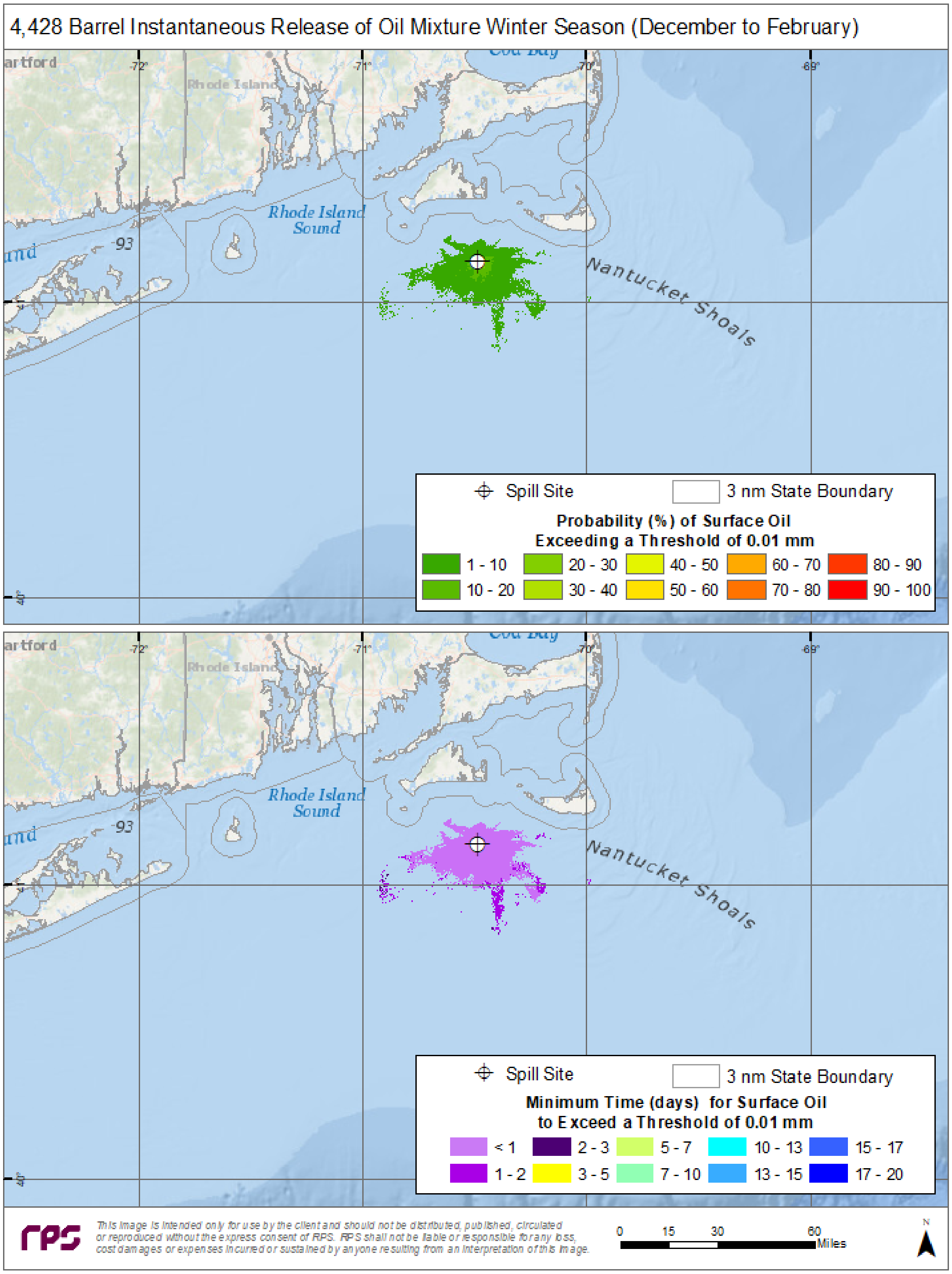


Figure A-23. **Detail View. Top Panel—Probability of surface oiling above a minimum thickness of 10 μm (10 g/m^2 on average over the grid cell) during winter months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for surface oiling to occur at thicknesses greater than 10 g/m^2.**

A.4.2 Oil Contamination to Shore

The following figures illustrate the results of oil contamination to the shoreline for the worst case oil spill scenarios over each season at the potential booster station. Figure A-24 through Figure A-27 indicate that, in all seasons, there is a 1–40% probability that oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) spilled from the potential booster station would reach the shorelines of Martha's Vineyard and Nantucket within a minimum of less than one day to four days of the spill. There is generally a lower probability (less than 20%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts in roughly two or more days following the spill. However, in the spring oil may contaminate some shorelines in the vicinity of Falmouth, MA in less than two days. There is also a relatively small (less than 10%) probability for shoreline contamination to occur above 100 g/m^2 along the shorelines of Long Island and Connecticut in all seasons; however, the timing for this to happen is longer (less than five days), in most cases, and would likely be largely mitigated with response measures.

The spring and summer scenarios are expected to have the largest spatial extent of shoreline oiling due to the prevailing winds and currents. It is important to note again that these scenarios are very conservative and do not include the use of oil spill response equipment, which the Proponent would implement in the case of a spill.

As described above and shown in Figure A-8, the differences in the footprint for the surface and shoreline oil contamination are a result of the surface oil less than 100 µm (100 g/m^2 on average over the grid cell) traveling farther distances and beginning to accumulate on shore. It is important to note that oil contamination to the shoreline has a cumulative effect over an individual run, since oil that hits the shoreline is stranded there, and more oil can accumulate.

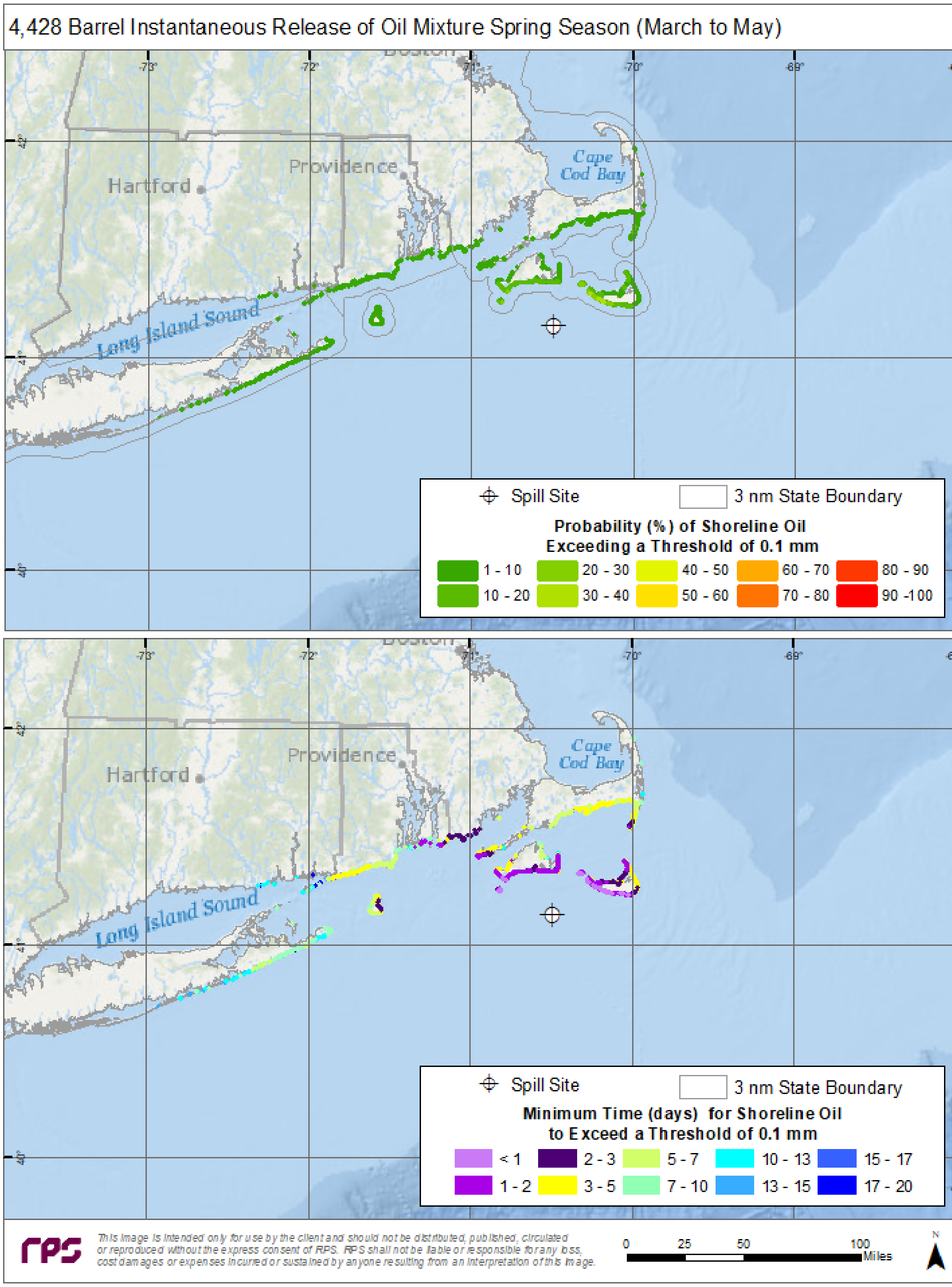


Figure A-24. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during spring months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

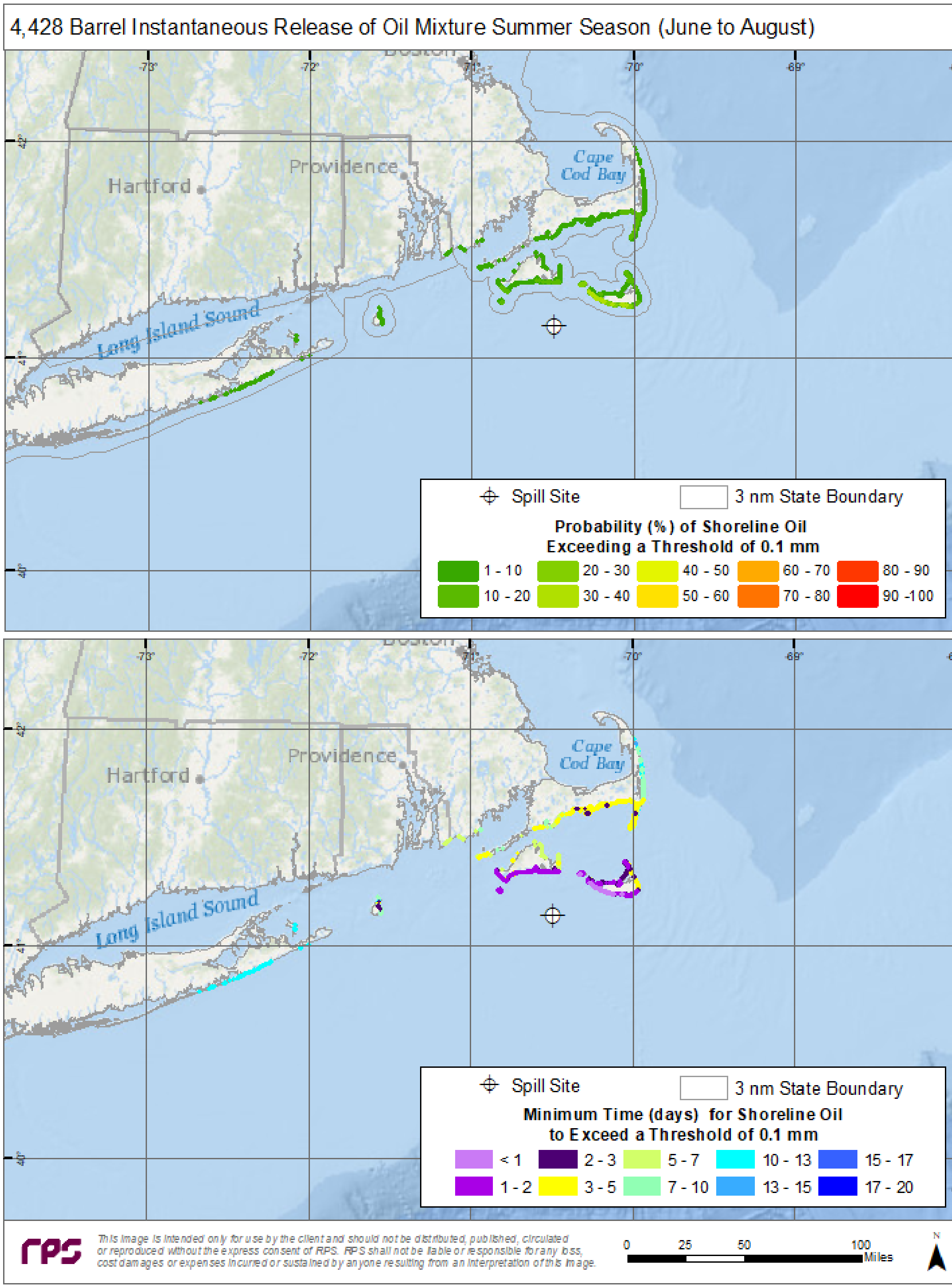


Figure A-25. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during summer months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

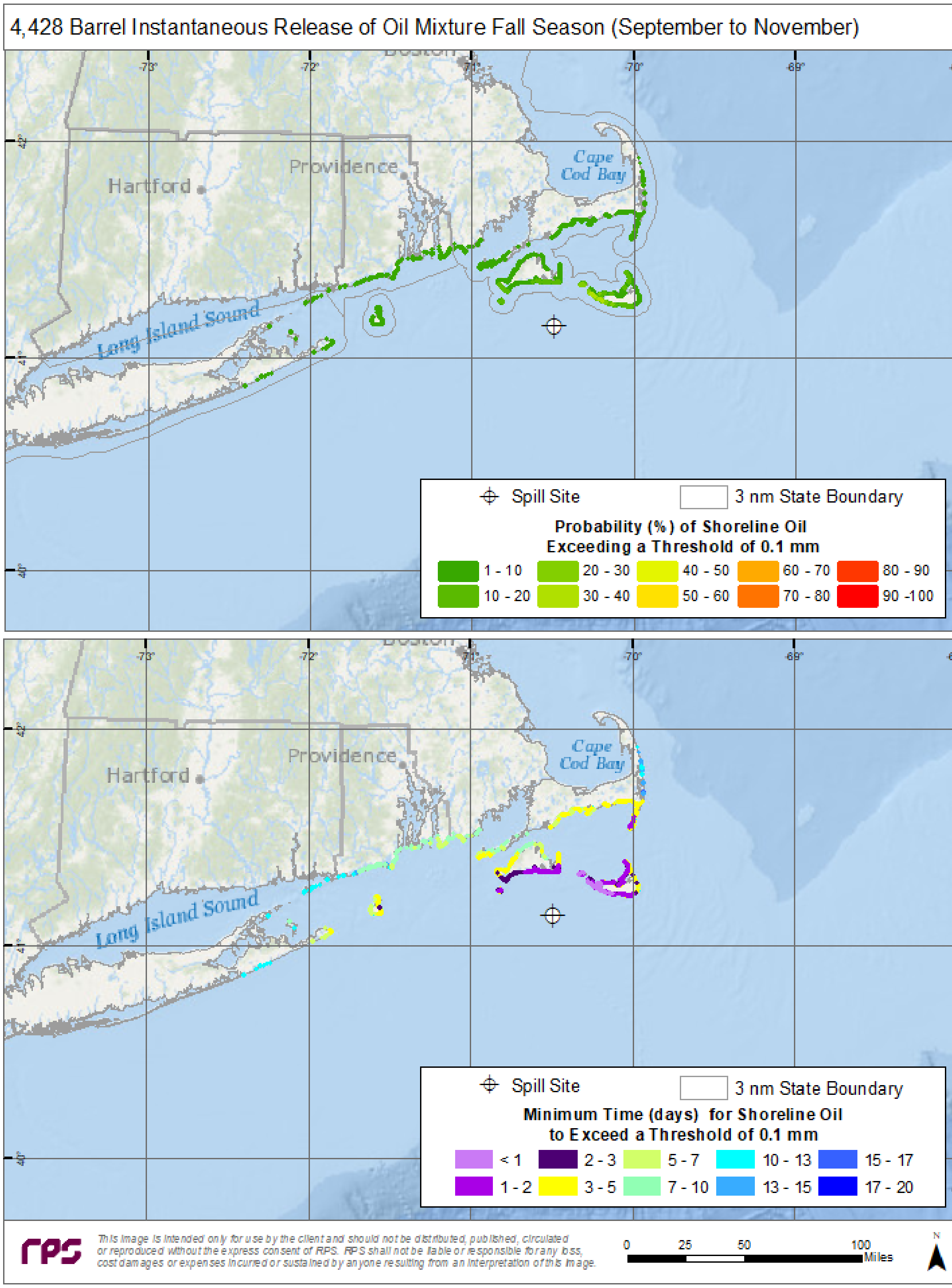


Figure A-26. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) during fall months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m^2.

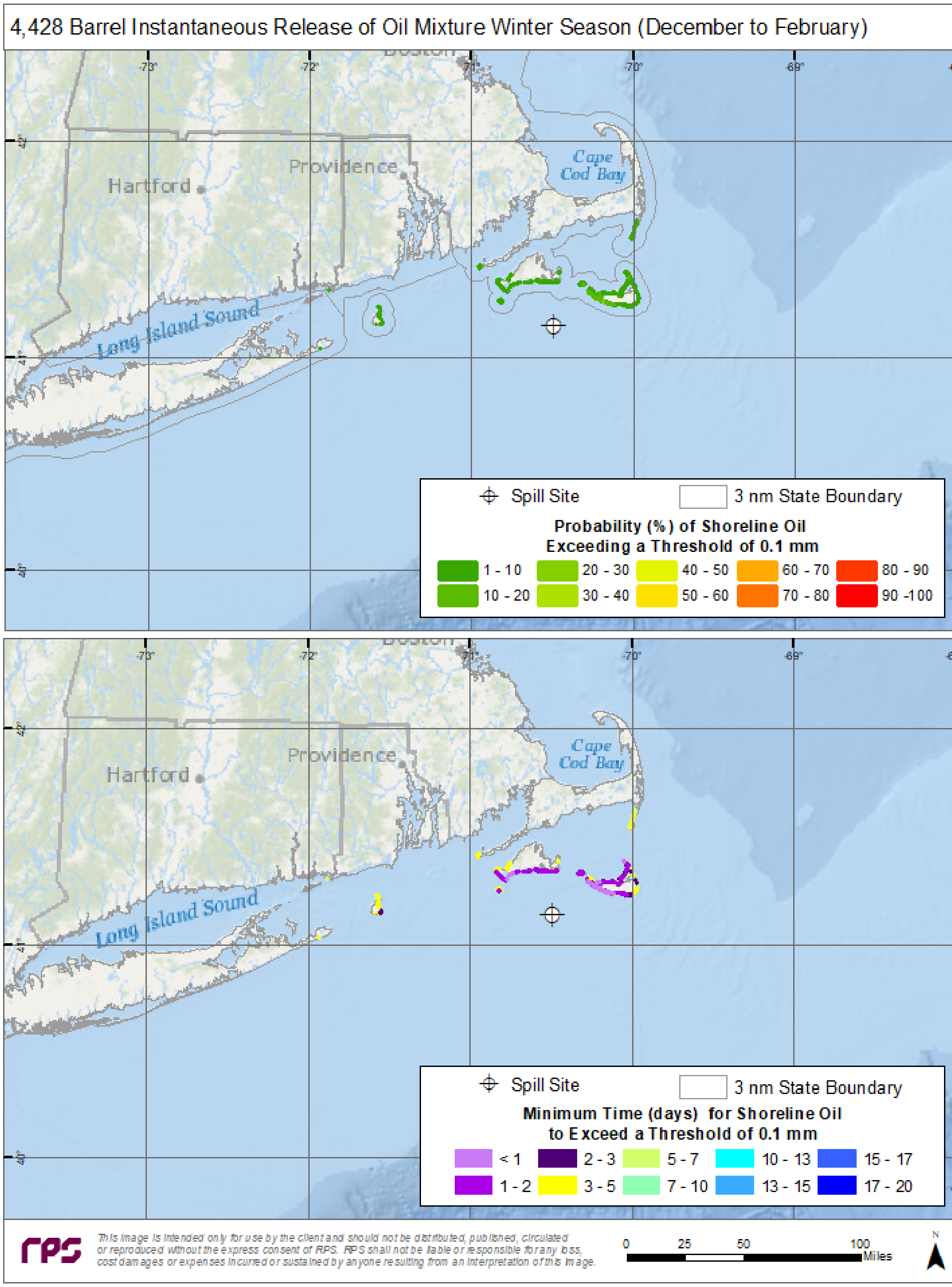


Figure A-27. Top Panel—Probability of shoreline oiling above a minimum thickness of 100 µm (100 g/m² on average over the grid cell) during winter months for an instantaneous discharge from the potential booster station. Bottom Panel—Minimum time for shoreline oiling to occur at thicknesses greater than 100 g/m².

A.5 CONCLUSIONS

This oil spill modeling study assesses the trajectory and weathering of a catastrophic discharge of all oil contents from the topple of a potential booster station, assuming the most conservative (i.e., highest) discharge volume. These scenarios simulate worst case discharges with an extremely small probability of such a catastrophic event occurring. In addition to the low probability of such events, the oil spill scenarios modeled in this study are for relatively small volumes compared to container vessel spills or oil well platforms. The scenarios also assume that no oil spill response or mitigation would occur, which is a very conservative assumption and would not happen in practice. As discussed in further detail in the OSRP (See COP Appendix I-F), in the event of a spill, response equipment employed on water would be used to prevent the spread of a spill, contain the oil to as small an area as possible, and protect sensitive areas before they are impacted.

Based on the environmental datasets analyzed as input for the oil spill modeling of the potential booster station, the following conclusions can be drawn:

- Winds in the region are moderate, generally blowing from the northwest (winter) or southwest sector (summer) with monthly average wind speeds ranging from 6–10 m/s (13–22 mph). The strongest winds are found in December and January, and the weakest winds are in August.
- Average currents at the spill site flow up to approximately 19 cm/s (0.6 ft/s), with a predominant east/east-southeastward and west/west-southwestward direction.
- Wind drift is the primary agent of surface transport throughout the year in the vicinity of the booster station.

Based on the results of the stochastic spill trajectory analysis assessing a potential spill of all oil contents from the potential booster station, the following conclusions can be made:

- The sea surface area exposed to oil exceeding the 10 g/m^2 threshold is predicted to be contained within a radius up to 73 km (45 mi) of the potential booster station for all four seasons. The stochastic footprint of exposed surface waters was smallest for the winter simulation, likely due to increased winds and surface waves that enhanced vertical entrainment into the water column.
- In all seasons for each of the sites, there is a 1–40% probability of oil above a minimum thickness of 100 µm (100 g/m^2 on average over the grid cell) reaching the shorelines of Martha's Vineyard and Nantucket within a minimum of one to three days from discharge. There is a lower probability (less than 20%) of oil above the threshold reaching the shorelines of Rhode Island and Massachusetts in roughly two or more days following the spill. There is the relatively small (less than 10%) potential for shoreline contamination to occur above 100 g/m^2 on parts of Long Island and Connecticut; however, the timing for this to happen is longer (less than five days) in most cases, and would likely be largely mitigated with response measures.

As noted, the stochastic spill trajectory analysis conservatively assesses a catastrophic spill of all oil contents from a potential booster station and does not consider mitigation measures. In the unlikely event of a worst case discharge, the Vineyard Northeast will implement all available and appropriate response countermeasures to contain the spill, to protect environmental, cultural, and socioeconomic sensitive sites, and to recover the oil as quickly as possible (See COP Appendix I-F). Therefore, any potential impacts from an oil spill are likely to be less than predicted by the modeling results for the conservative worst case discharge scenario.

A.6 REFERENCES

Bejarano, A.C., J. Michel, J. Rowe, Z. Li, D. French McCay, L. McStay and D.S. Etkin. 2013. Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf. US Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213.

Fewings, M. and S. Lentz. 2010. Momentum balances on the inner continental shelf at Martha's Vineyard Coastal Observatory. *J. Geophys. Res.* 115: C12023. Available at: doi:10.1029/2009JC005578.

Fewings, M., S. Lentz, and J. Fredericks. 2008. Observations of cross-shelf flow driven by cross-shelf winds on the inner continental shelf. J*. Phys. Oceanogr.* 38: 2358–2378.

Halliwell, G.R. 2004. Evaluation of vertical coordinate and vertical mixing algorithms in the HYbrid-Coordinate Ocean Model (HYCOM). Ocean Modelling, 7(3-4), 285-322.

He, R. and J. Wilkin. 2006. Barotropic tides on the southeast New England shelf: A view from a hybrid data assimilative modeling approach. *J. Geophys. Res.* 111: C08002. Available at: doi:10.1029/2005JC003254.

Isaji, T., E. Howlett, C. Dalton, and E. Anderson. 2001a. Stepwise-Continuous-Variable-Rectangular Grid Hydrodynamic Model, Environment Canada's 24th Arctic and Marine Oilspill (AMOP) Technical Seminar.

Isaji, T., E. Howlett, C. Dalton, and E. Anderson. 2001b. Stepwise-Continuous-Variable-Rectangular Grid Hydrodynamic Model, Environment Canada's 24th Arctic and Marine Oilspill (AMOP) Technical Seminar.

Lentz, S., M. Fewings, P. Howd, J. Fredericks, and K. Hathaway. 2008. Observations and a model of undertow over the inner continental shelf. *J. Phys. Oceanogr.* 38: 2341–2357.

Locarnini, R. A., A.V. Mishonov, O.K. Baranova, T.P. Boyer, M.M. Zweng, H.E. Garcia, J.R. Reagan, D. Seidov, K. Weathers, C.R. Paver, and I. Smolyar. 2018. World Ocean Atlas 2018, 1: Temperature. A. Mishonov Technical Ed.; in preparation.

Provincetown Center for Coastal Studies (PCCS). 2005. Toward an Ocean Vision for the Nantucket Shelf Region. Provincetown Center for Coastal Studies (PCCS), Provincetown, MA, 1-61.

Saha, S. and coauthors. 2010. The NCEP climate forecast system reanalysis. Bull. Amer. Meteor. Soc. 91: 1015-1057.

Wilkin, J. 2006. The summertime heat budget and circulation of southeast New England shelf waters. *J. Phys. Oceanogr.* 36: 1997–2011.

Zweng, M. M., J.R. Reagan, D. Seidov, T.P. Boyer, R.A. Locarnini, H.E. Garcia, A.V. Mishonov, O.K. Baranova, K. Weathers, C.R. Paver, and I. Smolyar. 2018. World Ocean Atlas 2018, 2: Salinity. A. Mishonov Technical Ed.; in preparation.

APPENDIX B – OIL SPILL MODELING SYSTEM DESCRIPTION

B.1 OILMAP/SIMAP INTRODUCTION

OILMAP and SIMAP are part of RPS' comprehensive oil spill modeling system comprised of several interactive modules to reproduce the transport and fate of oil spills in different environments: land, water, and atmosphere. The impact assessment module – SIMAP – was derived from the physical fates and biological effects submodels in the Natural Resource Damage Assessment Models for Coastal and Marine and Great Lakes Environments (NRDAM/CME and NRDAM/GLE), which were developed for the U.S. Department of the Interior (USDOI) as the basis of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) Natural Resource Damage Assessment (NRDA) regulations for Type A assessments (French et al. 1996; Reed et al. 1996). The physical fates model has been validated with more than 20 case histories, including the *Exxon Valdez* and other large spills (French McCay 2003, 2004; French McCay and Rowe 2004), and test spills designed to verify the model's transport algorithms (French et al., 1997). The wildlife mortality model has also been validated with more than 20 case histories, including the *Exxon Valdez*, that verify the values are reasonable (French and Rines 1997; French McCay 2003, 2004; French McCay and Rowe 2004). The technical documentation for SIMAP is in French McCay (2003, 2004, 2009).

Applications for OILMAP/SIMAP include impact assessment; hindcast/forecast of spill response; Natural Resource Damage Assessment (NRDA); contingency planning; ecological risk assessment; cost-benefit analysis, and drills and education. The model may be run for a hindcast/forecast of a specific spill, or be used in stochastic mode to evaluate the probable distribution of contamination.

OILMAP/SIMAP contains several major components:

- The physical fates model estimates surface distribution and subsurface concentrations of the spilled oil and its components over time.
- The biological effects model estimates impacts resulting from a spill scenario on fish, invertebrates, wildlife, and for each of a series of habitats (environments) affected by the spill.
- The probability of impact from an oil discharge is quantified using the 3-D stochastic model.
- Currents that transport contaminant(s) and organisms are entered using the graphical user interface or generated using a (separate) hydrodynamic model. Alternatively, existing current data sets may be imported.
- Environmental, chemical, and biological databases supply required information to the model for computation of fates and effects.
- The user supplies information about the spill (time, place, oil type, and amount spilled) and some limited environmental conditions at the time (such as temperature and wind data).

As with RPS' other modeling systems, OILMAP/SIMAP is easily applied to a wide variety of conditions. It is set up and runs within RPS' standard Geographic Information System (GIS) or ESRI's ArcView™ GIS, and can be applied to any aquatic environment (fresh or salt) in the world. It uses any of a variety of hydrodynamic data file formats (1-, 2- and 3-dimensional; time varying or constant) and allows 2-D vertically-averaged current files to be created within the program system when modeled currents are not available. Outputs include easily interpreted visual displays of dissolved and particulate concentrations and trajectories over time, as appropriate to the properties of the chemical being simulated. An optional biological exposure model is available to evaluate areas and volumes exposed above concentrations of concern and to predict the impacts on exposed fish and wildlife.

OILMAP/SIMAP specifically simulates the following processes:

- initial plume dynamics;
- slick spreading, transport, and entrainment of floating oil;
- evaporation and volatilization (to atmosphere);
- transport and dispersion of entrained oil and dissolved aromatics in the water column;
- dissolution and adsorption of entrained oil and dissolved aromatics to suspended sediments;
- sedimentation and re-suspension;
- natural degradation
- shoreline entrainment, and
- boom and dispersant effectiveness.

The physical and biological models require environmental, oil and biological data as inputs. One of RPS' strengths is the ability to synthesize data from disparate sources. The data come from many sources including government and private data services, field studies and research. Modeling techniques are used to fill in "holes" in the observational data, thus allowing complete specification of needed data. The environmental database is geographical, including data of the following types: coastline, bathymetry, shoreline type, ecological habitat type, and temporally varying ice coverage and temperature. This information is stored in the simplified geographic information system. The chemical database includes physical-chemical parameters for a wide variety of oils and petroleum products. Data have been compiled by RPS from existing, but diffuse, sources.

An oil spill is simulated using site-specific wind, current, and other environmental data gathered from existing information, on-line services, and/or field studies. Shoreline and habitat types, as well as bathymetry, are mapped and gridded for use as model input. The physical, chemical, and toxicological properties of the spilled oil are provided by the oil database or updated to the specific conditions of the spill. The model estimates the fate of the oil over time. The model outputs are time-varying concentrations and mass per unit area on surfaces (i.e., water surface, shoreline, sediments), which quantifies exposure to aquatic biota and habitats. Atmospheric loading in space and time is also computed, and provides input to air dispersion models.

B.2 DECAY / DEGRADATION PROCESSES

Degradation, also known as decay, is the result of several processes in the water column and sea surface. Decay represents both biodegradation and photolysis. Photolysis is a chemical breakdown process energized by ultraviolet light from the sun as it penetrates the oceans sea surface layer. Biodegradation occurs when microbes metabolize oil as a carbon source, producing carbon dioxide and water as by-products. The biodegradable portion of various crude oils can vary, ranging from 11% to 90% (NRC 1985). Not all types of organisms utilize the same oil components, nor are all types of organisms present in all locations.

In the RPS oil spill model, degradation is applied to all oil components present in the sea surface, shoreline, and in the water column. The degradation rate captures all degradation processes (e.g., photolysis and biodegradation) and is calculated for each environmental compartment. Degradation rates are constant throughout the simulation and based on empirical evidence. Oil degradation rates in OILMAP's oil database are based on French et al., 1996. The following table lists the different degradation rates used in this modeling study for each compartment, expressed in day^{-1}. It should be noted that these rates are being re-evaluated based on new findings in particular for the water column; however, the rates used in this study can be considered conservative (i.e., slightly underestimating decay in the water column).

Table B-1. Oil Decay rates used in OILMAP for each marine compartment and oil components (THC range).

Environmental Compartment	Oil exposed to air (surface (0-1m), shoreline)	Oil in water column	Oil in sediments
Daily Decay Rate (1/day)	0.001	0.240 – THC1 (1-180 °C) 0.078 – THC2 (180-265 °C) 0.042 – THC3 (265-380 °C) 0.01 – Residual oil	0.001

B.3 MODEL UNCERTAINTY / LIMITATIONS

The model has been developed over many years to include as much information as possible to simulate the fates and effects of oil spills. However, as in all science, there are significant gaps in knowledge and the ability to simulate the detailed behavior of organisms and ecosystems. Typically, assumptions based on available scientific information and professional judgment are made in the development of the model, which represent our best assessment of the processes and potential mechanisms for effects (consequences) that would result from oil spills.

The major sources of uncertainty in the oil fates and biological effects model are:

- Oil contains thousands of chemicals of varying physical and chemical properties that determine their fate in the environment. In addition, those chemicals (their properties) change over time. The model must treat the oil as a mixture of a limited number of hydrocarbon components, grouping chemicals by physical-chemical properties.
- The fates model contains a series of algorithms that are simplifications of complex physical-chemical processes. These processes are understood to varying degrees, but can dramatically vary depending on the environmental conditions (e.g., cold vs warm waters).
- Organisms are assumed uniformly distributed in affected habitats they occupy for the duration of the spill simulation. The accuracy of this assumption varies between organisms, but the objective is to assess potential effects for an average-expected condition, which is what this assumption most closely resembles.
- Biological effects are quantified based on acute exposure and toxicity of contaminant concentrations as a function of degree and duration of exposure. The SIMAP model used is not designed to address long-term, chronic exposure to pollutants.
- The model treats each spill as an isolated pollution event and does not account for any potential cumulative effects.
- Various physical / environmental parameters including river flow, depth / sea bottom roughness, total suspended solids concentration, etc. were not sampled extensively at each location of the extended domain (hundreds of square kilometers). What limited data that did exist was applied to each location, leading to a certain degree of homogenization of the environmental (marine/coastal) conditions.

In addition, in any given oil spill, the fates and effects will be highly related to the specific environmental conditions, the precise locations of organisms, and a myriad of details related to the event. Thus, the results are a function of the scenarios simulated and the accuracy of the input data used. The goal of this study was not to capture every detail that could potentially occur, but to describe the range of possible consequences so that an informed analysis could be made as to the likely effects of spills under various scenarios. The model inputs are designed to provide representative conditions to such an analysis. Thus, the modeling is used to provide quantitative guidance in the analysis of the spill scenarios being considered.

B.4 REFERENCES

French, D., M. Reed, K. Jayko, S. Feng, H. Rines, S. Pavignano, T. Isaji, S. Puckett, A. Keller, F. W. French III, D. Gifford, J. McCue, G. Brown, E. MacDonald, J. Quirk, S. Natzke, R. Bishop, M. Welsh, M. Phillips and B.S. Ingram. 1996. The CERCLA type A natural resource damage assessment model for coastal and marine environments (NRDAM/CME), Technical Documentation, Vol. I - V. Final Report, submitted to the Office of Environmental Policy and Compliance, U.S. Dept. of the Interior, Washington, DC, April, 1996; Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, PB96-501788.

French, D.P., and H. Rines. 1997. Validation and use of spill impact modeling for impact assessment. In: *Proceedings, 1997 International Oil Spill Conference*. Fort Lauderdale, Florida, American Petroleum Institute Publication No. 4651, Washington, DC, pp.829-834.

French, D.P., H. Rines and P. Masciangioli. 1997. Validation of an Orimulsion spill fates model using observations from field test spills. In: *Proceedings of 20th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar*. Vancouver, Canada, June 10-13, 1997, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 933-961.

French McCay, D.P. 2003. Development and Application of Damage Assessment Modeling: Example Assessment for the *North Cape* Oil Spill. *Marine Pollution Bulletin* 47 (9-12): 341-359.

French McCay, D.P. 2004. Oil spill impact modeling: development and validation. *Environmental Toxicology and Chemistry* 23(10): 2441-2456.

French McCay, D.P. 2009. State-of-the-Art and Research Needs for Oil Spill Impact Assessment Modeling. In *Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response*, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 601-653.

French McCay, D.P., and J.J. Rowe. 2004. Evaluation of Bird Impacts in Historical Oil Spill Cases Using the SIMAP Oil Spill Model. In: *Proceedings of the 27th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar*, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 421-452.

Reed, M., D.P. French, S.Feng, F.W. French III, E. Howlett, K. Jayko, W. Knauss, J. McCue, S. Pavignano, S. Puckett, H. Rines, R. Bishop, M. Welsh, and J. Press. 1996. The CERCLA type a natural resource damage assessment model for the Great Lakes environments (NRDAM/GLE), Vol. I - III. Final report, submitted to Office of Environmental Policy and Compliance, U.S. Department of the Interior, Washington, DC, by Applied Science Associates, Inc., Narragansett, RI, April 1996, Contract No. 14-01-0001-88-C-27.